International Journal of Advanced Engineering Research and Science

(IJAERS)

An Open Access Peer Reviewed International Journal

International Journal of Advanced Engineering Research and Science

Vol-7, Issue-6

Jun, 2020

Editor in Chief	*Chief Executive Editor*
Dr. Swapnesh Taterh	S. Suman Rajest

Publisher

FOREWORD

I am pleased to put into the hands of readers Volume-7; Issue-6: 2020 (Jun, 2020) of **"International Journal of Advanced Engineering Research and Science (IJAERS) (ISSN: 2349-6495(P) | 2456-1908(O)"**, an international journal which publishes peer-reviewed quality research papers on a wide variety of topics related to Science, Technology, Management and Humanities. Looking to the keen interest shown by the authors and readers, the editorial board has decided to release print issue also, but this decision the journal issue will be available in various library also in print and online version. This will motivate authors for quick publication of their research papers. Even with these changes our objective remains the same, that is, to encourage young researchers and academicians to think innovatively and share their research findings with others for the betterment of mankind. This journal has DOI (Digital Object Identifier) also, this will improve citation of research papers. Now journal has also been indexed in **Qualis (Interdisciplinary Area) (Brazilian system for the evaluation of periodicals, maintained by CAPES).**

I thank all the authors of the research papers for contributing their scholarly articles. Despite many challenges, the entire editorial board has worked tirelessly and helped me to bring out this issue of the journal well in time. They all deserve my heartfelt thanks.

Finally, I hope the readers will make good use of this valuable research material and continue to contribute their research finding for publication in this journal. Constructive comments and suggestions from our readers are welcome for further improvement of the quality and usefulness of the journal.

With warm regards.

Dr. Swapnesh Taterh
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July, 2020

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Vol-7, Issue-6, Jun 2020
(10.22161/ijaers.76)

Educational processes experienced in the social practice bicycling agroecological

Leandro Dri Manfiolete Troncoso[1*], Gabriel Marostegan Ruffino[2], Sandra Soledad Troncoso Robles Dri Manfiolete[3], Thiago Mônaco Ferreira Nespule[4], Carlos José Martins[5]

[1] Master in Motricity Sciences - Paulista State University "Júlio de Mesquita Filho" (UNESP). PhD Student in Human Development and Technologies - Paulista State University "Júlio de Mesquita Filho" (UNESP).
[2] Bachelor of Agricultural Engineering - Paulista State University "Júlio de Mesquita Filho" (UNESP).
[3] Pedagogy in Physical Education, Sports and Recreation – Chile Austral University (UACH). Candidate Master in Education. Mention Political and Educational Management - Chile Austral University (UACH).
[4] Bachelor of Agricultural Engineering - Paulista State University "Júlio de Mesquita Filho" (UNESP).
[5] Doctor in Philosophy - Rio de Janeiro Federal University (UFRJ). Profesor Postgraduate Studies in Human Development and Technologies - Paulista State University "Júlio de Mesquita Filho" (UNESP).
* Corresponding Author: leandro_dri@hotmail.com

Abstract— *The objective this article is comprehend educational processes experienced in the social practice bicycling agroecological. Phenomenological qualitative approach 4E Cognition of embodied, situated, extended and enactive cognitive processes since existential description "Pedaling for Cityzenship". For data collection, we performed two bicycling trips in the years 2017 and 2018, pedaling 4200 kilometers each trajectory with the objective interviewing nine farmers in the five Brazilian states from inclusion criteria: 1) agroecological farmer; 2) working with agroforestry systems and c) development community education projects for citizenship. For speeches analysis, the approach "situated phenomenon" being constituted ideographic analysis organized in a framework discursive convergences for nomotetic matrix. The units of meaning emerged: a) Agroforestry knowledge; b) Care for environmental health; c) Agroecological community training support general category "Bicycling agroecological as a cognitive-educational process". We believe promotion bicycling culture through social practice bicycling agroecological, should be as a driving alternative for human motricity development between urban cyclists and family farmers producing organic food consciously preserve biodiversity, generating benefits for collective health environment.*

Keywords— *bicycling, education, citizenship, sustainable agriculture, environment and public health.*

I. INTRODUCTION

Agroforestry systems used as an effective methodic production of food by several rural producers in Brazil, addition to being a complementary alternative income, collaborates for the restoration native vegetation [1]. This cultivation technique based on management, stratified agroecological consortium reproduces the process of natural plant succession with the purpose increasing biodiversity [2].

On the other hand, bicycling collaborating for urban environmental health [3], including a micro politic action mitigating effects of climate change [4]. In this sense, documents gives World Health Organization (WHO) [5] and United Nations (UN) like as Paris Agreement [6], Secretary General's report on sustainable transport [7], New Urban Agenda (Habitat-III) [8] and Sustainable Development Goals

(SDG) [9], bicycling involved 17 goals to the according to the European Cyclists Federation [10].

In relation Brazilian letters commitment, featured for Statute of Cities [11] institute municipal public managers organization planning cities, the elaboration of Director Plans; the National Urban Mobility Policy [12] establish hierarchy of importance for the transit with Urban Mobility Plans [13] and Bicycle Brazil Program [14] to the promotion bicycling culture. We also highlight, family farming gains strategic importance with National Food and Nutrition Policy [15] and National Family Agriculture Policy and Rural Family Enterprises [16], in addition to other constitutional provisions related to Brazilian family farming [17].

These official documents expressing ideas of Latin American social movements contextualized with the

proposals of Dialogical Pedagogy [18] and Cultural Biology [19]. Given practical knowledge is essential for the conscious emancipation of "know-how", bicycling trip [20], pedaling takes an interdisciplinary character related to health, leisure, mobility, economics, politics and ecology. From this, the concept education for citizen formation, educational processes occur from the praxis shared among individuals in their groups, outside formal teaching-learning spaces for their reproduction control of survival and coexistence [21].

With the intention of expanding discussion phenomenon bicycling in the field "Agriculture, Environment and Rural Development", we performed a search keyword "cycling" in database *International Journal of Advanced Engineering Research and Science*, we found eighteen articles outlined from: materials engineering [22-26], civil construction [27-32], metabolism energetic [33], aeronautic engineering [34], habitat conservation [35], contaminants from food packages[36], waste management [37-38]. However, there is little research bicycling from an educational perspective, the human right to active mobility [39] and bicycling culture as institutional policy [40]. Therefore, we present bicycling agroecological contextualized research strategy with a view an alternative of social practice to bring urban inhabitants together family farmers of recreational-recreational potential for population free time [41].

The objective research is comprehend educational processes experienced in the social practice bicycling agroecological.

II. METHODS

Participants

We approached nine farmers from the states of São Paulo (SP), Paraná (PR), Rio Grande do Sul (RS), Minas Gerais (MG) and Bahia (BA), Brazil, based on the inclusion criteria: a) be an agro-ecological farmer; b) working with agroforestry systems; c) development community education projects for citizenship. For data collection, used digital recorder capturing interviews semi-structured methodological format [42] and a model camera *Go Pro Sesion* making videos, resulted documentary "*Cicloturismo agroecológico*" [43].

The following research subjects participated in the study: 1) *Ari Batista*, 70 years old, farmer *Associação dos Agricultores Agroflorestais de Barra do Turvo e Adrianópolis (Cooperafloresta)* - Barra do Turvo (SP) [44]; 2) *Adilson Batista*, 32 years old, farmer Cooperafloresta [45]; 3) *Nelson Eduardo Corrêa Neto*, 66 years old, creator Agroflorestar Project [46], coordinator *Assentamento Mário Lago* - Ribeirão Preto (SP) [47]; 4) *Lucas Faria Machado*, 32

years old, farmer Sítio das Mangueiras - Florestal (MG) [48]; 5) *Luiz Silva*, 62 years old, farmer *Assentamento Contestado - Lapa (PR)* [49]; 6) *Juan Santos*, 37 years old, farmer *Assentamento Contestado*, integrating *Articulação Nacional de Agroecologia (ANA)* [50]; 7) *Nilo Schiavon*, 56 years old, farmer *Colônia São Manoel* - Pelotas (RS) [51]; 8) *Gilberto Ribeiro Alves*, 40 years old, farmer *Sucupira Agroflorestas* - Valença (BA) [52]; 9) *Ernst Gotsch*, 72 anos, farmer *Sítio Olhos d'água* - Piraí do Norte (BA) [53].

Procedures

We adopt a phenomenological qualitative approach *4E Cognition* for understanding cognitive-educational embodied, embedded, extended and enactive processes [54], referring existential description "*Pedaling for Cityzenship*" [55]. During years 2017-2018, two bicycling trips pedaling on each trajectory, averages 4000 kilometers over two months:

a) the first trip in 2017, left city of Botucatu (SP), Barra do Turvo (SP), Curitiba and Lapa (PR), Timbó, Balneário Camboriú and Florianópolis (SC), Porto Alegre and Pelotas (RS), Punta del Leste and Montevideo (Uruguai), Buenos Aires and Mendoza (Argentina) and Los Andes and Valparaíso (Chile);

b) the second trip in 2018, left again from the city Botucatu, São Carlos and Ribeirão Preto (SP), Passos, Florestal, Belo Horizonte, Governador Valadares and Teófilo Otoni (MG), Vitória da Conquista, Piraí do Norte, Valença, Ilhéus, Porto Seguro and Prado (BA), Linhares and Vitória (ES), Campos dos Goytacazes, Rio de Janeiro and Paraty (RJ), Caraguatatuba, Campinas and Santa Bárbara do Oeste (SP).

For speeches analysis, the approach "situated phenomenon" being constituted ideographic analysis that makes subjects ideology visible with emphasis units of meaning emerged from reduction by attitude, disposition and suspension beliefs, organized in a framework discursive convergences; and nomothetic analysis to the formation matrix composed individual analyzes identified by comparison and imaginative relational phenomenon [56]. Participants signed the Free and Informed Consent Form (ICF) in agreement with the research procedures and the breach of anonymity. The project registered Brazil Platform, proof 029413/2015, record CAAE: 43889115.1.0000.5465, official opinion 1.202.636, Ethics and Research Committee of the Rio Claro Biosciences Institute of Paulista State University "Júlio de Mesquita Filho" (IBRC-UNESP) [57].

III. RESULTS

In the methodological application *4E Cognition*, the cognitive-educational embodied, embedded, extended and enactive processes emerge among researchers and

interviewees for the constitution world-life or lebenswelt body production cultural and sensori-etnografy experience [58] related bicycling agroecological. Thus, the world-life or lebenswelt concept [59], moving towards interpret scientific knowledge developed at both the formal theoretical and common sense levels, which results in a hermeneutical analysis of society [60].

At phenomenological reduction formed by 60 discursive convergences construction nomothetic matrix organized from the units of meaning: 1) Agroforestry knowledge; 2) Care for environmental health; 3) Agroecological community training, structuring central category "Bicycling Agroecological as a cognitive-educational process". At the end exposition speeches, a conceptual analytical synthesis exposed.

IV.   DISCUSSION

1. Agrofloresty knowledge

In the unit of meaning Agroforestry knowledge, Edson affirms the training agroecological farmer starts from daily work and complemented question improve his knowledge life:

> It is sand there, we started using the tractor and was a problem erosion, why don't working a big machine, only mowing, hoe, chainsaw and tractor due to the high investment, with the hoe you can produce a lot. The garden will produce according farmer's care, monitoring is related to the reward, if you are not managing it, it will decrease acquire knowledge grows together, more give yourself return.

For Lucas, learning agroforestry systems occurred in the coexistence with farmers and the study group:

> I learned agroforestry with family farmers and with students in a study group. There several reasons work: first, show feasibility system, have a campus at the Federal University of Viçosa (UFV) with agricultural science courses, but don't work agroecology, partnership is a process, teachers lack interest in reproduce research model laboratory, after three years of work, student initiatives have appeared. Second, food security, almost 80% our food is from family farmer and, in addition, Florestal small municipality most income derives from family farming. Thirdly, property serves as a school having all the realities for planting, top part flat hill mechanized with red soil, but it is very windy and dry with winter, it is strict, next to it we have an adapted valley for the mountain system, the front slope has gravel with sand, so we can show different situations and, in addition. We work on projects with the community

receiving a group of farmers engaged in creating an organic certification in the metropolitan region of Belo Horizonte.

For Luis, the economic income generated with implementation agroforestry system, contributed understanding processes of soil regeneration:

> The agroforestry system used in this area, where are employed, it has already been paid for and I am not fully exploring it, the grass is winning the cycle fulfilling its function, then I place a vegetable garden and import organic matter to produce vegetables. I realized that the plants pass information from *napiê* grass with its pruning point. The job requires persistence and stubbornness, cold came and killed napiê pruned, it has principle must be a cattle rancher feeding his flock, eats two thirds grass and one-third ground. For agroforestry it is the same proportion, two thirds goes line and one-third between lines feed microorganisms, it cannot leave soil bare, before I pruned everything found half gave changed scheme concentrate planting interspersed bed, confirm plants transmitting information to their neighbors.

For Nilo, agroforestry methodology allows diverse management of plants whose interaction collaborates for efficiency in the production of healthy foods:

> In this area we have 980 plants, 78 species of different trees in here among fruit, native and exotic, here I planted seedlings the way I wanted to leave, then there is no need to thin out, I copied a little of the native forest, mainly the fruits. We have a job with Embrapa people where they supply us with seedlings and we supply native seeds, in addition to Garden Forestry Cambuçu is a seed bank, we choose the seedlings by going to the unit they have and bring missing. I chose acacia because the best accelerator in the region a fast-growing nitrogen-fixing plant, the moment it stops playing role, I'm going to cut and all root becomes organic matter to enrich soil because here nothing else. We planted corn and beans, but it didn't grow, today observes the health and vigor of the plants with nothing, so the idea is to diversify production because I'll have a diversity of birds and from I don't plant anymore just select, at the beginning we planted cassorova, we harvested two tons in a year, when the citrus was small. We managed to create several trees such as capororoca, cedar, cajirana, taruma, plants resist the sun in the field, we also planted Adália shade, we harvested flower and save trees, have a lot yellow, red and pink flowers.

For Ernst, agriculture primarily needs knowledge to understand the syntropic processes of life regeneration:

Two important things to know: the climate and the resources available. The cultivation of cocoa in the south of Bahia produces 1,200,000 tons per year which, despite the large quantity, is of low quality, I dedicate myself to produce a quality cocoa. Agroforestry intercropping tree elements with the annuals, this is literature definition. I started teaching courses on syntropic agriculture process, the biggest external input is knowledge, brazilian government is dictatorial, which generates a generalized problem of violence. Witch's broom is a fungus that attacks cacao with the lack of sun in the fruit, the result of aging shading and inadequate pruning, it would have no problem if the price of product was good, but one main factors low price, formerly if planted with shade, which requires pruning work, however, human production in agriculture is not valued. In addition, working conditions are inadequate due to tree climbing training requiring appropriate equipment as it is an unhealthy service, in addition to of the legislation being made to not happen, then it is not just monoculture, which justifies making room for opportunistic species, a capitalist term that we learned at school. Before it was a degraded pasture, so I planted cacao and all kinds of trees, here there are more than 500 varieties of plants that like each other, some are angry and exotic forget planted forests. There was a year that the average rain in the region was 1200 milliliters, on the farm, it was 1400 milliliters, here humidity has been higher than in the region.

For Gilberto, regeneration is the main component of agroforestry management with farmer having the function controlling the species he wishes to cultivate

Based on the experience of restoration in a mined area, we admit regeneration to make the succession progress and the grass suppressed with regenerates, which favors diversified biomass. The beginning of the work was in an area of 22 hectares with a yellow and cohesive soil, very dense and clayey that retains water, soils poorly used due to traditional livestock and with forest on the riverside, we have five hectares of good land recently. deforested, so they were not spent like the others, a good part of the resources used are to manage the succession, inviting interesting plants to manifest and maintain those that have already been planted. There are 13 people working in the selective mowing, I run a site with woody biomass full of bushes. The farm increased to 82 hectares, with 52 planted, we have a seedling nursery, we plant what we produce, irrigation is reduced, I have two mechanical pumps that throw water gravity at zero cost. When there is biomass and the canopy closes, it ends with the sun, if it is efficient

it leaves soil covered, but it still does not support the demand, so I count on plants that grow alone.

Human ecology in forest management, property being a place for pedagogical practices, sensitivity to regeneration processes, the variety of biodiversity for the family economy, syntropy as a systematic relationship between species and increase humidity in the local, are perceived factors that directly contribute which optimizes agroecological knowledge. Furthermore, these existential conditions verified generates an increase quality of food linked conservation of the environment and people's health.

2. Care for environmental health

In the meaning unit "Care for environmental health", Ari emphasizes importance of the forest for ecosystem balance and consequently for human survival:

There was a visit from some people from the capital saying here in Barra do Turvo, were at the end of the world. I said contrary, you are at the end of the world, we are beginning of the world because is a strike and stop system transport, São Paulo will starve to death first than us, if it rains there for two hours it is flooded with concrete. We live in a paradise, beginning of the world because it was same as here, if every owner in São Paulo used half the land to build a house other grass and tree, there was no flooding. God, when planning the planet, did not think about concrete, so it really floods.

For Nelson, water economy of irrigation produced by agroforestry, contributes conservation and dissemination this cultivation technique with family farmers:

Agroforestry has greater resilience compared other type of agriculture. Here in Ribeirão Preto, families have an irrigation system, 80% fresh water extracted goes to irrigation agroforestry system is ten times smaller due to the soil cover reduces evapotranspiration forming a box water. Moreover, the bill paid because several areas managed nature works alone, putting vegetables and not every place drought irrigate a little, which keeps the soil covered, but when the rainy season comes, this water will be stored returned aquifer. I'm sure if you the balance will be positive, so we fulfill an environmental function and enhance food production families with the generation income for leveraging from a difficult situation, using irrigation sparingly, increases people's adhesion and restructuring the soil to save water.

For Lucas, the importance of restoring springs and soil moisture to farmers becomes a strategy for communicating agroforestry concepts:

We faced a drought crisis in the history of the municipality, the river dried up and the city had to be supplied for months by water truck coming from outside, my water dried up, I had to drill a well, but with little use because the agroforestry system conserves water in ground. We have an economy of 80% compared to conventional system; spend water intensively in the garden. In most of the plantation space we do not turn on irrigation, if it can rain for a week without watering, we must create an infiltration system with a reservoir for rainwater storage. Agroforestry shows water most valuable asset, it even transcends monetary issue. We are often able enter communities to talk about method for the sake of water because the producer creates barriers to an alternative crop, it is a general problem to talk about the pesticide which causes contamination and affects health, the farmer does not believe. The complexity establish a horizontal dialogue, which justifies science as a method with strategy for convincing farmers, otherwise they will stop participating.

For Nelson, the production knowledge about agroforestry systems is little valued in Brazilian research institutions, due to political power of industrial agriculture:

It has a huge strength Brazil called ruralist bench with its own interests. The wealth monocultures engaging economic activity industrialization generated from fertility of the forest, accumulated capital and went agricultural industry. There is a mentality-dominated government since the industrialization of the countryside, being an artificial place. Everything necessary produce comes from outside, it is a destructive activity to uproot nature place, the project is not manifest itself, a business subjected need for inputs, an impute transforms and removes things. Moreover, mastery-marketing technique entered universities, if you are studying agronomy; the doctor professor offers a scholarship study the optics of industrial agriculture. Hardly offer to work with agroforestry that regenerates sustainable processes. However, it is difficult interesting because make a profit, so domination manifests itself in the duality nature and food production are antagonistic, so we have to overcome. This view expressed Yanomami speech: when the forest is unprotected, mofocari solar entity burns, rivers and streams, swallows the fish, the earth burns with the scorching heat that hangs everywhere, earthworms die, leaves dry out, there are no more seeds in the soil and waters run away and wind refreshing us now hides fertility of the forest. The basis productive system attributed to spiritual characteristics beings of nature.

The importance of vegetation native cover in the soil to regenerate cycling of nature, the resilience hydrological for irrigation, the dialogical pedagogy for understanding agroforestry system and the capitalist interests, involved in monoculture are factors that exemplify the difficulties encountered by those work with agroforestry. In addition, we highlight justify little institutional political support wide care of water as a symbolic and indispensable material for biological life.

3. Agroecological community formation

In the unit of meaning "Agroecological community formation", Ari describes functioning of Cooperafloresta:

We do community work, but the production is individual, Cooperafloresta's work is different because no one works free for the other, it is a joint work of respect where each one sells his product. The task force is the regiment, by law we have to do two task forces from network, using a pattern, if you brush and cover it is normal, cannot use fire, if you burn suspended for 30 days without selling, if you put poison 60 days, if you repeat, you can be expelled. Each one is part of the group in relation to the other, it is a job approved as organic production, when passing the poison and selling as organic, pass poison Ecovida chain, and finds out it will be the whole group canceled, so we are all inspectors for the regulations. If you want to join Cooperafloresta, we have a statute where you read to learn about your ability to participate and not harm the entire group. We are three groups, the producer takes his product, he can take it to be noted sends the amount, it is heavy and stays in the farmer's name, each one goes receiving what you sent, it is not because it is a cooperative that is the same for everyone.

Regarding commercialization, Lucas reports on the generation of income from family production aimed at fairs and organic food purchase groups:

We have the city fair every Saturday, where we started created network agroecological farmers in the municipality, these products in Belo Horizonte with a purchase order through website deliver every wednesday at a distribution point. I am also part Community Supports Agriculture (CSA) with delivery ready baskets, the chain holds a fair in a location in the city. We are trying articulate more points, working only with baskets makes it difficult and only the fair is unstable, we work two types businesses. The intermediary becomes a partner in the process expertise much it costs, everything done fairly for support idea.

For Juan, the engagement struggle for agrarian reform in his country of origin ended up guiding his way

until Farm Contestado, contributed deep understanding agroforestry as a strategic tool for citizen emancipation:

> I came from Paraguay as part Paraguayan Farmer Movement and La Via Campesina, articulator social movements in the countryside. The Contestado Farm had slaves until recently, under the mansion slave quarters, we want revitalization become a cultural center. The MST occupied it in 1997 and in 1999 became a settlement with 108 families, the children grew up and got married, now are 150 families plots vary between 10 to 15 hectares. There were two Petrobrás projects, the Agroflorestar Project with 60 families and the Flora Project with 30 families; many gave for not understanding proposal, currently 40 families working system, but only ten people who live on it. It is a challenge requires awareness for commercialization; the good thing work with collective. Agroforestry has helped to break paradigms, realized there is always someone showing results being a reference in the region. We are learning from mistakes, increased diversity of foods and improved lives people involved, helped to unite them by working together. On the financial side beginning, you need inputs and seedlings to start, but mainly take advantage whatever is within your reach. Our investment channel Family Agriculture Program (PRONAF), it is difficult to get money from a bank. There is case settler who obtained financing and planted creole seed, the bank's technician he saw situation cut credit because condition acquire conventional package - transgenic seed, pesticide and chemical fertilizer, we cannot depend on external financing, only on work and will, this is our reality.

For Lucas, the interest of the public authorities directed towards the articulation of public policies that substantially favor family agroforestry agriculture as a problem of strategic common interest for this type of food produced, to be the basis of Brazilian food:

> We have no support from the public authorities, while praise them can barely see the importance of the work, are meeting with a group of farmers strengthening an association through a marketing network. The public power role collaborating in the articulation Rural Extension Company of the State of Minas Gerais - EMATER, responsible for technical assistance local producers. Each municipality has an office to promote public policies related to project financing and fundraising; now due changed mentality, it has turned agroecology for receiving pressure from top to bottom. Florestal city there is another producer agroforestry, also some transition experiences practice land cover and consortium. Based on the example, we intend to show problem way of applying knowledge, aimed at knowing how create productive systems that respect the ecosystem recovery of biodiversity as a value.

Despite the difficulties witnessed by the farmer to "close the account" because it does not fit into a macroeconomic logic generated with organic production, the government, as well as subsidizing the automobile industry, should favor subsidies for agroforestry as a food security measure. Thus, agroecological micropolitics emerges in the social practice bicycling agroecological as a form motricity human condition affects urban cognition with the logic of the rural worker in his time-space that sustains the population. As an analytical synthesis, the scheme units of meaning presented below supports general category "Bicycling agroecological as a cognitive-educational process:

Table 1. Personal authorship
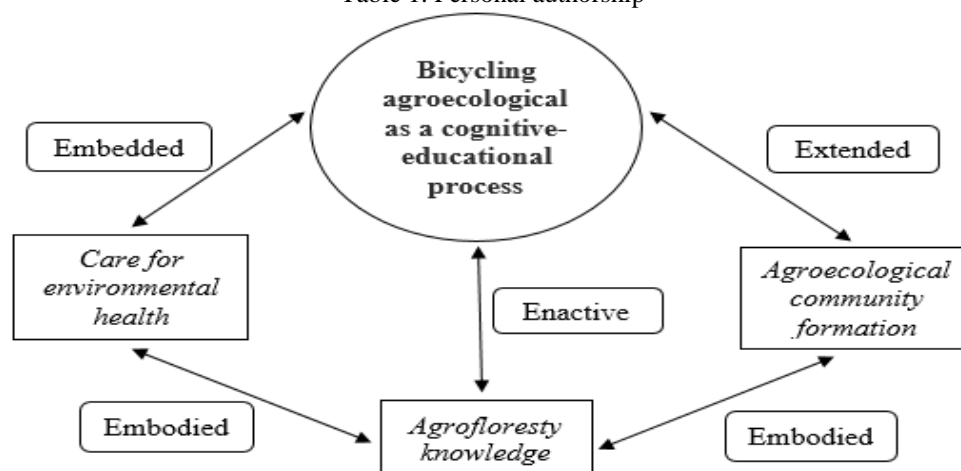
Based on the above, we consider that the knowledge incorporated about agroforestry systems, requires a permanent academic-professional dedication of the farmer in his operation. In a situated way, work

environment as a factor care for his own health environment as a notion of water as universal value doing whatever it takes protect. The extension knowledge his participation citizenship agroecological community formation at its various levels, through need work actively production of biodiversity, until pedagogy teaching method in an enactive way arrives in social justice trade relations; being an agroecological farmer requires a particular sensory-motor action of fundamental importance for social life [61].

V.   CONCLUSION

We consider through social practice bicycling agroecological as a cognitive-educational process, an enactive proposal observing experiences agroforestry method, a work tool collaborates recovery of degraded areas for the production of quality food and a source permanent income due to the variety of species produced by farming families. In the same way, we perceive union of communities care for the common good [62], as an example Ciclovida Project [63] bicycling campaign recovery of natural seeds, a cultural form values ecomotricity process human apprehension of nature in playful-ecological interaction [64].

The relationship between bicycling and agroecology promotes awareness of energy use and equity [65] as an ethical way of life, but as they are alternative social practices. They lack interest on the part general population, who are alienated ecological crisis in its temporal dimension [66], in large urban centers and can even as a preventive measure public health [67]. That said need more institutional attention, whether from the university with production of knowledge, from executive creation of strategies for political articulation and fiscal incentives and road safety, promote social peace as a politics of recognition [68].

In this sense, we affirm that the position of mobility for women is more limited in view of the lesser possibility of going out a long time away from home to pedal, be it because of the responsibility generated a mother judgment not complying with this pattern, criminalized as opposed to being a parent where abandonment is normalized. We also observed in the two trips that women in the field are invisible, giving more importance to men in this work, being essential that women given space to express and make visible, since many work over 12 hours daily and outside work, have to carry the housework excluded from the cultivation process whose decision is made by men. In this way, the patriarchal model is implicit in the agroecological practice, which justifies working of the land connected with women. We are seen from a role of caregivers and we can still think that someday that violence against women may decrease, because violence that the earth experiences with

chemicals, toxic, poison, for seeking a better production and appearance in food, is the same women experience with our corporeality, transformed into machines used by capitalism.

Therefore, the concept bicycling agroecological, emerges in the field of humanities sports as an alternative connecting physical activity "rural-city". In order attention, population's awareness regarding production and commercialization organic foods, as structuring territorial food system, cognitive-educational process "teaching-learning" aimed at cooperation with intention seeking new knowledge for human evolution.

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Exploratory Study on the behavior of the Brazilian Financial Market using Google Trends

Fernando Gonçalves de Castro Filho, Alexandre Acácio de Andrade, Jadir Perpetuo dos Santos, Júlio Francisco Blumetti Facó , Sergio Goldman

Engineering, Modeling and Applied Social Sciences Center, Universidade Federal do ABC, Brazil

Abstract— *Search engines have changed the way people find relevant information on the Internet. It was suggested that investors use these Internet tools during the acquisition decision process and that the data sets generated by search engines are related to stock market movements. This study aims to analyze the relationship between this social phenomenon and the evolution of the Brazilian stock exchange. After previous studies, the correlation between Google's query volumes for terms related to a specific index of the Brazilian stock market (Ibovespa) and stock market metrics (opening, closing, high and low prices) was analyzed. The data showed a positive correlation between investor attention, represented by Google's search volumes and market prices. These results suggest that Google Trends data is more positively correlated to the highs of financial data, suggesting that investors tend to search more on the web when the market reaches its peak or vice versa. This article highlights the potential that this source of information has in understanding the Brazilian stock market.*

Keywords— *Brazilian Financial Market, Data analysis, Google Trends.*

I. INTRODUCTION

Financial market prices fluctuate at all times, and this is the result of interaction between participants in this market. The participants can range from companies with large capital to small individual investors, but they all buy or sell financial products according to their expectations about the future of the market.

Usually, what is expected of the consumer - and, in particular for this study, we can substitute the term consumer for investor - is that he always seeks to increase his satisfaction by reducing any uncertainty involved in the process of choosing a product, or any investment. Thus, consumers and investors tend to assume a more active behavior in the search for information related to that product or investment, which, nowadays, thanks to technological advances and greater accessibility, leads to searches on the Internet. When a consumer searches for products online, this usually leads to the purchase of this product [35].

According to Simon (1955), the investor's decision-making process begins with the stage of gathering information. With the use of the Internet, the process of collecting information has been greatly facilitated over time, and search engines are the main technology for this purpose. This type of technology helps in web browsing

and, many users use it as an entry point to the World Wide Web [24].

As of 2006, Google (considered one of the largest search engines in the world) allowed any interested party to access information regarding the frequency of specific search terms that were being inserted into its search engine. An innovative tool - called Google Trends - its data originates from the constant use of the Google tool -, has been used as a way to explain some social phenomena; a simple example is the detection of influenza epidemics according to the search for words related to the symptoms of the disease [17]. This type of data has also been applied to the most varied subjects, from forecasts related to the unemployment level in the United States [12] to forecasts of house and apartment prices [39].

These types of analysis have been used to forecast gold prices [26], to forecast commodity movements [34] and to forecast general market volatility [10]. According to Da & Gao (2011), the volume of searches carried out on the Internet related to stock market index names can be interpreted as a measure of investor attention to this market. When this investor finds increasing demand for information about a given market index, he has a great chance of using search engines as a source of information.

Thus, analyzes that establish a relation between databases of search volumes and the behavior of the financial market in Brazil have been little explored. This study aims to fill part of this gap and provide more depth to studies aimed at this market, drawing parallels between studies consolidated in the United States and bringing them to the reality of the Brazilian stock market.

Given this scenario, the present study seeks to understand whether it is possible to use the search data, generated on the web, as a source of information to predict the behavior of the Brazilian financial market. Following the recent literature ([31]; [7]; [33]), it can be said that this type of data can be used for the financial market in the United States, however, what we propose here is to explore these same properties in a smaller market, in this case,

Brazil; which remains underdeveloped and is more dependent on foreign capital. the paper.

II.   LITERATURE REVIEW

This item represents the literature review, considering themes that helped to understand the behavior of investors in these markets, explaining the possible reasons for the adoption of certain actions and reactions.

Considering the Brazilian market as a whole, there are few studies that relate the behavior of Brazilian consumers with the search volumes obtained by search engines, this additional reading was carried out on the topic, as shown in Table 1.

Table.1: Works carried out relating the search volume in search engines with financial instruments.

Title	Author	Year	Search mechanism	Market	Financial Instrument	Statistical Tool
The Forecasting Power of Internet Search Queries in the Brazilian Financial Market	Henrique Pinto Ramos, Kadja Katherine Mendes Ribeiro e Marcelo Scherer Perlin	2017	Google	Brazil	PETR4, VALE5, BVSP, Taxa CDI, Selic, Tesouro Direto and Renda Fixa	Auto-regressive vector model (VAR) and Granger causality tests
Can internet search queries help to predict stock market volatility?	Thomas Dimpfl e Stephan Jank	2016	Google	USA and Europe	DJIA, FTSE 100, CAC 40 and DAX	Volatility models with and without research queries, Granger causality test
Quantifying the semantics of search behavior before stock market moves.	Chester Curme, Tobias Preis, H. Eugene Stanley e Helen Susannah Moatb	2014	Google	USA	S&P 500	Own modeling - relative change in search volume - compared to benchmarks and calculating
Quantifying trading behavior in financial markets using Google Trends.	Tobias Preis, Helen Susannah Moat, e H. Eugene Stanley.	2013	Google	USA	DJIA	Own modeling - relative change in search volume - compared to benchmarks
Modeling movements in oil, gold, forex and market indices using search volume index and twitter sentiments.	Tushar Rao e Saket Srivastava	2013	Google	USA, Commodities and Forex	DJIA, NASDAQ-100, Oil, Gold and EUR/USD (Forex)	Pearson's correlation, cross-correlations and Granger's causality test

Web Search Queries Can Predict Stock Market Volumes.	Ilaria Bordino, Stefano Battiston, Guido Caldarelli, Matthieu Cristelli, Antti Ukkonen e Ingmar Weber	2012	Yahoo	USA	Listed companies - NASDAQ 100	Correlation between query volume and volatility, cross-correlation, Granger causality test, resampling
Predicting financial markets: Comparing survey, news, twitter and search engine data.	Huina Mao, Scott Counts e Johan Bollen	2011	Google	USA and Commodities	DJIA, VIX and Gold	Pearson correlation, Granger causality test and multiple linear regression
In search of attention.	Huina Mao, Scott Counts e Johan Bollen	2011	Google	USA	Russell 3000 and IPO	Pearson's correlation, autoregressive vector model (VAR)
Complex dynamics of our economic life on different scales: insights from search engine query data.	Tobias Preis, Daniel Reith e H. Eugene Stanley	2010	Google	USA	S&P 500	Cross-correlations and autocorrelations

Source: The Authors, 2020

2.1 Search engines

Search engines are tools designed to retrieve information (Information Retrieval) from the World Wide Web. The input of a search engine is usually a query that consists of one or more keywords creating a query term. The output can be web pages, images, or other types of files. These responses are presented on a search engine results page (SERP) and are called hits. The SERP is a list of hyperlinks that point to the pages found along with descriptive text (snippet or teaser). The database used to store information on the web page is generally called an index [24].

The motivation for using search engines comes from the sum result of several factors. The search process begins with the need for information. The user is looking for information and, from there, formulates the query in its verbal form, choosing some keywords. The system then returns to those files that, within a collection of documents, correspond to the query [24].

Brin & Page (1998) mention that people, even at the beginning of the 21st century, were used to surfing the web using links, usually starting with hierarchical indexes maintained by companies - such as the Yahoo portal. This was about to change when link analysis engines were introduced to the world of Information Retrieval. This technique consists of exploring the additional information that the web's hyperlink structure has to improve the search results [23].

To better contextualize the impact that the link analysis mechanisms have brought to this market, the Google search engine - founded in 1998 by the authors of the previously cited article, Sergey Brin and Lawrence Page -, were the pioneers in the use of this type of analysis. In mid-2004, this same company already had the largest market share (37%) among search engines at the time, followed by the Yahoo conglomerate (27%). In 2020, Google dominates the search engine market representing 72% of all searches made on the web, followed by the Chinese search engine Baidu with 14%, as illustrated in Table 2 [28], etc.

Table 2: The 10 largest virtual search engines[28]

Positon	Search Engine	Share %
1	Google	91.17
2	Bing	3.12
3	Yahoo!	3.06
4	Baidu	0.77
5	YANDEX RU	0.36
6	Ask Jeeves	0.26
7	YANDEX	0.23
8	Naver	0.14
9	AOL	0.13
10	Haosou	0.1

In 2018, Google processed an average of 6 billion searches per day and 2 trillion searches per year worldwide. This corresponded to approximately more than 70,000 search queries each second. Another interesting fact is that in August 2012, the company's former senior vice president and responsible for the development of its search engine revealed that Google found more than 30 trillion unique URLs on the Web, crawled 20 billion sites per day and processed 100 billion searches per month [38].

After expanding significantly in the first decade of the 21st century, the growth rate of Google's search volume began to decline in 2009 and 2010, currently estimated at around 10% per year. In the start-up phase, growth was phenomenal, with an increase of 17,000% per year. The volume of research in the period 1998 - 1999 reached 1000%; in the 1999 - 2000 range it reached 200%. Google searches continued to grow at rates between 40% to 60% from 2001 to 2009, and that's when it started to slow down, stabilizing at a rate of 10% to 15% in recent years[22].

2.2   How search engines work

According to Lieberam-Schmidt (2010), search engines can be classified in two ways: between portals and result providers or between web catalogs or search engines. In the first classification set, queries are evaluated by how they are processed; for the second set, how the databases are generated are measured. It is worth mentioning that many of the existing research tools cannot be classified into just one of the categories. They use, for example, directory search results and search engine on the same results page.

The weblink structure is used as an evaluation criterion and the academic citation process comes in as inspiration to evaluate the importance of the pages. What the algorithm does is to count "citations" or links that a page has, both for reference to other sites and other sites pointing to the page. The rationale is: the greater the number of references that a given page presents, the greater the chance that this page will be relevant and, consequently, it will be presented to the user first.

In the article in which the Google tool originated, Brin & Page (1998)[4] explain some differences and improvements that the search engine presents concerning the "conventional" structure (Figure 1). One of them is the PageRank, which for the present study, will be classified as an analyzer.
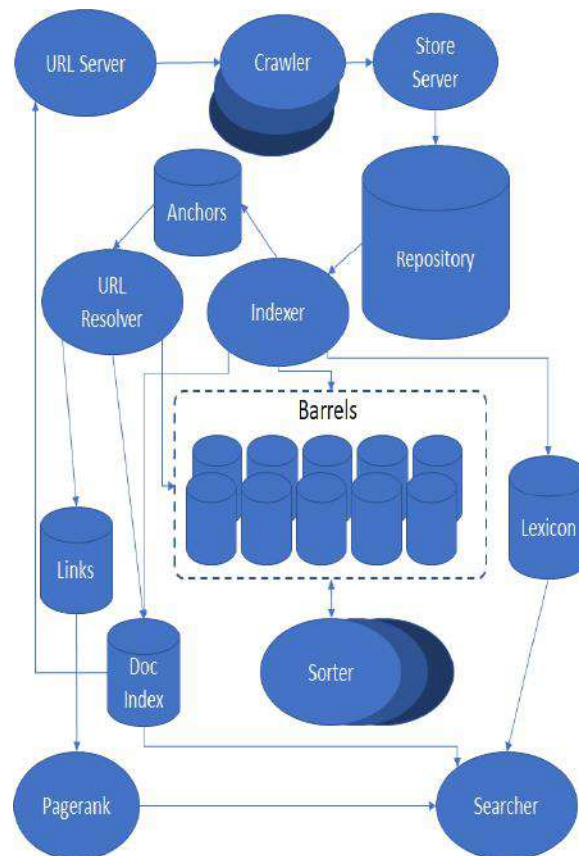
Fig. 1: High-level Google architecture [4]

2.3   Estimation and search data

Whenever a user accesses a search engine and makes a query, data such as the day, time, search term, and the region where the computer is located are saved in databases of the companies that provide these services. These data can be classified as search data on the web and are called digital trace.

These " digital trace " that are left can provide insights into a wide range of disciplines [3] and can apply to virtually any market where Internet searches precede the transaction, which holds for a large share of the world economy [39].

According to Oust & Martin (2018), inserting Google search data into prediction models for the real estate market improves its performance. The author explains that the choice of search terms is a fundamental part of the success of the model, as well as the choice of the region where the terms are searched.

According to Limnios (2018), increasing models using data from Google Trends does not improve its performance in predicting movements in the real estate market, and the use of this practice worsens the model's forecasting capacity. The same result was shown by Oust & Martin

(2018), when he replaced an established market indicator - the Consumer Confidence Index (CCI) started in 1977 - with the volume of Google searches, with a worsening of the model's assertiveness.

2.4 Financial market

At all times, economic agents are making decisions about how they will consume, as well as their production of goods in the capital market. Within this group of agents, there will always be those who consume more than they produce, and those who produce more than they consume. In this way, the second group (savers) can meet the needs of the first group (borrowers) with what was saved. Therefore, the creation of a mechanism that makes the transfer of these resources feasible has become fundamental for the development of productive activities in modern society [15].

2.5 Capital market - Brazil

In Brazil, all operations that take place in the financial market and their respective participants are supervised by the Securities and Exchange Commission (CVM). The CVM was created by Law No. 6,385, on December 7, 1976, to discipline, supervise, and develop the securities market (https://www.investidor.gov.br/menu/Menu_Investidor/introducao_geral/introducao_mercado .html). It is an autarchy under a special regime directly linked to the Ministry of Finance and its scope can be seen in Figure 2[8].
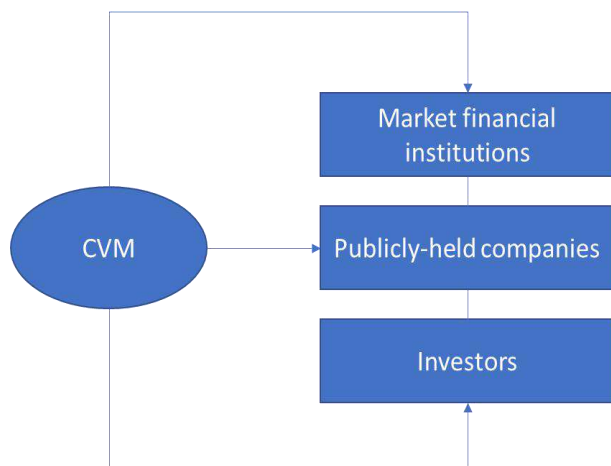
Fig. 2: CVM's scope [15]

The largest stock exchange in Latin America, B3 (former Bovespa), is located in Brazil. It has its headquarters in the central region of São Paulo, also the largest financial center in the region. This is the only stock exchange in the country for trading securities and it has listed 267 companies (in April 2020). Shares in the Brazilian market, different from what is commonly used in other international markets, can take two formats: common shares or preferred shares.

Usually, when one wants to evaluate the performance of investments involving shares, the Bovespa index always indicated as a reference for such comparison, being considered the main benchmark for the variable income market. The Ibovespa (Bovespa index) is revalued every four months and is the result of a theoretical portfolio of assets. Its main objective is to be the indicator of the average performance of the most tradable and representative assets of the Brazilian stock market (approximately 80% of the number of trades and the financial volume of the entire market), being composed only by the shares and units of companies that meet the criteria of its methodology [1].

Another interesting feature of the Brazilian capital market is the distribution of the types of investors and their respective market shares. It can be seen from Figure 3; currently, half of the Brazilian spot market is composed of foreign investors. These showed strong growth between the years 2010 to 2014, and have maintained steady growth since then. Only 17.2% of the market share is held by individual investors [2].
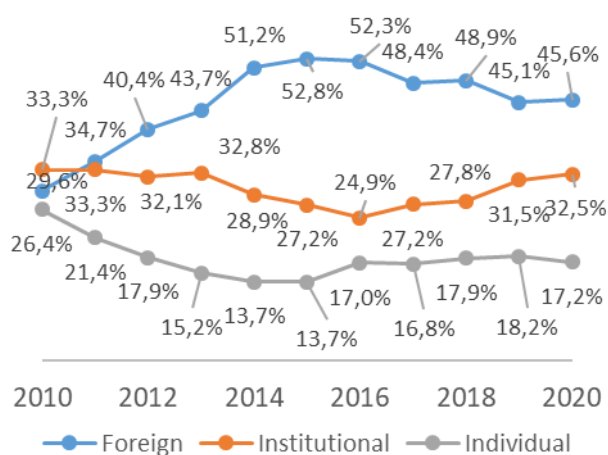
Fig. 3: Evolution of Investor Participation in the Market from a Brazilian perspective.[2].

III.   METHODOLOGY

The present study has an exploratory character, and it aims to provide an overview of a subject, until then, little-explored to our national market. Descriptive, as it presents characteristics of a certain phenomenon and establishes a relationship between its variables. It is slightly explanatory, as it is also concerned with identifying factors that contribute to the occurrence of the studied phenomenon [16].

The scientific methodology used is the result of the combination of the inductive method and the statistical method. The first method will provide the logical basis for the investigation being proposed, starting from particular cases to generalization [13]. The second method, based on the application of variable statistical theories of the phenomenon[41], making it possible to determine, in numbers, the probability of a given conclusion[16].

According to Popper (2015), the inductive leap from particular cases to generalization requires that observations of particular phenomena reach infinite proportions, which never occurs. For Gil (2019), one way to get around this problem is to use the statistical method, which makes it possible to indicate different degrees of confidence for a conclusion obtained through induction. The limitation of the statistical method is because its explanations cannot be considered as absolute truths, but as explanations with good chances of being true.

According to Dimpfl (2016), who also assumes that search engines are the primary source of information for amateur investors, the authors demonstrate that an increase in the number of searches performed on search engines today is followed by increased volatility on the markets tomorrow.

To corroborate the aforementioned hypothesis, the web search data generated by the Google search engine tool will be used to estimate the movements of the Brazilian stock market, concerning asset pricing. Google will be used due to its dominance in the search engine market (See Table 2 - The 10 largest virtual search engines), thus being the best available representation of the general behavior of the population in this type of tool.

Thus, to apply the methodology for assessing the validity of this hypothesis and its causal relationships, the following steps presented in figure 4 will be followed.
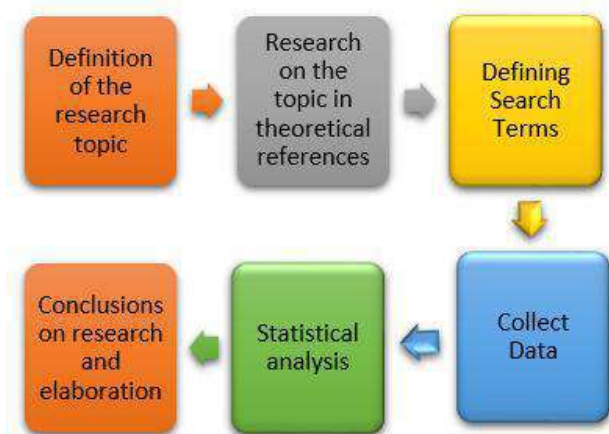
Fig. 4: Methodological Flow

IV.   DEVELOPMENT OF THE RESEARCH

Next, the steps of the research and its data analysis shall be presented.

4.1   Definition of search terms

The search terms are the keywords that the user enters into the search engines. The whole process begins at the moment when the user identifies a research task to be accomplished and converts this need into words. In order to achieve success and obtain relevant information, it is essential to choose the correct search term, otherwise, the results obtained may be unsatisfactory [24].

We can illustrate this process using a simple example: a potential investor in the company "X" wants to obtain information about the value of its shares. This way, he inserts "X" as his keyword in the search engine and, as a result, obtains the link to the company's website, its geographical location and its social networks. For this specific task (obtaining the share price of company "X"), the key term could be the ticker itself (an abbreviation used to exclusively identify shares traded on the stock exchange, eg "ITUB3" for Banco Itaú and "ABEV3" for the manufacturer AmBev beer) of company "X" or even the addition of the term "shares" before the company name.

Lieberam-Schmidt (2010) explains that during the research process, some common mistakes lead to unsatisfactory search results. They are: I. believing that information is necessary for a task and this is not true; II. verbalization of the task does not reflect the need for information; III. poor formulation of the consultation; IV. the same word has different meanings (polysemy) and V. use of synonyms.

For the more specific analysis of this market, only six (6) companies were selected to facilitate the methodology, data analysis[14], and the amount of information. For this selection, the companies with the greatest representation in the market were listed, as well as the differentiation of the sectors, which will be specified according to each company analyzed. The final list of search terms for individual companies as shown in Table 3.

Table 3: List of key terms used for individual companies separated by economic sector and ordered by participation in IBOVESPA [20].

#	Company Name	Sector	Part. (%)
1	Vale	Mining	12,89
2	Itaú	Financial Intermediary	10,89
3	Petrobras	Oil, Gas, and Biofuels	7,48
4	Renner	Retail	1,75
5	Cogna	Education	1,28
6	Gerdau	Metallurgy	1,41
Representativeness on the IBOVESPA			35,33

The selection made represents 6 different sectors of the Brazilian economy and approximately 35% of the Ibovespa. As previously stated, for the Bovespa index, the term "Ibovespa" will be used.

Given all the data collected so far, and to have a faster and more objective targeting of them, tickers were not used in searches on Google Trends, but rather the names of the companies themselves.

4.2 Data collection

Two types of data were used during the study, these are search data and financial data. The period evaluated will be from January 2008 to January 2018. The features and particularities of the tooling will also be described, when necessary.

4.2.1 Search Data

According to its question page, the Google Trends service analyzes a random part of searches performed on Google itself to calculate how many searches were made for specific terms. The tool is based on two variables: time and location. Each data point in Google Trends is calculated by dividing the total searches for a specific geographic region and the length of time the total searches cover, which results in a measure of relative popularity. The resulting numbers are scaled in a range from 0 to 100 based on the ratio of one topic to all searches across all topics. For example, a value of 100 represents the peak popularity of a term[18].

It's important to keep in mind that Google Trends only provides data related to search terms for which traffic exceeds a certain threshold, disregarding those with low volume. Repeated queries by a single user for a short period of time are also excluded so that the level of interest is not artificially impacted by this type of behavior. There is also the query filter with apostrophes or other special characters.

Google Trends does not provide search volume with daily granularity, except for extremely frequent search terms, this is not the case for all of our terms[18]. Therefore, we conduct our analyzes on a weekly granularity, thus, data related to the set of selected search terms are available. Research data was also obtained using region filters, both for Brazil and for Global. What we want to validate here is whether there is any difference between the research relationships in the different regions, given that the Brazilian financial market has a strong influence from foreign investors, another important limitation to be highlighted is that the Google Trends values vary according to the date of access to the tool, due to its normalization process. For example, when a new top of interest is reached, it becomes the new value "100" in the database, changing everything else. In addition to this, the normalization process results in only whole numbers, which can also add rounding errors. These problems do not currently have a solution and can impair the reproducibility of the results [6].

In the case of Brazil, the dominance of the Google search engine is clear. In the country, for the year 2020, the mechanism had 97.33% of the national search market, against timid 1.33% of the second-place Bing.[37].

4.2.2 Financial data

In this work, weekly trading volumes for the general Ibovespa market index and weekly volumes for the first 3 individual companies listed in figure 6 were used as inputs.

The volumes traded in isolation were analyzed, the direction (ascending or descending) that the market presented during that determined period was disregarded. This evaluation aimed to verify if there is any type of correlation between the volume of searches and the volume of negotiations that occur for a financial instrument - which aims to be a reference for investors – [7] and, for individual companies [33].

Weekly opening and closing prices were also used for both the Ibovespa and the 6 (six) largest individual companies listed on this list. The other possibilities would be to use the weekly maximum or minimum price, however, we opted for the analysis of opening and closing prices by what they represent for the market.

According to Elder (2004), the opening price generally reflects the opinion of amateur investors about the value. Opening prices, most of the time, are closer to the lows or

highs of that period, and during the course of the day, the asset price tends to recover and reach a more moderate value.

Still, according to Elder (2014), the closing price tends to reflect the opinions of professional investors, characterizing them as more active at the end of the trading periods. For the author, professional investors generally operate against amateur investors. The first group tends to profit according to the more emotional reactions of the second group.

All financial information (volume, opening, and closing price) presented in figure 5, were extracted from the Yahoo Finance portal. The service is provided free of charge and, in this way, the website informs that the data provided is for informational purposes only and is not intended for commercial or investment purposes [40]. Another feature of the service is that it receives information from the data company ICE Data Services (market data company) and passes it on in the original format received with a 15-minute delay (for Brazil).
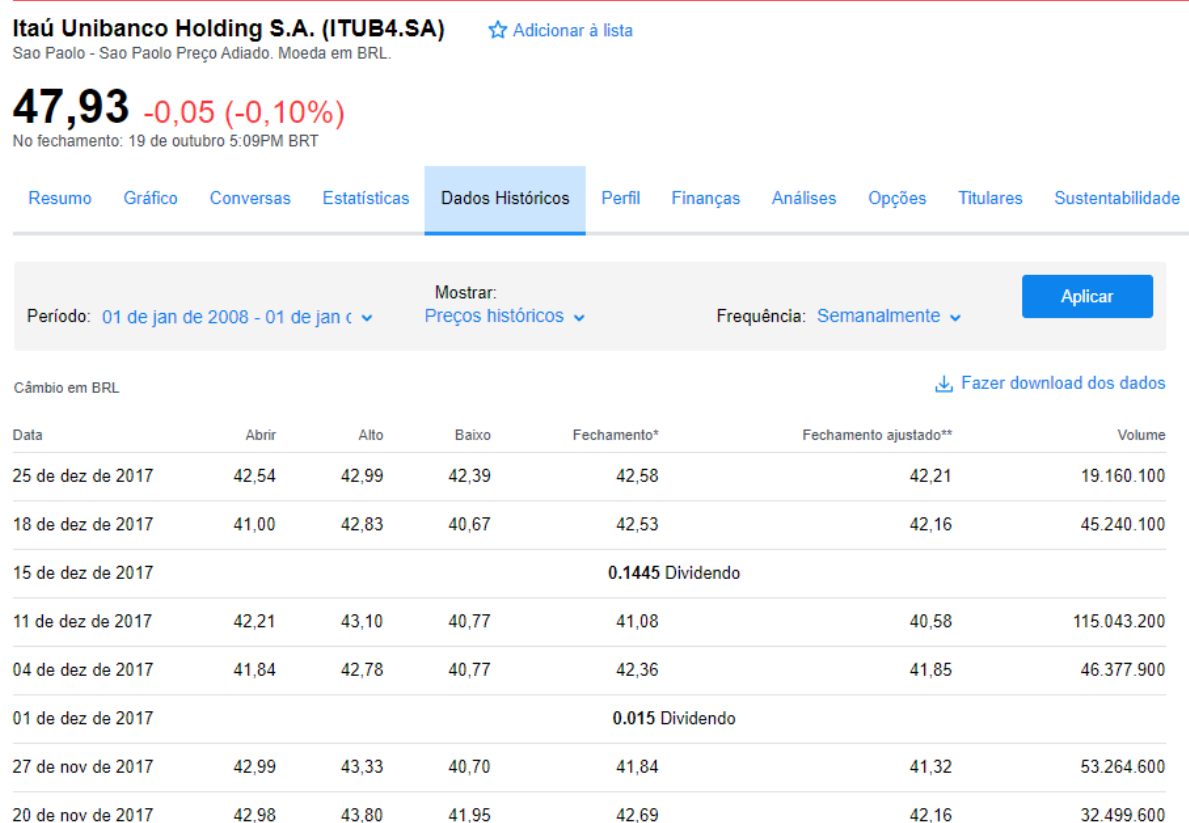
Fig. 5: Example search result, using Yahoo Finance, for Banco Itaú (ITUB4) for the trial period

In this research, the programming language interpreted by Python was used to carry out statistical analysis. Python is a free, open-source language, and an excellent option as the main language for creating data applications [27].

The causality study seeks to identify whether a given variable is capable of improving the prediction of another in the context of time series. In order to ascertain whether this causality relationship, Granger's concept of causality (1969) was used.

Granger causality direction can be defined as:

a) Unidirectional (PF $\Rightarrow$ PV);

b) Bilateral Causality (PF $\Leftrightarrow$ PV);

c) Independence (PF and PV are independent, PF not Granger causes PV and PV not Granger causes PF).

According to Gujarati (1999), if the calculated probability value exceeds the critical value at a chosen level of significance, we reject the null hypothesis. That is, if the null hypothesis is rejected, it can be said that there is a causal relationship of Granger between the variables.

All of these statistical analyzes will be presented according to the companies mentioned and developed. Below, Granger's concepts, as well as proportionalities,

will be exemplified, commented, and analyzed according to the assets situation of each institution in the defined period from 2008 to 2018.

4.2.3.1   Data from Vale

Vale, a Brazilian multinational mining company and one of the largest logistics operators in the country. It is one of the largest mining companies in the world and also the largest producer of iron ore, pellets, and nickel. The company also produces manganese, ferroalloy, copper, bauxite, potassium, kaolin, alumina, and aluminum. On the Stock Exchange (see Table 4) it remains listed on B3 with common shares (VALE3) and is also present in the fractional market (VALE3F).

Table 4: Descriptive analysis of Vale's asset prices.

VALE				
	Opening	**Maximum**	**Minimum**	**Closing**
Min.	9.63	13.03	8.60	**9.72**
Median	36.45	38.96	33.54	**36.49**
Max.	65.54	73.80	64.65	**65.64**

4.2.3.1.1 Vale statistical analysis

According to Table 5, all correlations of Vale's assets remain positive and of low strength, and there is a remarkable correlation of greater expression in the maximum price of the asset when compared to data from Google Trends do Brazil and a correlation of greater expression in the opening price (Open) of the asset when compared with data from Google Trends of the World, indicating that the interest in searching for the asset when it reaches its maximum value in the current month for the Brazilian market and the opening for the Global market.

Table 5: Vale correlations.

CORRELATIONS WITH ASSETS VALE				
	Opening	**Maximum**	**Minimum**	**Closing**
WORLD	0.4959763	0.4941035	0.4510825	0.462266
BRAZIL	0.5349776	0.5398466	0.4782662	0.502440

According to the test for trends without a geographic filter (world) it is possible to establish a causal Granger relationship between prices (opening, closing, maximum and minimum) and search interest in trends with up to 99% confidence. This relationship is not possible to prove when

significance levels below 0.1% are adopted except for the opening price (Open).

With no acceptable significance level, a causal relationship of trends with prices was found (Table 6), that is, trends do not precede price.

Table 6: Granger Causality - World Vale.

VALE - WORLD			
GRANGER CAUSALITY TEST - Probabilities			
	Price -> Trends		**Trends -> Price**
Opening	0.0006915095	↔	0.2597236
Maximum	0.001761687	↔	0.8140406
Minimum	0.001761687	↔	0.7988959
Closing	0.0011733033	↔	0.7370794

According to the test for trends without a geographic filter (world) it is possible to establish a causal Granger relationship between prices (opening, closing, maximum and minimum) and search interest in trends with up to 99% confidence. The present relationship is not possible to prove when significance levels below 0.1% are adopted.

With no acceptable significance level, a causal relationship between trends and prices were found (Table 7), that is, trends do not precede price.

Table 7: Granger Causality - Brazil Vale.

VALE - BRAZIL			
GRANGER CAUSALITY TEST - Probabilities			
	Price -> Trends		**Trends -> Price**
Opening	0.001125861	↔	0.2370143
Maximum	0.001942837	↔	0.5780904
Minimum	0.00327824	↔	0.2700823
Closing	0.002488181	↔	0.3014495

4.2.3.1.2   Statistical analysis ITAÚ

Itaú Unibanco Holding S.A. In 2019, Itaú Unibanco had R $ 28.3 billion in net income and distributed R $ 18.8 billion in dividends.

Itaú Unibanco is a major merger of companies with numerous employees. Due to the union between Casa Moreira Salles, which in 1960 became Unibanco; and Banco Central de Crédito S.A., which was renamed Itaú.

The two banks merged in 2008. This merger led to the Instituto Moreira Salles, Instituto Itaú Cultural, Fundação Itaú Social, and Instituto Unibanco. With around 5,000 branches in Brazil and abroad, it also operates in 21 countries.

Itaú shares (ITUB4, ITUB3) are part of the IBOVESPA index and were one of the sensations from 2016 to 2019, going from the range of R $ 20 then to the current R $ 35/36 now, an appreciation of almost 100% in three years. An investor who had purchased R $ 100 thousand in Itaú shares (ITUB4, ITUB3) in 2016 would have earned R $ 75 thousand by December 2019.

In table 8 we can see that for the analyzed period, the median closing value of Banco Itaú shares is closer to its minimum value than to its maximum value, this can show that the prices of this share, in moments of euphoria, tend to value themselves more strongly than to devalue themselves in times of pessimism.

Table 8: Descriptive analysis of Itaú asset prices.

COMPANY: ITAÚ				
	Opening	Maximum	Minimum	Closing
Min.	8.94	10.94	7.00	**9.19**
Median	17.73	17.87	15.75	**16.97**
Max.	36.80	43.82	35.35	**43.74**

4.2.3.2.1 Itaú statistical analysis

According to Table 9, all correlations of the Itaú asset remain negative and of very low strength, thus indicating that the interest in searching for the asset is independent of prices and vice versa.

Table 9: Descriptive analysis of Itaú asset prices.

CORRELATIONS WITH ITAÚ ASSETS				
	Opening	Maximum	Minimum	Closing
WORLD	-0,253752	-0.250883	-0.228290	-0.234694
BRAZIL	-0.359435	-.3590946	-0.332986	-0.341298

Unlike all the assets studied so far, there is no causal relationship of Granger (Table 10), either from price trends

or from prices to trends at any level of acceptable significance.

Table 10: Granger Causality - Itaú Mundial.

ITAÚ - WORLD			
GRANGER CAUSALITY TEST - Probabilities			
	Price -> Trends		Trends -> Price
Opening	0.2163918	↔	0.7464781
Maximum	0.1119121	↔	0.6729117
Minimum	0.39484	↔	0.4449923
Closing	0.1541122	↔	0.4560661

Even in the face of the assets World against Brazil, Granger's theory of non-causality for both is confirmed - being the first (and only) company to behave in this way. Table 11 confirms the theory.

Table 11: Granger Causality - Itaú Mundial.

ITAÚ - BRAZIL			
GRANGER CAUSALITY TEST - Probabilities			
	Price -> Trends		Trends -> Price
Opening	0.2488691	↔	0.4629911
Maximum	0.2166089	↔	0.3747098
Minimum	0.3994947	↔	0.5587284
Closing	0.2385429	↔	0.2839803

4.2.3.2.2   PETROBRÁS statistical analysis

For four decades, since its creation in 1953, Petrobras has monopolized oil research, refining, and transportation in Brazil. In 1997, it lost this condition when Law 9.478 allowed other companies based in Brazil to start operating in all stages of the oil chain.

Even so, Petrobras still maintains majority control in the fuel production chain, and is one of the most important companies in the energy sector in the world, specializing in oil production in deep and ultra-deep waters.

Shaken by the corruption scandals pointed out by Operation Lava Jato, (Infomoney, 2020) the oil giant has accumulated losses of more than R $ 70 billion in successive losses since 2013, interrupted in 2018. Officially, it recognizes the loss of around R $ 6 billion for

corruption between 2004 and 2012 and ensures that its new governance model reverses the problems highlighted by Lava-Jato operation.

The publicly traded mixed-capital company is controlled by the Federal. It has more than 60 thousand employees and produces around 1.7 thousand barrels of oil products daily. Its capital consists of common (PETR3, PBR, and ADR) and preferred (PETR4, PBR / A-ADR) shares traded on the São Paulo, New York, Madrid, and Buenos Aires stock exchanges.

In table 12 we can observe a phenomenon similar to what occurred in the descriptive analysis of Itaú's actions. During the analyzed period, the median closing value of Petrobras shares is closer to its minimum value than to its maximum value, this may show that the prices of this share tend to appreciate more strongly in times of euphoria than to devalue in moments of economic pessimism.

Table 12: Descriptive analysis of Petrobrás asset prices.

COMPANY: PETROBRAS				
	Opening	Maximum	Minimum	Closing
Min.	4.74	5.28	4.12	4.84
Median	19.76	21.58	17.90	19.72
Max.	50.97	53.68	43.00	49.00

According to Table 13, all correlations of the Petrobras asset remain positive and of moderate strength and there is a notable correlation of greater expression in the maximum price of the asset when compared to data from Google Trends do Brazil. Indicating that the search interest for the asset when it reaches its maximum value in the current month.

Table 13: Petrobras Correlations

CORRELATIONS WITH PETROBRAS ASSETS				
	Opening	Maximum	Minimum	Closing
WORLD	0.6003359	0.6111687	0.5811080	0.5883111
BRAZIL	0.6573648	0.6725125	0.6383784	0.6546579

According to the test for trends without a geographic filter (world) it is possible to establish a causal Granger relationship between prices (opening, closing, maximum

and minimum) and search interest in trends with up to 95% confidence. The present list is not verifiable when significance levels below 0.1% are adopted except for the opening price (Open).

With no acceptable level of significance, a causal relationship (Table 14) of trends with prices was found, that is, trends do not precede price.

Table 14: Granger Causality - Petrobrás Mundial

PETROBRAS - WORLD			
GRANGER CAUSALITY TEST - Probabilities			
	Price -> Trends		Trends -> Price
Opening	0.0009736962	↔	0.1506712
Maximum	0.004103743	↔	0.3344646
Minimum	0.006109518	↔	0.2525364
Closing	0.01791153	↔	0.3277053

According to the test for trends without a geographic filter (world) it is possible to establish a causal Granger relationship between prices (opening, closing, maximum and minimum) and search interest in trends with up to 95% confidence. The referring relation is not subject to proof when significance levels are adopted below 1% except for the opening (Open) and maximum (High) price.

With no acceptable significance level, a causal relationship (Table 15) of trends with prices was found, that is, trends do not precede price.

Table 15: Granger Causality - Petrobrás Brazil

PETROBRAS - BRAZIL			
GRANGER CAUSALITY TEST - Probabilities			
	Price -> Trends		Trends -> Price
Opening	0.001460834	↔	0.06837931
Maximum	0.006888635	↔	0.1675851
Minimum	0.01052826	↔	0.2512003
Closing	0.02282375	↔	0.5383188

V. CONCLUSION

After all this analytical historical survey, researched from the purpose of verification when using query data for searches generated by search engines as a source of information to predict the behavior of the Brazilian financial market, it was possible to understand the existence of a certain consistency in the data which point to confirming Granger's causality in prices, thereby affecting the level of Google searches.

Thus, it is not significant evidence that Google searches affect prices, but that there is a greater chance that prices affect the curiosity of the general public. This shows that search engines are used after major price movements and not the other way around. The theory can be supported by the hypothesis that institutional investors, who are more representative, do not use common search engines - such as Google - as a source of information for decision making, corroborating the proposition that highly qualified mechanisms exist to assist them. them in your result.

Strong and moderate correlations were presented confirming how the maximum prices, like Petrobras, fluctuate and vary between search engines in Brazil and the world. These correlations confirm the idea that when prices reach their peaks - as well as their falls - they are validated in greater activation of the search curiosity for such companies on Google.

Even the behavior of different sectors, remaining uniform in this perspective, also presented moderate and positive correlations of strength, corroborating Granger's causality that prices affect search levels.

Another interesting fact is that another company that has a direct relationship with the population, but in another sector, Itaú (Financial Intermediaries), presented a weak and negative correlation, demonstrating again that we cannot affirm that there is a pattern in this sector.

Concerning the geographical filters between searches carried out by the World and searches carried out only in Brazil, it is not possible to state that there is any significant impact. The data alternates between companies, some of which are more or less related to global markets, but without a relevant difference. Thus, it is not possible to say that the national market is influenced by the levels of international searches, even though it is characterized by the large participation of foreigners. This corroborates the possibility that institutional investors do not use Google as a research source, only individual investors, who, in the world market and based on global data, are not very representative.

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Vitamin D as an Immunological Factor in Combating COVID-19

Eliana dos Santos Farias[1], Dayana Ferraz Silva[2], Valdir Silva da Conceição[3], Angela Machado Rocha[4]

[1,2]Bachelor of Biotechnology from the Federal University of Bahia, Salvador, Bahia, Brazil

[3]Master's student of the Graduate Program in Intellectual Property and Technology Transfer for Innovation at the Federal University of Bahia, Institute of Chemistry, Salvador, Bahia, Brazil

[4]PhD in Energy and Environment from the Federal University of Bahia, Professor at the Institute of Health Sciences at the Federal University of Bahia (ICS-UFBA), from the Graduate Program in Intellectual Property and Technology Transfer for Innovation (ProfNIT) Focal Point from the Federal University of Bahia, Salvador, Bahia, Brazil

Abstract— The world is facing the worst pandemic caused by the new coronavirus (COVID-19) since the end of 2019, which started in China and continued to spread over the world. Several studies confirmed that when the immune system is strengthened, it is able to modulate the immune response at the time of infection, reducing the amount of proinflammatory cytokines. Vitamin D participates in the absorption of calcium by the body, which contributes to bone health and also facilitates the absorption of other vitamins. This article highlights about the role of vitamin D to the immune response. The methodology used was the qualitative and descriptive approach. It is concluded by the studies carried out that vitamin D reduces the chance of respiratory infections and can be another element to be used to combat contamination by COVID-19.

Keywords— Coronavirus, Pandemic, Immune System, Health, Vitamin Absorption.

I. INTRODUCTION

The main function of vitamin D is the regulation of calcium homeostasis, contributing to bone formation and resorption, through its interaction with the parathyroid, kidney and intestines. These are all involved in the immune system, regulating the differentiation of lymphocyte cells and interfering with the production of cytokines, which are the proteins that cells release. They also increase body temperature in response to infection or inflammation, producing fever as a defense mechanism to stop the virus reproducing [1, 2, 3, 4]. According to the level of vitamin D found in the body, there is a classification made by the scientific community which are as follows: vitamin D deficiency, insufficiency and sufficiency [5].

Some studies show that patients with autoimmune diseases have low concentrations of calcitriol and when they are supplemented with vitamin D, there is a clinical improvement [6]. The relationship between the serum vitamin D level and the severity of COVID-19 (Corona Virus and Disease 19) has been discussed worldwide, due to a pandemic alerted by the World Health Organization - WHO, in March 2020. Research into alternatives to treat

people contaminated with COVID-19 indicate that vitamin D can this is because in addition to its homeostasis function, it participates in the regulation of the immune system and manages to destroy viruses in the body through cathelicidin [7, 8, 9, 10, 11].

The influenza virus affects the respiratory tract by direct viral infection or damage to the immune system's response. This can cause death due to the resulting pneumonia and there is a higher probability of this occurring in patients under the age of five and over 65 years of age, residents in nursing home, those admitted to hospitals with chronic lung or heart disease, those with a history of smoking and immune-compromised individuals [9, 10, 11].

Seasonal influenza infections typically peak in winter, as this is the period when doses of sun and concentrations of 25-hydroxyvitamin D {25 (OH) D} or calcitriol are at their lowest, especially among people residing in countries at medium and high altitudes. Also during this period, there are low temperatures and low relative humidity, both of which contribute to the survival of the influenza virus for longer outside the human body, compared warmer periods. One of the ways to reduce the risk of developing influenza

in winter is to increase concentrations of 25 (OH) D, using vitamin D supplementation. Some studies show a 27% reduction in influenza-like diseases [9, 11, 12] with this.

In winter, the low levels of vitamin D enable viral epidemics among people not taking Vitamin D supplements. These tend to reduce serum concentrations of 25 (OH) D i.e. Vitamin D which has the ability to reduce the risk of viral diseases. High concentrations of 25 (OH) D have the power to reduce the risk of several chronic diseases such as cancer, cardiovascular diseases, diabetes, chronic respiratory tract infections, among others [9, 11, 13]. It also reduces the risk of urinary tract infections through the following mechanisms: "maintaining tight junctions, killing viruses involved in the induction of cathelicidin and defensins and reducing the production of pro-inflammatory cytokines by the innate immune system, thereby decreasing the risk of a storm cytokines lead to pneumonia" [9, 11].

Elderly people belong to one of the groups at risk, especially those who live in nursing homes and who are deprived of exposure to sunlight. They often also have inadequate nutrition and interactions with medications, and for these reasons tend to have vitamin D deficiency [9, 11, 13, 14].

Coronavirus is a pathogen known since the 1960s and has the power to infect humans and other vertebrate animals. In humans, they attack the respiratory and / or gastrointestinal systems, ranging from a simple flu to a more serious infection such as pneumonia. There is an increase in the inflammatory response that resembles several autoimmune diseases and in patients trigger an imbalance in the production of pro-inflammatory cytokines, causing the disease to worsen [15, 16, 17, 18, 20].

Among the possible hosts of COVID-19 is the bat, the same animal responsible for the appearance of the Severe Acute Respiratory Syndrome (SARS) that occurred in 2002 [8, 15, 19].

II.   METHODOLOGY

The present study was carried out from a literature review, addressing topics related to COVID-19, vitamin D and the association between these two items.

The research was exploratory in character, to gain a certain familiarity with the studied themes, collaborating for the improvement of ideas, in order to obtain a greater understanding of the various aspects related to the studied theme [20].

In order to collect data, literature research was carried out using scientific articles, theses, dissertations, essays and specialized sites on the subject and with the help of material already published at scientific events, in magazines, newspapers, books, among others [20].

III.   THEORETICAL FOUNDATION

3.1 VITAMIN D METABOLISM

Vitamin D is a steroid hormone that is present in living beings. It can be obtained in two ways: endogenous production which is due to sun exposure and exogenous so obtained through diet and fortified foods. It is understood as a fat-soluble compound, which can be obtained by skin synthesis in the presence of ultraviolet light, when the 7-dehydrocholesterol compound changes to cholecalciferol (D3). In plants, this process also occurs by transforming ergosterol into ergocalciferol (D2) [13, 14, 21]. A reduction in vitamin D in humans can be related to the following factors: age, skin pigmentation, altitude, time of sun exposure and food intake. The need to expose the body to solar radiation was verified at the time of the Industrial Revolution. Workers confined in factories for long hours of labour were not exposed to sufficient sunlight, causing disease, especially rickets [14, 22].

The chemical structure of vitamin D2 differs from that of D3 in that it has an additional double bond and a methyl group incorporated into the long side chain of vitamin D2. Vitamin D derived from the diet is absorbed together with fats in the small intestine. This is aided by bile generated in the liver, while in the endogenous bile, metabolism occurs in the liver. About 80-90% of vitamin D metabolism occurs through endogenous synthesis and only 10-20% occurs through diet. Foods rich in vitamin D include: herring, tuna, mackerel, salmon, sardines, beef liver, chicken and cod, egg yolk, cabbage and mushrooms [1, 3, 4, 14, 23].

Vitamin D undergoes photolysis to become biologically active, and the conversation begins with the endogenous synthesis of vitamin D in the epidermis, after sun exposure, where 7-dehydrocholesterol (7-DHC) is found, which is vitamin D3, a cholesterol precursor. The activation of vitamin D begins with the absorption of the photon of ultraviolet radiation B (UVB) by 7-DHC, promoting the photolytic breakdown, resulting in the formation of pre-vitamin D3. This is then transported in the blood by a glycoprotein, the protein binding vitamin D (DBP), and this coupling to DBP is directed to the liver. However, pre-vitamin D3 undergoes hydroxylation mediated by the microsomal enzyme of the cytochrome P450 superfamily (CYP450), known as CYP2R1 (cytochrome P450 family 2, subfamily R, member 1), forming 25-hydroxyvitamin D or calcidiol [25 (OH) 2D3]. 25-hydroxyvitamin D bound to

DBP, which is carried to the kidney. The enzyme 1-α-hydroxylase (CYP27B1) promotes hydroxylation by forming 1-α, 25-dihydroxyvitamin D [1,25 (OH) 2D or calcitriol], which is the metabolically active molecule. The expression 1-α – hydroxylase is distributed in several cells of the human body and can be hydroxylated in these locations [3, 14, 23, 24, 25, 26, 27].
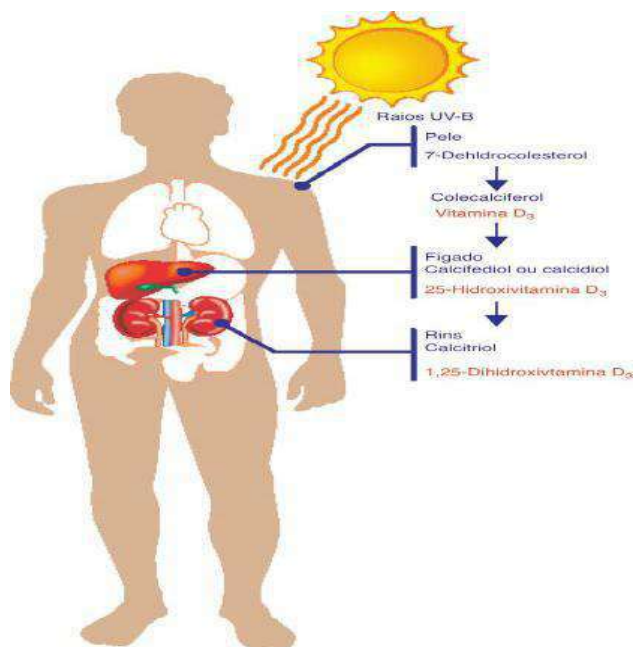
Fig. 1: Vitamin D metabolism and nomenclature

Source: Lichtenstein et al., (2013)

The radiation actions of the type B ultraviolet ray (UVB) of the sun produces vitamin D3 in the skin, reaching 7-dehydrocholesterol, which subsequently generates a thermal reaction. In the next step, vitamin D3 or oral vitamin D is converted to 25 (OH) D in the liver and then to the active metabolite of vitamin D, 1.25 (OH) 2D in the kidneys or other organs as needed. The major effect of part of vitamin D arises from calcitriol, which is introduced into the nuclear vitamin D receptor. This is a DNA-binding protein, which interacts directly with regulatory sequences close to the target genes and which invokes the active chromatin complexes, which genetically and epigenetically contribute to transcriptional production [9, 11, 28].
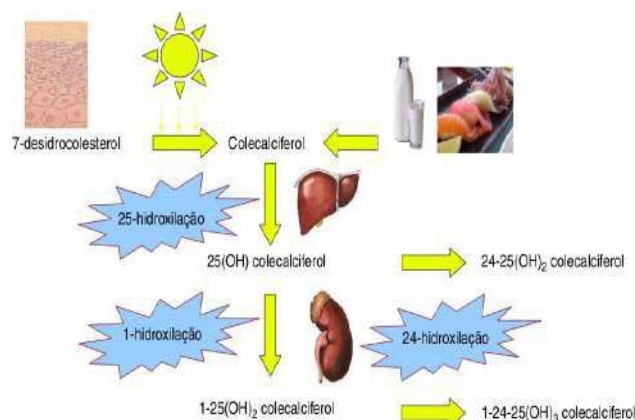
Fig. 2: Vitamin D synthesis and metabolism

Source: Bellan, Pirisi, Sainaghi, (2015)

3.2 VITAMIN D ACTION IN THE IMMUNOLOGICAL SYSTEM

Recent research has found that the vitamin D receptor (VDR) is widely expressed in immune cells present in immature cells, in mature CD8 T lymphocytes, in the thymus, in monocytes, in macrophages, in dendritic cells, in NK cells and in lymphocytes T and B. It is known that VDR modulates the immune response by autocrine and paracrine pathways, culminating in an increase in the innate immune response, associated with a regulation of the acquired response [3, 29].

Vitamin D inhibits the maturation and differentiation of dendritic (DC) cells, inducing a reduction in the expression of molecules of the main class II histocompatibility complex (MHC-II). It also modulates the expression of co-stimulatory molecules CD40, CD80 in monocytes and CD86 and the expression of inflammatory cytokines [IL-1 (interleukin 1), IL-6 (interleukin 6), INF (interferon), IL-8 and IL-12]. Calcitriol also acts in the regulation of B lymphocyte differentiation by raising IL-4 and favoring the change of class to IgE. In addition, 1,25 (OH) 2D directly modulates the proliferation of plasma cells, memory B lymphocytes and induces the apoptosis of immunoglobulin-producing cells. In rheumatic diseases mediated by T lymphocytes, calcitriol has been proven to be an effective alternative in controlling the disease [3, 29, 30, 31].

Evidence shows the possible association of vitamin D with some rheumatic diseases, a classic example being rheumatoid arthritis, whose pathophysiology involves a subpopulation of Th1 cells. Another disease that also has the target pathophysiology of calcitriol immunosuppression is systemic lupus erythematosus (SLE). For patients with SLE who have multiple risk factors for 25 (OH) D deficiency, it has been consistently demonstrated that vitamin D deficiency culminates in decreased immune

tolerance, allowing the development of the autoimmune disease in genetically predisposed individuals [32, 33].

Studies both in vitro and in vivo have demonstrated the immunomodulatory role of calcitriol and how supplementation with vitamin D has improved the clinical status of patients. Epidemiological data demonstrate the correlation between low serum vitamin D levels and the clinical manifestations of autoimmune diseases [33, 34, 35].

Several studies have shown that patients with SLE, RA and MS have low concentrations of calcitriol in the body, and the occurrence of this anomaly triggers the worsening of their clinical condition. When patients were supplemented with vitamin D, they showed clinical improvement over patients who were not. With supplementation, there was an improvement in the levels of inflammatory markers, a preferential growth of naive CD4 + T cells and an increase in Treg and Th2 cells. There was a decrease in effector T cells (Th1 and Th17), memory B cells and anti-DNA antibodies and they had an immunosuppressive action, thus controlling the disease activity [5, 36, 37].

3.3 CORONAVIRUS

COVID-19 is a diverse group of an RNA virus from the Betacoronavirus group, genus coronaviridae, subgenus sarbecovirus and subfamily Orthocoronavirinae. It makes use of a wide variety of vertebrate hosts, which cause the individual to have symptoms ranging from mild to severe intensity, with the potential to cause death. The difference between COVID-19 and other recent viral epidemics is as follows: it is more widespread than Severe Acute Respiratory Syndrome, more infectious than seasonal flu and its mortality is higher than that caused by Ebola. The coronavirus and the flu have some similar characteristics: they are viruses whose peak normally occurs in winter, causing deaths due to the resulting pneumonia. Coronavirus can survive outside the body on surfaces or objects for example. On aluminum and paper, it can survive up to two hours, however, on plastic and stainless steel, it can survive up to 72 hours, according to measures taken at normal room temperature. At a temperature between 30°C and 40°C, there is a drop in survival time, however, at a temperature of 4°C, it can survive up to 28 days [8, 9, 10, 15, 18, 19, 38].

Coronaviruses received this name due to their shape in the form of a crown of protein peaks on their surface. Seven viruses have been identified in the group of coronaviruses that cause human diseases and these are as follows: HCoV-229E; HCoV-OC43; SARS-CoV; HCoV-NL63; HCoV-HKU1; MERS-CoV and SARS-CoV-2 [8, 15, 38, 39].

In the sequencing of the SARS-CoV-2 genome, its similarity to the bat virus was observed of about 96.2%. For this reason it is suspected that the bat is the natural host that originated the virus and that transmission has been caused by it, through unknown intermediate hosts capable of infecting humans [10, 11, 19].

The SARS-CoV-2 epidemic officially began in December 2019 in China, in the city of Wuhan, capital of Hubei province. This is a city larger than London or New York. The name of the "2019 coronavirus disease" was abbreviated to COVID-19, from the English Coronavirus Disease. It is believed that the pandemic started in September 2019, with the maximum peak occurring on February 13, 2020 with 15,141 people infected and with the occurrence of 254 deaths [7, 8, 9, 18, 19].

The spread and death rate in China and South Korea may be associated with low serum concentrations of 25 (OH) D, especially in winter. In China, between July 2013 and February 2014, postmenopausal women showed values of 14 ng / ml, while in South Korea, between October 2011 and May 2014, at mean serum concentrations of 25 (OH) D for elderly people over 60 years of age were ~ 18 ng / ml for men and ~ 15 ng / ml for women [9, 11].

COVID-19 spreads through the respiratory tract through droplets, respiratory secretions and direct contact. The incubation period varies from 2 to 14 days. The most common symptoms reported in confirmed cases are fever, a dry cough and general malaise in most cases, in addition to fatigue, sputum production, dyspnoea, sore throat, headache, earache, chills, muscle pain, loss of smell and taste, shortness of breath and analgesia or arthralgia. The elderly and people with underlying health disorders such as hypertension, diabetes, cardiovascular disease and chronic obstructive pulmonary disease are those more vulnerable to develop acute respiratory distress syndrome, septic shock, metabolic acids and coagulation dysfunction, which can lead to the death of the patient [8, 9, 10, 11, 15, 18, 19, 38].

IV.   DISCUSSIONS AND RESULTS

A survey of the most frequent laboratory abnormalities in patients with COVID-19 enable a better understanding of the relationship with the risk factors that lead to the worsening of the disease. In most cases there is an increase in the white blood cell count, neutrophils, lactate dehydrogenase (LDH), alanine aminotransferase (ALT), aspartate aminotransferase (AST), C-reactive protein (PCR), total bilirubin, creatinine, cardiac troponin, increased D-dimer, procalcitonin, longer prothrombin time (PT), a decreased lymphocyte count and albumin [40, 41].

Cathelicidin is regulated by vitamin D or CYP27B1 (family 27 of cytochrome P450, subfamily B, member 1) and is present in neutrophil granules, monocytes, Nk cells. B cells play an important role in the inhibition of viruses and bacteria. Cathelicidin has the ability to break the lipid envelope of the virus and can block viral entry. The CYP27B1 gene is highly expressed in pulmonary epithelial cells in the case of viral respiratory infections at 1.25 (OH) 2D. This increases the level of the TLR CD-14 co-receptor, cathelicidin and the IkBα induction that acts as an NF- kB, causing a viral decrease in inflammatory genes to occur [42].

Research carried out in patients with autoimmune diseases measured the increase in the inflammatory response and found that they had low serum vitamin D levels and, from the moment they were supplemented, improvements in the clinical picture began to appear. The serum concentration of 25 (OH) D above 30 ng / ml is recommended for the population. However, there are several factors that tend to influence concentrations below what is recommended, among which the winter period stands out. Due to lower exposure to the sun, there is a decrease in serum concentration. Right now the vast majority of people are in quarantine and consequently will have a lower vitamin D [9, 10, 11]. Wimalawansa et al. (2020) suggest that people should take an oral daily dose of between 200-300 IU of vitamin D because if the person is infected, they may have fewer complications compared hose with a vitamin D deficiency.

Table. 1: Controlled studies of vitamin D-based treatment to prevent respiratory tract infections and influenza.

Item	Researcher				
	Rehman	Avenell *et al.*	Li-Ng *et al.*	Urashima *et al.*	Aloia e Li-Ng
Period	1.5 month	24 months	3 months	4 months	36 months
Type of evaluation	NRCT	RCT	RCT	RCT	RCT
Test group criteria	> 6 respiratory infections in the previous 6 months	Outpatient, age> 70 years	Outpatient, 18-80 years	School children, 6 to 15 years old	African American women in post-menopause
Test population	27 (children, of both sexes, aged between 3 and 12 years)	1740 (70 years old or over, 85% women)	78 (78.2% female, mean age 59.3)	167 (43% female, average age 10.0)	104 (100% female, median age 61.2)
Control population	20 (corresponding children, age and sex)	1704 (age over 70, 85% female)	70 (81.4% female, mean age 58.1)	167 (45% female, mean age 10.4)	104 (100% female, mean age 59.9)
Dosage and type of vitamin D	60,000 IU per week, orally	800 IU daily, oral D3	2000 IU daily, oral D 3	1200 IU daily, oral D3	2000 IU daily
ITR / influenza assessment method	Clinical diagnosis	Self-report in the questionnaire 18 (median) months after randomization	Self-report in the biweekly questionnaire	Nasopharyngeal swab by the doctor	Self-report during visit to the doctor every 6 months
Significant reduction in ITR or influenza	Y	N	N	Y	Y
P-value	<0,005 *	0,06	0,56	0,04 *	<0,002 *
95% CI	N / D	0,64–1,01	-2,4 a 3,4	0,34-0,99	N / D

NRCT = Non-randomized controlled trial, RCT = Randomized controlled trial.

* P-values less than 0.05 considered significant.

Source: BEARD, BEARDEN, STRIKER, (2012)

Studies by Beard, Bearden, Striker (2012), and summarized in Table 1, concluded that there is a direct relationship between the single nucleotide polymorphisms of the vitamin D receptor (VDR) and the worsening of infections. This finding concludes that this is related to the action vit D3 modulator of the innate response. Other studies argue that the high mortality rate due to COVID-19 infection suggests a relationship with serum vitamin D level and the immunoregulatory effect of vit D helps to control and reduce the worsening of the coronavirus [44].

A 30 ng / ml dose of vitamin D is more recommended for people in risk groups, composed mainly of pregnant women, the elderly, patients with osteoporosis, inflammatory and autoimmune diseases, chronic and pre-bariatric kidneys. The dose should be prescribed by a doctor in order to avoid problems related to excess, such as hypervitaminosis, which can cause the appearance of kidney stones, weakening of the bones and metabolic disorders. Treatment should also include eating healthy foods including fish and eggs, in addition to seeking sun, which is the natural activator of vitamin D and which will contribute to the absorption of calcium [9, 10, 11, 13].

4.1 CORONAVIRUS AND VITAMIN D AS A FIGHTING FACTOR

Wuhan is a port city in the interior of China and is home to the best universities of science and technology. It has a powerful market for the sale of live animals and seafood, mainly wild animals, such as the pangolin. It is believed that this animal was responsible for the initial contamination in humans. Such animals are sold as food and as an integral part of oriental medicine however, it is traded illegally. This animal presented a viral strain with a 99% genetic similarity to the new coronavirus. It is impossible to say with conviction that the virus passed from an animal to a human in the Wuhan market because it is not known which the animal it was not who patient zero was, that is, the first person infected [7, 8, 19, 45, 46 47].

Coronavirus has a high rate of contagion and one person has the power to infect five other healthy people, with each infected person shaping this virus spread factor. If transmission occurs at the same time, contamination occurs exponentially and this can contribute to the collapse of health systems. This is one of the reasons for the application of social isolation, as one of the tools used to control the rate of transmission of the coronavirus and thus avoid chaos in public health services. This is having relative success in some countries, with adherence by the majority of the population [9, 11, 19, 47].

Human-to-human transmission occurs mainly among family members, with the inclusion of relatives, friends and other people who somehow come into close contact with sick and / or infected people and who are in the incubation period of the virus [9, 10, 11].

After China enforced social isolation, starting with the locking up of the city of Wuhan on January 23, there was a reduction in the number of cases of contamination, and from March 8, 2020 this fell to dozens. This demonstrates that the measure was correct and had positive effects, stabilizing the number of cases and subsequently the return to normal activities. Cases of transmission grew once again due to the return to China of people from epidemic regions [9, 11, 46].

In a study carried out among people with SARS, it was observed that 17% of the patients required mechanical ventilation and 5% died. The health system of a nation / state / city does not have hospital beds for the entire population because people in general are healthy. Only a minority have or develop diseases requiring hospital beds. For some people who come into contact with viruses, their body creates antibodies with the ability to fight the virus. They become asymptomatic for the diseases generated by these organisms, but they still have the ability to transmit the virus to people who come into direct contact with them and this requires awareness and some care in order to hinder transmission [9, 11, 48].

People who work and/or deal directly with sick people with COVID-19 run a high risk of becoming infected due to their close contact and due to the high rate of transmission of the virus. In China, by February 14, 2020, more than 1,716 healthcare workers had been infected, with 1,502 from Hubei province and 1,102 from Wuhan, with a total of six deaths. Another group of people with potential for infection are those who work in the health system; doctors, nurses, security, cleaning and food service personnel, among others. They can spread this virus to several places as they travel from their communities to work and back home. This tends to generate an outbreak only among the components of this group [9, 10, 11, 47].

Health care workers tend to have low concentrations of 25 (OH) D, as a result of working long periods indoors. This was seen among nurses at a children's hospital in Iran, who had an average concentration of 12 +/- 9 ng / ml. However, in the United States of America doctors had a concentration of 22 +/- 2 ng / ml, while nurses and other health professionals had 25 +/- 4 ng / ml. Transmission among health professionals, in most cases, is due to hospital infection. In China, only 3.8% of cases were transmitted by patients with COVID-19 [9, 10, 11].

Recent magazine articles mention that infection by COVID-19 produces an increase in the production of

proinflammatory cytokines, C-reactive protein, an increased risk of pneumonia, sepsis, respiratory distress syndrome, diabetes and hypertension, with these symptoms associating almost simultaneously [9, 11, 47].

According to Grant et al. (p.8, 2020), the main epidemiological characteristics of the COVID-19 outbreak in China until February 2020 were as follows:

- The lethality rate (CFR) increased by 0.2% for young patients under the age of 40 and 14.8% for the elderly aged 80 and over

- The CFR was higher for men than for women (2.8% x 1.7%)

- Having comorbidities contributed to a significant increase in CFR (N = none, 0.9%; cancer, 5.6%; hypertension 6.0%; chronic respiratory tract infection (chronic RTI), 6.3%; diabetes melitus, 7.3%, cardiovascular disease [CVD], 10.5%).

The monotonic increase in CFR may be related to the presence of chronic diseases, which tends to appear and increase its effects due to the increase in the age or aging of people, who tend to reduce the serum concentration of 25 (OH) D. Other factors may also be associated with changes related to age in relation to the innate immune response, where the response increases the production of cytokines with the aging of people. Young children are more susceptible to influenza A as a result of the difference in the innate immune response [9, 11, 49].

People who have chronic illnesses usually have a low concentration of 25 (OH) D and increased inflammation. In the city of Trieste, Italy, a study was carried out with the elderly with a mean age of 67 +/- 12 years of age, who developed acute myocardial infarction and presented mean serum concentrations of 25 (OH) D of 11 + in winter / - 2 ng / ml. In the study conducted in Wenzhou, China, with the group of people with diabetes, the age was 43 +/- 11 years old and with the mean serum concentrations of 25 (OH) D, the value found was 13 ng / ml, and 16 ng / ml for control subjects [9, 11, 50].

When the COVID-19 injures the lung epithelial cells, it facilitates the occurrence of pneumonia, by increasing the production of Th1 type cytokines, which responds innately to viral infections with an increase in cytokines. In cell studies carried out in the laboratory, it was observed that at the late stage of the SARS-CoV pathology, and that responsible for the lung injury was interferon [9, 10, 11, 31].

Few, if any foods, are enriched with Vitamin D and few people take vitamin D supplements. The ban on fortifying foods with vitamin D occurred after the Second World War, due to the intoxication of children and adolescents as a result of their excessive dose in milk. Vitamin D reduces the risk of death in RTI-related pandemics according to results found in the 1918-1919 influenza pandemic studies in the United States of America [9, 11, 14].

Some evidence points to the fact that Vitamin D supplementation and higher concentrations of 25 (OH) D may be linked to a reduced risk of several chronic diseases such as cancer, diabetes mellitus, among others. A higher level of vitamin D is inversely associated with infection caused by viruses such as dengue, hepatitis, HIV, influenza, rotavirus, among others [9, 11, 43].

In order to increase serum concentrations of 25 (OH) D, which has the ability to help reduce infections acquired due to COVID-19, vitamin D supplementation is recommended. In studies, the recommended concentrations are at least 40- 50 ng / ml (100-125 nmol / l). This enables the prevention of infections and thus lowers the likelihood of their spread, serving people who work directly in the fight against coronavirus, including those who deal with sick people in homes and people who are quarantined and / or infected [9, 10, 11].

The main mechanisms for reducing the risk of infections and microbial death provided by vitamin D are: physical barrier, natural cellular immunity and adaptive immunity. It also helps to maintain tight joints, gaps and sticking joints. Viruses tend to disturb the integrity of the joints, with the power to increase infection by the virus and other microorganisms, whose viral action progress to pneumonia [9, 11, 51].

Vitamin D plays an important role in natural cellular immunity due to the induction of antimicrobial peptides, a group which includes human cathelicidin, LL-37 via 1,25-dihydroxyvitamin D and defensins. The function of host-derived peptides is to kill invading pathogens, acting by disturbing the invader's cell membranes and which can neutralize the biological activities of the endotoxin [9, 11, 52].

Serum concentrations of 25 (OH) D fall with the increasing age of people or aging of the individual due to the lack of exposure to the sun, in addition to the natural reduction of vitamin D production. This is due to the lower levels of 7-dehydrocholesterol in the skin. Also certain drugs can lead to a reduction in serum concentrations of 25 (OH) D, such as antibiotic drugs, anti-inflammatory agents, antiepileptics, antiretroviral drugs, anti-hypertensive drugs, endocrine drugs and some herbal medicines, among others, which are consumed as people get older [9, 11, 53].

Vitamin D supplementation also has the power to improve the expression of genes that are related to antioxidation. It

influences the increase in glutathione production and avoiding the use of ascorbic acid, which has among its functions antimicrobial activity [9, 11, 48].

V. CONCLUSION

One of the ways to protect the body against COVID-19 and other viruses and to reduce the vulnerability of the body as well as to strengthen the immune system against diseases, is to adjust the intake of vitamins and minerals, mainly C, D and Zinc that work as system optimizers.

In winter there is a peak of viral illnesses such as influenza that attack the respiratory tract system. Climatic conditions of low temperature and relative humidity are conditions that allow the virus to survive for a longer time outside the body, when compared to hotter seasons. During this period, a person has less access to the sun's rays, reducing the concentrations of 25 (OH) D, which can increase the risk of developing the flu. The most vulnerable population group for COVID-19 is the one with the greatest vitamin D deficiency. This group is composed of the elderly and people with existing comorbidities, such as diabetes mellitus, chronic respiratory disease, cardiovascular disease and cancer, among others.

Vitamin D plays an important role in maintaining human immunity, which helps the body to defend itself against other viruses and specifically against COVID-19. This makes it an ally in the fight against SARS-CoV-2, mainly for the elderly, with the ability to neutralize the damage caused by diseases resulting from complications in the respiratory tract system. It plays an important role in protecting against respiratory infections and vitamin D supplementation can serve as protection against COVID-19 infection.

In the current quarantine, with the recommendation by the authorities to stay at home, people should seek to consume healthy foods that have some vitamin D content such as fish and eggs, as well as take time to sit in the sun by windows and doors of the homes. To avoid skin problems, sunscreen should be used.

Coronavirus has a high rate of contagion in relation to influenza, MERS-CoV and SARS. This can lead to health system collapse if the virus is transmitted to the population all at the same time. One of the ways to avoid contagion is through non-pharmaceutical solutions, such as covering the mouth and nose when coughing and sneezing with something other than a hand, avoiding close contact and placing yourself at a minimum distance of 1.5 m from someone else, frequent handwashing with soap and water

or using 70%, alcohol gel, cleaning surfaces touched frequently and finally using a face mask.

The older population is more prone to morbidity and mortality and should be the group that require greater care. In groups with healthy and robust immune systems, the effect of the virus tends to be asymptomatic, but just like other groups there is a high risk of contagion.

Direct contact with virus carrying host animals or wild animal consumption is assumed to be the primary transmitter of SARS-CoV-2. Human contact with sick patients or infected people, or during the incubation period of the virus are the main mechanisms of transmission of the coronavirus. There are dozens of vaccines under study around the world, but the scientific community are developing the most appropriate and effective one to fight the virus.

The world is working to discover medicines and vaccines to fight coronavirus, a disease that has already spread to more than 205 countries around the world on almost every continent, with the exception of Antarctica.

However, further studies are still needed to determine the risks and necessary vitamin D replacement benefits, progress needs to be made in studies about vitamin D to validate its efficiency, in the literature there are few studies, in the long run, greater understanding is needed.

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Facilities and Services: An Assessment of Academic Institutions in Nueva Ecija

Mercy V. Torres, Eminiano P. Manuzon

Abstract— *Academic institutions face a lot of challenges and hurdles and one of it is to provide facilities and services that will meet the users' satisfaction. This paper evaluated the services of academic institutions in Nueva Ecija in terms of library, infirmary/clinical, food/canteen, and guidance counseling services. Also, this paper evaluated the facilities of academic institutions in terms of classrooms, comfort rooms, gymnasium and computer laboratories. This paper used the descriptive method. The researcher circulated a survey questionnaire to a total of 162 college students. Based on the results, the researcher drawn two conclusions. First, the services provided by academic institutions satisfied their respective students, notably the clinic and the guidance counseling office. Thus, it is recommended that the academic institutions look and improve the canteen services in order to satisfy their respective students. Second, the facilities which are classrooms, gymnasium and computer laboratories provided by academic institutions moderately satisfied their respective students. Thus, it is recommended that the academic institutions focus on the renovation and improvement of comfort rooms as it notably dissatisfied most of their respective students.*

Keywords— *Facilities, Services, Academic Institutions.*

I. INTRODUCTION

Academic institutions face a lot of challenges and hurdles and one of it is to provide facilities and services that will meet the users' satisfaction. An interest in receiving input on the quality of their facilities and services is important for educational institutions, especially private ones (Oluwunmi et al., 2016).Academic organizations agree that means of enhancing key service performance should be identified and enforced where applicable (Farber & Weiss, 2011).An updated curriculum must be provided by academic institutions; new infrastructure and equipment; efficient student services; proactive organization and management to support and optimize student learning (Laguador&Dotong, 2013).

The adequacy and quality of the school facilities affect the morale of the students and their academic performance, as it follows that facilities must not only be available, but must be adequate and in good condition to encourage the achievement of higher education among the students (Isa &Yusoff, 2015).In our academic institutions, considerations such as lack of funding, hardware, telephone, and networking infrastructure are terribly insufficient (Gambari&Okoli, 2007).

The academic institutions should be aware of the services that are critical and most important for teaching and studying students, as well as the campus environment that directly affects them in achieving academic excellence (Ramli et al., 2018).It is not easy to determine and assess the satisfaction of students with their educational experiences but it can be very helpful for the university to build strong relationships with their existing and potential students (Hanaysha et al., 2011).

With the foregoing insights, the researcher would like to assess the services and facilities offered by and provided by the academic institutions in the province of Nueva Ecija. With this paper, it will help sought the attention of the academic institutions on the needs of students as this could be a factor of academic achievement.

II. CONCEPTUAL FRAMEWORK

Institutional factors classified as educational material and usefulness have a minor impact on students ' academic performance, while the category of people and infrastructure has a moderate impact (Santos &Celis, 2020).

Facilities in terms of staff skills, which are specifically interested in pedagogy; classroom, library, school houses,

and the like are very important to high academic achievement (Owoeye&Olatunde, 2011).

The provision of facilities such as conducive offices, instructional materials, classrooms, laboratories, electricity supply, water supply, road network and information services should be taken into consideration (Babatope, 2010).

III. OBJECTIVES OF THE STUDY

This paper evaluated the services of academic institutions in Nueva Ecija in terms of library, infirmary/clinical, food/canteen, and guidance counseling services. Also, this paper evaluated the facilities of academic institutions in terms of classrooms, comfort rooms, gymnasium and computer laboratories.

IV. METHODOLOGY

This paper used the descriptive method. Descriptive approach is intended to collect knowledge about presenting current situations (Camic et al., 2003). The researcher circulated a survey questionnaire with likert-scale responses (Vagias, 2006) to a total of 162 college students consisting of 60 male students and 102 female students from different academic institutions in Nueva Ecija.

V. RESULTS AND DISCUSSIONS

Table 1.1. Library Services

Statement	Weighed Mean	Verbal Interpretation
The librarian is concerned with the needs of the students.	3.19	Moderately Agree
The librarian and other librarian personnel are approachable.	3.13	Moderately Agree
The collection of textbooks and other reading materials are available.	3.14	Moderately Agree
The library has a conducive learning environment which can be compared to a classroom.	3.20	Moderately Agree
The library offers e-library	3.42	Agree

services including e-books, e-journals and other online references.		
Average Weighed Mean	3.21	Moderately Agree

4.21 – 5.00 Strongly Agree (SA)

3.41 – 4.20 Agree (A)

2.61 – 3.40 Moderately Agree (MA)

1.81 – 2.60 Disagree (D)

1.00 – 1.80 Strongly Disagree (SD)

Table 1.1 illustrates the evaluation of library services. Based on the gathered data, it can be noted that the 5th statement, 'the library offers e-library services including e-books, e-journals and other online references' got the highest weighted mean $(\bar{x} = 3.42)$ which can be interpreted as agree. While, the 2nd statement, 'the librarian and other librarian personnel are approachable' got the lowest weighted mean $(\bar{x} = 3.42)$ which can be interpreted as moderately agree. Overall, the respondents moderately agreed $(\bar{x} = 3.21)$ to the positive statements about the services provided by the library.

Table 1.2. Infirmary/Clinical Services

Statement	Weighed Mean	Verbal Interpretation
The health workers/personnel are approachable.	3.43	Agree
There are medicines available in times of need.	3.68	Agree
The students undergo series of laboratory examination.	3.38	Moderately Agree
There is always a doctor/nurse-in-charge in the clinic/infirmary.	3.54	Agree
The clinic/infirmary maintains and protects the general health of the students.	3.53	Agree
Average Weighed Mean	3.51	Agree

4.21 – 5.00 Strongly Agree (SA)

3.41 – 4.20 Agree (A)

2.61 – 3.40 Moderately Agree (MA)

1.81 – 2.60 Disagree (D)

1.00 – 1.80 Strongly Disagree (SD)

Table 1.2 illustrates the evaluation of infirmary/clinical services. Based on the gathered data, it can be noted that the 2nd statement, 'there are medicines available in times of need' got the highest weighted mean *($\bar{x}$ = 3.68)* which can be interpreted as Agree. While, the 3rd statement, 'the students undergo series of laboratory examination' got the lowest weighted mean *($\bar{x}$ = 3.38)* which can be interpreted as moderately agree. Overall, the respondents agreed *($\bar{x}$ = 3.51)* to the positive statements about the services provided by the infirmary/clinic.

Table 1.3. Food/Canteen Services

	Weighed Mean	Verbal Interpretation
The price of the food offered is affordable and reasonable.	2.93	Moderately Agree
The food service is quick and fast.	2.83	Moderately Agree
The food served were good in quality and taste.	2.71	Moderately Agree
The canteen personnel exhibit proper personal hygiene.	2.57	Moderately Agree
The canteen personnel treat all customers fairly.	2.99	Moderately Agree
Average Weighed Mean	2.81	Moderately Agree

4.21 – 5.00 Strongly Agree (SA)

3.41 – 4.20 Agree (A)

2.61 – 3.40 Moderately Agree (MA)

1.81 – 2.60 Disagree (D)

1.00 – 1.80 Strongly Disagree (SD)

Table 1.3 illustrates the evaluation of food/canteen services. Based on the gathered data, it can be noted that the 5th statement, 'the canteen personnel treat all customers fairly' got the highest weighted mean *($\bar{x}$ = 2.99)* which can be interpreted as Moderately Agree. While, the 4th statement,

'the canteen personnel exhibit proper personal hygiene' got the lowest weighted mean *($\bar{x}$ = 2.57)* which can be interpreted as moderately agree. Overall, the respondents moderately agreed *($\bar{x}$ = 2.81)* to the positive statements about the services provided by the canteen.

Table 1.4. Guidance Counseling Services

	Weighed Mean	Verbal Interpretation
The guidance counselor is approachable.	3.79	Agree
The guidance counselor imposes proper sanctions to the violations of students.	3.74	Agree
The guidance counselor practices equality among the students.	3.83	Agree
The guidance counselor monitors and provide follow-ups to the student under observation.	3.76	Agree
During counseling, the guidance counselor observe strict confidentiality of recorded information.	3.77	Agree
Average Weighed Mean	3.78	Agree

4.21 – 5.00 Strongly Agree (SA)

3.41 – 4.20 Agree (A)

2.61 – 3.40 Moderately Agree (MA)

1.81 – 2.60 Disagree (D)

1.00 – 1.80 Strongly Disagree (SD)

Table 1.4 illustrates the evaluation of guidance counseling services. Based on the gathered data, it can be noted that the 1st statement, 'the guidance counselor is approachable' got the highest weighted mean *($\bar{x}$ = 3.79)* which can be interpreted as Agree. While, the 2nd statement, 'the guidance counselor imposes proper sanctions to the violations of students' got the lowest weighted mean *($\bar{x}$ = 3.74)* which can be interpreted as Agree. Overall, the respondents Agreed *($\bar{x}$ = 2.81)* to the positive statements about the services provided by the guidance counseling office.

Table 2.1. Evaluation of Classrooms

	Weighed Mean	Verbal Interpretation
The classrooms are well-ventilated.	2.64	Moderately Agree
The classrooms are well-lit	2.92	Moderately Agree
There are enough seats to accommodate every student.	2.92	Moderately Agree
The cleanliness of the classrooms is maintained.	2.91	Moderately Agree
The classrooms promote an ideal learning environment for the students.	2.97	Moderately Agree
Average Weighed Mean	2.86	Moderately Agree

4.21 – 5.00 Strongly Agree (SA)

3.41 – 4.20 Agree (A)

2.61 – 3.40 Moderately Agree (MA)

1.81 – 2.60 Disagree (D)

1.00 – 1.80 Strongly Disagree (SD)

Table 2.1 illustrates the evaluation of classrooms. Based on the gathered data, it can be noted that the 5th statement, 'the classrooms promote an ideal learning environment for the students' got the highest weighted mean $(\bar{x} = 2.97)$ which can be interpreted as Moderately Agree. While, the 1st statement, 'the classrooms are well-ventilated' got the lowest weighted mean $(\bar{x} = 2.64)$ which can be interpreted as Moderately Agree. Overall, the respondents Moderately Agreed $(\bar{x} = 2.81)$ to the positive statements about the classrooms provided by academic institutions.

Table 2.2. Evaluation of Comfort Rooms

	Weighed Mean	Verbal Interpretation
There is a stable water supply in the comfort room at all times.	2.42	Disagree
The cleanliness of the comfort rooms is well-maintained.	2.30	Disagree
The number of comfort rooms is proportionate to the number of students.	2.71	Moderately Agree
The comfort rooms are well-ventilated.	2.33	Disagree
The comfort rooms are well-lit	2.39	Disagree
Average Weighed Mean	2.43	Disagree

4.21 – 5.00 Strongly Agree (SA)

3.41 – 4.20 Agree (A)

2.61 – 3.40 Moderately Agree (MA)

1.81 – 2.60 Disagree (D)

1.00 – 1.80 Strongly Disagree (SD)

Table 2.2 illustrates the evaluation of comfort rooms. Based on the gathered data, it can be noted that the 3rd statement, 'the number of comfort rooms is proportionate to the number of students' got the highest weighted mean $(\bar{x} = 2.71)$ which can be interpreted as Moderately Agree. While, the 2nd statement, 'the cleanliness of the comfort rooms is well-maintained' got the lowest weighted mean $(\bar{x} = 2.30)$ which can be interpreted as Moderately Agree. Overall, the respondents Disagreed $(\bar{x} = 2.43)$ to the positive statements about the comfort rooms provided by academic institutions.

Table 2.3. Evaluation of Gymnasium

	Weighed Mean	Verbal Interpretation
The Gymnasium is large enough to accommodate the students during events.	3.51	Agree
The place is well-ventilated.	3.20	Moderately Agree
The Gymnasium is available for the students during school events.	3.46	Agree
The Gymnasium has emergency lights in-case there will be night events.	3.26	Moderately Agree
The place is well-lit.	3.45	Agree
Average Weighed Mean	3.38	Moderately Agree

4.21 – 5.00 Strongly Agree (SA)

3.41 – 4.20 Agree (A)

2.61 – 3.40 Moderately Agree (MA)

1.81 – 2.60 Disagree (D)

1.00 – 1.80 Strongly Disagree (SD)

Table 2.3 illustrates the evaluation of gymnasium. Based on the gathered data, it can be noted that the 1st statement, 'the gymnasium is large enough to accommodate the students during events' got the highest weighted mean $(\bar{x} = 3.51)$ which can be interpreted as Agree. While, the 2nd statement, 'the place is well-ventilated' got the lowest weighted mean $(\bar{x} = 3.20)$ which can be interpreted as Moderately Agree. Overall, the respondents Moderately Agreed $(\bar{x} = 3.38)$ to the positive statements about the gymnasium provided by academic institutions.

Table 2.4. Evaluation of Computer Laboratories

	Weighed Mean	Verbal Interpretation
The place is well-ventilated.	3.61	Agree
The computers and other equipment are functioning properly.	3.51	Agree
The computer units in the computer laboratory are enough to cater the needs of the students.	3.30	Moderately Agree
The place is well-lit.	3.51	Agree
The computer laboratory is open to all students for research purposes.	2.91	Moderately Agree
Average Weighed Mean	3.37	Moderately Agree

4.21 – 5.00 Strongly Agree (SA)

3.41 – 4.20 Agree (A)

2.61 – 3.40 Moderately Agree (MA)

1.81 – 2.60 Disagree (D)

1.00 – 1.80 Strongly Disagree (SD)

Table 2.4 illustrates the evaluation of computer laboratories. Based on the gathered data, it can be noted that the 1st statement, 'the place is well-ventilated' got the highest weighted mean $(\bar{x} = 3.61)$ which can be interpreted as Agree. While, the 5th statement, 'the computer laboratory is open to

all students for research purposes' got the lowest weighted mean $(\bar{x} = 2.91)$ which can be interpreted as Moderately Agree. Overall, the respondents Moderately Agreed $(\bar{x} = 3.38)$ to the positive statements about the computer laboratories provided by academic institutions.

VI.   CONCLUSIONS AND RECOMMENDATIONS

Based on the results, the researcher drawn two conclusions. First, the services provided by academic institutions satisfied their respective students, notably the clinic and the guidance counseling office. Thus, it is recommended that the academic institutions look and improve the canteen services in order to satisfy their respective students as this could refrain the students from buying foods that are nearby making them less efficient and productive. Second, the facilities which are classrooms, gymnasium and computer laboratories provided by academic institutions moderately satisfied their respective students. Thus, it is recommended that the academic institutions focus on the renovation and improvement of comfort rooms as it notably dissatisfied most of their respective students as this could also result to health problems.

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Product-service systems: a literature review on assisting development

Barbara Tokarz[1], Bruno Tokarz[1], Alexandre Borges Fagundes[2], Delcio Pereira[2], Fernanda Hänsch Beuren[2]

[1]Production Engineering, Department of Industrial Technology, Santa Catarina State University, São Bento do Sul, Santa Catarina, Brazil
[2]Department of Industrial Technology, Santa Catarina State University, Rua Luiz Fernando Hastreiter, 180, Centenário, São Bento do Sul, Santa Catarina, Brazil

Abstract— *The circular economy is gaining more space amongst academia and industry as a path toward sustainable development. The Product Service System (PSS) is pointed as a business model with a high potential of achieving circular economy, specially through efficient consumption and production. Even though literature on PSS is somewhat extensive and has been growing over the years, PSS is still troublesome to adopt, due to a lack of organization of the existing knowledge. This research seeks to gather and organize PSS development approaches (tools, methods and processes) presented in the literature, according to the PSS lifecycle. A bibliographical analysis was conducted, gathering researches in which PSS development approaches were mentioned. The approaches were later categorized, and their applications were analyzed. MePSS, PSS Board, Service Blueprint, and Business Canvas Model are some of the main approaches studied. Analysis showed research gaps concerning practical knowledge on the PSS field and approaches that comprehend the whole PSS lifecycle, completing the circularity of the product-service offer. Future research could aim at fulfilling those gaps, applying conceptual elements of Product-Service Systems and supporting the transaction toward a more circular economy.*

Keywords— *Circular Economy, Product-Service System, PSS Development, PSS Lifecycle.*

I. INTRODUCTION

In the modern industrial context, where industries are being pushed into reconsidering their ways of production because of tough competition, environmental policies, risks, and pressure from consumers [1], [2], the Circular Economy steps up as a path toward sustainable development [3]. Circular Economy is considered a regenerative system that aims at reducing resource consumption and energy and waste emission by closing the loop on production and distribution [3].

Authors have stated Circular Economy's benefits and links with the environment, the economy [3] and society [4]. Even though shifting from a linear business model to a circular one may be challenging [5], it is necessary for achieving Sustainable Development Goals [6]. One way of enabling circular solutions and reaching environmental, economic and social benefits is through servitization [7], [8], i.e., providing services to complement product offers [9].

A model which seeks to apply this shift, focused on sustainability [10], is the Product-Service System (PSS) defined as a set of products and services capable of satisfying customers' demands when combined [11]. Despite its benefits for company's competitiveness and the spheres of sustainability [12]–[14], PSS is still limitedly adopted [1].

A possible reason for this is that companies require "suitable models, methods and tools" that allow them to achieve customers' requirements [9] and support their transition to long-term offers [2]. However, although literature addresses these tools, they lack practical guidelines and biases for industry practitioners [15], [16].

Considering those issues, this research aims at congregating the main PSS approaches existing in literature, presenting industry stakeholders with a compile of tools, methodologies and processes that can be used to support the development of a PSS offer considering its lifecycle. Some of the approaches are deeper analyzed, and some conclusion are taken regarding PSS contribution to Circular Economy.

The paper is organized as follows: Section 2 presents a background on Product Service Systems and its lifecycle

and Section 3 presents the research methodology. The main PSS approaches are exposed in Section 4 and these results are discussed in Section 5. Finally, Section 6 presents some conclusions and suggestions for future work.

II. LITERATURE BACKGROUND

The concept of a joint offer of products and services seeking to add value to customers' needs with less impact on the environment derived from the proposal to shift the focus from selling products to selling their functions [17]. Consequently, highly materialized ways of production and consumption can be replaced by a dematerialized culture, providing satisfaction through services [18].

On this matter, PSS can be defined as a business model which seeks value in the usage instead of the ownership and provides a different approach to fulfill consumers' needs with the combination of products and services [14], [15].

Mont [18] defined four elements that must be considered when developing an offer, in order to ease the transition and provide quality to customers: the products, the services, the infrastructure and the actors network.

The product sphere refers to the need to comprehend the way the product is used so services can be combined, e.g. choosing between renting or sharing. The service sphere shows the change in marketing strategies to sell usage rather than volume of products. The infrastructure sphere contains the systems required to support the PSS offer, e.g. roads for car sharing. The actors network consists of the alliances that should be forged between stakeholders to add value to the PSS [19].

When developing a Product-Service System, there are requirements to be fulfilled and sub-systems to be established [9], [20]. These requirements, however, are not the same for the creation and offer of services and the traditional product-based manufacturing system [9]; PSS sub-systems are more complex than products or services ones alone, as they incorporate tangible and intangible components on the same offer [20].

Many PSS design approaches develop the system through sequential steps (e.g. [21]–[23]). In most cases, this step-by-step process is the illustration of a product-service system lifecycle. Authors ([24]–[26]) have stated the importance of systematically develop PSS through its lifecycle, as value is created in the system throughout the cycle [24], [26].

Wiesner *et al.* express that there isn't only one defined cycle for PSS, but all the existing ones surround three basic stages: Beginning of Life (product conception), Middle of Life (product use) and Ending of Life (product disposal) [27]. Many authors ([1], [9], [22], [27]–[30]) presented PSS lifecycles based on these concepts.

Beuren *et al.* [30] proposed a PSS cycle with 5 stages, which were chosen to guide this research. The first stage, PSS Requirements Definition, comprises organizational pre-requisites for the PSS [22] aiming at fulfilling customer needs [31]. PSS Development shows how the system is going to be developed, integrating product, service, infrastructure and actors network [30], [31]. The Implementation phase comprehends PSS installation, tests, delivery and use [30]. On the Monitoring stage, the system's conditions are monitored in order to decide between improving the offer or ending its life [30], [31]. If ending of life is the case, responsible ones can choose between replacement, recycling or product take back [32] on the Destination After Use stage of the cycle.

III. RESEARCH METHODS

Many authors [19], [25], [26], [28], [33]–[38] have listed different PSS approaches with different emphases. However, a clear link presenting the approaches and the PSS lifecycle with a practical focus for the industrial context hasn't yet been explored [2], [9], [15].

Regarding this topic, this research was conducted in three stages, as shown in Fig. 1.
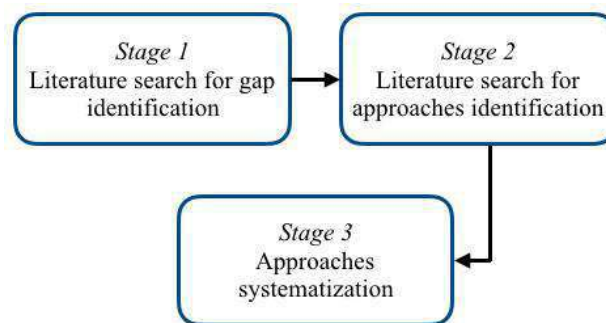
Fig. 1: Stages of the research

The first stage consisted in gathering research gaps presented by researchers on the PSS field. A bibliographical analysis was conducted, gathering papers published between 1999 and 2017. The search parameters are presented in Table 1.

From the 210 files encountered in Stage 1, the three authors with most publications were selected, and their recent papers (2015-2018) were fully read. The research gaps they presented were organized in tables, presented in Section 4.1.

Some of the gaps the authors pointed showed a lack of practical approaches to develop a PSS. Aiming at fulfilling those gaps, Stage 2 of the research focused on PSS development supporting methodologies. A new search was conducted in Scopus and Web of Science academic databases, searching for the PSS approaches on articles published between 2008 and 2017, as shown in Table 2.

In total, 196 papers were encountered. The title, abstract and keywords of the papers were skimmed, looking for those papers which would bring us the tools and methodologies we were looking for. This selection resulted in 87 papers, that were fully read.

Table.1: Literature search in Stage 1

Main keywords	Databases		Number of papers	Combined keywords	Number of papers
(phase 1)	Scopus	Science Direct		*(phase 2)*	
Product-service system	553	183	678	Sustainability; remanufacturing; service design; service economy; dematerialization; system solution; functional economy	188
Servitization	249	127	310		34
Productization	47	2	48		1
Databases total:	849	312	1036		223
				Non-duplicated files (phase 3):	**210**

In Stage 3 of the research, the PSS approaches were classified according to the PSS lifecycle stage they attended. Also, the approaches were cataloged into the four elements of a Product Service System according to

Mont [18], i.e. products, services, actors network and infrastructure, and into the type of approach they are presented as: method, tool or process.

Table.2: Literature search in Stage 2

Main keywords	Complementary keywords	Number of papers on databases	
(phase 1)		Scopus	Web of Science
Product-service system + methodology	Development; developing; implementation; implementing; modeling; disposal; post use; after use; post processing	108	178
Product-service system + tool		100	145
	Database total:	208	323
	Non-duplicated files *(phase 2):*	196	
	Selected for full read (phase 3):	**87**	

The results found in the gap analysis and the search for PSS development approaches are listed in Section 4.

IV. RESULTS

This section explores the results obtained on the three phases of literature search and data analysis. Section 4.1 presents the results from Stage 1 – a content analysis of PSS main authors, and Section 4.2 presents the results from Stages 2 and 3, listing the main approaches for PSS development, according to its lifecycle stages.

4.1. Results for Stage 1: research gaps analysis

Based on the 210 papers gathered on the bibliographical analysis and the defined criteria, three authors were selected: Carlo Vezzoli, Fabrizio Ceschin and Tomohiko Sakao. A table was assembled to organize the information presented in their research, emphasizing the research gaps they presented (see Table 3).

Sakao's papers focus mostly on the value PSS adds to the provider, and, in this scope, he shows the lack of practical knowledge on the field and that providers need that knowledge to develop profitable PSS offers. Vezzoli

and Ceschin point out the need to organize that knowledge. A similar conclusion was made by [35]. As presented in this paper's methodology, this gap guided the search to look for approaches to assist on PSS development, which are explored in Section 4.2

It should be noticed that we could not get access to several papers among the research gathered in the bibliographical analysis.

Table.3: Research gaps presented by the main authors

Reference	Research gaps
[39]	Practical methods to efficiently create modules for PSSs have yet to be developed for industry.
[40]	There is a much-needed faster development of knowledge in the sustainability discipline.
[41]	The main challenges are to organize the available knowledge in an accessible way (including training and educational programs) and to develop an open case base including Sustainable PSS concepts.
[42]	It could also be argued that interdisciplinary research lacks visualization: that is, it is difficult to determine or explicitly see how an insight has been used. Further research could communicate this in a clearer manner.
[43]	Future research may focus on developing a more comprehensive conflict resolving approach incorporating TRIZ tools more often.
[44]	Industry practitioners are still struggling with the adoption of PSS.
[45]	To continue to meet customer requirements more promptly, it is effective to take forecast of customer requirements into account in the framework.

4.2. Results for Stages 2 and 3: Main approaches for PSS

We realize there are differences among three types of approaches (method, tool and process) within the PSS field, even if a search on Google or on dictionaries tells us they are synonyms. A way of justifying this is taking a look on works like [2], which uses three words to refer to PSS development approaches: tools, techniques and methods; or even considering why one of the main PSS development approaches, Methodology for Product Service System Development (MePSS) is defined as a methodology that provided a toolkit [15], [46]. The same choice of words was used on [17] and [21]. A more extensive list of examples includes [9], [15], [34], [47].

In order to maintain the approaches developers' directions, we classified the approaches into methods, tools and processes according to what the papers we read had categorized them. The reason why some of the them are tagged as "undefined" is because the papers didn't put them in any category.

We chose to rank the approaches by two criteria: the most cited approaches on our 87-paper library, and the ones that fulfilled most of Mont's [18] four elements of a PSS.

It's important to state that the authors cited on the reference columns on tables 4-8 refer to those who mentioned the employment of the referred approach on the referred lifecycle stage and are not necessarily the approaches' developers.

In order to not present an exhaustive list of approaches, the lists below (tables 4-8) do not represent the entire scope of approaches encountered. The entire scope comprehends: 68 approaches for PSS requirements definition; 89 approaches for PSS development; 15 approaches for PSS implementation; 25 approaches for PSS monitoring; and 4 approaches for PSS destination after use.

The abbreviations A, P, S, I exposed on tables 4-8 stand for actors' network, product, service and infrastructure, respectively.

The first stage of the PSS cycle, PSS Requirements Definition, aims at defining pre-requisites for the system, in order to fulfill consumers' needs and achieve their satisfaction. Table 4 shows the PSS main approaches on the Requirements Definition phase.

Table 4. Main approaches on PSS Requirements Definition stage

Approach	Category	Nº citations	References	A	P	S	I
Service Engineering	Undefined	6	[48]		X	X	
PSS lifecycle model	Undefined	1	[49]	X	X	X	X
Model to integrate products and services on PSS development, adapted from IDEF0	Undefined	1	[50]	X	X	X	X
QFD (Quality Function Deployment)	Method	13	[19], [25], [28], [36], [51], [52]	X	X	X	
MePSS	Method	12	[34], [48], [53]				
Service CAD	Method	8	[9], [54]	X		X	
Business Canvas Model (BCM).	Method	4	[28], [54], [55]	X	X	X	X
System Dynamics	Method	4	[56]	X	X	X	X
Practical design framework	Method	2	[1]	X	X	X	X
Service Explorer	Tool	11	[9], [33], [35], [48], [49]		X	X	
Service Blueprinting	Tool	10	[28], [29], [34], [37], [49]			X	
PSS Board	Tool	4	[16]	X	X	X	X
FEPSS	Process	1	[28]	X	X	X	X
Developing method on service-oriented PSS	Process	1	[26]	X	X	X	X

On the second stage of the cycle, PSS development, the requirements will be aligned with the four elements of a PSS, i.e., product, service, actors' network and infrastructure; the conceptual ideas are put in motion. Table 5 presents the main PSS approaches on the development stage.

Table 5. Main approaches on PSS Development stage

Approach	Category	Nº citations	References	A	P	S	I
A model to integrate products and services in a PSS, adapted from IDEF0	Undefined	1	[50]	X	X	X	X
MePSS	Method	12	[19], [21], [34], [53], [54]				
QFD (Quality Function Deployment)	Method	12	[26]	X	X	X	
Service CAD	Method	8	[1], [25], [28]	X		X	
System Dynamics	Method	4	[57]	X	X	X	X
Practical design framework	Method	2	[1]	X	X	X	X
PSS for machine-tools	Method	1	[54]	X	X	X	X
PSS evaluation method through a 94 criteria framework	Method	1	[26]	X	X	X	X
5 stages to characterize PSS	Method	1	[58]	X	X	X	X
Service Explorer	Tool	11	[1], [9], [33], [59]		X	X	

				A	P	S	I
Service Blueprinting	Tool	10	[19], [34], [36]				X
Product-Service Blueprint	Tool	4	[26], [29], [33], [34]	X	X	X	X
PSS Board	Tool	4	[26]	X	X	X	X
FEPSS	Process	1	[28]	X	X	X	X

On the third stage of the cycle, PSS implementation, the offer is delivered and used by the consumer; the phase comprehends product installation and service implementation. Table 6 presents the main approaches for PSS Implementation.

Table 6. Main approaches on PSS Implementation stage

Approach	Category	Nº citations	References	A	P	S	I
PSS lifecycle model	Undefined	1	[49]	X	X	X	X
QFD (Quality Function Deployment)	Method	12	[26]	X	X	X	
Business Canvas Model (BCM)	Method	4	[60]	X	X	X	X
Practical design framework	Method	2	[1]	X	X	X	X
Product-Service Blueprint	Tool	4	[34]	X	X	X	X
PSS Board	Tool	4	[29]	X	X	X	X

The fourth stage of the cycle, PSS monitoring, is the one where the system's conditions will be evaluated in order to decide for its improvement or disposal. Table 7 presents the main approaches on PSS Monitoring stage.

Table 7. Main approaches on PSS Monitoring stage

Approach	Category	Nº citations	References	A	P	S	I
Life Cycle Assessment (LCA)	Undefined	3	[61]		X		
PSS lifecycle model	Undefined	1	[49]	X	X	X	X
FMEA	Method	5	[36]		X		
System Dynamics	Method	4	[62], [63]	X	X	X	X
Practical design framework	Method	2	[1], [28]	X	X	X	X
Product-Service Blueprint	Tool	4	[34]	X	X	X	X
PSS Board	Tool	4	[29]	X	X	X	X
Discrete Event Simulation (DES)	Tool	4	[49]		X		

After a PSS offer is evaluated, if decided that it doesn't satisfy consumers' needs anymore, the offer is disposed: replaced, recycled or taken-back. Table 8 presents the main approaches for PSS Destination After Use, the last stage of the referred PSS cycle.

Table 8. Main approaches on PSS Destination After Use stage

Approach	Category	Nº citations	Reference	A	P	S	I
Practical Design Framework	Method	2	[1]	X	X	X	X
Methodology for PSS development	Method	2	[28]	X			
PSS lifecycle model	Undefined	1	[49]	X	X	X	X

Some of the approaches presented on tables 4-8 are able to be employed into more than one phase of the PSS lifecycle. They were also classified as principal approaches on this research – either for being cited by many different papers or for fulfilling most of PSS elements proposed by Mont [18].

The Methodology for Product Service System Development (MePSS) is pointed as one of the main approaches to PSS design [25], [38], [41]. It has a great focus on sustainability and strategic analysis. The approach presents the system's development in a practical way, through customer requirements with support from various tools [48], [53].

Service Blueprint is a service visualization tool in terms of actors behavior and relationships [29], [34]. It is widely used for service design [19], [34], and it is composed of a vertical axis, representing the processes, and a horizontal one, representing actors' actions [49]. Even if the tool is also widely applied into the design of PSSs [34] it is not ideal for the referred task, as it focuses on services only, and does not consider other elements important for PSS design [19].

For that matter, Geum and Park [34] developed a tool called Product-Service Blueprint, extending Service Blueprint to PSS in order to satisfy its characteristics. The authors added different symbols to the framework and developed it through Mont's [18] four elements of a PSS. The result was a tool for concept development, activities identification, and building of relationships by linking stakeholders to products, services and supporting areas.

Lim *et al.* [29] developed the PSS Board, a visualization tool for PSS. The framework is a 45 cell-matrix, in which Mont's [18] four elements of a PSS and customer activities are presented in rows, and PSS general processes in columns. The authors state that the tool measures strengths and weaknesses of a PSS, with the main goal of presenting PSS scenarios and the way PSS components relate to each other [29].

The Business Model Canvas (BMC) is a widely known method to design business models [55]. For PSS, the method allows the choice of the best PSS type (i.e. product, use or result oriented PSS), and its nine blocks (value proposition, customer segments, distribution channels, customer relationship, revenue streams, key resources, key activities, key partners and cost structure) work as direction vectors for the design and implementation of a PSS, as the system's characteristics are built from these blocks [60].

The results presented in this section will be explored and discussed in Section 5.

V. DISCUSSION

It can be noticed that most of the PSS approaches gathered are congregated on the first stages of the PSS lifecycle. That can be seen as we move down on the paper and forward on the cycle stages, since the number of approaches in Tables 4-8 gets sequentially smaller. Also, the total number of approaches gathered among this search moves down from 68 approaches on PSS Requirements Definition to 4 approaches on PSS Destination After Use. This smaller amount of approaches on the former stages of the cycle was also pointed out by [2].

This could be explained because every system needs requirements to be developed [64]; even if the developers don't plan and write down the requirements, they exist. But not every system is planned with an expiration date, planned to be disposed, even Product Service Systems, as the cultural environment of product-service offers is still in adjustment [65]. In addition to that, it has been stated before [66] that not every PSS is oriented to Circular Economy, i.e. not every PSS is designed with a closed loop.

Furthermore, if we consider the development of a product-service offer through conceptual elements, as proposed by [30], it can also be noted that the number of conceptual elements regarding the PSS Requirements Definition phase is more significant than the number of conceptual elements for PSS Destination After Use phase (see [30]). With less conceptual elements to achieve and complete, less approaches could be necessary.

Moreover, authors [67] express that the PSS conceptual design phase – which stands for PSS Requirements Definition *plus* PSS Development – is crucial to ease the planning and development of other stages of the PSS lifecycle – another fact to justify the greater number of approaches on the early stages of the cycle.

From the approaches studied, many authors and proposed methods suggest the use of existing tools within the approaches. TRIZ tools are cited for PSS requirements generation and PSS development (e.g. [37], [48]), moving forward into filling the gap presented by [43] (see Table 3). But even with these initiatives, there aren't many approaches regarding TRIZ tools and the resolution of conflicts, so they could be further explored.

Generally, methods are broader, and sometimes comprehend step-by-step processes, in which the steps can be fulfilled with the employment of a tool – which are usually more practical and specific approaches. This indicates the possibility of collaboration between approaches, enabling and encouraging the accomplishment of a finer result.

Another interesting fact to point out is that the monitoring phase of the PSS lifecycle is mostly composed by simulation methods. These methods can be used to comprehend the link between system's variables and predict its behavior, playing a role of 'handler of system's complexity' on PSS [68]. As Product Service Systems are comprised by four elements and must be developed aligning them, this development process is a complex one [69]. Simulation methods can be of help on this matter, predicting system's conditions or the best way of combining variables.

Some of the approaches encountered can be employed into more than one stage of the PSS lifecycle, as pointed in Section 4.2. In fact, they are ranked as principal in those stages, e.g. PSS Board [29] and Practical Design Framework [1] for PSS Requirements Definition, Development, Implementation and Monitoring. Even though there are some approaches, this number is still not very significant, and PSS developers don't have a lot of options on the table to choose one to work with. Also, even if these approaches cover many of the PSS lifecycle stages, an even smaller amount of them covers the PSS Destination After Use stage.

It's important to assert the relevance of a PSS development supporting approach that addresses the whole PSS lifecycle. This enables stakeholders to guarantee that their system will be designed and put in motion with a closed loop on production, consumption, distribution and final destination, validating the statement from some authors (e.g. [10], [70]) that a PSS is a way of contributing to a Circular Economy.

VI. CONCLUSIONS

This research had the purpose of congregating the main PSS approaches existing in literature, presenting industry stakeholders with a compilate of tools, methodologies and processes that can be used to support the development of a PSS offer considering its lifecycle.

In order to do this, a bibliographical analysis was conducted to gather PSS approaches presented in the literature, and the approaches encountered were classified into the PSS lifecycle stage they attended, into Mont's [18] four elements of PSS, and into the type of approach they were presented as: tool, method or process.

It was noted that there was a more significant number of approaches in the first stages of the PSS cycle than in the last stages. Some reasons to explain this condition were presented in Section 5. It was also observed that some approaches could be employed in more than one stage of

the PSS lifecycle and that some of them were designed to be employed along with others, allowing the accomplishment of a more valuable result.

One suggestion for future work would be to link these approaches encountered for each stage of the PSS cycle with the conceptual elements for the stages, as they work as a checklist for the development of a new Product-Service System. This proposal could be of a conceptual model to PSS development, encompassing the whole PSS lifecycle.

Also, more research could be conducted in order to develop different approaches (e.g. tools) for the last stages of the PSS lifecycle, specially the former stage. Approaches from other fields can't be borrowed for the product-service disposal, as they can for PSS monitoring or implementation, for example.

This research is relevant as it works as a step forward into filling the gaps presented by [2], [9], [35]. Product-Service Systems are viable options for contributing to Circular Economy and to satisfying customer needs with sustainable and profitable options, if rightfully developed.

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Self-Care of Intensivist Nursing Professionals as a Strategy to Prevent Burnout Syndrome

Stephany Siqueira Braga[1], Mattheus Lucas Neves de Carvalho[1], Lidiane Assunção de Vasconcelos[2], Bianca Leão Pimentel[1], Ruhan da Conceição Sacramento[1], Ivanete Miranda Castro de Oliveira[1], Beatriz Duarte de Oliveira[1], Tatiana Menezes Noronha Panzetti[3], Laura Caroline Ferreira Cardoso[4], Ivonete Vieira Pereira Peixoto[5], Ilma Pastana Ferreira[6], Josianne Corrêa Cardoso[7], Adriana dos Santos Mendes Gomes[8], Margarete Carréra Bittencourt[9], Salvador Clebson Pureza Soares[10]

[1] Nursing Students in the State University of Pará (UEPA);
[2] Nurse, Master in Health, Environment and Society in the Amazon by the Federal University of Pará (UFPA), Belém, Pará, Brazil;
[3] Nurse, Master in Nursing by the State University of Pará (UEPA), teacher at the State University of Pará (UEPA), Belém, Pará, Brazil;
[4] Graduate in Nursing by State University of Pará (UEPA), Belém-PA, Brazil;
[5] Nurse, PhD in Nursing, School of Nursing Anna Nery, Federal University of Rio de Janeiro (UFRJ);
[6] Nurse, PhD in Nursing, School of Nursing Anna Nery, Federal University of Rio de Janeiro (UFRJ);
[7] Master in Public Management (UEPA/NAEA);
[8] Nurse, Specialist in Oncology, Auditing and Health Management;
[9] Nurse, PhD in Pathology of Tropical Diseases, Federal University of Pará (UFPA);
[10] Nursing Student in Escola Superior da Amazônia (ESAMAZ).

Abstract— The nursing team of an Intensive Care Unit is subjected to several injuries related to their physical and mental health. The large number of stressors present in this environment predispose to conditions in which they can affect the quality of care provided by these professionals, their interpersonal relationships and their quality of life. Therefore, it is intended to report an educational action on self-care as a strategy for the prevention of Burnout Syndrome in nursing professionals in an adult ICU. An activity was carried out, product of the problematization theory, to socialize knowledge about Burnout Syndrome, which is still little known by professionals, encouraging them to carry out self-care practices. During the time of socialization, the professionals were free to express their feelings about their work environment. Among the reports, can be highlighted the difficulty in self-perception, intra and interprofessional relationships, failures in effective communication and problems of managerial and bureaucratic nature. Such feelings externalize issues that directly and indirectly corroborate physical and mental exhaustion, high levels of tension and risks to the health of the professional and the quality of care. Through this work, it is noted that the Burnout Syndrome is a topic of great relevance for these professionals, whose work scenario requires resilient psychosocial conditions in the face of adversities, and who propose to these actors of care a special attention focused on their assistance and self-care.

Keywords— Nursing; Nursing professional; Intensive therapy; Prevention; Burnout.

I. INTRODUCTION

In an intensive care unit (ICU), attention, agility and skill are some of the many vocations that the nursing professional needs to have when working in this environment. The complexity of intensive care requires certain specific skills and competencies of nurses, as well as a different workload, and in this scenario, according to Machado, et al, (2012), it is common for physical and mental factors to act as aggravating to good nursing practices, interfering in the care and assistance provided to patients in intensive care.

In the last decades, good nursing practices, combined with patient safety, have been addressed worldwide, mainly in terms of "workload", due to the awareness that this professional class performs its activities based on care, and when exposed to exponential demands, in the case of many

brazilian ICU's, the income from their care declines, becoming stressful, prone to adverse events and other deficits involving the provision of care (Fernandes, Nitsche & Godoy, 2017).

In addition, ICUs are characterized by highly qualified environments for providing care to critical patients, in which the importance of using equipment and technologies is present with a view to the complexity of care for these patients, as well as the need for a multidisciplinary team trained and 24-hour monitored assistance. Due to the need for complex care, ICUs can produce job stressors, which in turn affect the professionals involved, especially nurses and nursing technicians (Franco & Barros, 2011; Schmidt, Paladini, Biato, Pais& Oliveira, 2013).

Burnout Syndrome is considered an occupational pathology very present in ICU nursing professionals and is characterized by three different components in which are specific characteristics of this syndrome: emotional exhaustion, depersonalization and the absence of professional achievement. These characteristics affect professionals who work directly with people, so it requires greater interaction with their clients (Machado, et al., 2012; Fernandes, Nitsche& Godoy, 2017).

Currently, the growing search for acceptable financial conditions exposes the nursing professional to an excessive and exhausting workday, which makes nursing a profession with higher rates of development of Burnout Syndrome (Oliveira, Lima & Vilela, 2017). The literature points out, in a study by Vasconcelos and Martino (2018, p. 3), that of the 91 (ninety-one) intensive care nurses interviewed in the study, 14.3% had the syndrome. In addition, there was a sample carried out by França, R. Ferrari, DC FerrarI& Alves (2012), which identified a percentage of 22.2% of nursing professionals who work 30 (thirty) hours a week, possibly because they can perform a double journey.

Thus, as mentioned above, it is essential to deepen the studies on this theme taking into account the growing number of articles that address this theme and its relevance within the field of nurses' performance, considering the professionals inserted in the context of an ICU; in addition to the importance of this study so that we, nursing students, can identify and socialize this knowledge about the possible characteristic signs of this pathology.

The problem identified for this study is related to the stressors present in the ICUs that can trigger the development of Burnout Syndrome. For Machado et al., (2012), the most common aggravating factors in this environment come from the excessive workload of each nursing professional, the technologies and equipment of the place, the great demand of patients at the expense of a

disproportionate number of nursing staff, in addition to the complexity of care pertinent to the critical patient.

The use of professional self-care strategies provide new parameters such as healthy practices and habits in order to promote the individual's physical and emotional well-being, making self-control possible to mediate situations and stressors in the work environment. That said, it is necessary to emphasize that self-care consists of a cognitive, affective and behavioral process, acquired during the experiences, with self-perception being fundamental so that responsibility with you is assumed (Melo, Alegre & Carlotto, 2017).

In this sense, the objective of this work is to report an educational action on self-care with a strategy for the prevention of Burnout Syndrome in nursing professionals in an adult ICU, making them aware of the indicative signs of this syndrome and the possible preventive measures in aspect of professional self-care, taking into account that the work environment in which they are inserted, predisposes to conditions that can lead to the physical and emotional stress of these professionals, making their performance subject to the occurrence of possible adverse events, iatrogenies, as well as susceptible to development of Burnout Syndrome.

II.   MATERIALS AND METHODS

Descriptive study, with a qualitative approach of the experience report type, in which the problematization theory followed the Maguerez arc, proposed by Berbel (2011) , in which it follows five stages of development: observation reality, identification of key points, theorizing, hypothesis of solution and application of the study in the reality of the place.

The observation of reality occurred during the practical classes of the curricular component "Nursing in Adult Intensive Care", from 27/08/2018 to 09/05/2018, in a hospital located in the city of Belém, Pará; in which it is reference in Oncology, Neurosurgery, Nephrology and transplants, with 28 (twenty-eight) beds distributed in 3 ICU's (Clinical, Surgical and Neurological).

In the survey ofkey points, the most important elements to be addressed in this theme were defined, directing the observation of the practical class with the respective theoretical findings in the databases, being careful not to diverge from the main theme of this article.

The solution hypothesis was structured based on the prevention of Burnout Syndrome in the ICU to the local nursing team, aiming at a moment of socialization and exchange of experiences and knowledge from both parties, informing them about the characteristic signs of the disease, curiosities and what measures these professionals

should take to avoid the occurrence of this pathology in their work environment.

As for the return of the study to the field of observation, the activity took place on October 22, 2018, between 4:30 pm and 5:00 pm, in the Neurological ICU of the aforementioned location, and had the participation of 11 professionals from the nursing team, 1 nurse and 10 nursing technicians.

This was divided into 4 stages, where at first the instrument was distributed (Instrument 1) in order to assess the degree of professional satisfaction of the participating team. The team was instructed to mark the "face" in which they represented their daily feeling regarding their workday. Soon after the end of this selection, the second moment of the activity began, which consisted of the distribution of informational folders (Instrument 2) in which it contained information about what is the Burnout Syndrome, the symptoms and what to do to avoid following the strand of self-care. Next to this moment there was a brief socialization about the theme, allowing the public to be at ease whenever they wanted to contribute.

In the third moment of the activity, a group dynamic was applied, which consisted of the elaboration of a pertinent problem in that workplace, which could be considered triggering factors for Burnout Syndrome. In this dynamic, one group exposes the problem situation and the opposite group elaborates a solution idea for the exposed problem. Thus, participants were asked to divide into two groups, where one group had the opportunity to expose 3 problem situations, and the other was tasked with making suggestions for solving the problems presented. At this time there was an intense socialization of knowledge and experiences, where we and the participants were able to talk about how to improve work processes, aiming at reducing any stressors that can lead to Burnout Syndrome, based on self-care activities.

In the fourth moment, the activity was completed suggesting some behaviors that aim to reduce any factors that may induce the appearance of the syndrome in the professionals working in that place.

III. RESULTS AND DISCUSSION

Regarding the return made, during the use of Instrument number 1, it was possible to identify that most of the participants positioned themselves with a feeling of "extreme happiness" in relation to their workday. A smaller group positioned themselves using the image referring to the feeling of "extreme stress". The others chose to select the image referring to the feeling of "indifferent". Similar studies point out that stress in the workplace is an elementary factor referring to psychosocial

aspects, elucidating the burnout syndrome a possible trigger reflected in these work stressors, therefore, the reflection of the above data brings to light a possible setback, according to what the recent ones say research about the stress that intensive care professionals face during their workday. For Preto & Pedrão (2009), ICU's are considered environments that expose professionals to various stressors due to the high level of technological complexity, as well as the requirement for intensive care to patients in critical condition, subject to sudden changes. Therefore, the work environment becomes a potential generator of compromised feelings, which includes stress, identifying in its research a percentage of 57.1% of nurses who consider the ICU a stressful place and 23.8% of them presented a high score, indicating the presence of stress.

Right after that moment, during the socialization, the professionals were free to express their feelings about their work environment. Among the reports, during the dialogue, we can highlight the difficulty in self-perception, intra and interprofessional relationships, failures in effective communication and problems of managerial and bureaucratic nature. Such feelings externalize issues that directly and indirectly corroborate physical and mental exhaustion, high levels of tension and risks to the health of the professional and the quality of care (Fonseca & Mello, 2016). Through these data, we observed an index of nursing professionals working in an ICU that predisposes to factors in which they can trigger the condition of Burnout Syndrome. Therefore, since it is an Intensive Care Unit, elements such as contact with the patients' life and death, interpersonal relationships, complexity in care can lead to professional dissatisfaction if there are no strategies to minimize these causes. (Schmidt et al., 2013).

Regarding self-perception, the most prevalent information was the double workday and little time for leisure activities, since many needed to work in other hospitals to guarantee financial stability, which, therefore, influences the little availability to develop recreational activities, due to an exhaustive workload in both work environments. The findings corroborate the brazilian national literature, based on the fact that professionals with more than one job have conflicts with their social and family life, due to the intense tiredness triggered by this condition, not putting into practice the activities of leisure (Sadir, Bignotto&Lipp, 2010). This condition is worrying, since carrying out such activities are strategies that provide the individual with regulation of emotional balance, in addition to allowing an escape from the individual in relation to their work routine, preventing the Bournout Syndrome (Melo, Alegre &Cartotto) , 2017).

Also analyzed, underlying the double workday, it is the reality of these professionals to be working in two ICU's.

According to reports, many of the professionals end up working in two ICU's in different hospitals. In view of all the complexity pertinent to intensive care, and that it can become exhausting, the duplicity of the work activity of having to take on two ICU's, increases the predisposition to the professional's energy depletion, making him even more fragile before the occupational stressors. In addition, this condition causes a chronic imbalance where work requires much more than it can offer (Vasconcelos & Martino, 2017).

Regarding intra and interprofessional relationships, it was reported the difficulty of working together between the nursing team and others, the latter being the most prevalent in their reports. To the detriment of this aspect, the issue of difficulty in communication was also highlighted, in which case conflicts in professional relationships occurred, becoming yet another stressor present in the work environment. For Dias, Santos, Abelha & Lovisi (2016), professional relationship and communication problems are considered occupational stressors, due to the physical and mental stress caused by these situations. Coexistence in the work environment is not easy to mediate, however, when the difficulty exists, it is necessary to work on it so that it provides opportunities for learning.

Regarding management and bureaucratic issues, the reports were related to the use of technologies that, in their view, were scrapped. Also punctuating, the delay in dispatching medication and the scarcity of some materials for carrying out procedures. These factors, in addition to triggering stress, pose risks to the safety of professionals and patients (Afecto& Teixeira, 2009).

In view of all these issues addressed by the group, self-care actions were suggested, such as relaxation techniques, regular physical exercise, rest, leisure and fun, sleep appropriate to individual needs, processes that favor self-knowledge, structuring free time with pleasant and attractive activities, as well as the revision and resizing of the forms of work organizations. Paiva et al., (2019), also mention, that the practice of self-care needs to be part of the awareness of nursing professionals so that it can be used in the work environment, aiming at a proposal to improve the policy focused on workers' health.

Finally, at the end of the activity, the participants verbalized that this type of approach is of great relevance to the work context, in which they are inserted, and that this moment of interaction is very opportune to strengthen the bond between professionals and also with academics who are in the field of practice. Also highlighting that they felt motivated to adopt self-care behaviors.

IV. CONCLUSION

In the light of the experience developed among nursing professionals in an ICU, it is noted that Burnout Syndrome is a topic of great relevance for these professionals, whose work scenario requires resilient psychosocial conditions in the face of adversity, and which these actors propose of care special attention focused on your assistance and your self-care.

Thus, given the various occupational stressors inserted in this environment, professional nursing assistance meets a transversal reality of care, where it needs to deal frequently with emotions, frustrations, managerial problems, and above all, an exhaustive workload with great demands and care complex.

Corroborating this information, the present study also presented important reflections regarding the professional's self-perception and his work relations, the importance of identifying stressors and working with them in order to face them.

Therefore, the work reveals the need for an in-depth look at the health of the professional who develops their care practices in ICUs, since, based on the results exposed in this work, the predisposition to Burnout Syndrome is real and is in different dimensions performance, becoming multifactorial.

In this way, it is important that the contributions developed in this work reach the academic and professional community, in order to have repercussions on the aggregation of knowledge regarding the topic addressed, so that, in this way, intervention measures in the work process are carried out, in order to optimize delivery for effective and efficient assistance.

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Biometric evaluation of *Passiflora cincinnata* seeds obtained from the herbaceous extract of the caatinga biome

Janilson Pinheiro de Assis[1], Roberto pequeno de Sousa[1], Paulo César Ferreira Linhares[1,*], Eudes de Almeida Cardoso[1], Walter Martins Rodrigues[2], Joaquim Odilon Pereira[2], Robson Pequeno de Sousa[3], Bárbara Bruna Maniçoba Pereira[4], Neurivan Vicente da Silva[1], Lunara de Sousa Alves[4] and Ewerton Gonçalves de Abrantes[5]

[1]Jitirana Research Group, Department of Agronomic and Forestry Sciences, Federal Rural Semi-Arid University, Mossoró, RN, Brazil
[2]Center of Exact and Natural Sciences, Federal Rural Semi-Arid University, Mossoró-RN, 59625-900, Brazil
[3]Teacher, Computing Department, State university of Paraíba, Campina Grande-PB, 58429-500, Brazil
[4]PhD in phytotechnics from the Federal University of Paraíba-PB, 58397-000, Brazil
[5]PhD of soil science, Federal University of Paraíba-PB, 58051-900, Brazil
*Corresponding Author

Abstract— *Seed biometrics is an important tool to detect genetic variability within populations of the same species. In this sense, the objective was to evaluate biometric evaluation of Passiflora cincinnata seeds obtained from the herbaceous extract of the caatinga biome. The work was developed at the Federal Rural University of the Semi-arid, Mossoró, Brazil, in the year 2019. 300 units of seeds of various genotypes of Passiflora cincinnata were collected, in an area of the herbaceous extract of the caatinga biome, where the following were evaluated characteristics: a) morphological characterization of Passiflora cincinnata, determining the length and width of 300 seeds, with the help of a caliper, being expressed in millimeters b) thickness of the seeds, being expressed in millimeters; and c) seed weight, expressed in grams. There was a regular degree of symmetry for the frequency distributions of the length, width, thickness, length/width ratio and weight of Passiflora cincinnata seeds, being different from zero. A degree of flattening or kurtosis of the platicurtic and leptocurtic type was found for the evaluated characteristics. Responses from scientific research on descriptive measures of location, variability or scale, asymmetry and kurtosis may serve as a basis for future studies of descriptive analysis and statistical inference, for comparison of different environments, genetic studies and plant breeding, as well as in construction of the so-called variance components, for simulation and modeling studies applied to agriculture.*

Keywords— *Wild passion fruit, Descriptive statistics, Inference.*

I. INTRODUCTION

Fruit growing has great relevance in the Brazilian economic scenario, being the third largest fruit producer in the world [1]. Among the fruit trees, Brazil stands out as the largest producer and consumer of passion fruit. With an approximate area of 51 thousand hectares cultivated in almost all states of the federation, with a total production of 694 thousand tons per year [2].

This fruit has great economic importance for the country, contributing to the increase in income among producers, in addition to being a promising market for the juice industry.

Passion fruit belong to the Passifloraceae family, which is predominantly from Tropical America, encompasses about 19 genera and 530 species, the majority belonging to the Passiflora genus, approximately 400 species such as at least 120 are native to Brazil [3].

In the caatinga biome there is a wide variety of fruit trees, adapted to the climate and soil conditions with exotic flavors, which meet the current trends in the consumption of natural products, which reinforces the initiatives of collection, characterization and cultivation in commercial areas [4]. There are only about 70 species of *Passiflora* actually edible [5]. Among them, the wild species *Passiflora cincinnata* Mast stands out, popularly known in Brazil as "Maracujádo-Mato" or "Maracujá-de-Boi" [6].

In the Northeast region, it is sold in the off-season of yellow passion fruit, presenting an excellent income option for small farmers, since it is a species adapted to local growing conditions, as it is native to the region. The seeds of this species are generally oval and flat, 5.5 mm long and 3.5 mm wide, with a reticulated aspect, covered by lighter punctuations when dried, surrounded by a juicy, yellow and aromatic pulp [7].

The size and characteristics of the seeds are of great importance for the study of a species. It is a basic parameter to understand the dispersion and establishment of seedlings [8], being also used to differentiate pioneer and non-pioneer species in tropical forests [9].

In the literature, there is a large number of articles specialized in the field of fruit seed biometry [10,11,12,13,14 and 15].

Biometrics is an important tool to detect genetic variability within populations of the same species and the relationships with environmental factors, providing important subsidies for the differentiation of species of the same genus [16 and 17].

Given the above, the objective was to evaluate, through statistical techniques of exploratory data analysis, the biometric variables referring to the seeds of *Passiflora cincinnata* Mast obtained from plants of the caatinga herbaceous extract.

II. MATERIALS AND METHODS

The study was carried out in Mossoró, Rio Grande do Norte-RN, Brazil, in 2019, whose geographic coordinates are: 5°11'S and 37°20' W, with 18 m altitude, annual average temperature around 27.5 °C and relative humidity of 68.9% [18]. According to [19] and the classification of Köppen, the local climate is BSwh', dry and very hot, the dry season being normally from June to January, and a rainy season being from February to May.

The average annual rainfall is 673.9 mm and the average relative humidity is 68.9%.

A total of 300 seed units of various genotypes of *Passiflora cincinnata*, were collected in an area of the caatinga biome herbaceous extract, located within the campus of the Federal Rural University of the Semi-arid (UFERSA) in May 2018 and taken to the phytotechnics laboratory, where the following characteristics were evaluated: a) morphological characterization of Passiflora cincinnata, determining the length and width of 300 seeds, with the aid of a caliper, being expressed in millimeters b) thickness of seeds, being expressed in millimeters; and c) seed weight, expressed in grams.

Descriptive and graphic analyzes were performed using the software package [20].

III.   RESULTS AND DISCUSSION

In estimating the important quantitative aspects of the distribution of the values of the random variables length, width, length / width ratio, thickness and seed weight, the present work was supported by specialized statistical literature [21,22,23,24,25,26 and 27].

In this study, exploratory data analysis was adopted, using frequency distributions, statistical series and heterogeneous series, box plot graphs, as well as the statistical estimators of the variables under study, which are the main typical measures of position, dispersion measures, variation or scale, asymmetry measures, flattening or kurtosis measures, using descriptive statistics.

The main parameters used were: arithmetic mean, median, total amplitude, variance, standard deviation, standard error of the mean, variation coefficient, asymmetry coefficient, kurtosis coefficient, quartiles, interquartile deviation, Pearson's correlation coefficient, as well as the application of statistical inference techniques, such as hypothesis or significance tests and the Z test at a significance level of 5% probability, based on Student's t distribution and Normal distribution, respectively, in the construction of intervals of confidence with 95% probability (Tables 1 to 5 and Figures 1 to 11).

Table 1. Descriptive and inductive statistical analysis of 300 sample units of seeds for the variables length, width, length/width ratio, thickness (mm) and weight in grams (g) of passion fruit (Passiflora cincinnata L.).

Sample or estimator statistics	Length	Width	Length/width ratio	Thickness	Weight
Sample Size (number of seeds)	300	300	300	300	300
Minimum value	2.85	2.10	1.01	1.27	0.002
Maximum value	5.96	3.10	2.70	1.99	0.015
Total Range	3.11	0.90	1.60	0.72	0.013
Arithmetic Average	5.15	2.46	2.10	1.69	0.011
Median or Second Quartile	5.18	2.44	2.10	1.70	0.011
Varinace	0.11	0.03	0.01	0.03	0.00001
First quartile	4.97	2.35	1.99	1.63	0.0097
Third quartile	5.33	2.59	2.22	1.77	0.012
Standard deviation	0.33	0.17	0.18	0.12	0.0019
Average standard error	0.019	0.001	0.010	0.007	0.0001
Coefficient of variation (%)	6.34	6.91	8.41	7.18	18.09
Skweness	-1.33	0.35	-0.61	-0.39	-1.08
Kurtosis	8.00	-0.20	3.378	0.55	2.23
Interquartile Range (IR)	0.36	0.24	0.23	0.15	0.0021
Z Test for the mean at 0.1% probability	271***	246***	210***	241***	110***
Confidence Interval for the average 95% probability	5.11 a 5.19	2.45 a 2.46	2.08 a 2.12	1.68 a 1.70	0.010 a 0.012
Fitting to Normal Distribution (D'Agostino-Pearson Test)	Valor p = 0.01 fit to Normal Distribution	Valor p = 0.73 fit to Normal Distribution	Valor p = 0.01 fit to Normal Distribution	Valor p = 0.01 fit to Normal Distribution	Valor p = 0.05 fit to Normal Distribution
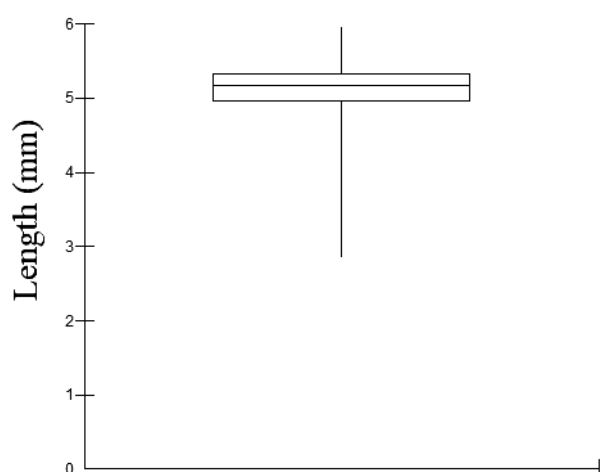
Fig.1: Boxplot with median and quartiles for the length of passion fruit seeds (Passiflora cincinnata L.).
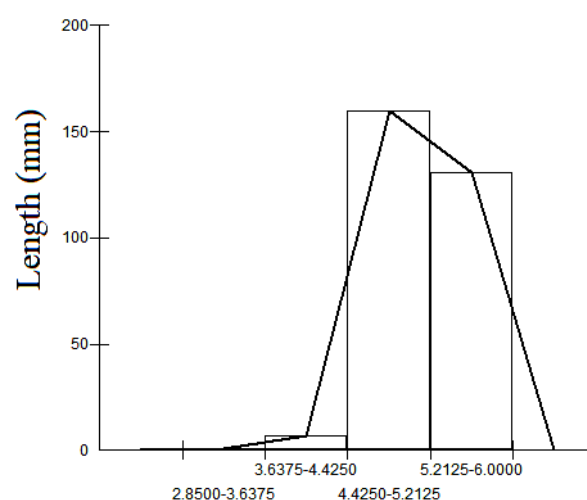
Fig.2: Histogram and polygon of frequencies for the length distribution of passion fruit seeds (Passiflora cincinnata L.).

Table 2. Frequency distribution of the length of passion fruit seeds (Passiflora cincinnata L.).

Length in mm	f_i	X_i	f %
2.85[---------)3.64	1	3.24	0.33
3.64 [---------) 4.43	7	4.03	2.34
4.43[---------) 5.21	161	4.82	53.52
5.21 [---------)6.00	131	5.61	43.81
Total	300	--------	100

Table 3. Frequency distribution of the width of passion fruit seeds (Passiflora cincinnata L.).

Width in mm	f_i	X_i	f %
2.10 |— 2.27	30	2.18	10.03
2.27 |— 2.43	116	2.35	38.80
2.43 |— 2.60	81	2.52	27.09
2.60 |— 2.77	56	2.68	18.73
2.77 |— 2.93	15	2.85	5.02
2.93 |— 3.10	2	3.02	0.67
Total	300	--------	100
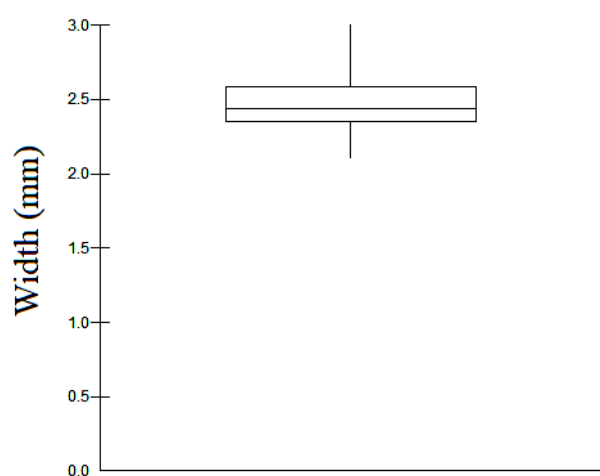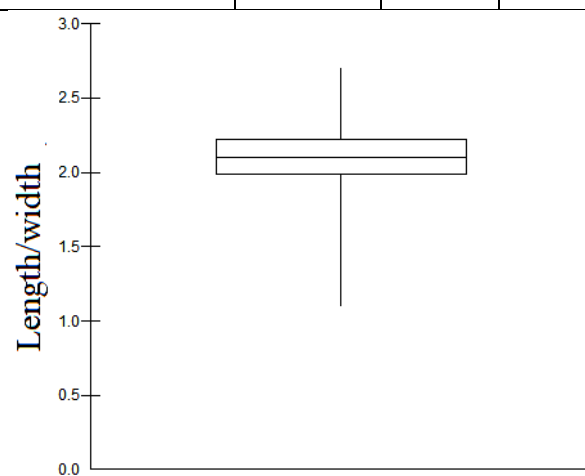
Fig.3: Boxplot with median and quartiles for the width of passion fruit seeds (Passiflora cincinnata L.).

Fig.5: Boxplot with median and quartiles for the length-width ratio, dimensionless value of passion fruit seeds (Passiflora cincinnata L.).

Fig.4: Histogram and polygon of frequencies for the width distribution of passion fruit seeds (Passiflora cincinnata L.).
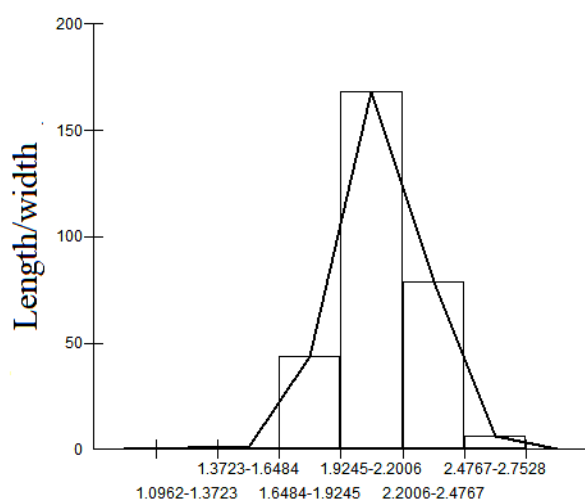
Fig.6: Histogram and polygon of frequencies for the length-width ratio, dimensionless value of passion fruit seeds (Passiflora cincinnata L.).

Table 4. Frequency distribution of the length-width ratio, dimensionless value of passion fruit seeds (Passiflora cincinnata L.).

Length/Width	f_i	X_i	f %
1.10 ⊢— 1.37	1	1.23	0.33
1.37 ⊢— 1.65	1	1.51	0.33
1.65 ⊢— 1.92	44	1.79	14.72
1.92 ⊢— 2.20	168	2.06	56.19
2.20 ⊢— 2.48	80	2.34	26.67
2.48 ⊢— 2.75	6	2.61	2.01
Total	300	--------	100

Table 5. Frequency distribution of the thickness of passion fruit seeds (Passiflora cincinnata L.).

Thickness in mm	f_i	X_i	f %
1.27 ⊢— 1.41	5	1.34	1.67
1.41 ⊢— 1.55	30	1.48	10.00
1.55⊢— 1.69	92	1.62	30.77
1.69 ⊢— 1.82	134	1.75	44.82
1.82 ⊢— 1.96	36	1.89	12.04
1.96⊢— 2.10	3	2.03	1.00
Total	300	--------	100
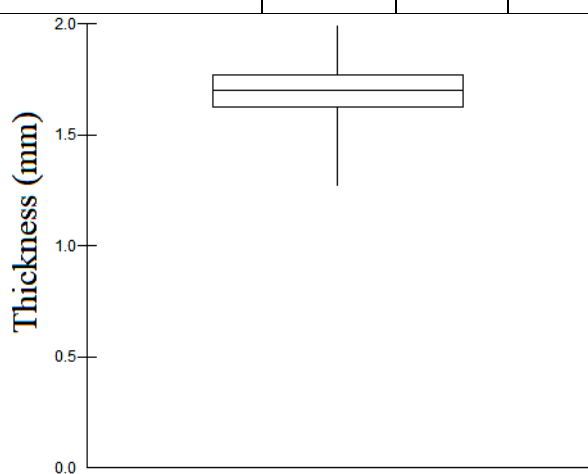
Fig.7: Boxplot with median and quartiles for the thickness of passion fruit seeds (Passiflora cincinnata L.).
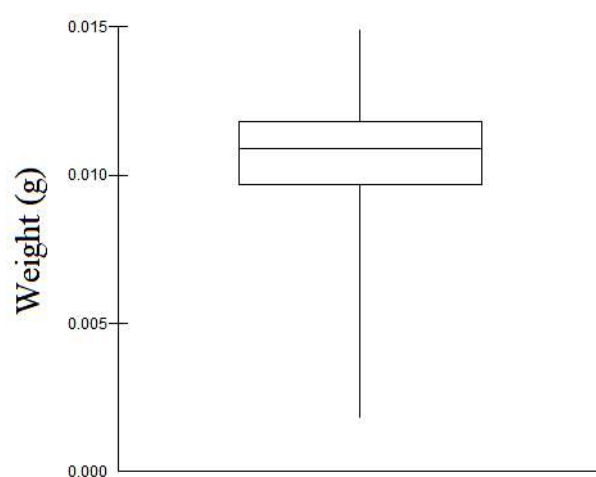
Fig.9: Boxplot with median and quartiles for the weight of passion fruit seeds (Passiflora cincinnata L.).

Fig.8: Histogram and polygon of frequencies for the thickness of passion fruit seeds (Passiflora cincinnata L.).
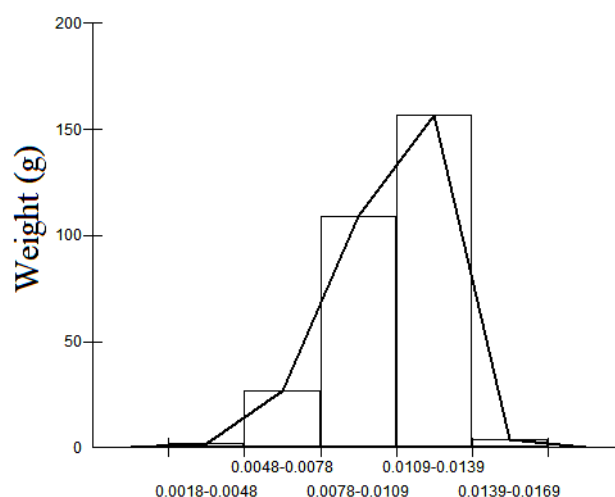
Fig.10: Histogram and polygon of frequencies for the weight of passion fruit seeds (Passiflora cincinnata L.).

Table 6. Frequency distribution of the weight of passion fruit seeds (Passiflora cincinnata L.).

Weight in g	f_i	X_i	f %
0.0018 |— 0.0048	2	0.0033	0.67
0.0048 |— 0.0078	27	0.0063	9.03
0.0078 |— 0.0109	109	0.0094	36.45
0.0109 |— 0.0139	157	0.0124	52.51
0.0139 |— 0.0169	4	0.0154	1.34
Total	300	--------	100
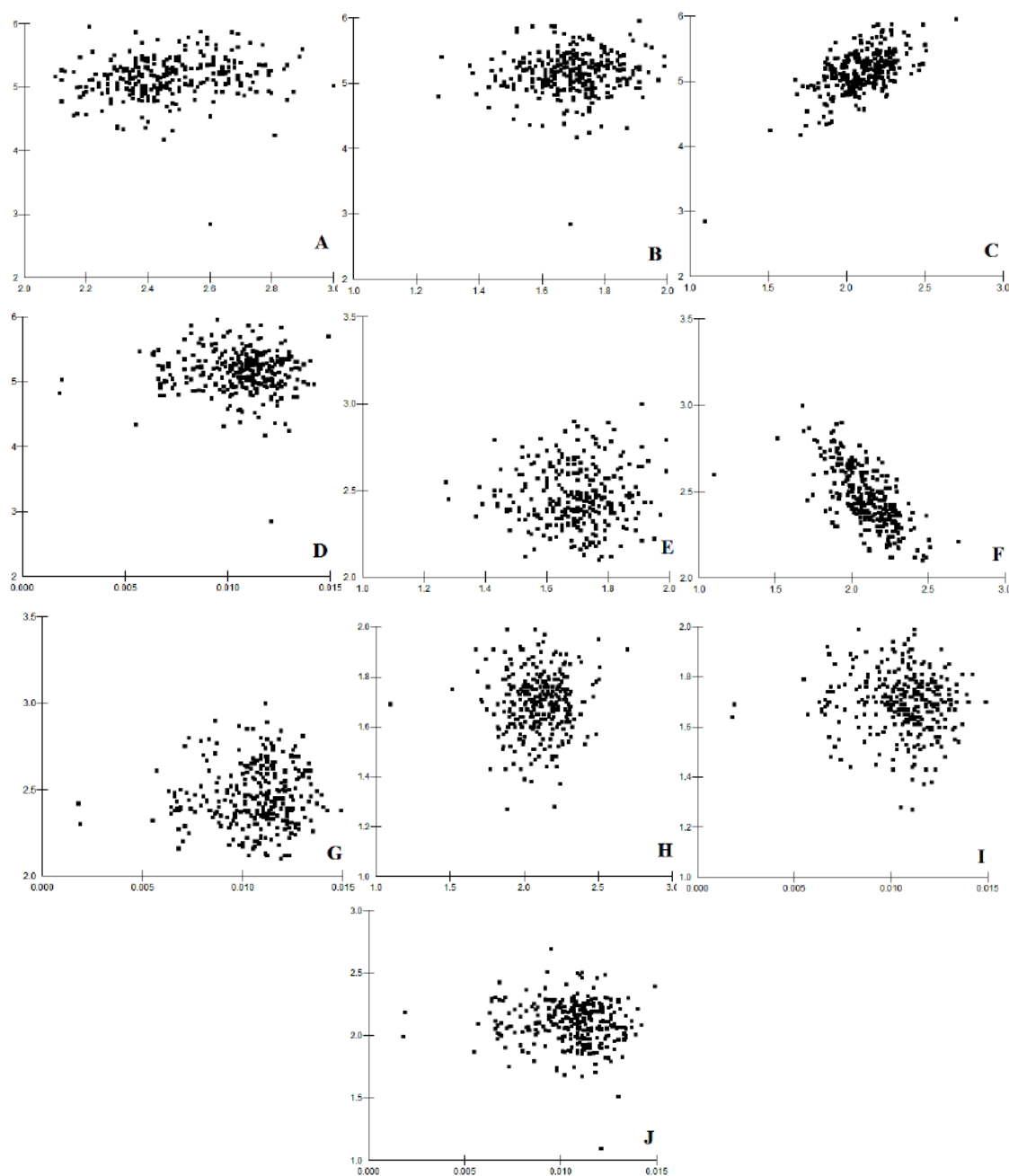
Fig.11: Dispersion plots of correlations between pairs of variables: length versus width (A), length versus thickness (B), length versus length/width ratio (C), width versus length/width ratio (D), length versus weight (E), width versus thickness (F) thickness versus length / width (G) width versus weight (H) thickness versus weight (I) and length/width versus weight (J) of passion fruit seeds (Passiflora cincinnata L.).

Table 7. Matrix of Pearson's linear correlation coefficients between pairs of variables: length, width, length/width ratio, thickness, and weight of the of passion fruit seeds (Passiflora cincinnata L.).

Variables studied	Variables studied				
	Length	Width	Length/width ratio	Thickness	Weight
Length	1,00	-----	-----	-----	-----
Width	0,17	1,00	-----	-----	-----
Leng/width ratio	0,07	0,02	1,00	-----	-----
Thickness	0,60	-0,68	0,05	1,00	-----
Weight	-0,02	0,06	-0,07	-0,06	1,00
95 % confidence intervals	Length x Width	Length x Length/Width	Length x Thickness	Length x Weight	Width X Length/Width
	0.06 a 0.28	-0,04 a 0.18	0.53 a 0.67	-0.13 a 0.10	-0.10 a 0.13
	Width x Thickness	Width x Weight	Length/Width x Thickness	Length/Width x Weight	Thickness x Weight
	-0,73 a -0,61	-0.06 a 0.17	-0.06 a 0,16	-0.18 a 0.04	-0.17 a 0.06
P-value of Student's t-Test	0,0030	0,2315	<0,0001	0,7657	0,7938
	< 0.0001	0.3121	0,3776	0,2347	0,3259

The descriptive results (Table 1) show that the variables: length, width, thickness, expressed in millimeters and the weight in grams of the seeds of *Passiflora cincinnata*, showed a high range of variation, except for the length / width ratio, being observed low for the relative variation of all variables, measured by their coefficients of variation, being great for Pearson's coefficients of variation, except for weight, as it presented a relatively high value for the coefficient of variation which corroborates with the fact to be a characteristic of high genetic variability [28].

With regard to homogeneity, the characteristics are presented with a high degree, the relative variation in length being similar to that of thickness, and width with that of the length/width ratio.

There was a reasonable degree of symmetry for the variables: length/width ratio, thickness and weight, and therefore a symmetrical and mesocurtic distribution for length, width, length/width ratio, and for the weight of *Passiflora cincinnata* seeds, except for the thickness that showed a close behavior with the mesocurtic curve.

A simple positive linear correlation was observed between length and width, length and thickness, width and

length/width, width and thickness and length / width and thickness. The average relation between length/width and the weight of the seeds, showed a significant difference between the averages whose results were 2.10 dimensionless and 0.011 grams, respectively.

However, it can be said that the seeds do not have a center of gravity in the distribution of these variables, showing that the length and thickness of the seeds are respectively distant, with average values of 5.15 and 2.46 millimeters, respectively. On the other hand, the weights are not very close to the average weight of 0.011 grams, due to the value of the coefficient of variation (18.9%).

The coefficients of variation, between the variables, were the most appropriate for comparing dispersion between samples, as they do not depend on the magnitude of the variable, as well as on its unit of measurement, and therefore the most correct procedure.

The values obtained from the variation coefficients were 6.34%, 6.91%, 8.41% and 7.18% for the length, width, length / width ratio and thickness, respectively, showing a similar or close relative dispersion for the four characteristics evaluated, thus showing an extremely similar and statistically equal relative variability for these

characteristics [29,30]. The coefficient of variation for the seed weight was 18.09%, which shows a high relative dispersion for this variable, showing a relatively high genetic variability.

The values obtained for the means and medians in the characteristics of *Passiflora cincinnata* seeds, as shown in Table 1, were close, these values being 5.15 and 5.18 mm for length, 2.46 and 2.44 mm for width, 2.10 and 2.10 in the length/width ratio, 1.69 and 1.70 mm for thickness and weight with values of 0.011 and 0.0011 g, respectively. These values indicated a certain degree of asymmetry, with values of -1.33; 0.35; 0.61; 0.39 and 1.08 for length, width, length / width ratio, thickness and weight, respectively.

In a symmetric frequency distribution, the measures of central position or tendency, such as arithmetic mean, median and mode are the same. However, the fact that the three means are close together does not imply that the frequency distribution of their values is symmetric [31].

On the other hand, the kurtosis coefficients were: 8.00; -0.20; 3,378; 0.550 and 2.230 for length, width, length/width ratio, thickness and weight, respectively (Table 1). These values presented a platicurtic distribution for length, leptocurtic for width, and platicurtic for length/width, thickness and weight, respectively.

However, it is worth noting that the characterization of the degree of asymmetry and kurtosis of a distribution, according to [22], [25], [32], [33], [31] and [34], can not be evaluated only by measures of position or central tendency, as is the case of the mean and median, but also by the coefficients of asymmetry and kurtosis, as well as through box plot diagrams, histograms and frequency polygons (Figures 1 to 10). Asymmetry describes how the sample differs in the form of a symmetric distribution.

A normal distribution has an asymmetry coefficient equal to zero. A distribution in which the value of the asymmetry coefficient is greater than zero has asymmetry on the right, that is, there is a long tail of larger observations, that is, on the right of the mean. In contrast, if the asymmetry coefficient is less than zero, it has asymmetry to the left, in this case, there is a long tail of smaller observations, that is, to the left of the mean.

Platicurtic distributions (flattened), have a kurtosis coefficient less than zero, compared to the normal distribution, in this case, there is more probability mass in the center of the distribution and less probability in the tails. In contrast, leptocurtic (tapered) distributions have a value for the kurtosis coefficient greater than zero. Leptocurtic distributions have less probability mass in the center and relatively heavy probability tails [31].

Regarding the quantiles, the first quartile shows that 25% of the lowest values for the length, width and thickness of the seeds of Passiflora cincinnata, when they reached a maximum of 4.97; 2.35; and 1.63 mm, respectively, and the length/width ratio, with a dimensionless value of 1.99, on the other hand, the weight reaches a value of 0.0097 g.

The 25% greater length, width and thickness of the seeds of *Passiflora cincinnata* were represented by the values of 5.33; 2.59 and 1.77 mm, respectively. In relation to length / width it reaches a ratio of 2.22 and weight of 0.012 grams, results corroborated by [35]. In this case, the interquartile range obtained, which serves to verify the dispersion of the data in relation to the median and thus to identify the presence of atypical or Outlier's data, was 0.36; 0.24 and 0.15 mm, for the length, width and thickness, since the length/width ratio reaches this level at a rate of 0.23, on the other hand, the weight presented an amplitude value of 0.0021 grams (Table 1).

Regarding the application of the Z test for population mean μ (Table 1), very high values were observed for both length and width, and for the length / width ratio, for thickness and also for weight of *Passiflora cincinnata* seeds, concluding that the average values of these characteristics were highly significant, or statistically different from zero.

Pearson's degree of association or simple linear correlation (Table 7), whose physical definition field ranges from - 1 to + 1, which can be zero or null, is a measure of the degree of association between two quantitative variables, and these associations between two variables can be measured mathematically through the correlation coefficient [36].

Correlations between the variables were observed: length and width, obtained a value of 0.17, insignificant correlation; length/width and length ratio, obtained a value of 0.07, insignificant correlation; length/width and width ratio, obtained a value of 0.02, insignificant correlation; thickness and length, obtained a value of 0.60, a marked correlation; thickness and width, obtained a value of -0.68, striking correlation, thickness and length/width ratio, obtained a value of 0.05, insignificant correlation; weight and length, obtained a value of -0.02, insignificant correlation, weight and width, obtained a value of 0.06, insignificant correlation; weight and length/width ratio, obtained a value of -0.07, insignificant correlation and weight and thickness, obtained a value of -0.06, insignificant correlation, according to what [36].

The correlations thickness and length and thickness and width showed a simple direct or positive linear

correlation between these characteristics, and thus these results bluntly revealed three important aspects, the direction, the shape and the strength or intensity of the association between the variables studied. , which was significant by the Student's "t" test at 0.01 probability, showing that when the thickness value increases or decreases the length values, as well as the thickness and width ratio also increase or decrease in a relatively proportion very close [35], where the x and y pairs grow in the same proportion, showing a normal bivariate distribution (Figure 11).

In addition, inferential statistical analyzes through the construction of 95% and 99% probability confidence intervals, showed that in repeated samples there is a high reliability that these results occur at least ninety-nine times, on the other hand, also in function from the application of Student's t-parametric test, it was found that it produced levels described for that test of results, with very high probability values not allowing researchers to reject the null hypothesis as the true population coefficient. Pearson's linear correlation ρ between these variables is null, that is, the null hypothesis H0: $\rho = 0$ is rejected.

It is worth mentioning that the null hypothesis used in this work will always be equal to zero, in order to guarantee the symmetry of the sample distribution of the estimate so that it can be modeled through the curve of a theoretical distribution of Student's t. probability, since it is assumed that this theoretical coefficient of the population is different from zero, that is, H0: ρ 0 would have to be applied a Fisher zeta transform in order to guarantee such symmetry of the sample distribution of the simple linear Pearson's correlation coefficient r, and thus allow the construction of confidence intervals and the application of the parametric tests of the Student t hypothesis [33].

These results reinforce the need to carry out work repeated in time and space, to verify convergent or divergent results, guiding researchers in the evaluation of genetics and plant improvement and the productive yield of this species to make it commercially viable.

The box plot graph using the median and quartiles is a graphic tool widely used by researchers in general in the areas of physical, biological, medical and social sciences, showing, in the box, the median, the first and the third quartiles. This graph also displays the lowest and highest score across the lower and upper limits of straight vertical lines, which originate from the first and third quartiles, respectively. According to the results shown in Figures 1, 3, 5, 7 and 9, there was a strong concentration of data on length, width, length/width ratio, thickness of *Passiflora*

cincinnata seeds in millimeters, with a lower concentration for weight of seeds in grams.

Under the graphic, visual or geometric asect, the scatter diagram (Figure 11), showed a certain pattern of the cloud of pairs of points, where an upward direction is seen from left to right, showing a positive coefficient, a shape close to a straight line, and also a relatively high association force, therefore, the longer the seeds of Passiflora cincinnata in millimeters, the proportionally wider and thicker seeds, the exception was for the point cloud between length versus weight ; width versus thickness and thickness versus length / width (Figure 11).

In general, the results of descriptive measures of location, variability, asymmetry and kurtosis can serve as a basis for future studies of descriptive analysis and statistical inference, for the comparison of different environments, studies of plant genetic improvement, subsidize criteria used for the grouping of experiments in joint analysis, in stability analysis of passion fruit cultivars, as well as in the construction of the so-called variance components [21,35,22,24,25,26 and 27].

According to [31], the law of large numbers proves that for an infinitely large number of observations, it is an approximation of the population mean, where is a sample of size n of a random variable Y with expected value. The standard deviation is simply the square root of the variance, so that is the same as the standard error of the mean, so we have an estimate of the standard deviation of the variance.

Extensive observational surveys covering large spatial scales with a significant number of samples are likely to be representative of the population of interest as a whole, therefore the standard error of the mean should be used, while small, controlled experiments with few replicates are probably based on a single group, and possibly little representative of individuals, therefore, it is recommended to use the standard deviation to characterize or measure the degree of absolute dispersion of the samples.

IV. CONCLUSIONS

It is concluded that the length, the width, the length/width ratio, the thickness of the seeds of Passiflora cincinnata, all expressed in millimeters, presented a reasonable adjustment to the normal distribution of probabilities, as well as a low total amplitude of variation and coefficient of variation. The weight, on the other hand, showed a reasonable degree of homogeneity for these

evaluated characteristics, including absolute dispersion, with a high coefficient of variation.

All characteristics had a low standard deviation.

Only the length and weight of seeds adjusted to a normal distribution, being evidenced by the histogram and frequency polygon as well as through the result of the application of the D'Agostino-Pearson normality test.

There was a regular degree of symmetry for the frequency distributions of the length, width, thickness, length/width ratio and weight of *Passiflora cincinnata* seeds, being different from zero. A degree of flattening or kurtosis of the platicurtic and leptocurtic type was found for the evaluated characteristics.

Responses from scientific research on descriptive measures of location, variability or scale, asymmetry and kurtosis may serve as a basis for future studies of descriptive analysis and statistical inference, for comparison of different environments, genetic studies and plant breeding, as well as in construction of the so-called variance components, for simulation and modeling studies applied to agriculture.

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The use of the Brazilian Sign Language in promoting equitable and comprehensive health care

Lidiane Assunção de Vasconcelos[1], Lorrane Teixeira Araújo[2], Jéssica Maria Lins da Silva[3], Wesley Brandão Dias[4], Stephany Siqueira Braga[5], Beatriz Duarte de Oliveira[6]; Camilla Castilho Maia[7]; Francinéa de Nazaré Ferreira de Castilho[8]; Simone Daria Assunção Vasconcelos Galdino[9]; Ilma Pastana Ferreira[10]; José Jorge da Silva Galvão[11]; Eliza Paixão da Silva[12]; Raimunda Silvia Gatti Norte[13]

[1]Master in Health, Environment in the Amazon by the Federal University of Pará (UFPA). Belém, Pará, Brazil.

[2, 3, 4, 5, 6,12]Nursing Student at the State University of Pará (UEPA). Belém, Pará, Brazil.

[7]Doctor. Resident in family and community health.).Belém, Pará, Brazil.

[8]Master in business management from the Lusophone university of humanity and technology. Lisbon, Portugal. Professor at the State University of Pará (UEPA). Belém, Pará, Brazil.

[9]Master in Health Services Management and Planning. Belém, Pará, Brazil.

[10]PhD in Nursing from the Anna Nery School of Nursing (EEAN-UFRJ). Professor at the Faculty of Nursing at the State University of Pará (UEPA).Belém, Pará, Brazil.

[11]Master's student in the Graduate Program in Nursing, Federal University of Pará(UFPA).Belém, Pará, Brazil.

[13]Master in Health Education in the Amazon by the State University of Pará (UEPA). Belém, Pará, Brazil.

Abstract— The Brazilian Sign Language is characterized as a form of communication and expression based on gestures, being considered visual and motor. In some moments in health services, the deaf and / or mute individual is faced with situations in which there are no qualified professionals to meet their needs. As a result, it was decided to carry out a study on the subject in question, in order to describe the experience of academics facing a continuing education action carried out with health professionals. This study is an experience report based on the methodology of problematization Arco de Maguerez, resulting from the observation of the inadequacy in the communicative process between this clientele and the health professional. As a result, a continuing education action was carried out, through the teaching of basic LIBRAS. Finally, the need for investments in professionals is emphasized in order to continue implementing communication strategies that recognize the needs of these users and respect their particularities, resulting in an improvement in the quality of service.

Keywords—Health Care, Communication Barriers, Sign Language, Deafness, Health Personnel.

I. INTRODUCTION

Since the proof of the ineffectiveness of oral practices for the development of communication for the deaf, sign language has become the communication method of greater scientific basis and promotion of autonomy for this audience (Vieira & Molina, 2018). In Brazil, the Brazilian Sign Language was established as a second language under Federal Law no. 10,436 (2002), defining itself as an essential instrument for the social inclusion of hearing impaired people.

The Brazilian Sign Language is characterized as a form of communication and expression based on gestures,

being considered visual and motor. It has its own alphabet and is essential for proper communication between deaf and hearing people. Currently, it has been gradually disseminated in the curricular components of some higher

education courses, optionally, as a way of preparing professionals to maintain at least a basic dialogue, favoring the interaction between these audiences (Carniel, 2018). However, it is noteworthy that this measure is still relatively new, and it is common for the deaf to encounter situations in which there is no qualified professional to meet their needs.

Inside the essential services for the citizen, there is health care, which is supported by the Brazilian Constitution, in its article 196 (1988), which guarantees health as a universal right, as a duty of the state that must ensure that, in all your spheres, be established. However, as far as the deaf public is concerned, the lack of qualified health professionals for comprehensive care at the various levels of care is still routine, which can lead to serious health complications for these individuals, mainly due to the ineffective communication between the service user and these professionals (Chaveiro and Barbosa, 2005).

In this way, the importance of continuing education, especially for health professionals, aimed at teaching LIBRAS is ratified, since it is a fundamental process for updating these professionals and for guaranteeing safe and efficient care of procedures. , directly affecting the quality of the service provided and promoting the well-being of deaf patients, improving interpersonal interaction and the development of the care team (Silva and Seiffert, 2009).

In addition, the role of the academic, especially nursing, is highlighted as an active agent and modifier of the environment in which he is inserted, since this professional, because of his training, presents himself as an educator within the promotion of population health, being able to use continuing education actions aimed at understanding and teaching LIBRAS, thus helping other professionals in their assistance (Backes, Lino, Prado, Reibnitz, &Canaver, 2008).

Therefore, it was decided to carry out this experience report that aimed to describe a continuing education action carried out with health professionals from an oncology hospital in Belém-PA and nursing students, aimed at teaching the Brazilian Sign Language within the main communicative needs In the health area.

II.   METHODO

It is an experience report based on the problematization methodology Arco de Maguerez, which starts from the principle of observing reality and defining a problem, covering 5 phases: 1- Observation of reality; 2 - Key points; 3 - Theorization; 4 - Solution hypotheses; 5 - Application to reality (Berbel, 2011).

In the first stage of the Arco de Maguerez, it was observed, from the practical experience of the curricular component of Semiology and Semiotechnics, a physical examination with a deaf person, during which it was noted that the professional tutor of the practical class did not know how to deal with effectively, and may cause damage to the patient's health.

In view of this, the key points of the problem were raised, from which it was chosen to develop a training-type action, aimed at health professionals. Theorizing was carried out from searches on digital bases on the platforms: Scientific Eletronic Library Oline (SCIELO), Latin American and Caribbean Literature in Health Sciences (LILACS) and Virtual Health Library (BIREME). From that, a total of 9 articles developed with the same theme to list the action in health focused on LIBRAS were listed.

The next stage took place from the development of the hypotheses of solution, through the definition of the aspects that would compose the action of health education, with the professionals of an oncology hospital. It was decided that the registration to participate in the training would be published for three days and made electronically in a form on Google Forms. The disclosure took place through digital media, pamphlets and folders on the premises of the hospital, located in Belém.

The training was organized by thematic axes related to the concept, history and legislation of the Brazilian Sign Language (LIBRAS), basic knowledge of LIBRAS, specific knowledge in the health area and evaluation of activities. The choice of thematic and content of the training was based on the theoretical and practical classes of the curricular component Brazilian Sign Language in the undergraduate course in Nursing at UEPA. oral exhibition, with the aid of audio visual resources and support materials (handouts) during the spaces.

The last stage of the Arco de Maguerez occurred through the application of the action in the observed reality, in the non-academic period of 2019, in an auditorium provided by the Hospital, being aimed at an audience of 20 health professionals, for 5 days (July 29 until the 3rd of August), in the morning shift from 9am to 1pm. Its development counted on the participation of nursing students, who had already gone through the optional component in graduation, and the collaboration of LIBRAS Professors from the State University of Pará.

III.   RESULTS

In the initial observation of the Arco de Maguerez, it was noted that the respective professionals, located on the day

of observation, had a deficit to establish a therapeutic dialogue with deaf and dumb users. Communication between user and professional was notoriously impaired, given that the professionals knew little about LIBRAS, as it is not a typical everyday situation and they do not have training for it. In view of the situation, a failure of communication due to lack of knowledge in the language of signs for possible work situations, impairing the therapy of the users in question.

The choice of the training-type action, aimed at health professionals, was due to the need to promote access to permanent education in LIBRAS to promote equitable assistance to users. Regarding the articles found on digital platforms to support the action proposal, it was evidenced that studies in the health area focused on LIBRAS are scarce, with little availability of projects aimed at training professionals, hindering work with people the public concerned.

The division of teaching by class days was carried out due to content complexity, starting with the most basic: history, context and concept of LIBRAS; medium: basic knowledge of LIBRAS signals; intermediate: specific knowledge of LIBRAS in the health area; and, the complex: completion and evaluation of activities. The classes took place during the morning shift, based on the content cited and exposed through lectures, directed studies and debates, which stimulated the construction and participation of knowledge, with practices for the preparation of signs every day.

Subsequently, the professionals were instructed about the evaluation that would be carried out on past contents, which would take place through the elaboration, in groups, of a playful activity of theatrical category for the evaluation of techniques and demonstration of the absorption of learning that occurred during the training. The activity was carried out by dividing the participants into four teams of five people, leaving them free to develop their theater representing a consultation with a deaf and / or deaf patient. All the teams were successful and were satisfied, since they demonstrated the necessary capacities for therapeutic assistance with the users in question, exposing this, later, through thanks to the team involved in the action.

On the last day, the certification for Training in Basic LIBRAS in Health was also delivered, making up the 25-hour workload, which was validated by the coordinating teachers. Furthermore, emphasis is placed on the gratification for the elaborating team, since the exchange of experiences, as well as the active participation and the speeches of the employees about the acquired knowledge,

reached the established objective, having been positive for both parties.

Finally, the importance of teaching LIBRAS was ratified through the speech of some participants, who evidenced the fact that these actions are relevant within the hospital environment, since many do not have time for realization of theexternal courses. In this way, the role of the academic as an educator and a modifier of reality is emphasized, as well as the value of continuing education to promote equitable and integral health.

IV. DISCUSSION

The access of people with deafness to public health services is guaranteed by Brazilian legislation through the Federal Constitution article nº. 196 (1988) and in the Organic Health Law nº. 8,080 (1990), which define universality and equality in health actions and services. Unfortunately, when we go to the Brazilian reality, it is clear that access and care for the deaf person is a challenge for health professionals and for the deaf himself, creating restrictions for the deaf public to achieve the benefits guaranteed by laws (Pereira, Caldas, & Cabral, 2016; Marques & Pereira, 2017).

When reporting to access and care in public health services, the person with deafness realizes the great difficulty regarding the communicative interaction with professionals, which makes it difficult to create the bond between professional and user (Lopes, Vianna, & Silva, 2017). Studies reveal that health professionals have a lack of knowledge to care for people with deafness, as well as a lack of preparation to diagnose health problems and interact with this clientele (França, Pontes, Costa, &França, 2016).

The lack of adequate communication for this public in health services, violates the principles of the Unified Health System (SUS), especially those referring to equity and integrality of access. Equity aims to reduce inequalities, despite the fact that all people have rights to services, people are not equal and, therefore, have special needs (Barros, & Souza, 2016). Integrality, on the other hand, considers the individual as a whole, meeting all his needs (Kalichman, & Ayres, 2016). It is important to point out that the breach of these principles results in damage to health, considering that the state must guarantee to all people, including the deaf and / or dumb, quality health care (CarvalhoFilha, Silva, &Lando , 2015).

The dialogue between professional and user mediated by LIBRAS is not always effective, since health professionals have a lack of knowledge due to the lack of preparation to

dialogue and interact with this audience (França, Pontes, Costa, &França, 2016). Without effective communication, it is not possible to identify and solve the user's needs, in this case, assistance provided may not be effective, since the individual may not understand what the professional wanted to pass on, thus impairing their self-care (Oliveira, Costa, Coura, Cartaxo, &França, 2012; Nóbrega, Munguba, & Pontes, 2017).

Communication barriers in some situations require the participation of third parties, who can be an interpreter of the health unit and friends or family members of the user, aiming to mediate the communicative process. The presence of another individual may inhibit the deaf's responsibility for their health, as it transfers control over information about themselves to another person and further corroborates the omission of user information to the professional due to the lack of privacy In view of this, it is clear that these individuals prefer to be assisted by professionals who know and have skills with LIBRAS (Oliveira, Celino, & Costa, 2015; Neves, Felipe, & Nunes, 2019).

It is speculated that the deficit of knowledge added to the skills of health professionals in using LIBRAS may be related to their academic training, since Higher Education Institutions (HEIs) do not integrate the discipline of LIBRAS in the curriculum and projects pedagogical courses of undergraduate health courses, and when offered, it is optional, which does not generate interest to students in taking it, as it is not mandatory for their training (Oliveira, Costa, Coura, Cartaxo, &França, 2012; Moura et al., 2019; Sanches, Bispo, Santos, France, & Vieira, 2019).

For professionals who lack the knowledge and skills to use LIBRAS in their work routine, investments in continuing education are necessary, since this method aims at personal and professional development through the improvement of skills, as well as greater vision the reality that they are inserted in order to improve their service, offering an effective service and guaranteeing the User an equitable, integral and humanized service (Vieira, Caniato, &Yonemotu, 2017; Cavagna, Silva, Braga, & Andrade, 2017).

When providing health care, the professional develops interpersonal relationships with the user, which requires communication skills for mutual understanding between professional and user (Nobrega, Munguba, & Pontes, 2017). As a result, investments in professionals are needed to put in place measures and strategies that recognize the demands of users, respect their particularities and act as needed (Ramos, & Almeida, 2017; Santos & Pontes, 2019).

In addition, the role of the undergraduate student in health is confirmed as having the transforming agent of the environment in which he / she is inserted, in which he / she must be able to propose measures and solutions for a certain problem in society, promoting theevelopment of reality in which it is inserted. In addition, through health actions, the academic becomes critical and reflective, which corroborates the provision of humanized assistance under ethical and legal principles that support his profession (Berbel, 2011; Sanches, Bispo, Santos, France ,& Vieira, 2019)

V. CONCLUSION

The Brazilian Sign Language is still not present in all professions in an effective and continuous way, and there are still few literature about LIBRAS in the health field, as well as in the education of professionals who already work in assistance. Most health professionals did not have access to undergraduate courses or training courses in LIBRAS, thus, communication between professionals and deaf patients proved to be impaired.

The failure in communication between professional and patient decreases the effectiveness of health care, directly interfering with its humanization, since, without effective communication, it is not possible to identify or solve all the user's needs. As a result, it is necessary to invest in continuing education, carrying out actions to promote training, especially aimed at teaching LIBRAS.

In view of the training carried out in this report with health professionals, there was a need to address the use of LIBRAS in the hospital environment. It was noticed that the vast majority did not have management with this audience and had a deficit in the linguistic approach. Thus, the action was able to promote an improvement in the quality of service to the deaf public, giving rise to an equitable, humanized and satisfactory assistance within the rights of these individuals.

It is important to note that the approach used proved to be effective, showing that the majority obtained a significant improvement in communication in LIBRAS, being able to perform a service with a deaf or dumb person. The domain of professionals in relation to LIBRAS is of fundamental importance for the good performance of professional assistance, through communication in LIBRAS, it is possible to promote holistic attention to the client.

Furthermore, the academy has a primary role in training ethical and trained professionals in their proper professions. More and more students in the health area are realizing the importance of continuing education, thus

leading to actions that help so much in their development plementary training of the professional. Thus, it was evaluated that the approach of academics in actions of the type is of paramount need, helping in the qualification of both parties.

Therefore, it is necessary the presence of academics and collaborating entities in educational actions for the provision of professional training within the relevant subject, as well as training and updates aimed at continuing education, as well as somatic factors necessary for advances assistance to the people.

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Soybean and maize in agrosilvipastoral system after thinning of eucalyptus at seven years of implantation

Wander Luis Barbosa Borges[1], Pedro Henrique Gatto Juliano[2], Letícia Nayara Fuzaro Rodrigues[3], Rogério Soares de Freitas[4], Giane Serafim da Silva[5]

[1]Advanced Center of Rubber and Agroforestry Systems, Agronomic Institute, BRAZIL
[2]Agronomic Engineering College, University Center of Votuporanga, BRAZIL
[3]Agronomic Engineering College, University Center of Santa Fé do Sul, BRAZIL
[4]Advanced Center of Rubber and Agroforestry Systems, Agronomic Institute, BRAZIL
[5]Animal Parasitology Laboratory, Biological Institute, BRAZIL

Abstract— *This work was carried out with the objective of investigating the effect of thinning eucalyptus at seven years of implantation on the components of production and productivity of soybean and maize crops, cultivated in the renewal of pasture in an agrosilvipastoral system. The experimental design used was a randomized block, with four replications, using as treatments three sampling positions of the components of production and grain productivity of soybean and maize crops in relation to the eucalyptus line: 2, 4 and 6 m away from the eucalyptus lines, under two thinning of the eucalyptus: thinning of 0% and 50% of trees, compared to a treatment with thinning of 100% of trees (standard). The different sampling positions in relation to the planting line, under the two thinning of the eucalyptus, provided differences in relation to the mass of one hundred grains and grain productivity of the soybean crop and in relation to the height of plants, number of ears and mass of one hundred grains of maize crop. The standard treatment provided greater plant height in the soybean crop and greater insertion height of the first ear and higher grain productivity in the maize crop, and the sampling position at 2 m from the eucalyptus planting line under 0% thinning provided a lower mass of one hundred grains for soybean and maize crops and a lower number of ears ha^{-1} for the maize crop.*

Keywords— *Cropping systems, Glycine max, integrated systems, sustainable agriculture, Zea mays.*

I. INTRODUCTION

Integrated agricultural production systems are interesting options for approaching global issues such as food security, climate change and sustainable farming besides improving social conditions in the rural environment [1].

The agrosilvipastoral system is among these systems. It consists of the implantation of different productive systems of grains, fibers, meat, milk, agro-energy, among others, in the same area, in intercropped, sequential or rotational planting [2].

In this exploration model, the interest is based on the benefits that can be obtained by the synergism between pastures and annual crops, such as: improvement of the physical, chemical and biological properties of the soil; breaking of the cycle of diseases and reduction of insect-pests and weeds; reduction of economic risks through diversification of activities; and cost reduction in the

recovery and renovation of pastures in the process of degradation [3].

However, the success of an intercropping system depends on the correct management of the species and the factors of production that affect the species, aiming to guarantee satisfactory economic and environmental returns [4].

Unlike eucalyptus monoculture systems, in the agrosilvipastoral systems it is necessary to manage the forestry component through pruning and thinning, so to promote light input between the hills and reduce competition for water and nutrients with agricultural crops and pasture.

There is too much information about the cultivation of soybean and maize in the initial phase of implantation of agroforestry systems. However, there are many doubts about the cultivation of a new cycle of these crops, for the

renewal of pastures, with the forest component well developed.

This work was carried out with the objective of investigating the effect of thinning eucalyptus at seven years of implantation on the components of production and grain productivity of soybean and maize crops, cultivated in the renewal of pasture in an agrosilvipastoral system.

II.   METHOD

The experiment was carried out over 2016/17 and 2017/18 harvests, in an experimental area with an agrosilvipastoral system, at the Advanced Research Center for Rubber and Agroforestry Systems, of the Agronomic Institute (IAC in Portuguese) owned by São Paulo Agribusiness Technology Agency (APTA), located in the municipality of Votuporanga, State of São Paulo, (20º20'S, 49º58'W and 510m of altitude), in a dystrophic Red Yellow Latosol with sandy texture, according to SiBCS [5].

The climate in the region is tropical with dry winters (Aw in the Köppen's classification) with an average annual temperature of 24°C, an average maximum temperature of 31.2°C and an average minimum temperature of 17.4°C. The average annual rainfall is 1328.6 mm.

The experimental design used was a randomized block, with four replications, using as treatments three sampling positions of the components of production and grain productivity of soybean and maize crops in relation to the eucalyptus line: 2 m away from the eucalyptus lines (2 m); 4 m away from the eucalyptus lines (4 m); 6 m away from the eucalyptus lines (6 m), under two thinning of the eucalyptus: thinning of 0% of the trees (0%); thinning of 50% of trees (50%), compared to a treatment with thinning of 100% of trees (standard), totaling seven treatments: T1 - 0% and 2 m; T2 - 0% and 4 m; T3 - 0% and 6 m; T4 - 50% and 2 m; T5 - 50% and 4 m; T6 - 50% and 6 m; T7 - standard.

The agrosilvipastoral system was implemented in an area with degraded pasture with ten years of cultivation. The area was prepared in a conventional manner, through plowing and harrowing. After tillage, in September 2009, millet (*Pennisetum glaucum*) was sown between the terraces for soil conservation (terraces).

In October 2009, Urograndis H-13 eucalyptus hybrid (*Eucalyptus urophila* x *E. grandis*) was planted on terraces, in a simple line system, with a spacing of 2 m between plants and 13.5 m between lines, totaling 370 plants ha^{-1}.

On November 30 2009, millet was desiccated and soybean sowing was carried out, between the terraces, in no-tillage system over the millet straw. The soybean harvest was carried out on April 8 2010.

After the soybean harvest, *Crotalaria juncea* was sown, used as a cover plant. *C. juncea* was desiccated on November 29 2010.

On December 15 2010, maize was sown, between the terraces, in no-tillage system on *C. juncea* straw.

The sowing of *Urochloa brizantha* cv. Marandu (pasture) was held on December 16 2010, with two lines sown between the lines of the maize.

In September 2011, the area was divided into 1.0-ha plots (paddocks) and four newly weaned beef cattle were introduced per plot, which remained in the area on continuous grazing for twenty-four months, when they were sent to the slaughter. After the slaughter of the first batch, new batches of beef cattle were introduced into the area, using a rotational grazing system, which remained in the area until slaughter. The stocking rate of cattle varied according to the forage supply.

In July 2016, animals were removed from the area for pasture regeneration, which was used as straw for sowing soybean, and thinning of the eucalyptus was carried out.

The crops used in the system are shown in Table 1 and the amount of nutrients used is shown in Table 2.

Soil samples for chemical characterization [6] were collected in the 0-0.20 depth layer, in October 2016 and 2017, and the results are shown in Table 3.

Soil samples for physical [7], particle size [8] and structural [9] characterization were collected in the 0-0.20 and 0.20-0.40 m depth layers, in October 2016, and the results are shown in Table 4.

On October 19 2016, the amount of straw in the area was sampled. Two 0.5 x 0.5-m samples were taken per plot, which were packed in paper bags and taken for drying in a forced ventilation oven, set at 65-70ºC for 72 hours. The average amount of dry matter in the area was 8404 kg ha^{-1}.

Table.1: Crops used in the September (Sep)/2009-August/2016 period

Sept/March	April/August	Sept/March	April/August	Sept/March	April/August
2009/10		2010/11		2011/12	
Millet/Soybean	*C. juncea*	Maize + *U. brizantha*	*U. brizantha*	*U. brizantha*	*U. brizantha*
2012/13		2013/14		2014/15	
U. brizantha	*U. brizantha*	*U. brizantha*	*U. brizantha*	*U. brizantha*	*U. brizantha*
2015/16					
U. brizantha	*U. brizantha*				

Table 2. Nutrient amount used in the September-August period 2016

N	P	K	N	P	K	N	P	K
				kg ha^{-1}				
	2009/10			2010/11			2011/12	
15.0	124.0	60.0	116.4	91.0	86.4	45.0		
	2012/13			2013/14			2014/15	
33.0			100.0			50.0		
	2015/16							
25.0								

Table 3. Soil chemical characterization in the 0-0.20 m depth layer, 2016 and 2017

Year	P	OM	pH	K	Ca	Mg	H+Al	Al	V
	mg dm^{-3}	g dm^{-3}		---------------mmol$_c$ dm^{-3}-----------------					%
2016	7	18	5.8	3.7	26	21	15	0	77
2017	10	17	5.2	2.0	18	12	18	0	64

Table 4. Particle size, physical and structure characterization of soil in the 0-0.20 and 0.20-0.40 m layers, 2016

	Sand	Silt	Clay
	---------------------------------g kg^{-1}----------------------------------		
0-0.20	815	104	81
0.20-0.40	783	142	75

	M[1]	μ[2]	TP[3]	BS[4]	> 2 mm[5]	AWD[6]
	-------------- m^3 m^{-3} ---------------			kg dm^{-3}	%	mm
0-0.20	0.03	0.34	0.38	1.59	57.88	2.76
0.20-0.40	0.03	0.34	0.37	1.58	52.26	2.61

[1]macroporosity; [2]microporosity; [3]total porosity; [4]bulk density; [5]percentage of aggregates larger than 2 mm; [6]average weighted diameter.

The area was desiccated on October 20 2016. The sowing of soybean was carried out mechanically on November 17 2016, between the terraces, in no-tillage system on the straw of *U. brizantha* cultivar Marandu. The cultivar used was Brasmax Potencia RR, at the spacing of 0.5 m and a population of 320000 plants ha^{-1}. For sowing fertilization, the 04-20-20 formulated fertilizer was used, in the dosage of 400 kg ha^{-1}.

The parameters evaluated in the soybean crop were: insertion height of the first pod, plant height, final stand ha^{-1}, mass of one hundred grains and grain productivity ha^{-1}. The evaluations were carried out at soybean harvest, performed on March 9 2017. The weight of one hundred grains and grain productivity were obtained by standardizing the grain moisture to 13%.

Sampling of the insertion height of the first pod and plant height was carried out in ten plants in each plot, and sampling of the final stand ha^{-1}, mass of one hundred grains and grain productivity was carried out in 10 m of each plot.

The pods were threshed in a mechanical thresher. After threshing, the grains were weighed and their moisture measured to calculate grain productivity. Next, one hundred grains were separated to calculate the mass of one hundred grains.

After the soybean harvest, *C. juncea* was sown, between the terraces, for seed production and also to be used as a cover plant.

On November 3 2017, a new sampling of the amount of straw in the area was carried out, using the same methodology as the previous year. The average amount of dry matter in the area was 12805 kg ha^{-1}.

The area was desiccated again on November 7 2017. Maize sowing was mechanically performed, between the terraces, in the no-tillage system on the straw of *C. juncea*, on November 24 2017, using the cultivar Dow AgroSciences 2B587 PowerCore™ at the spacing of 0.8 m and the population of 72500 plants ha^{-1}, with seeding fertilization at a dose of 315 kg ha^{-1} of the formulation 08-28-16.

On December 11, 2018, the first topdressing fertilization was carried out, using the fertilizer formulated 20-00-20, at a dose of 270 kg ha^{-1}.

Sowing of *U. brizantha* cultivar Marandu was carried out on December 14 2017, using 10 kg ha^{-1} of forage seeds, with a cultural value of 50%, mixed with simple super phosphate fertilizer, at a dose of 60 kg ha^{-1}, with two rows sown between the lines of the maize crop.

On December 18, 2017, the second topdressing fertilization was performed, using ammonium sulfate, at a dose of 250 kg ha^{-1}.

The parameters evaluated in the corn crop were the insertion height of the first ear, plant height, final stand ha^{-1}, number of ears ha^{-1}, mass of one hundred grains and grain productivity ha^{-1}.

The evaluations were performed at maize harvesting, which was carried out on March 27 2018. The mass of one hundred grains and the grain productivity were obtained by standardizing the grain moisture to 13% (wet basis).

Sampling of the insertion height of the first ear and plant height was carried out in ten plants in each plot, and the sampling of the final stand ha^{-1}, mass of one hundred grains and grain productivity was carried out in 10 m of each plot.

The ears were threshed in a mechanical thresher. After threshing, the grains were weighed and their moisture measured to calculate grain yield. Then one hundred grains were separated to calculate the mass of one hundred grains.

The data were submitted to the F test and the means were compared using the Dunnett test (p <0.05), using the computer program Assistat [10].

III.   RESULTS

The different sampling positions in relation to the planting line, under the two thinning of the eucalyptus, provided differences (p <0.05) in relation to the mass of one hundred grains and grain productivity of the soybean crop and in relation to the height of plants, number of ears and mass of one hundred grains of maize crop (Tables 5 and 6).

No differences were observed regarding the insertion height of the first pod and final stand ha^{-1} of the soybean crop and, in relation to the final stand ha^{-1} of the maize crop (Tables 5 and 6).

The standard treatment, with 100% thinning of the eucalyptus, provided greater plant height in the soybean crop and greater insertion height of the first ear and higher grain productivity in the maize crop.

The sampling position at 2 m from the eucalyptus planting line under 0% thinning provided a lower mass of one hundred grains for soybean and maize crops and a lower number of ears ha^{-1} for the maize crop.

IV.   DISCUSSION

The sampling position of 6 m from the eucalyptus planting line under 50% thinning provided height for maize plants and it was similar to the standard treatment, with 100% thinning. [11] also found higher height of maize plants as the distance from *Cordia oncocalyx* trees increased, in which the tallest plants were found in the treatment 4 m away from the trees, which were completely out of the canopy. They authors also mentioned that this result can be attributed to the fact that maize is a species that does not support shading [12],[13].

On the other hand, [14] found a difference in the height of the maize only at 1 m away from the stem of *Grevillea robusta* trees, where maize, in an agrosilvipastoril system, was smaller than in single cultivation.

On average, there was a reduction in grain productivity in the soybean crop by 48.4 and 37.7% with 0 and 50% thinning of the eucalyptus, respectively, in which the sampling position 2 m from the planting line, under 0% of thinning, provided a reduction of 59.0%, corroborating with [15], who also found a reduction in the productivity of soybean in agrosilvipastoral system in relation to soybean cultivation under full sun and claimed that productivity was possible related to the value of solar radiation that reached the strata formed by the soybean plants. According to [16], the intensity of shading decreases with the distance from the row of trees.

Table 5. Soybean crop production components and grain productivity, Votuporanga, SP, 2017

Treatment	IH	PH	Stand	One hundred grains	GP
	m		ha^{-1}	g	kg ha^{-1}
0% - 2 m	0.09 |	0.65 ||	196667 |	11.53 ||	972 ||
0% - 4 m	0.09 |	0.72 ||	243333 |	12.55 |	1388 ||
0% - 6 m	0.10 |	0.69 ||	248333 |	12.34 |	1306 ||
50% - 2 m	0.10 |	0.74 ||	216667 |	12.70 |	1187 ||
50% - 4 m	0.09 |	0.71 ||	268333 |	12.69 |	1673 |
50% - 6 m	0.08 |	0.71 ||	196667 |	13.50 |	1569 ||
Standard	0.08 |	0.86 |	218519 |	13.98 |	2368 |
F test	2.1584^{ns}	11.1679**	2.8446*	2.0843^{ns}	5.8723**
SMD	0.03	0.08	64619	2.20	743
CV	15.07	5.45	14.23	8.62	24.85

| - Not different from the standard treatment by the test of Dunnett at 5%; || - Different from the standard treatment by the test of Dunnett at 5%; SMD - significant minimum difference; CV - Coefficient of variation (%); IH - Insertion height of the first pod; PH - Plant height; Stand - Final stand ha^{-1}; One hundred grains: mass of one hundred grains; GP - Grain productivity; ns - not significant; * - significant at 5% by the F test; ** - significant at 1% by the F test.

A reduction was also found in grain productivity in the maize crop of 86.3 and 57.1% with 0 and 50% thinning of the eucalyptus, respectively. The sampling position of 2 m from the planting line under 0% thinning provided a 92.3% reduction in productivity. According to [17], there is influence of the tree component, according to its distance from the row of trees in an agrosilvipastoral system, and the effect is consistent with the importance of radiation in the photosynthetic processes of the plants, especially those of the C4 cycle, such as maize.

[18] also found that the agrosilvipastoral systems used provided lower grain productivity than the agropastoral system and no-tillage system with maize cultivation in monoculture under full sun, and the maize was sown after fourteen months of planting the forest component, which had a height greater than 4.5 m.

[19] also observed higher grain productivity of maize in the central planting lines of systems intercropped with eucalyptus clones, and [20] found a drop in the yield of shaded corn plants, in comparison to those completely exposed to the sun, and mentioned that this fall was related to changes in incident photosynthetically active radiation, air temperature and CO_2 concentration, and [21], observed some reductions in photosynthetically active radiation,

when the maize plants were closer to the trees, especially at sixty days after sowing, which, according to the authors, resulted in a drop in maize yield.

This highlights the need for thinning eucalyptus, with the removal of over 50% of the plants, when the intention is to carry out a new cycle of soybean and maize crops, in the renewal of pasture in an agrosilvipastoral system, with seven-year-old eucalyptus as there was a clear competition for water, light and nutrients between eucalyptus and soybean and maize crops, mainly in the sampling position at 2 m from the eucalyptus planting line.

[22] mentioned that shading and competition for nutrients and water for the tree component is likely to affect grain productivity, considering the spacing used, a fact observed in this study, where eucalyptus was 26.7 m in height, in October 2017, and according to [23], the solar radiation incident under the canopy becomes a highly determining factor for the insertion of agricultural and / or forage crops in wooded production systems.

Table 6. Production components and grain productivity of maize crop, Votuporanga, SP, 2018

Treatment	IH	PH	Stand	Ears	One hundred grains	GP
	m		ha^{-1}		g	kg ha^{-1}
0% - 2 m	0.74 ‖	1.61 ‖	59375		54167 ‖	29.01 ‖	705 ‖
0% - 4 m	0.97 ‖	1.84 ‖	65625		58333		30.71		1014 ‖
0% - 6 m	1.02 ‖	2.03 ‖	67708		55208		29.94		2018 ‖
50% - 2 m	0.77 ‖	1.71 ‖	64583		60417		30.46		3352 ‖
50% - 4 m	0.98 ‖	2.01 ‖	68750		62500		31.30		4086 ‖
50% - 6 m	1.07 ‖	2.12		67708		60417		31.07		4296 ‖
Standard	1.13		2.23		63021		61458		30.83		9106	
F Test	92.4604**	59.6764**	5.1830**	3.9933*	6.5109**	127.6661**
SMD	0.06	0.12	5760	6357	1.23	1008
CV	3.16	3.00	4.41	5.39	2.01	14.35

| - Not different from the standard treatment by the test of Dunnett at 5%; ‖ - Different from the standard treatment by the test of Dunnett at 5%; SMD - significant minimum difference; CV - Coefficient of variation (%); IH - Insertion height of the first pod; PH - Plant height; Stand - Final stand ha^{-1}; Ears - Number of ears ha^{-1}; One hundred grains: mass of one hundred grains; GP - grain productivity; ns - not significant; * - significant at 5% by the F test; ** - significant at 1% by the F test.

Since the highest grain productivity of soybean and maize crops were obtained with 100% thinning, an alternative would be to let the eucalyptus plants sprout and conduct the regrowth to carry out a new cycle with the soybean crops and of maize for pasture renewal in an agrosilvipastoral system, as [22] did not find negative effects on maize productivity intercropped with *E. grandis* x *E. urophylla* and *Acacia mangium*, in the spacing of 12 m between rows and 2 m between plants, in an agrosilvipastoral system in the first year of cultivation, possibly due to the small size of tree species until maize harvesting.

[24] also found that the total production of maize biomass intercropped with monospecific and mixed plantations of forest species did not differ between the treatments tested and mentioned that the same production between treatments can be attributed to the fact that there was no competition of forest species with maize, as maize sowing was carried out one month after planting the trees.

Another alternative for a new cycle with soybean and maize crops for pasture renewal in an agrosilvipastoral system, which should be studied, would be the thinning of alternating rows by increasing the spacing between the eucalyptus rows because [25] did not find competition with

the corn crop for the Xaraés grass (*U. brizantha* cultivar Xaraés) and the mulateiro forest species (*Calycophyllum spruceanum*) in an agrosilvipastoral system. They also mentioned that maize grain productivity was not affected by the intercropping with the trees due to extensive spacing between the lines in the system (20 m), which did not promote excessive shading in the area, and also due to the characteristics of the species, which has a high crown, with elliptical vertical and a fine shape [26].

V. CONCLUSION

The thinning of up to 50% of the trees was not sufficient to reduce the influence of eucalyptus on the components of production and grain productivity of soybean and maize crops in relation to the renewal of pasture in an agrosilvipastoral system, with eucalyptus at seven years of implantation.

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Locator Bracelet with QR Code for Elderly People with Alzheimer's

Alessandra Custódio da Silva[1], Wenderson de Souza Rodrigues[2], Bruno Pereira Gonçalves[3], Marcelo Alves da Cruz [4], Rilmar Pereira Gomes[5], David Barbosa de Alencar[6]

[1,2,3,4,5] Academic department, University Center FAMETRO, Manaus-AM, Brazil
[6] Research department, Institute of Technology and Education Galileo of Amazon – ITEGAM, Manaus-AM, Brazil

Abstract— *An accessory for monitoring and offering personal information related to risk situations of patients with Alzheimer's, thereby providing support, security and tranquility for family members and caregivers. A bibliographic research is carried out in this study with focus on on Alzheimer's Disease as well as on the patient's relationship with the family and the care offered to them. Furthermore, a quantitative study is performed, using specific forms and documentary based on public domain documents about the disease. Alzheimer's is an incurable and degenerative disease that affects nerve cells, and is responsible for causing spatial disorientation on memory. Spatial disorientation is one of the recurrent symptoms in with a patient suffering from AD. When the symptoms of this disease start to evolve, some patients do not feel familiar and do not even recognize certain places. The difficulty for family caregivers is noticeable when in dealing with these risk factors. This project is aimed at facilitating the reunion of the elderly with their family by proposing an accessory that provides 24 hours a day monitoring, along with a code that contains the patient's personal information. Given this context, cognitive research is relevant to express the need for minorities, leveraging home security, allowing patients the ability to have their independence for a longer time, without the disease preventing them from completely exercising their daily activities.*

Keywords— *Alzheimer; Spatial disorientation; Location; QR Code.*

I. INTRODUCTION

Alzheimer's is a disease that causes dementia, or loss of cognitive functions (memory, orientation, attention and language), which comes as a result of the death of brain cells. Neuronal losses do not happen homogeneously. The most commonly affected areas are nerve cells (neurons) responsible for memory and executive functions that involve planning and executing complex functions.

According to the Brazilian Alzheimer's Association (ABRAz), Alzheimer's Disease - AD is a dementia characterized by three main phases. It starts with forgetfulness and subtle memory loss as well as difficulties at work. It may be confused with depressive states; it progresses with more severe memory loss, the inability to perform complex tasks such as calculations and planning and has as third-stage manifestations the marked impairment of functional capacity, difficulties in feeding, dressing and bathing. This disease can destroy memory until it generates great gaps.

It is estimated that there are more than 45 million people living with dementias in the world, with projections that this number will double every 20 years, according to

data provided by The Brazilian Alzheimer's Institute (IAB). Dementias usually affect the elderly population. In Brazil alone, where today there are more than 29 million people over the age of 60, according to data from the Brazilian Institute of Geography and Statistics (IBGE), it is believed that almost 2 million people have dementias, with about 40 to 60% of them of Alzheimer's type. There are about 1.2 million cases, most of them still undiagnosed.

As the disease progresses, the patient's dependence also increases. The emotional impact for the patients' family members is undeniable. The use of medication is combined with doses of dedication and love from the people around them. It is necessary to live daily with manias, mood swings and the patient's memory loss. Despite good motivations, caring for such patients is not an easy task.

Starting with the premise that AD is a chronic and neurodegenerative disease, it is extremely important to think about the diagnosed patient's daily life, and also about the patient's caregiver. This study will apply the technology of locators on wristbands, making it possible to create a device that informs the patient's location in real time.

II. BIBLIOGRAPHIC REFERENCE

Choosing this project's theme was based on the observations made with respect to the need for care for patients with AD in their daily lives. This section presents the theoretical aspects that address the entire study used for the idealization of this project.

2.1 Alzheimer

Alzheimer's disease is an incurable disease that worsens over time, but it can and must be treated. Almost all of its victims are elderly people. It is not known what causes Alzheimer's disease, but some brain lesion characteristics of this disease are known. Neuronal losses do not happen homogeneously. The most commonly affected areas are nerve cells (neurons) responsible for memory and executive functions that involve planning and executing complex functions. Other areas tend to be affected later, increasing the losses.

2.2 Spatial disorientation

According to AbraZ, spatial disorientation occurs when the patient is no longer able to locate himself/herself in space, that is, he/she has difficulty with routes or identify the right direction. Initially, this occurs in less known environments, and may, as the disease progresses, it may include difficulty for the patient to direct himself inside his/her own home. Furthermore, if asked, he/she will also not be able to say when and how he/she got there.

2.3 QR Code

Quick Response (QR) Code is a 2D code originally developed for use in the automotive industry, in order to track vehicles during the manufacturing process. It is currently used to obtain quick access to websites, texts and numbers.

2.4 QR Code Generator

The QR Code Generator is a website that offers a tool with many resources for creating a QR Code with the possibility of downloading and tracking statistics.

2.5 ESP32 Board

Also known for being a "System on a chip", ESP32 is a series of low-cost microcontrollers, containing RAM memory, 2 processing cores, hybrid Bluetooth, WIFI connection, noise reduction, encryption and numerous other features which makes it a small but powerful microcontroller. It is coded in the Arduino IDE.

2.6 ESP32 and the Arduino IDE

The Arduino development platform has a large number of followers (developers) that provides several opensource codes to new programmers. To use the IDE to encode ESP, simply select your card's model, add a new library in the card management. This way, the passage of codes between IDE and card will be free.

2.7 GY-NEO6MV2 GPS Module

The GY-NEO6MV2 GPS module is a compact board with easy connection and configuration, suitable for air or land navigation projects, the module can be used with several types of microcontrollers, it is widely used due to quality, ease, size and reduced weight.

2.8 Java

Java is an object-oriented programming language developed for creating continuous platforms. In this programming paradigm the developer can carry out updates or continue with unfinished projects instead of starting a new one. The object makes one's code more organized and easier to modify.

2.9 MIT App Inventor

MIT App Inventor is web software created for Android applications development using a connected browser and smartphone. It is possible to create applications by selecting components, using block programming that shows how the application should behave. The entire development of the application is done visually by joining pieces as in a puzzle. At the end of the project, the project can be stored, and thus, an executable file is generated and ready to be installed on other smartphones.

III. MATERIALS AND METHODS

A bibliographic research is carried out, consisting of studies addressing the topic 'Alzheimer's disease: challenges faced by the caregiver in the family routine", "The elderly with Alzheimer's disease: the family caregiver's care and knowledge".

A quantitative survey was also conducted using google Forms and printed questionnaires with 15 closed questions for family caregivers of patients with AD, as well as participants in the Caregivers' Support Group of Alzheimer Patients. The evaluation criteria was defined as follows: being a family caregiver for one year or more of an elderly person with AD and living in the same household.

Another method used was a Documentary research based on exploratory readings of material during its trajectory, data collection was carried out through the official website of ABRAz, seeking to gather information through reports, guidelines, and identification of documents made available in the public domain. It is an Applied research based on the proposal of the use of bracelets in diagnosed patients.

As relates to the prototype development, the QR Code Generator website will be used to generate the QR Code with the patient's personal information and medical data, 1 GPS GY-NEO6MV2 Module, and 1 ESP32. An application for Android devices was developed on the MIT APP Inventor platform, in the JAVA language, using

boxed programming. The application would allow the user to have access to the locator used by the patient, and will be able to read the data available in the QR Code.

IV.   RESULTS AND DISCUSSION

4.1   Learning to Cope with Alzheimer's Disease Symptoms

Spatial disorientation is one of the recurrent symptoms in the life of an AD patient. The episodes initially occur in unknown places. After the disease progresses, some patients end up fleeing their homes, as they do not feel familiar with, and do not even recognize, the place. A patient may just automatically walk out of the house. There are even times when he/she does not recognize the place where he/she is. Thus, the patient has problems in creating a strategy to return to the place of origin.

It is noted that family caregivers do not have knowledge about symptoms and care related to Alzheimer's disease. The disease, due to its characteristics, significantly affects the family, leading to total the patient's total dependence on these family members.

"My father knows he is forgetting places, but he does not accept going out with anyone, he says that he is the boss, he has gotten lost a few times, people have called me." Reports Sonia Fonseca, who takes care of her father, diagnosed.

"It happened very early. He went for a bike ride, fell and only came back because the police brought him back." Icaro Jordão, about his grandfather.

"After some situations he got lost on the way to my home, I had to make caps with his name on them, and a phone number for contact. But there were days when he forgot to wear the cap." Vanessa, referring to her father.

4.2   Quantitative Research

After conducting a questionnaire using Google Forms, we obtained significant results that drive the evolution of this project:

Graph 1: Did you already know about the situation, regarding spatial disorientation?
Source: The Authors, 2020.

40.6% claim to have knowledge about the severity of spatial disorientation, however 59.4% do not have the same knowledge, a result considered alarming because spatial disorientation is one of the risk factors that cause the elderly to get lost.

Graph 2: Has it ever occurred that the patient got lost?
Source: The Authors, 2020.

64% of participants claim to have gone through situations where the disoriented patient got lost, and 36% say they have not experienced this disorder.

Graph 3: Did you have to make a custom object with identification information (shirt, badge, etc.)?
Source: The Authors, 2020.

Despite the severity of the spatial disorientation risk factor, which causes the AD patient to get lost, only 33.7% of the interviewees claim to have made an identification object. 66.3% do not consider its use necessary.

Graph 4: About the objects, was their use efficient?
Source: The Authors, 2020.

Of the objects made, 48.8% achieved some effectiveness. 51.2% did not provide any good result. Patients may not want to wear a certain accessory that would be different from what they are already used to, such as a new shirt, caps or badges.
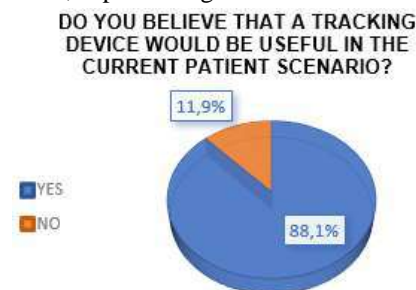
Graph 5: Do you believe that a tracking device would be useful in the current patient scenario?
Source: The Authors, 2020.

88.1% of respondents agree on the use of a device that would allow remote monitoring of the patient, and 11.9% disagree on the use of these technologies.
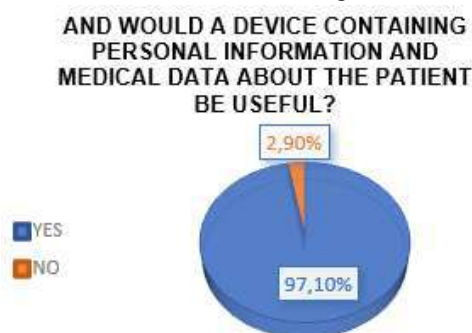
Graph 6: And would a device containing personal information and medical data about the patient be useful?
Source: The Authors, 2020.

97.1% are in favor of a device with personal and medical information, aiming at a scenario where the risk factor of spatial disorientation is the patient's result, whether the information about the lost patient would be useful to assist in the reunion with the caregiver. And only 2.9% see no need for this device.

4.3   The Proposal

This work proposes the development of a locating bracelet together with the use of the QR Code containing the patient's personal information and family contacts, an ESP32 that connects the bracelet to the smartphone with the android application and a GPS GY-NEO6MV2 Module that grants the precise location from the wearer of the bracelet to the responsible caregiver, aiming to handle situations in which the patient is disoriented or lost.

4.4   The Project
4.4.1 Software

The development refers to the QR Code Generator website (Figure 1). When accessing the QR Code, one must start creating the patient's data, including the patient's name, contact person's phone number, caregiver's name and the patient's diagnosis.

Fig. 1: Symbol of the QR Code Generator site.
Source: QR Code Generator site

The software consists of an ESP 32 technology (Figure 2) that will communicate with a smartphone through an Android application, developed by the group at the MIT APP Inventor (Figure 3). It will show the location to caregiver, who will have access to the application.

Fig. 2: ESP32 Microcontroller.
Source: Usinainfo site.

Fig. 3: Symbol of MIT APP INVENTOR.
Source: Celular1 MIT APP INVENTOR site.

4.4.2 Hardware

The QR Code will be generated and printed on adhesive tape that will be attached to the bracelet, containing information that will assist in providing assistance to the lost patient.

Fig. 4: QR Code generated by the QR Code Generator site.
Source: QR Code Generator site.

The bracelet will have the ESP 32 module (Figure 2) that maintains communication via Bluetooth or via Ethernet through an Android application. Alongside is the GPS GY-NEO6MV2 module (Figure 5) that will display the patient's caregiver's location.

Fig. 5: GPS GY-NEO6MV2 Module
Source: Autocorerobotica site.

4.4.3 The Bracelet

The purpose of the project is to facilitate the reunion of the elderly with their family just by scanning the code with a smartphone. The code will be generated on the QR Code Generator website. After being fed with the information, it can be printed on an adhesive containing the name, telephone number of a responsible person, caregiver's name and patient's diagnosis. The GPS Module connected to ESP32 is the location and communication service. The bracelet (Figure 6) will be made of silicon in the model without closure to make it difficult for the user to remove the object.

Fig. 6: Prototype of the Identification Bracelet
Source: Adapted by Source: The Authors, 2020.

V. CONCLUSION

The results acquired by collecting data through the forms present a wide lack of information regarding the cognitive problems of Alzheimer's Disease and despite being a known disease, people are not sure on how to react with some symptoms. The difficulty of some caregivers to handle technology was also noted, which could in turn assist in the daily life alongside the patient.

There was the development of a bracelet that transmits the location in real time to the caregiver's device, adding to the use of the QR Code with personal information and the patient's diagnosis. The bracelet won good prospects. The communication of the bracelet's GPS with the recipient device worked well. The information contained in the QR Code is useful to help the lost patient. The project is very effective, the use of the bracelet allows remote monitoring of the elderly, as well as providing necessary information in situations of risk, offering tranquility and security to caregivers and family members.

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Elevated temperature predisposes to impacted oil gland in sheep

Almahdi A. Jaber, Salem M. Mazeg

Department of pathology and clinical Pathology, Faculty of Veterinary Medicine, University of Tripoli, Libya

Abstract— *Impacted oil gland is one of the commonest problems which cause transient lameness in sheep. The inter-digital oil gland is normal structure of sheep feet, sheep farming has an economic importance around the world, therefore it's very important to consider sheep welfare in order to develop sheep husbandry. One of the common issues that faces sheep welfare is lameness, sheep lameness is very common around the world with variety of causes which include foot root, foot injury and impacted oil gland. Foot root is very rare in southern Libya as the climate in sub-Saharan area is dry, however impacted oil gland is one of the major causes of lameness in southern Libya, this study has speculated that the occurrence of impacted oil gland in sheep is correlated with increased climate temperature. Despite impacted oil gland causes lameness in animal, it has not had a bad effect on animal health as foot root and spontaneous recovery was observed within few days. Squeezing and evacuation of the affected gland was enough for recovery of sheep from lameness without administration of antibiotics and anti-inflammatory drugs within1-3 days. Good management including good sheltering and watering during hot seasons could reduce incidence of impacted oil gland in sheep.*

Keywords— *sheep, oil gland, temperature, Lameness.*

I. INTRODUCTION

Impacted oil gland is a skin disorder of sheep occurs due to accumulation of white greasy material in the inter-digital pouch. The inter-digital pouch is an anatomical structure located in the inter-digital space of the four limbs of both sexes of sheep and the exact role of this gland still unknown(Misk et 2013). Other study suggested the involvement of these gland in sexual communication, social behaviors and regional determination (Yilmaz et al 2017). The oil gland is a tubular structure consists of blind sac and long narrow neck ended with an opening on skin surface. Histologic examination of the neck and body walls showed presence of 3 layers which are epidermis, dermis and fibrous capsule, the dermis is consist of hair follicles, sebaceous glands, sweat glands and glandular apocrine (Awaad and Abedellaah 2010). Inflammation of the inter-digital pouches was observed (bokko 2003) and its position makes it exposed to frequent injuries(Sivachelvan et al 1992).Lameness is mainly associated with foot injuries, and interferes with animal productivity, other predisposing factors including both genetic and environmental factors are also involved in development of lameness (Gelasakiset al 2017).Studies have suggested that surgical removal of inter-digital pouch in lambs could be beneficial to solve problems of foot infection in areas of high incidence of foot problems (Misk et 2013,Sivachelvan et al 1992).

II. METHODOLOGY

This study was performed in region of Al-gatroun in southern Libya. The study has included 20 sheep of different breeds. The study has included both sexes of different ages. There was a variation in fleeces lengths of the animals. The general study was performed in April 2019 in a farm with good feeding and cleaning managements however the sheltering was not enough to be measured as an ideal sheltering to protect animals from high temperature. No changes were introduced to the animal's environment, the only change around the animal environment was elevation of temperature and no systemic diseases were observed in the flock. Animals have undergone to traditional treatment such as squeezing and cleaning of the oil gland without administration of any medication such as anti-inflammatory drugs.

III. RESULTS AND DISCUSSION

Impacted oil gland was observed in 30% of sheep (6/20) within 2 day when climate temperature suddenly changed

from 28°C to 38°C,among the affected group 83% were local breed which characterized with long fleece. 5/6 of the affected animals showed lameness on the first day of climate change and the other sheep showed lameness in the second day, the animal was very wet and sweating does not stop until the animal be shaved. The disease is mainly seen during hot season, incidence of the impacted oil gland is associated with elevation of temperature either in spring or summer, in this study impacted oil gland was observed during sudden elevation of temperature from 28°C to 38°C in April. Despite impacted oil gland cause lameness in animal (Bulgin), it has not had a bad effect on animal heath as foot root and spontaneous recovery was observed within few days. All of the animals have shown fore limb impacted oil gland except one ram showed impacted oil problem in the hid limb, despite this condition is not very severe as foot root the ram showed poor performance with

inability to serve ,this and other kind of foot problem may interfere with farm productivity(Gelasakis et al 2017).The problem was detected in adult sheep of both sexes, however lambs in the farm did not show any foot problem. Grossly, the lesion appears as extruded bead in the inter-digital space containing a bundle of hair figure A, and squeezing of lesion shows accumulation of white greasy material (Bulgin),pressing and evacuation of the gland lead to appearance of narrow pipe line structure(Mohamed and Adogwa2016) tinged with blood without any signs of inflammatory reactions. Squeezing and evacuation of the affected gland and cleaning the area with water was enough for recovery of sheep from lameness within 1-3 days without administration of antibiotics and anti-inflammatory drugs. Post squeezing complication was not observed.
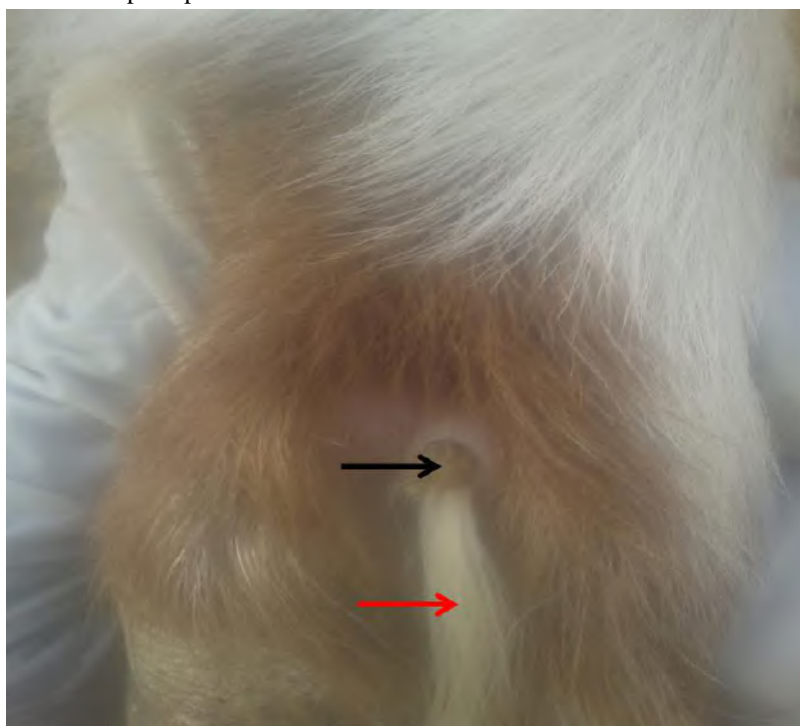
Fig.A: Impacted oil gland in sheep. Grossly, the lesion appears as extruded bead (Black arrow) in the inter-digital space containing a bundle of hair (Red arrow).

IV.   CONCLUSION

This study has demonstrated that elevated or sudden elevation of temperature predisposes sheep to impacted oil gland, particularly in long wool breeds. It looks a non-inflammatory condition associated with disturbance in secretory function of the gland. Good management through avoiding of exposure of animals to high temperature may reduce incidence of impacted oil gland. The problem can be solved without administration of antibiotics and anti-inflammatory drugs.

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Impacts of Celiac Disease on quality of life: Integrative Literature Review

Diego Silva da Conceição[1], Patricia Sousa Costa[1], Rosidalva Ramos Leite[1], Elisa Xavier Simões[1], Mayco Tadeu Vaz Silva[1], Márcia Soraya Quaresma Vera Cruz[1], Fabrício Gabriel Freitas Lima[1], Marcilene dos Santos Farias[1], Milk dos Santos Fernandes de Oliveira[1], Arlena Cristine Fonseca Souza[1], Daniel de Sarges Rodrigues[1], João Felipe Santos da Cunha Pantoja[1], Gleice de Araújo Steinheuser[1], Jolielma Marques da Costa[1], Karolinne do Socorro Sousa Neves[2], Maycon de Sousa Quaresma[2], Márcia Geovanna Araújo Paz[2], Gabrielle Santiago Costa Neves[2], Widson Davi Vaz de Matos[3], Cinthya Lorena Bezerra Sarmanho[4], Nathalie Porfirio Mendes[5], Eimar Neri de Oliveira Junior[6], Leliane do Nascimento do Espírito Santo[6], Carolina Maria Peixoto Farias[6], Fábyla D'Tácia Brito Trindade[6], Thamyris Abreu Marinho[7], Danielle Oliveira Maciel[8], Ana Flavia de Oliveira Ribeiro[9], Sivaldo Oliveira da Silva Júnior[10], Lucimario Valente Ferreira[11], Adams Brunno Silva[12], Beatriz Pinheiro Bechir[13], Adriana de Oliveira Lameira Veríssimo[14], Giselly de Lourdes da Silva Santana[15], Jean Antonio Macedo Martins[16], Lívia Karolina Silva de Oliveira[17], Lucilene Lima Sousa[18], Maicon de Araujo Nogueira*[19], Antonia Margareth Moita Sá[20]

[1]Nursing Academic. University of the Amazon (UNAMA), Belém, Pará, Brazil.
[2]Nursing Academic University of the State of Pará (UEPA), Belém, Pará, Brazil.
[3]Resident Nurse, Oncology Nursing Residency Program, Federal University of Pará (UFPA), Belém, Pará, Brazil.
[4]Nurse, Master in Health Education in the Amazon, Stricto Sensu Graduate Program, Professional Master in Health Education in the Amazon (ESA), State University of Pará (UEPA). Professor at the University Center of the Amazon (UniFAMAZ), Belém, Pará, Brazil.
[5]Nurse, Master, Postgraduate Program in Nursing, Federal University of Pará (UFPA), Professor at the University of the Amazon (UNAMA), Belém, Pará, Brazil.
[6]Nurse, University Center of the Amazon (UniFAMAZ), Belém, Pará, Brazil.
[7]Nurse, Post graduate. Stricto Sensu Graduate Program in Nursing, Universidade Federal do Pará (UFPA), Belém, Pará, Brazil.
[8]Nurse, João de Barros Barreto University Hospital (HUJBB), Belém, Pará, Brazil.
[9]Nurse, Family Health Strategy Bairro Novo, Santa Izabel do Pará, Brazil.
[10]Nurse, Gamaliel Faculty of Theology, Philosophy, and Human Sciences, Tucuruí, Pará, Brazil.
[11]Nurse, Specialist in Surgical and Oncology Clinic. Pará State University (UEPA), Ophir Loiola Hospital (HOL), Belém, Pará, Brazil.
[12]Nurse, Hospital Ophir Loiola (HOL). Master student of the Master's Program in Nursing, Pará State University (UEPA), Belém, Pará, Brazil.
[13]Nurse, Pará State University (UEPA), Belém, Pará, Brazil.
[14]Physiotherapist, Master in Health, Society and Endemics in the Amazon, Federal University of Pará (UFPA), Belém, Pará Brazil.
[15]Physiotherapist, doctoral student, Stricto Senso Graduate Program in Parasitic Biology in the Amazon (UEPA / Instituto Evandro Chagas-IEC), Belém, Pará, Brazil.
[16]Nurse, University of the Amazon (UNAMA). Belém, Pará, Brazil.

[17]Nurse Faculty Pan Amazon (FAPAN), Belém, Pará, Brazil.

[18]Nursing Academic. ESAMAZ, Belém, Pará, Brazil.

[19]Nurse, Master in Health Education in the Amazon, PhD student, Stricto Sensu Postgraduate Program, Professional Doctorate in Health Education in the Amazon (ESA), State University of Pará (UEPA). Professor at the University of the Amazon (UNAMA), Belém, Pará, Brazil. *E-mail: profmaiconnogueira@gmail.com

[20]Nurse, PhD in Nursing, Federal University of Rio de Janeiro (UFRJ). Permanent member of the faculty in the Stricto Sensu Graduate Program, Master and Professional Doctorate in Education and Health in the Amazon (ESA), State University of Pará (UEPA), Belém, Pará, Brazil.

Abstract— Objective: to understand the repercussions that Celiac Disease has on quality of life, through an integrative review. Method: integrative literature review, with searches in the LILACS, SciELO and Web Of Sciece databases, with a selection of articles published between 2014 and 2019. The articles were selected by searching with the following Health Sciences Descriptors: Celiac Disease, Glutens, Adult, Quality of Life, Patient Care Team and Gluten Free Diet, using the Boolean operators AND and OR as a tool for crossing them, enabling the location of 111 articles. Results: Six articles were analyzed in full from the application of the inclusion and exclusion criteria, with the production of data guided by the content analysis steps proposed by Bardin, enabling the construction of two empirical categories, namely: dietary practices and Quality of life of the person with Celiac Disease and importance of the multidisciplinary team in the diagnosis and monitoring of the person with Celiac Disease. Conclusion: it is essential to continue in the search for knowledge in the perspective that science finds other means of treatment, in addition to the restrictive diet, and the industry adapts itself to the needs of individuals, through the offer of quality and low cost products, for inclusive access, reducing the suffering and impacts generated by the disease on the quality of life of people with Celiac Disease.

Keywords— Celiac Disease. Quality of life. Patient Assistance Team. Gluten Free Diet.

I. INTRODUCTION

Celiac disease (CD) is recognized as a chronic enteropathy, genetic pathogenesis, characterized by partial or total atrophy of the microvilli of the small intestine mucosa, crypt hyperplasia and an increase in the number of intraepithelial lymphocytes, which affects the small intestine in nature autoimmune, triggered by exposure to the protein complex called gluten and derivatives, the main protein fraction found in wheat and rye, oats and barley, in genetically predisposed people. Exposure to this substance causes intestinal inflammation, with atrophy of intestinal microvilli, among other problems, which cause everything from malabsorption, bringing different clinical manifestations, lactose intolerance to intestinal cancers[1,2].

It is characterized by intolerance to gluten intake, and is associated with several other important diseases and complications, which makes early diagnosis a fundamental factor in the management of the disease. The diagnosis is admittedly difficult, considering that the majority of patients have an oligo-asymptomatic or asymptomatic form[3]. In the management of the disease, the gluten-free diet is the only treatment known to be effective for CD, as it corroborates and prevents the pathophysiological changes of the small intestine, promoting the efficient return of nutrient absorption and providing the individual's nutritional rehabilitation, with improvement of your quality of life[2].

This disease can manifest at any age and presents itself in two forms: atypical, non-classical or subclinical forms, characterized by a varied clinical picture, or even with the absence of gastrointestinal symptoms, and classic or typical form, which presents specific positive serology and biopsy compatible with classic signs and symptoms, such as malabsorption, chronic diarrhea, anorexia, abdominal distension, loss of muscle mass, flat buttocks, steatorrhea, hypoalbuminemia edema, flatulence, weakness, irritability[4].

Since the association between gluten intake and CD described by Dicke, during World War II, the knowledge about the pathophysiology of this gluten-sensitive enteropathy has increased dramatically, especially with the resources of molecular diagnostic investigation. However, it is clear that gluten intake causes enteropathy and extraintestinal disease in genetically susceptible individuals, lacking knowledge about the additional factors associated with the triggering and prevention mechanisms of the disease[5].

Historically, CD has been considered rare and predominantly pediatric. Currently, this scenario has changed, especially due to the development of more sensitive and specific serological tests, which, in addition

to making early diagnosis possible, allow the performance of several screening surveys in asymptomatic individuals, whose results indicate that the true prevalence of CD may be greater than 1% in different locations. Currently, CD has been diagnosed mainly at a later stage of life, with the highest prevalence found in female adults[6].

Evidence shows that CD can present with variable frequency in children and adults in different geographical areas, with a variable spectrum of symptoms. In Western countries, it appears that CD affects approximately 1% of the general population. In the United States, a prevalence of 0.71% is identified, and in the European continent, the highest occurrence of CD is found in Finland (2.4 to 2.6%) and the lowest in Germany (0.3 to 0.5 %). Evidence shows that the prevalence of CD in developing countries is similar to that identified in the western world, revealing the following data: Middle East (0.5 to 1.8%), East and South Asia (0.32 to 1, 04%), North Africa (0.14 to 5.6%) and Latin America (0.15 to 2.7%). In Brazil, results of studies carried out in some regions have shown that the prevalence of CD is similar to that found in developed countries, varying from 0.15 to 1.94%[6]. A study conducted in Brasília, Distrito Federal, showed a prevalence of 0.34% for CD[4].

The lack of information about CD has been considered an obstacle to be overcome, above all, due to the similarity of clinical findings with other diseases, which generates a late diagnosis, which in turn may go unnoticed by health professionals, making early diagnosis and management difficult. disease. For this condition, the opportunities for treatment of CD end up being underreported, contributing to a greater number of neglected and / or untreated cases[2].

People with celiac disease need a gluten-free diet, that is, they should avoid foods that contain gluten for life. Minimal amounts can trigger significant reactions due to the severe injury that such protein produces in the small intestine, atrophying it and resulting in malabsorption of nutrients, which can cause growth retardation, diarrhea and chronic constipation, vomiting, pain and bloating, anemia iron deficiency, osteoporosis, infertility, among other symptoms[4].

The treatment strategy for CD is completely dietary, consisting of the total removal of gluten and derivatives from the diet permanently, regardless of the clinical presentation of the disease. From the diagnosis, the person with CD goes through a process of arduous and continuous adaptation, given that, often the products offered on the market do not meet the total needs of the individual. Thus, the gluten-free diet is hampered by food

monotony, since there is a low variability and availability of gluten-free foods. Therefore, nutritional guidance with creative possibilities for food recipes becomes important in the treatment of CD[1].

In this context, people with CD tend to transgress the diet due to financial difficulties, absence or little clarification in relation to the disease and the preparation of food, eating habits with products containing wheat in their composition, lack of ability to prepare artisanal meals and difficulty in purchasing economically accessible gluten-free industrialized products[2].

In this understanding, it is considered that adapting to the condition of food selectivity, adapting old habits to their new condition can cause several conflicts and psychological suffering, therefore, the individual who is diagnosed with CD undergoes severe dietary changes, including in the way of eating. behave in the face of personal and social life[4,2].

In this dynamic of difficult adaptation, despite the advance in diagnostic techniques, it is possible to infer that most cases of CD still remain undiagnosed. Results of studies indicate that the late diagnosis of CD increases the risk of complications and severity of the disease, in addition to increasing the chance of the installation of associated comorbidities. Despite the severity of CD, there are few studies in Brazil and other parts of the world on its occurrence[6].

In this sense, the study is justified by the reemerging need to know the repercussions of CD on the quality of life of individuals, aiming at a better understanding of how this event occurs and impacts people's daily lives. It is believed that, based on the production of this knowledge, different characters, patient, health professionals, managers, educational institutions, who are interested and are interested in studying and getting to know the theme more deeply, can reach more subsidies to support their reflections. and discussions on the topic, with a view to seeking qualitative and humanized assistance. Thus, the identification and discussion of the characteristics that permeate the phenomenon, become important for the proposition and validation of public policies that present feasible strategies for coping and changing care paradigms, based on current evidence.

The scarcity of comprehensive studies that allow generalizations and estimates of magnitude, the methodological limitations of investigations on the theme, the multifactorial and multidimensional character of the phenomenon, point to gaps in knowledge, and the need to expand the discussion and studies, including different views, with a view to unveiling the aspects that permeate

the repercussions of CD on the quality of life of individuals. Given the above, the study aimed to understand the repercussions that Celiac Disease has on quality of life, through an integrative review.

II.   METHOD

Integrative literature review, a study that offers quick access to relevant research results and evidence that underlie the conduct or decision making, providing critical knowledge, from six distinct stages[7].

The guiding question consisted of: What are scientific evidences available in the literature about the repercussions and impacts that Celiac Disease has on quality of life? The search was carried out from October to November 2019. The time frame was from 2014 to 2019, with 6 full articles listed, published between 2014 and 2017.
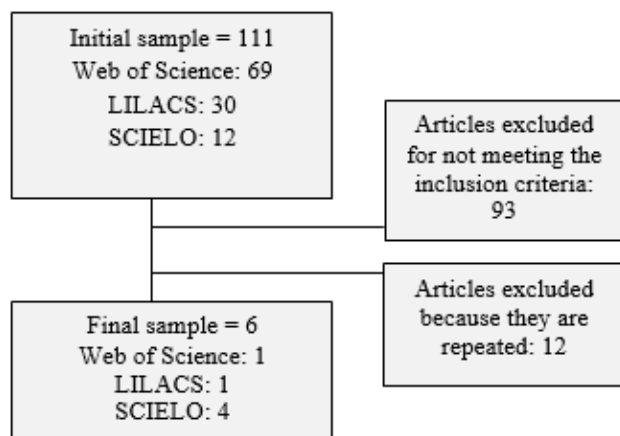
Fig.1: Flowchart of constitution of the sample.

Source: adapted from Pereira et al. 2019[8].

The search was carried out in the Scientific Electronic Library Online - SCIELO, Literature databases Latin American Health Sciences - LILACS and Web Of Science. The articles were selected by searching with the following Health Sciences Descriptors (DeCS): Celiac Disease, Glutens, Child, Adult, Child, Quality of Life, Patient Care Team and Gluten Free Diet, using operators Booleans AND and OR as a tool for their crossing, allowing the location of 111 articles, where 06 were included in the research (Figure 1). The texts are summarized in Table 1.

The inclusion criteria were: articles in Portuguese, published between 2014 and 2019, that addressed the repercussions and impacts of Celiac Disease on the Quality of Life of adults, adolescents and children, and full articles in the free version. This period was established due to the scarcity of content in the literature, related to the research topic, and because it considers that the publications of the last 5 years represent the current knowledge on the topic. Exclusion criteria were: articles in other languages, texts in Thesis, Dissertations, Monographs, Course Conclusion Papers, Letter to the editor, Annals of events, articles where only abstracts were available, articles published outside the established time frame for the present study. To systematize the articles selected in the search, an instrument validated by Ursi[7,9] was defined.

The analysis of the selected studies was carried out in a descriptive way, making it possible to observe, count, describe and classify the data, in order to gather the knowledge produced on the theme. The selected productions that were submitted to the Content Analysis technique[10] and grouped into two thematic pillars, which are presented and discussed below.

III.   RESULTS AND DISCUSSION

Table 1: Summary of articles according to author, title, journal, year, and methodological procedure and research findings.

Code	Author. Title. Periodic. Year	Data base	Methodological procedure	Research findings
A1	Pimenta-Martins, Ana; Pinto, Elisabete; Gomes, Ana M.P. Percepção do estado de saúde e da qualidade de vida numa amostra de celíacos	SCIELO	Cross-Sectional Research	Survey conducted with 195 Portuguese individuals, through a structured questionnaire, self-applied and online. The perception of the state of health and quality of life of the sample of celiac patients studied seems to be better than what is seen in the general population. These results are different from what is reported in the literature, with studies that do not find differences in quality of life between CD patients and the general population and others that report that celiac patients have a worse quality of life than the general population. The self-perception of health status and quality of life in the study sample may be underestimated in

	portugueses. GE J Port Gastrenterol. 2014.			relation to what will happen to the average of Portuguese celiac patients. The characteristics of age and education lead to the hypothesis that we are facing a sample of celiac patients who are very proactive in the search for solutions that minimize the limitations imposed by the disease, namely the search for information and new food products, as well as solutions for your preparation. These skills will allow them to live better with the disease, making it less affect their quality of life.
A2	Lins, Manuela Torres Camara et al. Tradução, adaptação transcultural e validação do Celiac Disease DUX (CDDUX). 2015.	SCIELO	Methodological study of translation, cross-cultural adaptation and validation of a questionnaire to assess quality of life	Research carried out with four pediatric gastroenterologists, a professional with experience in validating instruments, three English teachers and 33 celiac patients, between eight and 18 years old, with their guardians. Quality of life scores obtained from patients were compared with those obtained from their guardians. The translation and adaptation adequately followed the proposed steps, with equivalence being achieved satisfactorily. The translated instrument proved to be valid for assessing the quality of life of children and adolescents with CD.
A3	Cieslinski, Juliana Zimerman; Kotze, Lorete Maria da Silva; Utiyama, Shirley Ramos da Rosa. Tratamento da doença celíaca: estado da arte. 2016.	LILACS	Pesquisa de revisão	Review research, which aimed to identify the therapeutic options that present the greatest advances and, therefore, has the potential to be available to celiac patients in the near future. So far, the gluten-free diet remains the only effective therapy available for Celiac Disease, although promising results have been obtained in several experiments. The gluten-free diet allows a complete restoration of the intestinal mucosa in most cases, but its disadvantages such as the high cost of food for this diet, the short shelf life and the lower sensory properties have a great impact on the lives of patients , and continue to have a low resolution perspective. The development of non-toxic wheat varieties remains a major challenge; therefore, the most promising pathway for the treatment of CD is to assist the organism in the degradation of gluten or to awaken the individual's oral tolerance, thus preventing the inflammatory response from developing. Immunogenic studies were able to prove the pathogenic model of Celiac Disease and thus programs for the discovery of new therapies emerged based on this model. However, scientific research is still deficient in several aspects when it comes to CD, such as the lack of pre-clinical models and good non-invasive markers, factors that hinder new discoveries, since clinical studies need to be encouraged and driven by encouraging pre-clinical results.
A4	Brancaglioni, Bianca de Cássia Alvarez et al. Crianças e adolescentes que convivem com diabetes e doença celíaca. Rev Gaúcha Enferm. 2016.	SCIELO	Qualitative, exploratory and descriptive study	Research carried out with 3 children and 2 adolescents, in a diabetes clinic at the Hospital das Clinicas of FMUSP or at the residence of the participants in the city of São Paulo, through semi-structured interviews. The diet appears as the focus of the participants' experience, but with different meanings. Children have difficulty following the diet, while adolescents report that social and emotional aspects are the most affected. It reinforces the importance of the nurse to seek strategies in partnership with children, adolescents and their families in order to minimize the difficulties found mainly in the management of the diet imposed

				by both diseases. The results reinforce the importance of the nurse, when planning the care of the child / adolescent with DM1 and CD, to seek strategies together with the child / adolescent and the family to minimize the stress and suffering caused by the diet and to promote adherence or maintenance of the as well as other therapeutic measures. Various resources can be used by nurses, such as: using social networks and exchanging messages through "WhatsApp" programs in order to establish and strengthen bonds and, above all, to be available for questions related to the management of DM1 and CD.
A5	Rocha, Susy; Gandolfi, Lenora; Santos, Josenaide Engracia dos. Os impactos psicossociais gerados pelo diagnóstico e tratamento da doença celíaca. Rev Esc Enferm USP. 2016.	*Web Of Science*	Qualitative study	Research carried out with 12 newly diagnosed patients with CD, between the years 2013 and 2014, at the Hospital Universitário de Brasília (HUB). The interviewed patients had negative impacts in three categories: psycho-affective, family relationships and social relationships, indicating problems of social readaptation after the start of treatment, and difficulty in maintaining a gluten-free diet. Celiac disease has substantial impacts on the psychological, family and social relationships of diagnosed patients, requiring a biopsychosocial clinical view for better adherence to treatment and the patient's quality of life. From these three points, there were changes in the emotional state of the patients interviewed, conflicts in family relationships and difficulties in social relationships due to the gluten-free diet. On the other hand, the support of family and friends proved to be an important facilitator that had a significant impact on the adaptation of patients to the diagnosis, especially with regard to aspects of relationships and social adaptations, showing that greater knowledge of biopsychosocial factors may contribute to a significant improvement in the overall health and quality of life of celiac patients.
A6	Sevinc, Eylem; Cetin, Fatih Hilmi; Coskunc, Banu Demet. Psychopathology, quality of life, and related factors in children with celiac disease. J Pediatr (Rio J). 2017.	SCIELO	Cross-sectional study	Research carried out with 52 patients previously diagnosed with CD and recruited at the Pediatric Gastroenterology Department at Emel Mehmet Tarman Children's Hospital in Kayseri, Turkey, between January and March 2016. This study showed once again that CD is associated with some symptoms / diagnoses psychiatric disorders and reduced quality of life. The low rate of adherence to the DSG can mean more exposure to gluten and thus more psychiatric symptoms / diagnoses. Another important factor is the psychosocial stress related to CD. Not being able to eat out, the difficulty in finding DSG and the inconvenience in school and social life result in isolation and stigmatization. This can generate low self-esteem and constitute risk factors for psychopathologies.

Eating practices and quality of life of people with Celiac Disease

The dietary restrictions imposed by celiac disease and the care with contamination by products that have gluten in their composition, experienced by celiac people, lead to a new social behavior that ends up modifying the individual's daily life, bringing repercussions not only on their habits as well as their social, economic and quality of life habits as a whole. When changing their diet, the person can go through a process of reconstruction and resignification of their social identity[4].

Celiac disease has substantial impacts on the psychological, family and social relationships of people, requiring a biopsychosocial view of professionals, focusing

on the best therapeutic approach and quality of life. In the study (A5), there were changes in the emotional state of the interviewed patients, conflicts in family relationships and difficulties in social relationships due to the gluten-free diet. On the other hand, the support of family and friends proved to be an important facilitator, which had a significant impact on the adaptation of patients to the diagnosis, especially with regard to aspects of relationships and social adaptations, showing that greater knowledge of biopsychosocial factors can contribute to a significant improvement in the overall health and quality of life of celiac patients[4].

Research carried out with 195 Portuguese individuals (A1), showed that the state of health and quality of life of the sample of celiac patients studied seems to be better than what is verified in the general population. These results are different from what is reported in the literature, with studies that do not find such differences between people diagnosed with CD and the general population and others that report that celiac patients have a worse quality of life than the general population[11].

Regarding these impacts, a survey of 52 patients previously diagnosed with CD recruited at the Pediatric Gastroenterology Department of the Children's Hospital Emel Mehmet Tarman in Kayseri, Turkey, between January and March 2016 (A6), once again demonstrated that CD is associated some psychiatric symptoms / diagnoses and reduced quality of life. The low rate of adherence to a gluten-free diet can mean more exposure to gluten and, thus, more psychiatric symptoms / diagnoses. Another important factor is the psychosocial stress related to CD; not being able to eat out, the difficulty in finding a gluten-free diet and the inconvenience in school and social life, resulting in isolation and stigmatization. This can generate low self-esteem and constitute risk factors for psychopathologies. The statements that indicated low self-esteem in the sentence completion test in this study were: " unfortunately, I am sick ", " I wish I wasn't sick ", " I don't understand why I'm sick " and " I never forget that I'm sick"[12].

It should be noted that in the study sample a (A1), the characteristics of age and education lead to infer that it is a sample of celiac patients who are very proactive in the search for solutions that minimize the limitations imposed by the disease, notably characterized by the demand information and new food products, as well as solutions for their preparation. These skills allow them to live better with the disease, causing it to affect their quality of life to a lesser extent.

The fact that the vast majority of participants reported that, after diagnosis, the social relationship with family, friends, co-workers had not changed; that food had become healthier and even though they were satisfied that they had been diagnosed, even taking into account all the changes they had to make, are reasons that can help explain the results obtained. It is reasonable to consider that the discomfort associated with symptoms prior to diagnosis, which can take years, and the anxiety associated with not knowing the disease, make it possible for people, after diagnosis, to better control the signs and symptoms and to show better quality of life[11].

It is worth mentioning that in a survey conducted with 3 children and 2 adolescents, in a diabetes clinic at the Hospital das Clínicas of FMUSP in the city of São Paulo, through semi-structured interviews (A4), the diet appears as the focus of the participants' experience, however with different meanings. Children have difficulty following the diet, while adolescents report that social and emotional aspects are the most affected. In this context, the importance of nurses, within the multidisciplinary team, is to seek strategies in partnership with children, adolescents and their families in order to minimize the difficulties encountered mainly in managing the diet[13].

Review research (A3), which aimed to identify the therapeutic options that present the greatest advances and, therefore, has the potential to be available to celiac patients in the near future, demonstrated that until now, the gluten-free diet remains the only one effective therapy available for CD, although promising results have been obtained in several experiments. The gluten-free diet allows a complete restoration of the intestinal mucosa in most cases, but its disadvantages such as the high cost of food, the short shelf life and inferior nutritional properties have a great impact on the lives of patients[14].

Importance of the multidisciplinary team in the diagnosis and monitoring of people with Celiac Disease

Monitoring by a multidisciplinary team and periodic assessment of complications and diseases associated with CD, since childhood, regardless of age at the time of diagnosis or the duration of a gluten-free diet, are necessary measures for the life and quality of life of the celiac person which, if properly implemented, produce less financial and social impact. For this to happen, it is necessary to face the weaknesses in terms of guaranteeing the right to health and overcoming inequalities as a political and ethical commitment[15].

The importance of nurses is reinforced in the study (A4), in order to plan care, seek strategies together with

patients and family to minimize the stress and suffering caused by the diet and to promote adherence to the care and treatment plan, as well as other therapeutic measures. In this study, several resources were pointed out, which can be used by nurses, as an aid in the management of care for people with CD, such as: social networks and exchange of messages, through "WhatsApp" type programs, in order to establish and strengthen bonds and, above all, be available for questions; another very effective strategy pointed out in this study were educational workshops using games and games to learn skills and techniques related to the treatment of the disease[12].

In order to guarantee the quality of life of people with CD, systematic monitoring with a multidisciplinary health team, capable of meeting different needs, is necessary. Follow-up should start from suspicion, diagnosis, and remain throughout life, through joint and engaged actions, with competent professionals, whose care must involve eating habits and the control or mitigation of consequences from a biopsychosocial and spiritual perspective. Gluten-free addict is primarily responsible for the negative impact on quality of life, as it is indispensable and can directly interfere in the individual's social structure. In this perspective, support and professional guidance are the path to social reintegration and successful adaptation to the new reality of life[2].

The professional accompaniment of the person with CD aims to make him responsible for his treatment, without frustration or feeling of rejection, thus contributing to alleviate the repercussions on the quality of life and seek the reinsertion of the family and other social bonds in the process, as a way to ensure the least possible damage to everyday life[2].

In this understanding, health professionals should be informed about the symptoms, diagnosis and treatment, the most common problems and the multiple repercussions, regardless of their role in the health care system. The intervention must prioritize health promotion, teaching and learning to the patient and family, followed by confirmation of the diagnosis of CD[15,16,2].

The treatment and acceptance of the gluten-free diet are important to avoid possible more serious manifestations, such as, for example, infertility, osteoporosis, short stature, neuropsychiatric disorders, intestinal lymphoma that are problems associated with the absence of treatment. This usually happens in the classic form of the disease, which requires more attention to the diet, but asymptomatic patients should still be aware of these types of risks. In this context, maintaining discipline and accepting a gluten-free diet requires that the patient be determined and have the

support of the family, since basic and daily food has several gluten-based foods[17].

In the meantime, it is believed to be extremely important that the individual is informed about the clinical manifestations and complications arising from CD, and about what foods are allowed in the diet, following a care plan built jointly with professionals from the interdisciplinary team, trained to assist , being able to instruct people about the foods that may be included and excluded from the diet, in addition to contributing to the preparation of varied recipes and gluten-free preparations, using another nutrient as a substitute. Support from family members is considered an indispensable factor for improving results, contributing to improving the acceptance of the diagnosis. People with CD should be monitored frequently, ensuring the assessment with a focus on good nutritional status, analyzing adherence to eating habits and ensuring that the patient is in good psychosocial adaptation, thus ensuring positive results for health and quality of life[17,18,19,20,21].

IV.   CONCLUSION

The data revealed that so far the gluten-free diet remains the only effective therapy available for CD, although promising results have been obtained in experiments. It is confirmed that the gluten-free diet allows a complete restoration of the intestinal mucosa in most cases, but its disadvantages such as high cost, short shelf life and inferior sensory properties have a great impact on people's lives, remaining with low perspective for changes that meet the needs of people with CD.

Evidence of strategies emerged to facilitate the management of the disease, the use of resources such as the assistance of health professionals. The results reinforce the importance of the multidisciplinary team, when planning care, seeking strategies together with the patient and family to minimize the stress and suffering caused by the diet and to promote adherence to the care plan. The identification of social support is also essential for the multidisciplinary team to be able to support, help to establish and strengthen support. It is essential to continue in the search for knowledge in the perspective that science finds other means of treatment, in addition to the restrictive diet, and the industry adapts to people's needs, promoting inclusive access, reducing the suffering and impacts generated by the disease on quality. of life. This is believed to be a significant factor in reducing frustration and isolation after the diagnosis of the disease.

The construction of the data allowed us to realize that when well oriented, people tend to assume the role of co-

participants in the care process, becoming able to overcome limits, through new possibilities of coping, maintaining healthier social relationships and reframing the pursuing higher levels of quality of life. It is necessary to highlight that the small number of publications can be considered as limitations of the study. Finally, in view of the limited number of studies found, we reinforce the need for new research on the topic, with a larger number of participants, with variable methods and that evaluates the problem from other perspectives, so that understanding about diseases and its impacts on quality of life can be expanded.

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The Digitalization of Manufacturing: A Case Study

Cleiton R. Mendes, Fabio S. Bortoli, Cesar da Costa

IFSP-Federal Institute of Sao Paulo, Dept. of Automation and Control, Sao Paulo, Brazil

Abstract— *The digitalization of manufacturing, also known as Industry 4.0, is the fourth industrial revolution that is being substantiated by connecting cyber-physical systems to databases stored via cloud computing, enabling data acquisition in real time by management programs of the productive system. This research presents a case study of the digitalization of a manufacturing didactic cell located at IFSP-Federal Institute of São Paulo, Brazil. This study has two contributions. The first contribution categorizes the digitalization technologies of manufacturing into two parts: (i) human-machine interface and (ii) connectivity. The human-machine interface included the implementation of a new programmable logic controller that can enable data acquisition through a Supervisory Control and Data Acquisition (SCADA) system. The connectivity enables information storage that is intrinsic to the production process in cloud computing. The manufacturing cell resulted in greater connectivity and a significant improvement in the storage of information in the production process that provided remote access through electronic devices connected to the internet. This research modernized a manufacturing didactic cell that previously followed the ISA-95 model (Industry 3.0) to the technologies and trends of Industry 4.0.*

Keywords— *Connectivity, internet of things, cloud computing, Industry 4.0.*

I. INTRODUCTION

A new industrial revolution, Industry 4.0, is being conceptualized and is changing production automation. This new concept proposes to integrate information and automation technologies, creating an intelligent network of products and services called the internet of things (IoT). The main aspect of these concepts is high connectivity between all hierarchical levels of the automation pyramid (Figure 1). With device updates and new concepts in the industrial automation area, technical standards have been updated and others are being developed to organize and standardize this new industrial scenario [1-4]. Figure 1 shows the automation pyramid according to ISA-95.

Cloud computing has recently been introduced to industrial automation because it presents itself as a virtual infrastructure that allows the use of software systems, platforms and services without the need for a physical server. According to Shahzad et al. [3], some companies have implemented a cloud infrastructure to solve problems such as access to data, the costs of software updates, limited storage, and backup recovery. According to Xu [5], in collaborative environments, the IoT and cloud are identified as main trends in business technology that will reshape current companies. Another important aspect

added to the cloud, is the provision of computing services on demand with high reliability, scalability, and the ability to be in a distributed environment [6].
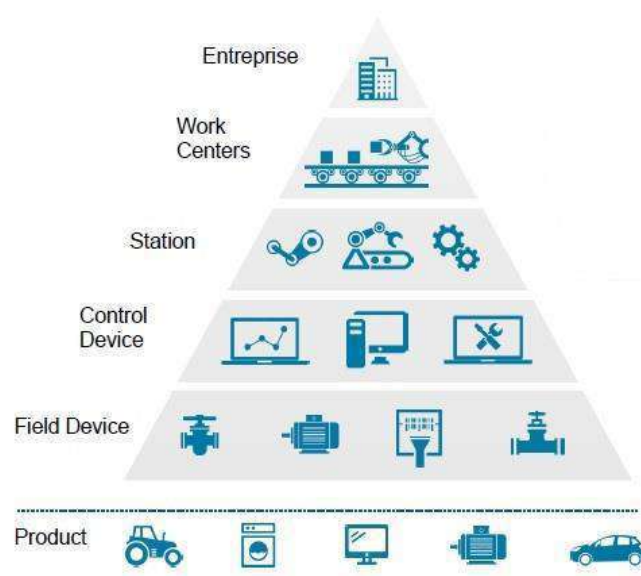
Fig. 1. Automation pyramid according ISA-95 [4].

This research intends to implement the digitalization of a manufacturing didactic cell located at the São Paulo

campus of the Federal Institute of São Paulo (IFSP). The previous manufacturing cell was automated following the ISA-95 model (Industry 3.0), which presents some issues when compared to a manufacturing cell inserted in the context of Industry 4.0. The main problems are the (i) human-machine interface that lacks communication between the Supervisory Control and Data Acquisition (SCADA) supervision system and enterprise system, and the (ii) connectivity which prevents remote access of systems stored in the cloud computing via the internet.

This research occurred over two stages, the first regarding the automation technology and the second with the information technology. From the perspective of the automation technology, a new programmable logic controller, industrial network (Profinet) and a data acquisition SCADA supervision system were implemented. Regarding the information technology, a service was implemented to store some information from the manufacturing cell process in the cloud computing and an IoT application for remote access.

This paper is organized as follows: Section 1 is a general introduction of the topic. Section 2 is a brief description of the ISA-95 reference model, RAMI 4.0 reference model, Industry 4.0, cloud computing, and SCADA system. Section 3 presents the testing procedure, materials and methods, design architecture for programmable logic controller (PLC), SCADA and cloud computing, while Section 4 provides the results and conclusion.

II. THEORETICAL BACKGROUND

A. Reference Model ISA-95

The ANSI/ISA-95 model was developed in the USA and has served for manufacturing companies as a standard reference model (Industry 3.0) and for the organization of production and automation activities, including integration, terminologies and process models. The ISA-95 model does not define how the automation system should be developed, but rather the terminologies, functional requirements and information that must be used to guarantee the transparent and flexible interface between the levels of control and manufacturing management. The ISA-95 reference model is usually represented by a automation pyramid (Figure 1) of the hierarchy levels of automation systems. According to Schweichhart [4], the main characteristics of the model are: (i) hardware-based structure; (ii) functions are bound to hardware; (iii) hierarchy-based communication, and (iv) product is isolate.

The ANSI/ISA-95 standard creates a model for connecting and exchanging data between business systems (Enterprise Resource Planning, ERP) and plant operating systems (Manufacturing Execution System, MES). This connection is called Business to Management (B2M). This standard segments the hierarchical levels of the automation pyramid: Levels 1 and 2 are inherent to the control and automation of the factory floor; Level 3 corresponds to the management of the manufacturing operations; Level 4 is related to business planning and logistics and Level 5 is decision-making systems.

B. Reference Model RAMI 4.0

The traditional ISA-95 standard is oriented to a hierarchical model. The RAMI 4.0 reference model (Industry 4.0) consists of three distinct axes [4]: (i) hierarchy of levels, axis 1; (ii) product life cycle, axis 2; (iii) organizational architecture, axis 3. Figure 2 illustrates the architecture of the RAMI 4.0 reference model for Industry 4.0.
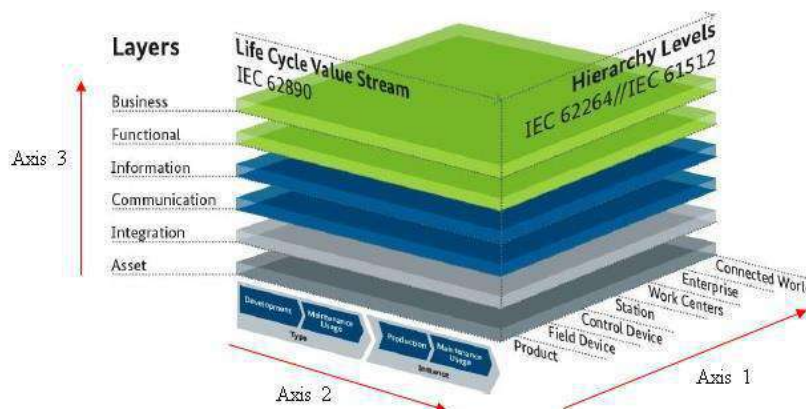
Fig. 2. Architecture of the RAMI 4.0 reference mode l [4].

Axis 1 shows the hierarchical levels of the factory (field device, control device, station, work centers and enterprise). Axis 2 shows the product life cycle (development, construction, computer simulation, prototype, product, and data). Axis 3 shows the organizational architecture and the connection between the physical world and digital world (business, functional, information, communication, integration and asset). One of the differences between the RAMI 4.0 model and ISA-95 model is that all hierarchy levels (Axis 1) can communicate with each other without a defined sequence.

C. Industry 4.0

According to Da Costa *et al.* [6], the impact of Industry 4.0 goes beyond simple digitalization, to a more complex form of innovation based on the combination of multiple technologies that will force companies to rethink how they manage their business and processes, how they position themselves in the value chain, how they think about developing new products and introducing them to the market, thereby adjusting their marketing and distribution actions. The pillars of Industry 4.0 form a set of nine enabling technologies and trends: (i) Autonomous robots; (ii) Digital Twin/Simulation; (iii) Horizontal/Vertical Software Integration; (iv) Industrial IoT; (v) Cyber Security; (vi); Cloud Computing; (vii) Additive Manufacturing; (viii) Augmented Reality, and (ix) Big Data and Analytics, as shown in Figure 3 [7].
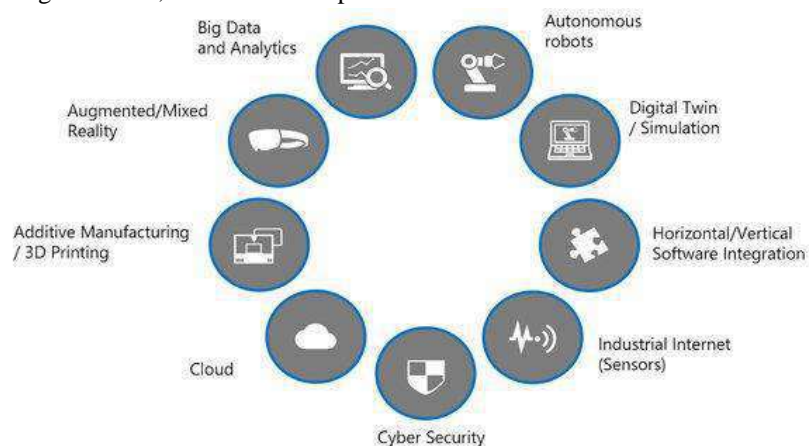
Fig. 3. The 9 Pillars of Industry 4.0 [7].

D. Cloud Computing

Cloud computing consists of storing data on virtual servers. It has the advantage of being able to access data remotely, from anywhere in the world, at any time. Another advantage is that it does not require the installation of large programs on physical hard drives [8]. According to Drath et al. [9], data can be stored and processed in the cloud, such as documents can be allocated and 3D models can be created. With the considerable increase in data flow in cloud computing, complex algorithms need to be developed to organize and make this information intelligent. The analysis of data stored in cloud computing is defined as big data [9]. Through this new scenario, new services can be implemented, connecting physical objects/users to customize services, as shown in Figure 4.

E. SCADA System

The SCADA supervision system is used for automation systems that have a high flow of information and require the use of a database. SCADA is a system made up of specific hardware and software that supervises and controls a production process of an integrated manufacturing cell [10]. In the architecture of the ISA-95 model, the SCADA system is inserted at Level 2 and is responsible for supervising the production system. For communication between the various devices with the SCADA system, the following industrial networks are used: Ethernet TCP/IP, Fieldbus, Profibus, Modbus, Profinet, AS-I, and CAN.
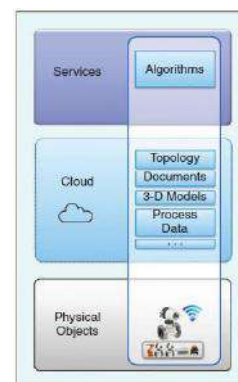
Fig. 4. Cloud computing [4].

Unlike the ISA-95 Standard, with the insertion of Industry 4.0 concepts, SCADA supervisors are integrated with systems stored in cloud computing. For users, the main benefit of this integration is in reducing costs and decreasing configuration time [11]. With the use of cloud computing in industrial areas, SCADA systems do not need to have a physical server, thus being able to virtually store data. The advantage is that several devices from the physical world can be included, generating a service-based

infrastructure [12]. The resources of cloud computing are acquired on demand, at a lower cost of ownership than systems proposed by the ISA-95 model that require hardware with advanced configurations and software with high costs. With the implementation of a service-oriented architecture (SOA), cloud computing can meet industrial requirements, as these services support cooperation, offer agility and operate in a heterogeneous environment, as shown in Figure 5 [13], [14].
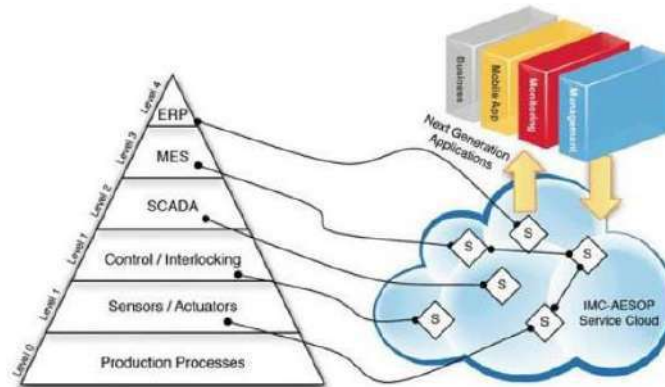
Fig. 5. SCADA based on SOA architecture [13].

III. TESTING PROCEDURE

F. Materials and Methods

This work focuses on the digitalization of a manufacturing didactic cell, located in the Laboratory of

Automation and Control of the Federal Institute of São Paulo (IFSP). Figure 6 shows the manufacturing didactic cell (Model DLB CIM B, manufactured by De Lorenzo).

Fig. 6. Manufacturing didactic cell.

The focus of the digitalization was the application of the SOA and cloud technologies. The SOA-based industrial solution was implemented with the following elements: a PLC, SCADA database, and cloud service integration. These components represent services that can interact with each other. The services increased the functionality and interoperability between the factory floor with systems stored in cloud computing. An architecture for SCADA

and service-oriented MES systems was created. This digitalization supports horizontal and vertical connections, such as communication between enterprise systems, plant-floor devices or controllers. This communication is an important part of Industry 4.0 for horizontal/vertical software integration, industrial IoT, cloud computing and big data. Figure 7 shows the architecture proposed for digitalization of the manufacturing didactic cell.
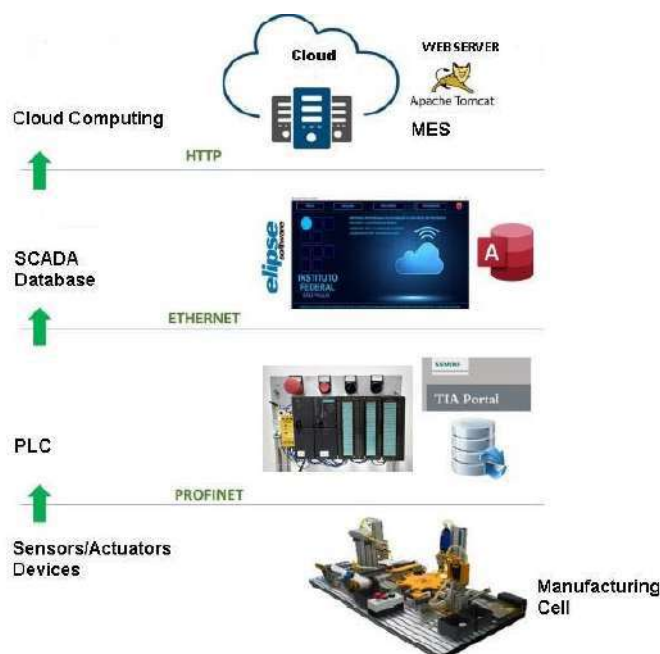
Fig. 7. Architecture proposed for digitalization of the manufacturing didactic cell.

G. Design Architecture for PLC

The architecture was based on the PLC S7-317F 2PN/DP model and on the TIA Portal software (version 15) from Siemens (Fig. 8). PLC programming was performed using Grafcet language, following the IEC 60848 standard. The Grafcet diagram was used as a system modeling tool, helping to define a representation of the manufacturing didactic cell behavior. The PLC includes the control logic and the programming focused on data acquisition, alarms and remote control. Sensors, actuators and field devices communicate with the PLC via the Profinet network. A database was developed on the PLC to store and send data to the SCADA system. In this database, the variables that interact with the SCADA system were created.

Fig. 8. Architecture proposed for PLC.

H. Design Architecture for SCADA

The SCADA system is responsible for the following functions: alarms, control, data management, Human-Machine Interaction (HMI), life cycle management, safety and process monitoring, resource management, scheduling and performance analysis. The architecture for the SCADA supervision system is based on the E3 Studio software (version 5.0.432) from Elipse. The Ethernet network (TCP/IP protocol) was used to communicate between the PLC and SCADA database.

The SCADA system (Fig. 9) acts as an interface between the manufacturing cell (physical system) and the database in cloud computing (virtual system). Another important aspect obtained as a result of the implementation of the SCADA system, was the traceability of the production system. The SCADA database has scalability that inserts a line at each part production event, stating the date and time of production, the operating condition of the cell, which operator was operating the cell and the final result of the production piece.
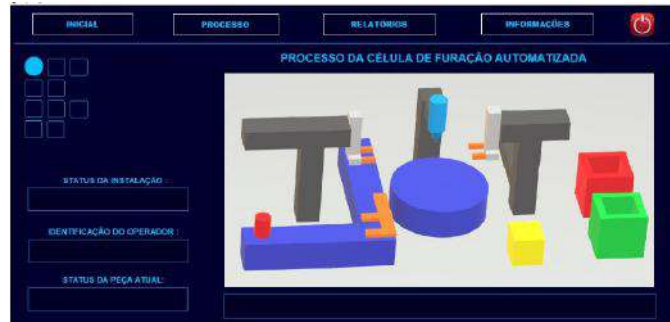
Fig. 9. The front panel of SCADA system.

I. Design Architecture for Cloud Computing

The IoT supports interconnection between the SCADA database and cloud computing. The Cloud hosts the representation of the environment where the services are hosted. The application server used Apache Tomcat software, an open source web server that developed by the Apache software foundation. After configuration in Tomcat, the system was prepared to function as a web server. At http://localhost:9966/manager, parameterizations were made so that the system could be transferred from a local database to a virtual database. This procedure performed the acquisition of the information from the local SCADA database every 18 seconds, updating the database using cloud computing. This cloud is private, the data stored is scalable and the data can be accessed at http://localhost:9966/IFSP.

Services with SCADA, HMI and MES functionality were implemented. With this implementation, some services were made available. For example, a tablet client or cell phone can remotely monitor the performance of the manufacturing cell, accessing a MES client application via cloud computing (Fig.10).
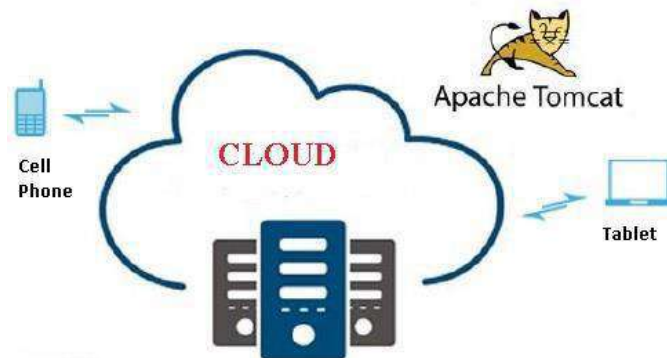
Fig. 10. Remote cloud access.

IV. RESULTS AND CONCLUSIONS

This work proposed an architecture that improves the data accessibility, integration and interoperability in a manufacturing didactic cell. The designed and tested architecture used a private cloud, IoT, and an architecture for PLC, SCADA and cloud computing (MES services). The results obtained on the digitalization of manufacturing a didactic cell satisfactorily demonstrate the beneficial resources of the cloud, such as data availability, alarms, HMI, life cycle management, process monitoring, resource management, scheduling and performance analysis. Therefore, this research allowed a manufacturing didactic cell that previously followed the ISA-95 model (Industry 3.0) to be modernized with technologies and trends of Industry 4.0.

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Capitalization and Financing of Brazilian Agricultural Cooperatives

Régio Marcio Toesca Gimenes

Agribusiness Postgraduate Program, FACE, Federal University of Grande Dourados, Brazil

Abstract— *The new scenario of the world economy presents itself to cooperative societies in the form of a permanent contradiction, that is, to remain a competitive company, capable of facing large multinationals that conquer their markets and, at the same time, meet the needs of its members, not always being able to do it with any result.This contradiction imposes limits on the financing of its expansion process with its own resources (self-financing), especially in developing economies, where the capital factor is generally scarce and expensive, and its need is apparently infinite. There is a consensus that the development of the capital market can supply this shortage of long-term private credit, just look at the international experience, in which this market captures the necessary resources to finance the expansion process of companies, promoting gains in competitiveness. and productivity across the economic system.The potential of the capital market to assume this role depends on the growth of voluntary institutional savings (investment funds, pension funds and open pension funds), as well as the persistent reduction in the interest rate on government bonds that will be possible, if there is a clear government intention to consolidate the long-term fiscal adjustment, reducing the vulnerability of the Brazilian economy to international financial capital.The expectation regarding the strengthening of this market is what justifies the proposal of this research, given the scarcity of credit permeating all the decisions of the agricultural cooperatives, when, from a certain stage of their growth process, a new relationship between own and third party resources, which, in some cases, compromises their financial balance.*

Keywords— *Agricultural cooperatives; Capitalization, Financing, Structure of capital; Rural development.*

I. INTRODUCTION

In order to resist and grow, cooperative or non-cooperative companies need to guarantee good economic performance through differentiating strategies and competent management of their businesses, acting with competitive advantage in international markets.

A new stance in relation to their strategic positioning and organizational architecture are actions that aim to increase the competitiveness of these organizations and are usually accompanied by investments and require additional resources.

The reduction of financial resources offered by the Brazilian Federal Government to rural producers and their cooperatives for the cost, investment and commercialization of their products, is evidence of the depletion of traditional sources of financing for national agribusiness.

In reality, this reduction is the result of transformations that the Brazilian economy underwent due

to its high fiscal deficit, which reduced the investment capacity of the public sector, forcing the government to finance itself in the private sector, and thus redirecting the private savings for the acquisition of public bonds, to the detriment of financing productive activities.To supply the demand for rural credit, agricultural cooperatives began to act as banks, providing resources for rural producers who were unable to capture them in the financial market.

As the cooperatives did not have their own resources to make these loans to producers, they did so using financial institutions, and therefore ended up assuming the credit risk. If at the time of the harvest, in the event of crop frustration, the producer did not honor its obligations to the cooperative, it could face financial difficulties due to the mismatch between the liquidity of its assets and the liabilities assumed on behalf of the cooperative members, which in fact occurred In so many cases.Among the main issues that are currently being debated in thecooperative movement, he most important,

conflictive and controversial movement is that whichrelates to the capitalization of agricultural cooperatives.

This article intends to discuss these issues and, for that, it reviews thetheoretical framework, exposing the thinking of several authors about the elements thatexplain the origins of cooperative thinking, the differences between societiescooperatives and capital firms, their contributions to developmentseconomic and social, and finally, its main challenges, especially thoserelated to the capitalization and financing of its expansion process.

II. ORIGIN OF COOPERATIVE THINKING

Even in competitive societies, there is a minimum of cooperation between individuals and organizations, otherwise it would be impossible to live together. This minimum cooperation does not always mean an intentional practice that can arise from simple attitudes of accommodation to coexistence and can change according to the circumstances or interests of the moment, both of individuals and groups. Such cooperation can happen informally and sporadically or formally, when a group of individuals decides to organize a cooperative society to meet their needs (Ricciardi, 1996).

Cooperativism as it is known today began in the 19th century. The transformations that marked the last century, the emergence of new ideas and philosophies, especially the Industrial Revolution, were the fertile ground for the emergence of cooperativism that is directly associated with workers' initiatives against state and business oppression from the beginning of the last century, by seeking solutions to their socio-economic problems by associations that aimed at mutual assistance (Pinho, 1982).

In England, two of the greatest creators of cooperativism emerged, William King (1786-1865) and Robert Owens (1772-1858), who disseminated in the labor-producing midst a movement encouraging the organization of cooperatives.Thus, in 1820, the League for The Propaganda of Cooperation was born. A few years later, William King, in 1827, organizes in Brighton, England, the first pre-cooperative of consumption. In 1835, a society similar to those found in England emerged in the city of Lyon, France: the Lionesa Association named *Au Commerce Véridique* (Menegário, 2000).

However, only in November 1843, in *Rochdale,Lancashire*district, near Manchester, England, a group of 28 weavers founded a consumer cooperative called *the Rochdale Society of Equitable Pioneers,*whose aim was to find ways to improve their precarious economic

situation by mutual assistance. This act symbolized the beginning of the cooperative movement that spread throughout the world and is characterized by the predominance of the doctrinal approach, since the foundations of cooperative doctrine were based on the principles declared in the statutes of this society. (Menegário, 2000).

With regard to these "principles", Pinho (1966, p. 32) warns that they should not be so named, since they do not represent moral postulates that derive from the rules established by the cooperative custom, but the rules or norms of operation of the cooperative. Its first wording (1844) was somewhat modified in 1845 by the Pioneers themselves and, later, by the members present at the Congresses of the ACI (International Cooperative Alliance) in 1937 (Paris) and in 1966 (Vienna). Its current wording is thus understood: (i) free membership – allows the entry or withdrawal of the cooperative, voluntarily, without coerfraction or discrimination for political, religious, ethnic or social reasons; (ii) democratic management – administration of the cooperative members themselves, each of which is entitled to one vote only, with no relation to their participation in the share capital; (iii) distribution of net leftovers – to pro rata members of operations according to what each one performed with the cooperative;(iv) limited interest rate on share capital – capital is considered only a factor of production; establishment of a technical, social and education fund for members and the general public;(v) inter-cooperative cooperation, at local, national and international level.

At this stage, according to Bastiani (1991), the well-known School of Nimes (1886) appears under the leadership of Charles Gide (1847-1932). Gide was the main systematizer of Rochdale's cooperative thinking. Charles Gide (1847-1932) bears the phrase: "cooperative societies serve to give the working class knowledge and virtues without which it could not occupy the place to which it aspires and to which it is entitled" (Pinho, 1982, p. 35).

Over the course of 100 years, cooperativism has endured time without significant changes in its doctrine. The vigorous growth in the number of cooperatives and cooperatives ended up fostering the creation of an international entity representing the cooperative movement.The origin of this entity is due to a project of Robert Owen (1835), called Association of All Classes of All Nations, whose objective was the constitution of a central cooperative with branches around the world. The idea did not materialize, but resulted in the foundation, in London (1895), of the International Cooperative Alliance (ACI) (Menegário, 2000).

The International Cooperative Alliance is an independent non-governmental organization representing cooperative organizations around the world. It has more than 230 affiliated organizations in more than 100 countries, representing more than 730 million people worldwide. It was the first non-governmental organization to receive advisory body status from the United Nations. The world cooperative has more than 740,000 companies, bringing together about 355 million members and working in various sectors of the economy (OCB, 1997).

III. COOPERATIVISM IN BRAZIL

Cooperativism in Brazil only found a favorable climate after the liberation of slaves (1888) and, concomitantly, the coming of European immigrants who brought in their culture associative doctrinal content.In Brazil, at the time of Gide's speech, a Brazilian representative – Santana Nery – would have participated in the Cooperative Congress then held in France. And in May 1888, The Financial Magazine, from Rio de Janeiro, had drawn attention to cooperatives as a way of reorganizing agricultural production and commercialization, after the crisis aggravated with the liberation of slaves.From the beginning of this century, some idealists began campaigns to disseminate cooperativism, to which were added experiences of immigrant groups, especially Germans, Italians and Japanese (Pinho, 1966).

From 1932 it was verified whether the appearance of a larger number of cooperatives, as a consequence of Decree No. 22.239/32 and campaigns disclosed by the Federal Government. These campaigns were developed by cooperative assistance agencies that were gradually being created, without, however, any of them reaching national coverage.In 1969, in Belo Horizonte, during the IV Brazilian Congress of Cooperativism, the national body representing the Brazilian cooperative movement was created, namely, the Organization of Brazilian Cooperatives (OCB) (Menegário, 2000).

The Organization of Brazilian Cooperatives is a non-profit civil society, is the result of the merger of the National Union of Cooperative Associations (UNASCO) and the Brazilian Alliance of Cooperatives (ABCOOP), entities that represented cooperatives until that date. Legally implemented in 1971, by Law 5,764, the OCB System also acts as a technical – advisory body of the government, bringing together all the Organizations of State Cooperatives (OCEs). Internationally, OCB is affiliated with the Organization of Cooperatives of the Americas (OCA) and the International Cooperative Alliance (ACI) (Menegário, 2000).

The structure of Brazilian cooperativism consists of three modalities:(i) *individual cooperatives*: are those consisting of at least 20 natural persons, being exceptionally allowed the admission of legal entities having as their object the same or related economic activities of individuals, or even those not for profit;(ii) *central cooperatives or cooperative federations:*those consisting of at least three individual cooperatives and may exceptionally admit individual members;(iii) *confederations of cooperatives*: are those consisting of at least three federations of central cooperatives or cooperatives, of the same or different modalities (Ferreira, 1999).

IV. THE CONCEPT OF COOPERATIVE ENTERPRISE

The International Cooperative Alliance (1995) concept the cooperative company as an autonomous association of people who voluntarily unite to meet common economic, social and cultural aspirations and needs through a collectively owned and democratically managed company.Cooperatives are societies that do not aim only at the pursuit of profit. The member, regardless of his or her capital contribution, is entitled to only one vote at the meetings. The leftovers, at the end of each fiscal year, are distributed in the direct reason of their participation in the delivery of production and consumption. These factors make cooperativism an economic-social system that seeks the collective interest of production and distribution (Antonialli, 2000).

It should be stressed, first, that cooperatives are private collective management companies. Its owners and managers are the users themselves, giving this company unique characteristics, both in terms of its operation and its internal regulation. Thus, the partners are not the capitalists, as in other private companies, but, according to the type of cooperative that is concerned, it is the users themselves, who contribute to the raw material, thus called associates.In this organization, the internal logic of operation is not guided by capital, but by the principles of democracy and solidarity. Within this perspective, the performance of these companies should also be evaluated by compliance with doctrinal principles and not only by maximizing corporate profit (Antonialli, 2000).

As Lauschner (1989, p. 11) observes, the cooperative is one:Technical, economic and financial body, under the collective administration that maintains, in the hands of workers, all management and risk and allocates to the work factor and to the global society all the added

value after the interest has been paid (or fixed rate of lease of the capital factor).

Fleury (1983) concept cooperative society as an entity with three basic characteristics:(i) *cooperative ownership*: means that the users of the cooperative are its owners and not those who contribute capital;(ii) *cooperative*management: implies the concentration of decision-making power in the hands of the cooperative members;(iii) *cooperative distribution*: means that the distribution of the cooperative's profit (net leftovers) is made pro *rata* and proportional to the operations of each member in the year.

According to Antonialli (2000, p. 10):these characteristics give it the character of 'associated company' because it includes: the voluntary association of people who constitute a society and a common undertaking by which this society achieves its objectives. Two aspects of this organization arise from the nature of this organization: the first is that individuals associate themselves with the purpose of organizing a joint venture; the second is that it meets the interests and needs of your individual economies.

V. DIFFERENCES BETWEEN COOPERATIVES AND CAPITAL COMPANIES

The cooperative is a different undertaking from the capital companies found in the economy and aimed at profits. This organizational form is based on doctrinal principles derived from utopian socialists and has as its ideas equality, solidarity and freedom.

This doctrinal origin makes these organizations have a differentiated organizational architecture. In this enterprise there is not a private property, but a co-property, private and common, not with the objective of achieving profits, because it is intended to offer conditions, so that each of its associates can establish themselves with greater advantages before an oligopolized market (Bialoskorski Neto, 1994) and Zylbersztajn (1994, 1999).

Pinho (1966) distinguishes cooperatives of capital companies by two basic points: while cooperative companies put people first, aiming at the provision of services, capital companies prioritize the maximization of capital by generating profits.

Irion (1997) states that cooperatives are an option of economic organization that lives together and even maintains business with the business option, since capital companies are sometimes clients; sometimes they are suppliers of the cooperatives themselves.

The cooperative company differs from the capital company by having a different relationship with the factors of production, capital and labor. The vote in a cooperative is proportional to the work – each man a single vote – while in a capital company, the decision is proportional to the number of shares, that is, proportional to the capital of each investor.

Whereas, in the cooperative, the distribution of the result is proportional to the activity of each partner, in a capital company, this result is divided proportionally to the capital invested by each owner.From the point of view of the factor of remunerated production, for example, capital companies and cooperative societies are different. Unlike the former who pay a capital, the latter pay a raw material, a job, a good or a final service.

Unlike the other companies, the cooperative is not structured in order to accumulate capital. The capital is necessary to the cooperative as well as in the other companies, however the first purpose of the cooperative is not capital, that is, the power of the producer associated with a cooperative does not emanate from the amount of capital that this producer has.

With regard also to capital, cooperative societies and capital companies present differences. For the cooperative, the financial supplement consists of bank loans, and members can be called upon to secure these loans. In commercial companies, capital is provided by shareholders/investors.

While members' rights are reduced in a cooperative, in commercial companies, shareholders have absolute rights to capital. In a cooperative, the member's capital cannot be transferred or sold.

In the case of self-financing, there is a difference between cooperative societies and capital firms. Capital companies can either distribute dividends or withhold profit, which, for the shareholder, constitutes, in any case, a gain.

In cooperatives, the retention of leftovers does not necessarily mean a capital gain for the member. AsJoseph Ballé put it, when the *Symposium de Lígia* (1988) put in place, the retention of leftovers is like a deduction on the wealth created by the associates, and it can be compared to a tax on the work of the producer and the cooperative collectivity, for its own development (Rocha, 1999).

Another fundamental point in these debates is that the cooperative is a working company with the objective of generating services to its members. This will only be possible consistently if it grows under some market precepts, according to usual assumptions of maximization

of results, distributing its fruits after the exercise, in order to enable investments with equity and require associated members to also maintain the level of economic efficiency of the market without transferring to the cooperative company its economic inefficiencies.

Thus, the cooperative company has to act according to the economic logic of the market, both for "outside" the organization, as is clear, but also for "within" the organization, in the relationship with its associates, these are directions that can ensure its business efficiency and therefore its social effectiveness (Bialoskorski Neto, Marques and Neves, 1995).

The cooperative will present a clear tendency to overlap its functions of providing services to the associate above the very efficiency of the market business, focusing much more on the short-term benefits for the cooperative members than by the external environment of the consumer market. Such situations are not sustainable in the long term (OCB, 1997).

Pinho (1986, p. 12) also justifying the relevance of the balance between the social and the economic, reports the following:(i) the fact that the cooperative combines the characters of association and company causes many difficulties for its administrators. If they prioritize the associative aspect, they run the risk of encountering problems in the financial management of the company; (ii) if they consider only the business aspect, they can distance themselves from the cooperative members and forget the social purposes of the cooperative. The ideal will, of course, be the balance between both approaches. This balance can be verified by measuring social activity and economic-financial activity.

The cooperative is an association of people, but at the same time it is an economic company. For a long time the laws were very concerned with defining the cooperative according to its associative character, but did not take into account sufficiently this other concept, this other ingredient, which integrates the notion of cooperative, which is its condition of economic enterprise. This is one of the facts that should illuminate the reflection about the legislation of cooperatives in the future (Cracogna, 1997).

VI. COOPERATIVE CONCENTRATION STRATEGIES

Strategies of cooperatives and private companies are not very different. Analyzing the generic strategies described by Porter (1986), leadership in costs and differentiation strategies, it is verified that they are used by agricultural cooperatives, as well as by capital companies.

Zuurbier (1997) analyzing strategies of eighteen milk cooperatives from the European Union and private companies in the same sector, found some significant differences: (i) in both categories of companies, the strategies focused on cost reduction, value addition, geographic expansion and market segmentation. One difference found was in the number of mergers and acquisitions on the one hand and in the number of strategic alliances on the other. Capital companies have carried out more mergers and acquisitions than cooperatives;(ii) the reasons that led to the merger, acquisition and strategic alliances processes were different. Capital companies argued that their motives were derived from the need for expansion and better effectiveness in the distribution of products, while cooperative societies emphasized the arguments of efficiency and economies of scale;(iii) a difference was also detected in the strategic behavior of these organizations in relation to the concentration and establishment of the company in local markets and other markets. Mergers and acquisitions were identified as strategies for local markets, while strategic alliances were preferred in operating in other markets.

The research revealed that the need to add value, cost efficiency and expansion by mergers, acquisitions, or strategic alliances puts enormous pressure on the financial capacity of cooperative companies.

Most agricultural cooperatives seek to guarantee the highest selling price for the product of their members, in the short and long term. This condition creates clear conflicts, as in many cases short-term investments are needed to ensure long-term prices.

The cooperative is obliged to sell all the production of its members, reducing their chances of obtaining higher profit margins and, if it does not process the production received, ends up supplying raw materials with low added value to the industry.

When markets are saturated, cooperatives are forced to opt for low-cost and increased efficiency strategies. As long as capital companies allow, the prospects are good. But from the moment new companies appear in the market with lower costs, cooperatives start to face a big problem.

Conflicts can also occur between member groups that make decisions in the cooperative. Some may wish to explore international markets, and others consider, better or cheaper, the use of local processing raw materials. The resulting is a direct competition between the suppliers of the cooperative and its organization.

Another critical point for cooperatives is the decision to enter markets for products unrelated to their original mission. To ensure the greatest possibility of selling price to their members, cooperatives can strategically diversify their operational activities, provided that the risk to be assumed is evaluated with technical rigor.

In short, Zuurbier (1997) raises at least four critical points of a strategic nature, which pose challenges to the cooperative company: (i) the financial capacity for mergers and acquisitions; (ii) new companies with low-cost strategies; (iii) competitive supply e (iv) risk when diversifying.

Cooperatives have always followed the aggregative trend of capital companies, including having common objectives, such as: eliminating intermediaries from the various stages of production, operating on a larger scale, reducing the cost of labor by mechanizing production, acquiring complementary manufacturing plants, stabilizing the company's activities by diversifying products, conquering new markets or new consumer ranges , reduce administrative costs, advertising and distribution costs of products (Pinho, 1966).

At first, the concentration of cooperatives in Brazil occurred within the scope of intercooperative combinations, that is, limited exclusively by the constitution of central cooperatives and cooperative federations. Only from 1971, mergers and acquisitions began.

Strategically, the forms of concentration smissible by cooperative legislation are as follows: (i) v*ertical concentration*: vertical concentration integrates, in the same unit, the similar or complementary activities of singulars or central. Cooperative legislation allows for three forms of integration: central ones, federations and confederations; (ii) *Horizontal*concentration: horizontal concentration occurs when cooperatives expand their dimensions in the activities to which they were already engaged. The legislation allows for three types of horizontal concentration: mergers, incorporations and dismemberments; (iii) m*ixed concentration*: mixed concentration is the combination of horizontal and vertical concentration of cooperatives. If, for example, a group of single cooperatives found a plant, incorporate another cooperative, merge with other single cooperatives, and join two other plants at least, they will be constituting a confederation; (iv) d*iversification*: it is a strategy that allows to increase the potential of members by more product and market options; (v) a*greements between cooperatives*: are combinations between two or more cooperatives to carry out some activities together (such as in the case of *pool* sales pool or purchasing) or broader sectors (such as in the condominium of industries); (vi) c*oncentration of cooperatives and capital societie:*this type of concentration is only allowed to complement activities, fulfill contracts and supply the idle capacity of the cooperative's facilities.When cooperatives of raw material producers participate in non-cooperative companies to transform their raw materials into finished products, there is an example of this type of concentration e (vii) m*ultinational cooperative complex or hyper cooperatives:*multinational cooperativecomplexes carry out their manufacturing and commercialization operations in more than one country, assuming proportions of hypercooperatives.

VII.   ADVANTAGES OF THE COOPERATIVE COMPANY

Cooperatives constitute a different organizational model of capital companies, and can become an alternative to manage business in the capitalist world, especially with regard to the distribution of income in the field in a more equitable way, since it can promote the aggregation of value to agricultural products and increase the bargaining power of the rural producer in relatively imperfect markets.

According to Michels (2000), in order for a cooperative to be able to offer advantages to members, it is necessary that it be covered with three characteristics: (i) self-help; (ii) self-responsibility e (iii) democratic self-determination.

Since the beginning, cooperativism has been based on the principle of self-help. Although any company, which is not individual, is based on the assumption that the association of people earns individual advantages by synergism of efforts and capabilities, it is in cooperativism that these advantages become more evident. Self-responsibility is the result of the cooperative act, certainly the greatest distinction between a cooperative society and other types of societies. Democratic self-determination in cooperatives is based on the principle that each member represents a vote, regardless of the capital that each member holds in society.

Schneider (1984) states that cooperativism must practice, in an authentic way, cooperative values and principles, mainly raising the material conditions of life by improving the income of its associates.

In some regions of the State of São Paulo, statistical analyses show that, for every 10% increase in the proportion of cooperative members, there is a probable

average increase of 2.5% in the income of rural producers in the region. Where there is the presence of cooperatives, there are also better prices for agricultural products and lower prices in the inputs demanded by rural producers, these differences can be significant and benefit the entire rural community (Bialoskorski Neto, 1998a).

The improvement of the average income of the rural producer is also related to the increase in productivity achieved in agricultural enterprises, assisted by cooperatives. The Agricultural Census of 1985 shows an interesting relationship between the percentage of rural properties linked to cooperatives and land productivity.

In the States with the highest number of establishments linked to cooperatives (Rio Grande do Sul, 49%; Santa Catarina, 42% and Paraná, 38%), also recorded higher levels of land productivity. On the other hand, the States of the Northeast, with the lowest number of properties linked to cooperatives (Ceará, 8% and Rio Grande do Norte, 10%), have low land productivity.

Zuurbier (1997) analyzes the reasons that lead a producer to enter a cooperative, among which he highlights: (i) *market access*: the producer individually has limited opportunities to enter the market. By cooperating, market power increases and market access is made possible; (ii) e*conomies of scale:*by cooperating, the individual producer may have an operating scale that makes it possible to operate at lower costs; (iii) a*ccess to resources*: bycooperating, the producer can have access to information, technology, sources of capital at lower costs, improving the performance of the business; (iv) *risk spraying:* the individual producer can invest alone in technology and new processes. However, by cooperating, the risks of these investments are diluted; (v) i*deological motives*: the individual producer can enter a cooperative for ideological reasons, because of his belief in the fact that solidarity between producers can help everyone and increase the common well-being.

Agricultural cooperatives should especially exploit their advantages related to direct contact with rural producers and consequently their greater capacity to coordinate the supply chain, an aspect that may be interesting for companies more focused on stages of processing and distribution of products to final consumers (Lazzarini and Bialoskorski Neto, 1998).

Second Bastiani (1991, p. 26):Another comparative advantage that the cooperative agroindustry offers is that of higher return for the rural producer. These higher returns are due to the existence of leftovers which are paid (distributed) to the associates, according to their participation in the purchase and sale operations with the

cooperative, in addition to the market price received at the time of sale of agricultural products. The net result of the year belongs to the associates who, at the same time, assume among other roles those of users and suppliers of raw materials (agricultural products) to the cooperative.

The cooperative enterprise is also superior to other forms of organization, when it enables the development of the private company of each member, providing services and offering conditions for the development of these efficient and autonomous work units without prejudice to the necessary freedom of each member.

Finally, there is a clear advantage of cooperatives in the coordinating role of a chain of processes in a constantly changing business environment, as is the case of agro-industrial systems in the agricultural cooperative segment (Bialoskorski Neto, 1997).

VIII.   COOPERATIVE COMPANY PROBLEMS

Agricultural cooperatives, the largest segment of Brazilian cooperatives, have been facing difficulties to adapt to the new business environment. Their survival depends on their competitiveness, and for this, they need to professionalize their management, reduce costs, review their statutes, demand efficiency and loyalty of the cooperative members and, mainly, prevent political interests from interfering in the decision-making process, harming the economic and social performance of society.

The great challenge of cooperatives is to find the balance between the economic, social and political interest of their associates. The economic interest lies in the mutual growth of the shareholders' equity and the cooperative; the social is linked to the services that the associates and their respective families receive from the cooperative, and finally, the politician, which leads to internal disputes for power, as well as to the representativeness of the cooperative and its associates before the community. Managing these interests is a difficult and complicated task, and many cooperatives are losing space to their competitors because they cannot satisfactorily balance these interests (Antonialli, 2000).

Rodrigues (1997) understands that cooperatives with their peculiar characteristics make up the only sector of the economy whose doctrine has its emphasis on the balance between economic and social and has it as its first problem in the face of globalization, because they will have to be efficient and competitive. This will necessarily imply improvement of management, cost reduction, dismissal of employees, dismissal of bad co-workers and

differentiated treatment for associates depending on size, efficiency and reciprocity.

With the pressures imposed in this new environment, either by the market or by the regulatory action of the State, cooperativism was challenged to adapt urgently, before it lost its effective importance as an economic system of production and or provision of services.

In order to survive, the cooperatives had to face the enormous challenge of acting as private companies in the market, besides having to preserve their relations with the cooperative members, who are, at the same time, owners, customers and suppliers (Dornelas, 1998).

Agricultural cooperatives, in order to survive in this new competitive environment, should develop strategies that allow them to be inserted in this context of modernization, analyzing three important aspects: the market, the company and the field (Koslovski,1998).

In the market topic, they should analyze competition in the marketing of inputs and in the marketing of products. To reduce costs they should make full use of installed capacities, establish partnerships in the acquisition of raw materials and increase the scale.

In the company topic, they should review the internal organizational aspects, human, physical and financial resource management, processes and methods of work and their optimization in the search for productivity and total quality; for this, integrations, partnerships and mergers must be carried out.

In the field, the strategies should contemplate the development of the cooperative members, seeing them as decentralized productive units of the cooperative, with management and own capital.

Historically, the 1960s and 1970s have been marked by various federal government incentives for agriculture, with much of these incentives transferred to farmers by cooperatives. As important agents in the conduct of the federal government's agricultural policy, cooperatives not only had broad access to subsidized credit, but also passed on part of the government's credit to their associates.

The transfer of the government's credit lines and the cooperative itself to the members was important to address the lack of resources needed to finance agricultural crops, as well as contributed to increase the participation of members in their cooperatives.

With the reduction of the availability of rural credit by the government, several cooperatives decided to finance their cooperatives with their own resources. This

activity increased the operational risk of cooperatives, because, in periods of crop frustration and consequent drop in the revenue of associates, the default rate increased dramatically.

As the guarantees of the loans of the members in the cooperative did not always have good legal guarantees, the cooperatives had to manage high rates of default in the early 1990s. The lack of liquidity of cooperative credits further increased their indebtedness due to the need to seek third-party capital at high financial costs to try to balance a cash shortfall.

Agricultural cooperatives may have suffered the most from all the changes in the economy, since changes in the economic environment also influenced agricultural policy patterns and competitiveness, directly affecting all agricultural cooperatives. The state's removal from its traditional functions – technical assistance, minimum pricing policy and credit – has led to an increase in the short- and long-term liabilities of cooperatives (Bialoskorski Neto, 1988b).

The professionalization of the management of the cooperative, clearly determining the boundary between ownership and control, is fundamental to the success of the business, but, on the other hand, requires a commitment to safeguard the rights of the member as to the certainty that the cooperative is being administered according to the will of the majority and effectively (Annals of the XI Brazilian Congress of Cooperativism, 1997).

Another point to highlight is the difficulty that cooperatives face in making decisions. Second Rocha (1999):The functioning of cooperative democracy and the participation of associates tend to slow down the decision-making process.This is a difficulty that the cooperative faces and is due to the specificity of the democratic principle that regulates cooperative institutions. In the current economic context, the speed of decisions is an important element, not only of effectiveness, but also of the company's own survival.

The voting principle puts pressure on the decision-making process. The cost, quality and time of the decision-making process exceed the capacity and competence of the cooperative board. The larger the membership, the more it can be said that the need for communication of future visions, strategies, new investment plans, new procedures and new actions is worse or more challenging. An alternative found by large cooperatives was to maintain the decision-making structure at a certain distance from the operational units. The restructuring of traditional cooperatives has been implemented in most of Europe's large milk-producing

cooperatives. The result in all cases is a separation between ownership at the strategic level and administration at the operational level (Zuurbier, 1997).

In this sense, Rocha (1999) believes that cooperatives, in order to meet market conditions, impose on their associates production conditions increasingly distant from cooperative principles. Cooperative solidarity (cohesion between the cooperative and the cooperative) finds limits increasingly difficult to transposed. The complexity of the new cooperative groups that are forming hinders the participation of members, gradually distancing them from activities and strategic decisions. As the pyramid rises, the risk of losing contact with the base also grows.

Jager (1992) pointed out several problems in Brazilian agricultural cooperatives, calling them "four dangers", namely: political interference, the opportunism of the cooperative members, the interference of competitors and paternalism.

Specifically, with regard to the opportunism of the cooperative members, Zylbersztajn (1994, p. 31) explains it as follows:as the cooperative is also a client of the cooperative, there is a strong tendency to define business positions that benefit him, to the detriment of the corporation. Because access to leftovers is less important than the income from the sale of the product, the behavior of the cooperative reflects opportunistic action, a presupposition of the Transaction Cost Savings. The assumption that this assumption ceases to exist is not correct because it is a cooperative company. The impossibility of leaving the business without losses, different from non-cooperative companies, also creates a condition of little attractiveness for the cooperative member to invest in companies within the cooperative structure. Finally, the high negotiation costs, which characterize the decision-making process in cooperatives, generate less competitive situation for this type of corporation. Small and large cooperatives tend to reorganize their structures to address such challenges. Complete separation between ownership and control is demanded by the growing presence of contracted professionals in the market, with experience in managing non-cooperative corporations.

Still on the separation of property and control, Jank (1997) points out that cooperatives have faced many difficulties to manage this conflict, which has frequently led to populist attitudes that result in decisions that please the majority in the short term, but strongly undermine their future competitive insertion in the market.

The cooperative must orient itself to the market, changing the focus of selling everything that the cooperative produces, to produce what the market is really demanding. It is essential, therefore, for the cooperative to know how to identify its *core business* (essential business) and focus exclusively on it.

It is necessary to definitively break with myths and taboos that still prevail in the cooperative environment, presenting cooperatives as welfare entities that must provide social services at any cost, instead of seeking effective economic management.

Meireles (1981) analyzes the problems of cooperativism by the theoretical model proposed by Henri Desroche, which distinguishes four groups of people in the cooperative and their forms of rupture: the cooperative, the managers, the professional managers and the employees.

The ruptures happen metaphorically through centrifugal and centripetal forces that lead each group to divide between cooperative solidarity and other types of external solidarity, defined below:Coalition of leaders against the grassroots;Break between farmers and industries;Isolation of leaders and members of the world;Disruption of the four groups.

In this way, the cooperative members will be able to support the cooperative or the demands of other producers organized in trade unions (solidarity of producers).

Leaders may claim mandates in the maximum representative bodies of cooperativism, or seek local notability (political solidarity). Professional managers will maintain links with their technocratic class and defend the predominant ideology of their training school (technocratic solidarity). Finally, employees, in defense of their interests, will be protected by their unions (union solidarity).

In large part, the rupture processes are due to the lack of information, which has contributed to the low participation of members in the General Assemblies. Cruz Filho (1995) researching the importance of accounting information as a factor to stimulate the participation of the cooperative member in the decision-making process of cooperatives, reached the following conclusions: (i) the participation of the members in the ordinary and extraordinary general meetings presented indexes lower than 10%; (ii) in the most important decisions in which members should be consulted, 50% declare that they should not be consulted; (iii) for the members interviewed, 62% stated that there was no independence and autonomy of the members of the fiscal council; (iv) it is difficult for the supervisory board to develop its functions, since its members do not have adequate techniques and mainly basic knowledge of accounting and administration; (v)

asking the interviewed associates what kind of information they would like to receive from the cooperative, it was found that 31.30% would like to know the value of their capital and how to increase it; (vi) 28.60%, the situation of the cooperative and its balance sheet;26.80% would like to know in advance the price and how to improve milk quality; and 14.30% would like to know what the value of the board's salary is; (vii) it was observed that there is no concern on the part of cooperatives to inform the farmer, when associated, the importance of capital for the cooperative. This aspect is manifested by 75% of the members interviewed, as well as 83% do not have information on how the capital increase takes place, and 88% would like to know how it is processed.

The biggest challenge of cooperatives is to discover the original and pure sense of cooperation to try to overcome the limits and restrictions imposed by the globalized environment, transforming threats into opportunities through an efficient system of managerial information. The ability to anticipate the market will undoubtedly be the main competitive differential of agricultural cooperatives.

It is concluded by borrowing the words of Rodrigues (1997, p. 12):without cooperatives there is no cooperative and without solid cooperative there is no future for the cooperative. It is undoubtedly the great current challenge of cooperativism, reconciling its doctrinal principles (based on solidarity, equality, fraternity and freedom) with the fierce competitive spirit of free competition, in which cooperatives are inserted in their relations with the external environment. The challenge of this balance is far from trivial and, increasingly, will be placed in greater or lesser dimension for all branches of cooperativism.

IX. CAPITALIZATION AND FINANCING OF AGRICULTURAL COOPERATIVES

Lauschner (1984), in a research conducted on the different forms of capitalization of agricultural cooperatives, observed that initially the capitalization occurs through admission of members, by the subscription of share-shares of capital, paid in the same year or over a certain period.

Another form used by the cooperative company is the raising of own resources by the appropriation of the net leftovers earned in the year that were not distributed to the members by decision of the General Assembly.

The author points out that the most efficient way of training own resources in cooperatives is that carried out

by the creation of indivisible funds, supported by the retention of a percentage on the volume of operations of associates.

In agricultural activity, this whole process is more complex, since, in addition to the imperfections in the market, its activity is subject to climatic factors (unpredictable and uncontrollable).In addition to the uncertainties arising from climate factors, cooperatives working in the agricultural sector finance their membership with their scarce own resources.

This decision increases the operational risk of cooperatives, because, in periods when producers' crops are not able to generate a sufficient level of revenue to cover their obligations to the cooperative, the default rate increases sharply.

Delinquency decreases the cooperative's liquidity, increasing its level of indebtedness, in which the need to zero its cash deficit leads the organization to raise funds from third parties in the financial market, usually at a very high cost.

Without equity, the cooperative loses autonomy and independence. In many cases, in Brazil, the members of the board of directors need to grant endorsements to the cooperative's loans, because it does not have its own resources, that is, the equity is insufficient to finance its operational investments (Masy, 1982).

Gava (1972) came to the same conclusion when, analyzing the patrimonial structure of agricultural cooperatives, he concluded that insufficient capital formation (self-financing) is the main obstacle to the economic and social development of cooperatives. Thus, dependence on external resources is a relevant source of financing for its growth.

The capital structure of cooperative companies presents some particularities that are not present in capital firms. The cooperatives are controlled by the members, who own them and receive the benefits generated by the cooperatives according to their use.

For Barton and Gordon (1988), these basic principles indicate differences in the organization and in its ownership and control structure. Property rights in cooperatives are defined equally, that is, by the principle of each man, a single vote, which makes the decision-making process much more costly than in capital firms where this right derives from the proportional participation of capital.

The main consequences of the incomplete division of property and control rights for cooperative societies stand out:In a cooperative the associate is at the same time "agent" and "principal" of the same contractual

relationship. That is, the associate has the possibility to "self-contract" for the next phases of the production process, administrative, or service provision, ultimately determining through participation and management, the prices, costs, and the structure of services that this same associate will enjoy. This situation is due to the non-division between ownership and control in cooperative societies, that is, the same economic "actor" is not only the one who makes the managerial decision but will also exercise later control over the consequences of this same decision, allowing the occurrence of deviations in the company's management process. Since, in principle, contractual relations between actors in the economy are always subject to "opportunism", they will always tend to maximize their individual earnings, even if these short-term gains negatively interfere with the long-term performance of their company. It is also often possible to identify the contractual "opportunistic" behavior in business relations between the associate and his/her cooperative. When the conditions of the cooperative are better than the market the associate trades with the cooperative, but when for some reason this stimulus does not exist, the cooperative soon begins to transact with the competing companies, either buying, selling, or providing services, even if this will occur to the detriment of their cooperative, and ultimately, at their own loss in the medium and long term. A cooperative will only be an efficient company if, among other factors, it is also formed of economic agents, whether producers and / or professionals, efficient and with some level of cooperative education and loyalty to your company (The XI Brazilian Congress of Cooperativism, 1997, p. 73).

Fulton (1995) states that property rights, defined as the right and power to obtain income, consume or dispose of a particular asset in a cooperative, are not separated from the control of the organization, in which associates cannot appropriate residual profit.The author believes that the future of the cooperative organization depends on a new institutional architecture that establishes a different relationship between ownership and control, a greater incentive to efficiency, the monitoring of the actions of agents and principals of the contractual relationship, more stable contractual relationships and, finally, lower costs of coordination, transaction and corporate governance.

In fact, members may have ownership of the share-shares of the capital they paid into the cooperative, only at the time of their departure and with the consent of the cooperative's board of directors. It is observed that there is no possibility of transaction of these papers, due to the fact that each quota entitles to a single vote and the

results are distributed proportionally to the operations and not according to the participation of the capital in the cooperative (Bialoskorski Neto, 1998c).

Another factor discouraging the commercialization of quotas is their remuneration. By doctrinal principles, it will be corrected by a flat rate of 12% per year, if the statutes are determined, not mirroring the growth of the capital invested by the cooperative over the years. This last factor, coupled with non-bankruptcy, can make it difficult to obtain loans in financial institutions.

With regard to non-bankruptcy, it is worth remembering that cooperatives can be extinguished by a process called "dissolution", which can be judicial or extrajudicial and which obeys a series of legal formalities called "liquidation" (Menegário, 2000).

It is noticed that there are still no incentives, so that cooperatives can capitalize, grow and seek a situation of economic efficiency, in which its associate can invest in the business and have guarantees of return on the waste of operations.

Agricultural cooperatives, because they have strong limitations on the contribution of equity, have a tendency to present a capital structure based on the intensive use of third-party capital.In addition to the lack of flexibility in generating or raising own resources, agricultural cooperatives have a structure of high financial risk, due to the existence of specific assets.

A particular asset is specific, when value loss occurs, when it is targeted at alternative uses or users. Agricultural cooperatives have a high level of locational specificity of the assets, because their investments are usually directed to a certain group of regionally defined cooperativemembers.

There are other types of asset specificity, such as physical specificity, when a given quality attribute is required, temporal specificity, when products used as raw material or finished product are perishable, and human and dedicated specificity, when a plant or production process serves only one or one particular group of customers (Williamson, 1988).

The specificity of the assets has an influence on financing decisions, because specific investments require greater participation of sources of resources that ensure greater control and greater power of adaptability to crises and various setbacks that may occur in the market. Own resources have this characteristic, since third-party resource providers are little tolerant of market instability and will therefore demand a certain return according to

pre-established contractual clauses (Bialoskorski Neto and Marques, 1998).

When the agricultural cooperative grows and demands a better performance of this company and its members in the pursuit of survival in a competitive market, the external environment and the decisions of the managers lead the cooperative to a greater specialization of its activities, increasing the transaction costs, which will be embedded in the interest rates charged by bank loans in the financial market.

The theory of the New Institutional Economy through its aspect, the Economy of Transaction Costs, whose greatest contribution was given by Williamson (1985) proposes the opening of the capital of cooperatives as a form of alternative capitalization, which would reduce transaction costs.

The process of demobilization of part of the assets of agricultural cooperatives, as well as the studies to open their capital, can be explained by this new economic theory, which visualizes the cooperative society with high specificity of assets, high transaction costs and high agency costs between its owners and managers.

This is due to the necessary structure of participation by the general meetings and the high costs of financial governance that occur in their capitalization process. All these factors make the adaptation of cooperative societies to the market is slow and costly (Bialoskorski Neto and Marques, 1998).

The theory of agency (Jensen and Meckling, 1976) ends up complementing the theory of the New Institutional Economy, when it explains how the opening of the capital of cooperatives promotes the monitoring of their leaders by the financial market. The financial market is attentive to the decisions of the managers by the neoclassical price mechanism, warning the organization, when its performance is different from what was hired, producing greater economic efficiency in the whole system.

Agricultural cooperatives, because they have assets with strong specificity and difficulties in financing their expansion process with their own resources, are in extreme dependence on bank loans, presenting high transaction and agency costs.

Bialoskorski Neto (1998a, p. 17-35), in a text on governance and perspectives of cooperativism, proposes the following aspects to be considered in the study of the modification of the governance standards of agricultural cooperativism: (i) it is necessary to intensify the separation between ownership and control through the

professionalization of management; (ii) the board of directors shall ensure compliance with the strategic planning and social functions of the cooperative; (iii) the supervisory board shall assume monitoring and guide periodic auditing in the cooperative with the help of experienced professionals; (iv) contractual relations between members and the cooperative should be adjusted in order to enable new standards of fidelity and cooperation; (v) allow transactions and transfer of ownership rights (share), making the right to the leftovers of the cooperative, by the cooperative members, clear and transparent; (vi) modify the institutional environment in order to provide a distinct form of organization of auditing and monitoring of the system itself to ensure the economic efficiency and social effectiveness of cooperatives; (vii) adjust the legislation to allow a new relationship between the productive factors, allowing the opening of capital of the cooperatives.

Even before the issues of financial governance, Brazilian agricultural cooperatives have enormous difficulties in raising funds from third parties due to the failure of several cooperatives.

The insolvency situation signals to the market that the cooperative company is a client with high credit risk and consequently the financial agent will charge the resources a higher interest rate, in addition to demanding a higher level of guarantees and, at the limit, not lending the resources (Zylbersztajn, 1999).

The situation can get even worse, when the cooperative, in addition to seeking the resources for its financing, is often obliged by the principles that constitute it to finance the associate in the acquisition of its products or in the sale of agricultural inputs. As the default in this activity is high, the liquidity situation deteriorates and the image of the organization is compromised before the market.

Although equity is the most interesting for agricultural cooperatives from the point of view of transaction costs, as the organization grows, this resource becomes scarcer, in addition to the pressures arising from financial governance, aggravated by the increase in size, generally increasing inefficiencies and reducing the leftovers generated by operations.

Parliament and Lerman (1993),analyzing the capital structure of agricultural cooperatives, observed that when cooperatives grow, there is a decrease in the proportion of equity in relation to third-party capital and a greater difficulty in the relationship with financial agents to contract new loans.

The relationship between the size of the cooperative and its financial difficulties was also proven by Moller, Feathostone and Barton (1996), when they discovered in empirical research that in small cooperatives, the main difficulty is the low returns of their operating assets and, in large ones, the high level of indebtedness and the high interest rates charged on bank loans.

When analyzing the alternative sources of capitalization and financing for agricultural cooperatives, the cost of each source should also be measured, especially those related to attracting new investors and the loss of tax benefits.

Regarding the calculation of the cost of capital sources of agricultural cooperatives, Gimenes (1999) found that 70.73% do not. Generally the cost of equity is underestimated by managers, which facilitates the approval of investment projects with low rates of return, besides causing an excess of investments.

A feasible alternative for agricultural cooperatives would be to let the market itself determine the cost of its own equity. This would be due to changes in cooperative legislation, allowing the negotiation of share shares and the definition of a policy of distribution of leftovers that would restore the share capital invested. To remunerate the invested capital, the allocation of leftovers to so-called indivisible funds should be avoided, as this decision renders null the cost of equity and stimulates investments in projects whose rate of return are below the weighted average cost of capital, since it is undervalued. These measures contradict the principles of cooperativism, but should be considered when seeking efficiency gains in the whole system (Lazzarini and Bialoskorski, 1998).

It is a challenge for agricultural cooperatives to seek ways to raise their own resources to finance their expansion projects and, if applicable, reduce obstacles to the raising of funds from third parties.

It would greatly contribute to overcoming this challenge by promoting organizational incentives that would allow a more efficient exchange of property rights over waste.

Because they do not have shares traded on the stock exchange and receive pressure from members to distribute the leftovers, agricultural cooperatives depend on the operating generation of cash and resources of third parties to finance their working capital and immobilization needs. However, when the pressure of members is not so great managers prefer to use the internal resources in the funds and reserves.

Share capital, besides being a source of operational resources, is also a measure of interest to members by their cooperatives. The associates, like any investor, compare the marginal rate of return of additional investments in the cooperative with other alternative sources of investments, defining an opportunity cost for their capital (Requejo, 1997).

When the agricultural cooperative does not have a program of restitution of the share capital, the marginal return of the capital invested by the cooperative is low, hindering any attempt to raise additional capital, especially of the new members.

The lack of capital restitution programs has led several U.S. states to include in their legislation maximum periods to repay social capital. The plans for the restitution of the share capital ensure the return of the resources invested by the members who invested in the cooperative and provided capital according to its use in previous years. In the case of Brazil, however, most cooperatives do not have specific plans for the restitution of share capital (Requejo, 1997).

The problem of the restitution of social capital is an obstacle to the growth of cooperatives. When the share capital is repaid in order to remunerate the member, the cooperative has lower cash inflows and this can change its capital structure (Requejo, 1997).

There is no valid justification for a cooperative to retain any form of its result in indivisible funds and reserves. The leftovers must belong to the cooperative members, because they are the owners of the cooperative. Moreover, the argument that the cooperative must retain part of the results in funds and reserves to protect itself against possible liquidity crises is not justified, because one can achieve this same protection by a long-term plan of restitution of the share capital, even because the funds and reserves required by law already offer part of these resources (Fisher ,1989).

Also with regard to the allocation of net leftovers, part of them must capitalize the FATES (Technical and Educational Assistance Fund) and the Legal Reserve, in accordance with the cooperative legislation and recommendation of the ACI - International Cooperative Alliance.

After the allocation of net leftovers to funds and reserves determined by law, the rest of the funds have allocated at a general meeting, which usually decides to capitalize the cooperative, which means appropriating the capital lof the members.

Even though the decision to allocate the net leftovers is voted in the assembly, it is questioned how it is organized. It is common for decisions to be made in advance, and the associate only ratifies the vote, signing a minutes, which he often believes is the best decision for the cooperative. With this, managers have almost unlimited powers to invest internal resources, which, in reality, via social capital account should be returned to the cooperative members (Requejo, 1997).

Another form of capitalization begins to be used by Brazilian agricultural cooperatives. This strategy is used when the main objective is to have access to external capital. The agricultural cooperative opens its capital indirectly, establishing strategic alliances with other non-cooperative companies.

Rodrigues (1997, p. 12)calls the strategy of the *holding*structureas a way for agricultural cooperatives to create capitalist companies, noting that:the cooperative defines what is its business, its specialty, and acts predominantly or exclusively in this area, together with its base. The cooperative does not leave its area of action and acts firmly in services that it knows how to do well. Instead of verticalizing cooperatively, or even complementary to this form of integration, it associates with other cooperatives of the same branch and other specialties to create capitalist competitive companies. These companies, run by professionals, will operate in the market in search of profits and advantages of interest of their proprietary cooperatives, without being a cooperative model. This is the case of the creation of *trading,*banks and insurance companies already in progress, or even the deployment of large singular or central cooperatives together with associated and independent companies. A holding company is created owned by one or more cooperatives.

In the formation of the *holding*structure, the cooperative company may sell part of its assets to pay its capital in the new non-cooperative company. In this structure the cooperative represents its members in the new company, it is it that saves the shares of the capital firm for the associates.

A negotiation of this nature took place in Brazil, when the Central Dairy Cooperative of Paraná (CCLPL), whose best known brand is *"Batavo",*sold 51% of its assets to Parmalat S.A., constituting a new company, BATAVIA S.A., whose focus is the processing and distribution of milk products.The most important thing is that, with the creation of the new company, Parmalat ceases to be a fearsome competitor to CCLPL and becomes an ally in the search for greater market share of milk products.

Brandão (1998, p. 21) reports the following statement by the main leader of the Batavo Agricultural Cooperative on the partnership with Parmalat:The situation has changed a lot due to the opening up of the Brazilian economy and globalization.The competition intensified strongly, and we were affected. The food area needs investments for value-added production. as an industrialized cooperative, we had to quickly leverage our growth, and in a cooperative this is extremely difficult. Even worse, we suffer losses. We then looked for ways to leverage growth, and the best way would be to find a partner, make a strategic alliance. There were about 10 interested companies, and we ended up closing this strategic alliance with Parmalat. Everything was indicating and indicates that the food industry will be in the hands of large companies, basically multinationals. We then seek this partner to seek synergies and the capital needed for investment. *core business'* Parmalat and Batavo's core business is milk. We have a meat activity that Parmalat was interested in, too, unlike the others.

The new company increased Batavo's competition power and facilitated the trading of its liabilities. It also allowed the raising of funds in the financial market by issuing securities, with the prospect of directly opening its capital in the future by issuing shares.Thus, strategic alliances are viable alternatives to recompose the capital structure of agricultural cooperatives, enabling new investments to be made at a lower cost of capital.

Bialoskorski Neto (1998a, p. 181), concludes that:at the level of the processing industry, it is clear the increase in asset specificity due to plants increasingly oriented to an entire agro-industrial system in which the quality, brand and product must have defined characteristics to meet the requirements of consumers, and thus calls for certain processes, technologies, investments, stable contractual relationships, in order to ensure the supply and quality of the product. Thus, financial governance based on a specialization process dependent only on third-party capital becomes unfeasible to sustain long-term growth at competitive costs for the company. This was the reason why Batavo realized that it should open up to the capital market, trying to adapt its cost structure, that is, its financial governance and equate its liabilities. The agency costs associated with the company's structure as a Central Cooperative also show the inability to continue in the same direction and sustain a continuous process of growth. The interests of associates to the detriment of markets, or vice versa are a conflict in the cooperative system.

Strategic alliances are also not always feasible at all, and it is necessary to evaluate what synergies are

necessary for partners and what agricultural cooperatives can offer in this partnership (Lazzarini, 1998).

The capitalization and financing of agricultural cooperatives are basically concentrated in three forms: external financing, internal financing and strategic alliances. External financing, in turn, is due to the subscription and payment of quotas by new members and/or by loans and financing with financial institutions. Loans and financing raised in the financial market may have short- or long-term maturities, thus constituting the onerous liability, which generates financial burdens. On the other hand, internal financing can occur: by the disposal of assets of the permanent asset, by the retention of part of the result of the operations with the associates for the formation of reserves (indivisible funds) and by the retention of net leftovers (self-financing). The third form is strategic alliances, where the cooperative and a capital firm come together, for the formation of a new non-cooperative entity. The results of this new company, when they return to the cooperative, are mandatorily destined to indivisible funds.

One of the topics where there is consensus is the growing need for capital to finance the expansion of agricultural cooperatives towards agro-industrial complexes. This mainly occurs, due to the smaller rural population, which reflects in the smaller number of cooperative members and, on the other hand, in the greater need for investments to add value to basic raw materials (agricultural products), through industrial plants.

This mismatch between the limitation of funding sources and the increase in capital needs, has led to the search for new forms of capitalization for agricultural cooperatives. Currently, it is observed that these capitalization alternatives are concentrated in the opening of its capital.

Following the strategy of agricultural cooperatives in other countries, Brazilian cooperatives could also have the right to open their capital, remunerating the financial risk by interest, obtaining a longer maturity and, certainly, at lower costs than the capital from bank loans.

In the case of smaller cooperatives, the law could allow securities to be traded on the over-the-counter market, safeguarding the benefit of having them valued by the market, thereby improving governance and reducing agency costs. This process could be regulated and supervised by CVM, a body in Brazil responsible for the inspection of public limited companies and that, in the case of agricultural cooperatives, many of their practices could already be used, such as, for example, the publication of its balance sheets, the relative transparency of its management

and the decision-making process taken at the shareholders' meeting. The cooperative bankscould carry out, in this process of going public for agricultural cooperatives, all financial engineering to make the issuance of debt securities viable, monitoring and helping to control economic efficiencycooperatives. To ensure better corporate governance, the issuance of debt securities should be accompanied by the requirement by regulatory bodies, the opinion of independent audits, which would provide greater security for investors (BIALOSKORSKI NETO, 1998b, 1998c, 1998d, 1998f).

Therefore, it is necessary to make the capitalization of agricultural cooperatives viable through the issuance of debt securities, in order to allow an allocation of costs and risks between this and its potential investors, in order to minimize its cost of capital and extend the profile of its indebtedness. This alternative is based on the advantages that fundraising through debt securities has over other financing modalities. The main advantage is that the issue can be tailored to meet the needs of the cooperatives, allowing greater flexibility in terms of terms, guarantees and payment terms of the contracted debt.

Despite the advantages linked to flexibility, the cooperative should only raise funds through issuance, if the return provided by the use of these resources is higher than its issuance cost, otherwise, the operation would be damaging its members. Debt securities have a lower cost of borrowing than short-term bank loans, thus, covering their financial charges by operating results, would result in a lower level of risk for cooperatives.

From the analysis carried out, it was found that the direct opening of capital by the issuance of debentures cannot be carried out by any agricultural cooperative. It is necessary that preliminary studies identify their economic-financial balance, their ability to create economic value and the transparency of their management (cooperative corporate governance).

Good governance should also be guaranteed by the creation of monitoring structures, such as an independent audit system, which guarantees the rights of associates and investors, enabling the construction of a serious image of cooperative management with its main stakeholders.

Another important prerequisite is the definitive separation between ownership and control of the cooperative by the professionalization of managers, ensuring that associates and investors strictly comply with a strategic business plan, the objectives of which must be effectively achieved.

X. CONCLUSIONS

The new scenario of the world economy presents itself to cooperative societies in the form of a permanent contradiction, that is, to remain a competitive company, capable of facing large multinationals that conquer their markets and, at the same time, meet the needs of its members, not always being able to do it with any result.

This contradiction imposes limits on the financing of its expansion process with its own resources (self-financing), especially in developing economies, where the capital factor is generally scarce and expensive, and its need is apparently infinite. There is a consensus that the development of the capital market can supply this shortage of long-term private credit, just look at the international experience, in which this market captures the necessary resources to finance the expansion process of companies, promoting gains in competitiveness. and productivity across the economic system.

The potential of the capital market to assume this role depends on the growth of voluntary institutional savings (investment funds, pension funds and open pension funds), as well as the persistent reduction in the interest rate on government bonds that will be possible, if there is a clear government intention to consolidate the long-term fiscal adjustment, reducing the vulnerability of the Brazilian economy to international financial capital.

The expectation regarding the strengthening of this market is what justifies the proposal of this research, given the scarcity of credit permeating all the decisions of the agricultural cooperatives, when, from a certain stage of their growth process, a new relationship between own and third party resources, which, in some cases, compromises their financial balance.

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Development Trend of Wind Power Technology

John Yan[1], Gang Li[2], Kan Liu[3]

[1]Talos Industry Crop., Marlborough, USA
[2,3]Department of Mechanical Engineering, University of Maryland Baltimore County, USA

Abstract— This paper describes the main types of the state-of-the-art wind energy harvesting technologies and their commercial prospects, and presents shortcomings of Betz's limit and misleading of the blade element-momentum theory for aerodynamic design and computational fluid dynamic simulation of vertical-axis wind turbines. A new aerodynamic design method for vertical-axis wind turbines is presented. A modular, combined, and low-cost wind turbine solution ("super turbine") is developed based on the new aerodynamic design method. By comparing of levelized costs of energy of the super turbine and other wind energy harvesting technologies, the development direction of the new wind energy harvesting technology is explained.

Keywords— Betz's limit, blade element-momentum theory, wind power, attack angle regulation.

I. INTRODUCTION

The year 2019 is the 100th anniversary of Betz's law. Till this year, wind energy harvesting technologies have been developing for nearly one hundred years. Traditional horizontal-axis wind turbines (HAWTs) have been considered as the mainstream wind energy harvesting technology, which have similar design ideas and configurations. Thus, those HAWTs have resemblances in aerodynamic performances. Since blades of a HAWT rotate in a two-dimensional (2D) plane, each blade has the same aerodynamic performance when the blade rotates to different azimuths. If the HAWT is well designed, the power generation efficiency of the tip region of the blade can reach the maximum value of 59.3% based on Betz's law [1] or computational fluid dynamic (CFD) simulation. Besides the traditional HAWT technology, various vertical-axis wind turbines (VAWTs) have been developed in the last decade. Different types of VAWTs have been designed based on different configurations of blades, including lift-driven based, drag-driven based, and lift- and drag-driven hybrid based blades [2,3]. Due to the misleading of traditional HAWT design and the tip speed ratio (TSR) in the blade element-momentum (BEM) theory [4,5] for VAWT applications, only a few of VAWTs can achieve high wind energy harvesting efficiency and over-speed regulation protection. Some VAWTs cannot harvest enough wind energy under low wind speed conditions and may disintegrate under high wind speed conditions.

Some other wind energy harvesting technologies, such as airborne turbines, wind tunnel turbines, and vortex bladeless turbines, have also been developed. The key challenge of airborne turbine technologies [6] is power transmission, which transmits power (electricity or mechanical power) from a wind turbine at a high altitude to the ground. The levelized cost of energy (LCOE) of airborne turbines will be increased due to their high operations and maintenance (O&M) costs. Therefore, the airborne turbine technologies are difficult to be commercialized now or in the future. Wind tunnel turbines are developed by using a wind tunnel with nozzle design. The basic design concept of a wind tunnel turbine is that the wind tunnel can increased wind speeds and a turbine can increase its harvesting efficiency [7]. However, since the air pressure in the wind tunnel is much higher than that of outside, the airflow is difficult to enter the wind tunnel. Hence, the wind speed at the entrance of the wind tunnel is much lower than the far-field wind speed. The actual generated power and power coefficient of the wind tunnel turbine is much lower than its theoretical design value. Vortex bladeless turbines are developed to harvest wind energy based on vortex effects and rod resonance [8]. Since the energy density of vortex bladeless turbines is very low under non-resonant conditions, the key of the vortex bladeless turbine technology is to make the rod resonate with vortex effects. However, swing frequencies of the rod depend on the wind frequency, and it is difficult for rods to resonate under most natural wind conditions. Hence, the vortex bladeless turbine technology is also difficult to be commercialized.

There is a new research and develop trend to study lift-driven VAWTs since 2015. New lift-driven VAWTs are

developed based on an active real-time attack angle regulation technology [9]. Therefore, no matter what technology is developed for wind energy harvesting, the key point is to reduce the LCOE. Only wind energy harvesting technologies with lower LCOE can dominate the wind power market in the future.

II. MAIN FEATURES OF HAWTS

The traditional HAWT technology has been developed to a proven level. However, except for the larger and larger output power, there is no innovative idea in this area. Currently, all manufacturing companies of HAWTs do not provide the trajectory of wind speeds and the output power and design parameters of their HAWT products, such as the diameter of the HAWT, the rated wind speed, and the rated power. The reason is that wind power is the cubic function of the wind speed, and in reality, wind speed is the average wind speed. The energy density of the average wind speed is much higher than the constant wind speed [10]. Under limited conditions, the wind energy of the average wind speed can be quadruple as a constant wind speed. For instance, at normal atmospheric pressure, the wind energy with a constant speed of 5 m/s for 2 hours per square meter is about 153.125 W·h. If the wind speed in one hour is 10 m/s and in another hour is 0, the average wind speed is still 5 m/s, but the energy for these two hours is about 612.5 W·h, which is about quadruple as the constant wind speed. Therefore, the energy is about the frequency of the wind. Based on the experiment, the ratio between the energy of average wind speed and the constant wind speed is about 1.5 to 2.0. That is the most important reason that wind speed and power trajectory cannot represent the aerodynamic performance of wind turbines.

Another reason is that the TSR of the HAWT will exceed the optimal value in the BEM theory that is 5 to 6 with the larger and larger output power of a single HAWT. The TSR of a HAWT product of a Chinese company is close to 10, which is almost doubled the TSR in the BEM theory. Additionally, the customer can calculate aerodynamic performances of HAWTs based on design parameters provided by manufacturing companies, e.g., the power generation efficiency, and compare these aerodynamic performances with actual aerodynamic performances.

The aerodynamic efficiency of a wind turbine is relative to the length of blades. The aerodynamic efficiency of the HAWT can reach the maximum value of 50% at the tip part of a blade when the blade is well designed. However, power generation efficiencies of different positions of the blade get lower with closing to the root part of a blade. The power generation efficiency of the root part of the blade is almost zero. Considering low efficiency of mechanism and electricity and wind power loss, the power generation efficiency of HAWTs is hardly higher than 25% [11]. The LCOE of the HAWT mainly depends on two aspects, i.e., the cost of facilities of a wind turbine and the power generation efficiency. Once those two aspects are determined, the LCOE of the HAWT only varies with wind conditions of a wind farm. Wind turbines are mechanical products, and their costs cannot drop quickly as electronic products.

III. TRADITIONAL VAWTS

Blades of traditional lift-driven VAWTs are fixed. Attack angles of blades can be only changed by centrifugal forces of blades when the wind speed is higher than cut-off speeds of traditional lift-driven VAWTs, as shown in Fig. 1. Attack angle changes of blades of traditional VAWTs cannot improve their aerodynamic efficiency, but protect VAWTs by reducing their aerodynamic efficiency when the wind speed is higher than cut-off speeds of VAWTs. Since attack angle control of blades of traditional VAWTs is achieved by using elastic components, diameters of traditional VAWTs are small, as shown in Fig. 2. Generally, traditional VAWTs can be only designed for small-scaled wind turbines, whose rated power is lower than 10 kW.
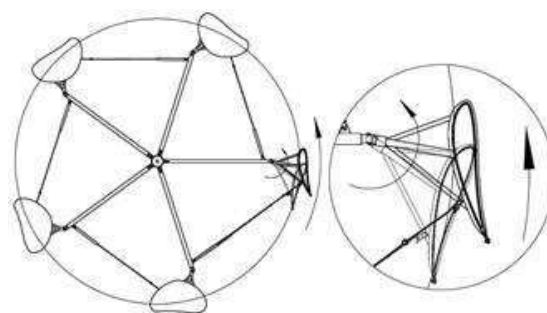
Fig. 1: Structural diagram of a VAWT using centrifugal forces for over-speeding protection

There are five steps in design procedures of these lift-driven VAWTs. (1) Blade selection. The blade airfoil must select an asymmetrical low-speed airfoil instead of the symmetric airfoil, such as NACA0012, NACA0015, and NACA0018 [12]. (2) Concave direction. The concave side of the centerline of a blade is outward instead of the convex side. (3) Attack angle design. The attack angle of the blade should be design within 4 to 8 deg. (4) Design of the ratio of the blade width to the diameter of the lift-driven VAWT. The optimal ratio of the blade width to the

diameter of the lift-driven VAWT should be 0.16 to 0.165. This ratio is not the solidity of HAWTs. The optimal TSR of blades of a VAWT with a fixed attack angle is between 1.4~1.5 [13] not 4.0~6.0, which is designed based on Darrieus VAWT theory. It is this misleading conclusion that makes shapes of lift-type VAWTs varied. (5) Number of the blades. Based on experimental results, VAWTs with five blades perform the best harvesting efficiency of wind energy.

Fig. 2: A VAWT with relatively fixed blade angles

Many researchers work on CFD simulation of VAWTs with a fixed attack angle. However, since turbulence of VAWTs is complicated, there are differences between CFD simulation results and actual aerodynamic performances of VAWTs [14]. CFD simulation of VAWTs should be improved based on further understanding of the aerodynamic characteristics of blades at different positions and the turbulent characteristics of VAWTs.

In order to simulate aerodynamic performances of VAWTs by current CFD software, a static CFD method is developed. Detailed processes of the static CFD method are described below. 1) Determining design parameters of the VAWT, including the airfoil, the blade chord, the blade length, the diameter of the VAWT, blade installation orientation, and installation angles of blades. 2) Predesigning the rotation speed of the VAWT for different wind speeds to calculate the combination speed of the rotation speed of the VAWT and the wind speed at different positions (or azimuth angles). 3) Simulating the lift-driven torque of the blade at the position (or azimuth angle) with the combination speed. In order to accurately calculate a total lift-driven torque of the blade for one revolution, one can simulate the lift-driven torque of the blade for each degree (or every 5 or 10 deg) and calculate the average value of lift-driven torques of the blade at different positions.

IV. ACTIVE REAL-TIME ATTACK ANGLE REGULATION TECHNOLOGY

For a VAWT with fixed blades, the attack angle of each blade continuously changes with the change of blade position due to the rotation of the VAWT. The magnitude and the direction of its torque of each blade also change with the change of its attack angle. At some positions, the toque of the blade is negative. Since the final output torque of the VAWT is the sum of torques of all blades, the aerodynamic efficiency of the VAWT is not very high

The wind energy harvesting efficiency of a VAWT can be improved by controlling attack angles of its blades based on the position of blade, the rotation speed of VAWTs, the wind direction, the wind speed, and power of the VAWT, as shown in Fig. 3. Additionally, the output power of the VAWT can be adjusted to be constant when the rotation speed of the VAWT is variable or over-speeding.

An active real-time attack angle regulation technology of VAWTs is developed to maximize wind energy harvesting efficiency by adjusting the attack angle of each blade. The control motion of attack angles of blades can be achieved by using rotating shaft supporting mechanism and servo motors. The active real-time attack angle regulation technology is different from the pitch control technology of HAWTs since the attack angle a blade of the VAWT is a vector quantity, but the blade pitch of a HAWT is a scalar quantity.
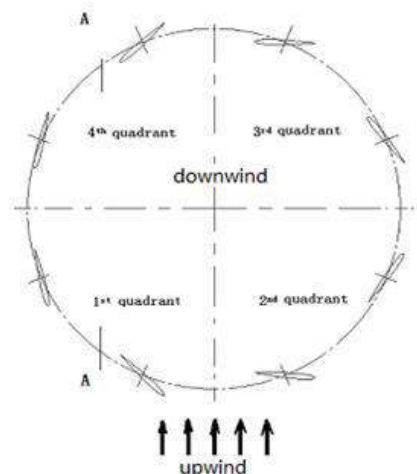
Fig. 3: Attack angles of a blade of the VAWT at different quadrants

A wind energy harvesting test of a VAWT with the active real-time attack angle regulation technology was conducted in a wind tunnel, as shown in Fig. 4. The blade length the diameter of the VAWT is 1 m and 1.36 m,

respectively. The load of the VAWT is generated by a magnetic brake. The cross-sectional area of the wind tunnel is 10 m^2. When the wind speed was 2 m/s, the rotation speed of the VAWT was 44 rpm and the output torque of the VAWT was a constant value of 1 Nm. Test results showed the power generation efficiency of the VAWT with the active real-time attack angle regulation technology was about 68% (ignore the blockage ratio), which was higher than Betz limit. Betz limit is used for designing blades of HAWTs that rotate in a 2D single-disk plane. Since blades of the VAWT with controllable attack angles can harvest wind energy from the upwind and the downwind, the VAWT with the active real-time attack angle regulation technology actually harvests wind energy in a three-dimensional multi-disks space [12]. When the VAWT in the upwind and downwind directions are unfolded separately, it is equivalent to a HAWT in a plurality of 2D plane, as shown in Fig. 5.

The power generation efficiency of VAWTs with the active real-time attack angle regulation technology can be significantly improved by adjusting attack angle of blades. Even if the VAWT adopts the active real-time attack angle regulation technology, the power generation efficiency of VAWTs can greatly changes with changes of the attack angle setting at different positions.

Fig. 4: Wind tunnel test of a VAWT with active real-time attack angle regulation technology

The TSR of the VAWT in this wind energy harvesting test was 1.6, which is much lower than the TSR designed by the BEM theory, where the optimal value of the TSR is 5~6 and the minimum value of the TSR is 3, as shown in Fig. 6. The TSR of the VAWT in this wind energy harvesting test was also much lower than the TSR of a HAWT. Therefore, the optimal TSR in the BEM theory is incorrect and cannot be used for VAWT design. This is the reason why there are so many configurations of VAWTs nowadays.
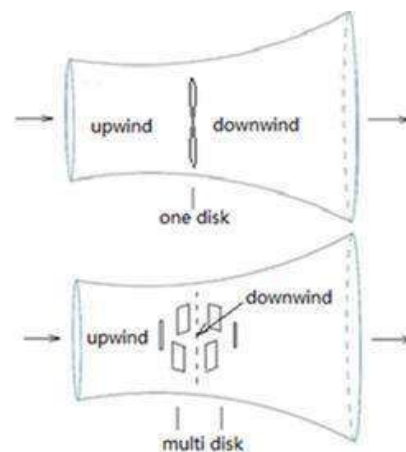
Fig. 5: Schematic diagram wind energy harvesting tests for single-disk and multi-disk
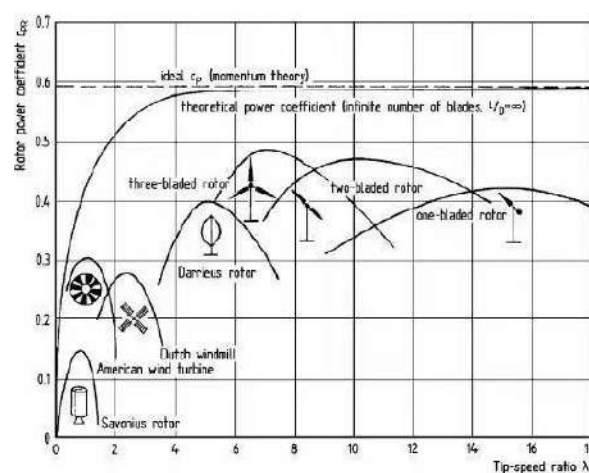
Fig. 6: TSRs of different wind turbines based on BEM theory

V. VAWTS WITH ACTIVE REAL-TIME ATTACK ANGLE REGULATION

Active real-time attack angle regulation of VAWTs can make each blade has the optimal angle of attack at any position, and maximize wind energy harvesting efficiency of VAWTs. When the wind in the upwind direction passes through the first half of the VAWT and reaches the inside of the VAWT, it becomes the downwind direction similar to the HAWT and the wind speed decreases. Hence, the power generated by the blades in the second half of the VAWT is much lower than the work done by the blades in the first half of the VAWT. Magnitudes of the power generated by blades at different positions are also different. The moment generated by the blade in the first quadrant is much larger than the moment generated by the blade in the fourth quadrant. Similarly, the moment generated by the

blade in the second quadrant is also much larger than the moment generated by the blade in the third quadrant.

Wind energy can be represented by a function of the cube of the wind speed. If the wind speed in the downwind direction inside the VAWT can be recovered to the upwind speed, the wind energy utilization rate of the VAWT can be higher than 68%. Due to aerodynamic characteristics of the wind, the wind speed will gradually recover to the original wind speed under the action of subsequent wind when the wind passes through an object. If the diameter of the wind turbine is infinite and the blade height is sufficiently low, the wind will gradually recover to the original wind speed after passing through blades in the upwind direction. Hence, blades in the downwind direction can be affected by the same wind as the blades in the upwind direction, as shown in Fig. 5.

In order to achieve the wind speed recovery in the downwind direction of the VAWT, the VAWT should be designed based on the ratio of the diameter of the wind turbine and the blade length that is set to more than 10. In most of the third and fourth quadrants, the wind speed will be recovered. The wind energy harvesting efficiency of VAWTs can be greatly improved, which is higher than 68%.

The costly components in the VAWT system are the generator, the wind turbine support structure, and turbine blades. If lower costs of these three components and higher wind energy harvesting efficiency can be achieved, the LCOE of wind turbines can be greatly reduced. This is the basic design concept of a super turbine [15].

VI.   SUPER TURBINE DESIGN

A super turbine is composed of a series of π-shaped steel structures with the same specification to form an annular support system. Dozens or hundreds of sets of blades, which are similar to sails, are fixed on movable trolleys. The trolleys move on a circular track. The attack angle of each blade can be adjusted by active real-time control. Each blade connects to its two neighboring blades through two steel cables and a chain. A plurality of small high-speed generators, which are fixed on the circular track, are driven by a chain-pinion system to generate electricity. Multiple currents are collected through a combiner box and supplied to a medium-sized power inverter for grid-connected power generation. Super turbines are completely different from existing wind turbine technologies. Regardless of turbine blades, transmission systems, generators, the support structure, and grid-connected systems are different from traditional wind turbines.

VII.   STRUCTURE OF THE SUPER TURBINE

According to wind conditions of the wind farm, the site environment, and customer needs, the power generation capacity of the super turbine can be scaled from 7 MW to 50 MW. If the track of the super turbine is designed to be oval, the long axis direction is taken as the windward direction. The steel structure used for each span of the track is in the same size. The size of the super turbine can only change with changes of the number of spans of the track.

The super turbine includes six major subsystems, which are the steel structure support and track system, the turbine blade positioning system, trolleys, the hydraulic and transmission system, the active real-time control system, the grid connection system, and the monitoring system.

7.1 Steel structure support structure and towers

The tower and the steel structure are composed of standard 70 H-shaped steel. The height of each tower is 20 m. The distance between two neighbouring towers is 20 m. The beams form a π-shaped network support structure, as shown in Fig. 7.

7.2 Circular track

The existing standard No. 15 light rail is used to build the track of the super turbine. Three sets of tracks are set on H-type beams at different positions. Each trolley has six customized wheels, but only four wheels can contact the track at the same time. It can ensure the stable operation of the trolley and reduce the frictional resistance of the trolley.

Fig. 7: Towers and supporting structures of the super turbine

7.3 Turbine blades

Turbine blades are manufactured by FRP pultrusion process. The height of each turbine blade is 11.5 m, and the width of each turbine blade is 2.6 m. It is divided into upper and lower blades, and the weight of each turbine blade is 350 kg. The upper blade and the lower blade are coaxially designed. The central axis of the blade passes

through the center position of the trolley and is rigidly connected to the shaft of the hydraulic rotary motor, so that the angle of the upper blade and the lower blade can be synchronized to change, and sufficient rotation torque can be obtained.

7.4 Turbine blade positioning system

In arc segments of the track, a mechanical and optoelectronic positioning device is arranged every 10 rad, and each trolley is coded (001, 002, 003 ...). When differently coded trolleys pass different positioning devices, locations of different blades are obtained by the positioning device, as shown in Fig. 8.

Under 5G communication conditions, inch-level GPS can also be used to independently position each blade. The advantage of using GPS to locate the blade is that the control system is simpler, but it depends on GPS signals and 5G network. Once the signal is interrupted for a short time, there will be a serious of impacts on the super turbine.
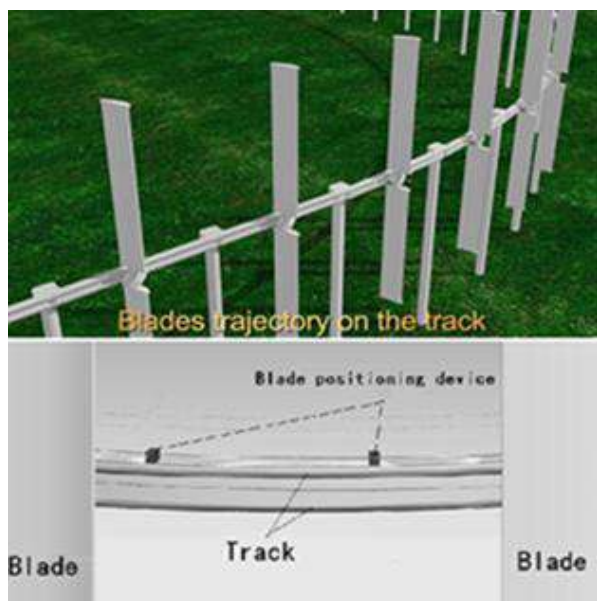
Fig. 8: Turbine blade positioning system of the super turbine

7.5 Trolleys

The body of the trolley is made of cast steel. The cantilever of the trolley is made of forged parts. The rotary shaft of the hydraulic motor in the trolley and shafts of upper and lower blades are rigidly fixed, as shown in Fig. 9. Since the diameter of the super turbine is 255 m, the maximum speed of the trolley on the track cannot exceed 21 m/s, which is equivalent to the rotation speed of 1.6 rpm of the trolley on the track. Since the rotation speed of the blade is very low, rated rotation speed and torque of current motors can satisfy the requirements. When the

typhoon is coming, attack angles of blades can be adjusted to minimize the load on the super turbine. At the same time, the trolleys on the track are stopped by brakes.

Fig. 9: Trolley and the track structure of the super turbine

7.6 Generators

Generators that are conventional standard permanent magnet generators with a rated speed of 1500 rpm and the rated power of 100 kW (or 50 kW) are used to maintain low cost and easy replacement. Generators are fixed on the track and vertically installed (or parallel) to the track, which are driven by a chain pinion system at the end of generators and trolleys, as shown in Fig. 10.

7.7 Steel cables and chains

There are two steel cables at upper and lower ends of trolleys, which connect two adjacent trolleys. The steel cables is used to tow the trolleys, and two adjacent trolleys are connected to each other by a chain. The back of each trolley is made into a gear type, so that the chain can be made into segments, and the length of each chain is the trolley spacing. If the track with the diameter of 255 m allows the chain to be bent, generators can be horizontally placed (parallel to the horizontal line) to facilitate maintenance.
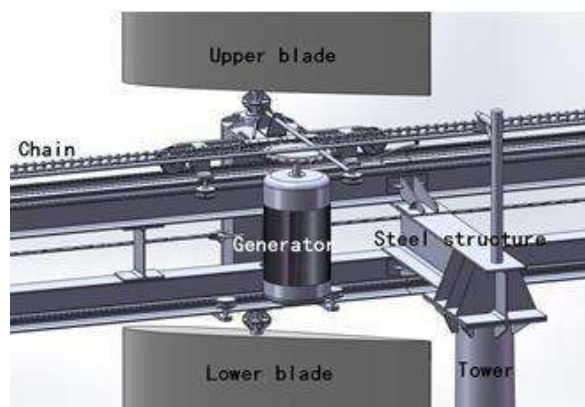
Fig. 10: Generators, the chain, and the supporting structure of the super turbine

7.8 Central Control Unit

The central control unit is composed of multiple sets of motion controllers or PLCs. One motion controller controls the movement of a trolley. The advantage is that any group of motion controllers or trolleys does not affect the function of other trolleys, which can ensure the whole super turbine system continuously working. The disadvantage of this control solution is the cost of the central control unit is relatively high. Another control solution is to use a motion controller to control the trolley with the number 001, and the trolley with the number 002,003, ... follows the movement of the trolleys with the number 001. The advantage of the control solution is that the cost is low, and the shortage is that if the motion controller fails or the trolley numbered 001 fails, the entire system will stop running.

The second design scheme but use two motion controllers, and the second motion controller is used as a backup controller. Which scheme is adopted will be determined through comprehensive evaluation after specific design and trial operation on a computer.

7.9 Collection and grid connection

As 50-kW or 100-kW grid-connected power inverters are already popular products, their costs are lower. The AC permanent magnet generators are connected to one or two grid-connected power inverters and then connected to the grid after AC-DC conversion, as shown in Fig. 11.
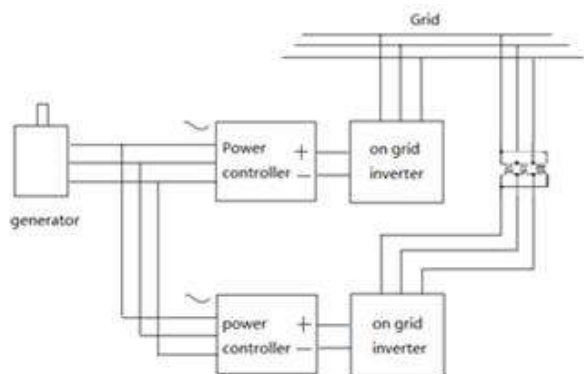
Fig. 11: On grid logic diagram of the super turbine

VIII.   FEATURES OF THE SUPER TURBINE

The design of the super turbine can be customized based on wind conditions, site conditions, and customer needs. The diameter of a circular track and the swept area of a blade of the minimum super turbine are 255 m and 18,400 m², respectively. The rated power of the minimum super turbine is 7 MW. The maximum super turbine can be scaled up to 50 MW with an oval-shaped track, as shown

in Fig. 12. If the wind direction of a wind farm is relatively constant, such as the southeast wind in summer and the northwest wind in other seasons, one can choose the oval-shaped super turbine for wind energy harvesting. If the wind direction of the wind farm frequently varies with weather changes, one can choose the circular-shaped super turbine for wind energy harvesting.
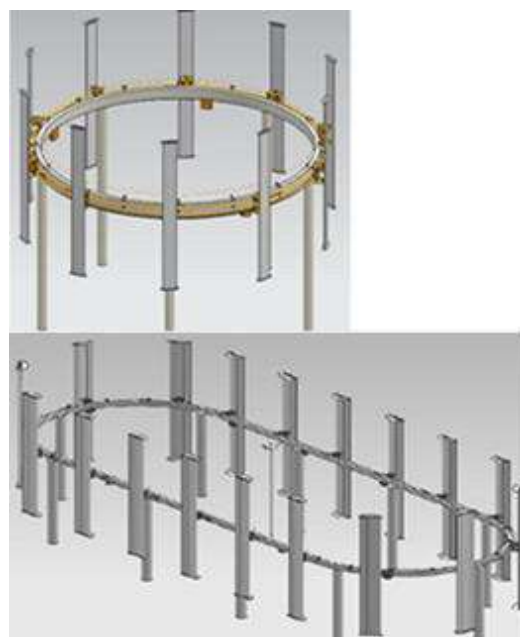
Fig. 12: Shapes of super turbines for different wind conditions

Table. 1: Costs of components of a 7 MW super turbine

Components	Type / Size	Price	Quantity	Total cost
Turbine blades	350 kg	$4,500	120	$540,000
Trolleys	-	$8,000	60	$480,000
Generators	100 kW	$5,000	70	$350,000
Support structure	4000 kgs	$4,500	40	$180,000
Track	8500 kgs	$10,000	40	$400,000
Power inverter	100 kW	$70,000	8	$560,000
Control unit	-	-	1	$200,000
Cables	-	-	-	$100,000
Others	-	-	-	$200,000
Total price	-	-	-	$3,010,000

Table. 2: Power generation costs of a 7 MW super turbine under different wind conditions

Average wind speed (m/s)	Annual power generation (MWh)	Total generation in 20 years (MWh)	20 years income ($)	Cost of per MWh ($)	Cost of per KWh ($ cent)
5	7,500	150,000	18,000,000	24.0	2.40
5.5	9,800	196,000	23,520,000	18.4	1.84
6	12,800	256,000	30,720,000	14.1	1.41
6.5	16,200	324,000	38,880,000	11.1	1.11
7	20,300	406,000	48,720,000	8.9	0.89
7.5	25,000	500,000	60,000,000	7.2	0.72
8	30,300	606,000	72,720,000	5.9	0.59
8.5	36,400	728,000	87,360,000	4.9	0.49
9	43,200	864,000	103,680,000	4.2	0.42
9.5	50,800	1,016,000	121,920,000	3.5	0.35
10	59,200	1,184,000	142,080,000	3.0	0.30

A 7 MW super turbine is developed by using standardized components, including a circular track with the diameter of 255 m and an effective swept area of 18,400 m^2, 60 sets of turbine blades, and 70 100 kW permanent magnet generators. The total cost of the 7 MW super turbine is $3.5 million, including costs of construction and installation. The comprehensive cost per watt is only $0.5. In addition to lower capital costs and operation and maintenance costs, the overall cost of the super turbine will be only one third of a traditional 7 MW HAWT.

Table 2 shows the LCOE of a 7 MW super turbine under different wind conditions. The construction cost of the super turbine is $3.6 million. The LCOE of the super turbine is ¢0.6 - 2.4 / kWh in a wind farm with a wind speed of 5~8 m/s. Due to low costs of investment, operation, and maintenance of super turbines under the same scale, the LCOE will be much lower than that of wind farms using traditional wind turbines. Super turbines can make profits without any subsidies, making wind power investment shift from policy-driven to capital-driven.

IX. CONCLUSION

Electricity power is a special commodity. In addition to the quality of electricity, the LCOE of wind turbines is the most important economic indicator of power plants. In the future, wind power technology, which does not rely on various subsidies and has lower LCOE than those of

thermal power and hydropower technologies, is the future development direction of the wind power technology

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An overview of international practices for authorization and monitoring CO₂ storage facilities

Romario de Carvalho Nunes, Hirdan Katarina de Medeiros Costa

Energy and Environment Institute, São Paulo University, São Paulo, Brazil

Abstract— The present work intends to approach the literature review related to the regulatory structure and legal requirements to obtain authorization for commissioning and operation of CO2 storage installation, as well as an approach to methodologies for monitoring operational aspects and technologies used for this purpose. The importance of monitoring as a fundamental part to guarantee the integrity and safety of the facilities will be scored together with the risk management practice using a methodology called bowtie. As a result, flaws in the monitoring process of the CO2 storage facilities can be verified and how the parties involved in the process can be held responsible.

Keywords—Carbon, Capture and Storage; Regulatory Framework; Integrity and Security facilities; Failures and Liability of the Parties.

I. INTRODUCTION

In the contemporary context, the issue of climate change mitigation is the subject of international consideration. In the meantime, companies and governments are looking for alternatives to deal with climate change, caused mainly by global warming, made possible by the intensification of greenhouse gas emissions. Among projects capable of mitigating the emission of these gases, there is a technology called Carbon Capture, and Storage (CCS). (NUNES; COSTA, 2019)

However, to perform such an activity it is necessary to comply with a series of requirements and authorizations, being a common practice in several countries studied by the International Energy Agency (IEA) and required in several ways, from a single authorization or license to a combination of multiple authorizations and/or licenses, being able to cover both the operation and the decommissioning (IEA, 2010).

In general, a significant amount of information is required before a grant is provided. This information includes details of how the project will be operated, including results modeling and a monitoring plan, and how the project will be completed, including decommissioning and rehabilitation plans. Since this information is provided prior to the start of the injection, all revised documents

include mechanisms to update these plans in the light of the data generated throughout the project (IEA, 2010).

All of these rules take place through laws, regulations, and other rules issued by the government and can be defined as a form of State intervention to discipline the functioning of markets, thus limiting the degrees of freedom of economic agents in decision-making (RATHMANN, 2017).

The scope of a regulatory CO2 storage framework varies significantly depending on the environment in each country (COSTA et al., 2018). There may be limitations in scope that include only onshore storage regulations and not offshore, geological, or related to the volume of CO2 injected. Several revised IEA documents also specify relevant prohibitions for the storage of CO2, for example, restrictions on storage in the water column (ocean storage). (IEA 2010)

Following practices and recommendations are important, including studies that find a positive correlation between operational performance and reputation, improving the company's assessment of interest groups and a resource to be used both for higher superior economic performance and for times of crisis, such as environmental accidents. (VARELA, 2014)

In addition, the company must account for and take into account in its decisions all members of this interest group

such as shareholders and investors, customers, governments, and suppliers. And, traditional notions of corporate social responsibility imply that companies must be accountable to the communities in which they are located. (VARELA, 2014).

Thus, the purpose of this article is to review international practices and recommendations with a focus on themes related to authorization and monitoring of CO2 storage facilities. In this line, topic 2 presents a summary of the regulatory structure and steps for obtaining authorizations for commissioning and operation of the installation. Item 3, we show a view of the operational parameters associated with the monitoring process of the facilities necessary to guarantee their integrity and safety, a topic that will be explored in detail in item 4. Item 5 addresses the failures that may occur in the process monitoring and respective accountability by the parties. Finally, we bring final remarks.

II.   REGULATORY STRUCTURE AND AUTHORIZATION FOR COMMISSIONING AND OPERATION OF THE INSTALLATION

The International Energy Agency produced in its Regulatory Framework Model a series of processes and standards for obtaining authorizations throughout the project.

According to the IEA (2010), CCS regulatory approaches must require operators who wish to develop and operate storage facilities to apply to the competent regulatory body for specific storage authorization before proceeding with the development of the project. An authorization process allows the disclosure of technical details of the proposed site and the planned mode of operation, as well as the opportunity for regulators to evaluate the technical details of the site and to measure the operator's training, as well as to allow stakeholder consultation on the project, including the general public (IEA, 2010).

The IEA's Regulatory Framework Model (2010) also addresses details about the storage authorization application that will generally require the disclosure of the following information:

- Details of the legal entity proposing the development and operation;

- Evidence of the technical competence of the entity that will develop and operate on the site;

- CO2 source (s) to be received for injection, including composition, delivery rate, time and expected date of cessation of the CO2 offer;

- Planned injection site (s), storage site (s), injection mass (per unit time and total) and so on;

- Location and geographic extent of the storage location, including details of the storage complex;

- Results of the site characterization process, including all the information collected and research work carried out (data sets, maps, etc.) and the results of interpretation and analysis;

- Results of reservoir modeling studies and sensitivity analysis;

- Results of the risk assessments carried out; Operating modes proposed for the storage complex (injection sites, pressures, injection rates, etc.);

- Contingency plans in the event of any significant leak, unintended migration or irregularity in a storage location;

- Preliminary results of the baseline survey for the site; Monitoring plan proposal;

- Consideration of other storage activities in connected formations and pressure interactions as a result of new developments;

- Details of other activities in the area, including the subsurface and adjacent surroundings and in the area covering the planned storage location;

The regulatory body must assess a requirement on technical and legal merits and determine whether authorization will be granted (IEA, 2010). The regulatory body must then deal with any questions raised and determine whether to issue an authorization (IEA, 2010). If the regulatory body does not feel sufficiently informed about the short, medium and long term security of the location or the economic viability of the operations, the applicant should be allowed to provide additional information and analysis or the application for authorization should be denied (IEA, 2010).

It may also be useful to establish a minimum volume of CO2 storage in a structure to simplify the approval process for research and development scale projects (IEA, 2010). The European Union's CCS Directive, for example, set its minimum regulatory threshold at 100,000 tonnes of CO2, which effectively exempts small-scale projects from the approval or authorization requirements that apply to larger projects (IEA, 2010). However, scale research and development projects may still require authorization processes for some activities in the European Union (IEA, 2010).

From a legal perspective, regulatory frameworks for CO2 storage must ensure that any significant leak, unintended migration or other irregularity in the storage

site operations is corrected so that any damage is remedied. Regulatory CO_2 structures should stipulate who will be financially responsible for remedial and remedial measures and who will carry out these measures (IEA, 2010).

Meanwhile, from the group of countries that have specific legislation on CCS activities, issues related to operationality, such as Monitoring, Reporting and Verification (MRV) routines have definitions of methodology for obtaining the licensing of CO_2 capture and storage operations, as well as the way the owners of the places and operators should manage such operations, also specifying periodicity and minimum technical characteristics for issuing reports accompanying the activities. (IEA, 2010).

The Australian law called the Greenhouse Gas Geological Sequestration Act (2008) states that before starting the injection of CO_2 or other greenhouse gases, the holder of an injection, monitoring and license must submit to the Minister a "monitoring and injection plan", including a description of the proposed monitoring techniques, monitoring and verification plan detailing how the behavior of any stored greenhouse gas will be monitored and an estimate of the cost of monitoring and verification activities (IEA, 2010).

The Canadian carbon sequestration tenure regulation (Canadian Carbon Sequestration Tenure Regulation) complements the licensing issue (IEA, 2010). This regulation determines the need for all MRV plans to present an analysis of the likelihood that operations will interfere with mineral recovery, in addition to linking the renewal of the contract / lease to the triennial renewal of MRV (IEA, 2010). This law also establishes obligations to obtain contracts such as the payment of the application fee prescribed in the Regulation, payment of the rent applicable for the first year of the contract, presentation of evidence that the area covered by the application is suitable for CO_2 sequestration, shipping a monitoring, measurement and verification plan for approval and submission of a decommissioning plan (IEA, 2010).

If the aforementioned standards raise issues relatively marginally, therefore, in a macro context, the North American Code of Federal Regulations, Title 40: Protection of the Environment, Parts 78 (Appeal Procedures) and 98 (Mandatory Reporting Rules) CO_2 storage), brings important milestones and definitions as one of the few laws that explain the difference between injector well for CO_2 storage and injector well for better hydrocarbon reserve performance and efficiency, as well as determines the obligations and duties of both operators of the owner (IEA, 2010).

US law also establishes well-defined technical and administrative guidelines, such as the need for owners and operators of such CO_2 sequestration facilities to follow reporting and monitoring procedures, quality assurance, missing data estimation and maintenance of data. specified records, as well as carbon monitoring, reporting, for example, the amount of CO_2 received, injected, produced, emitted by surface leak and emissions from equipment leaks and ventilated emissions from surface equipment (IEA, 2010).

Brazilian legislation, above all environmental, is very comprehensive, covering a wide range of topics (COSTA et al., 2017), although specific CCS activities are not yet covered (COSTA et al., 2018). First, it is necessary to understand that the monitoring phase (including the issuance of reports and eventual inspections) may depend on the type of licensing obtained by the operator. According to art. 225, § 1, IV, it is incumbent upon the Public Power to demand, by the law, a prior impact study on the installation of a work or activity potentially causing significant environmental degradation. Also, art. 23 defines the common competence of the Union, the States, the Federal District and Municipalities to protect the environment and combat pollution in any of its forms (COSTA et al., 2017).

Therefore, to fulfill this role, Law no. 6.938 / 81 (Law of the National Environment Policy) provides in article 10, § 4, the competence of IBAMA for licensing activities and works with significant impact, national or regional, subsequently regulated by Decree no. 99,274 / 90. In the oil and gas industry, the execution of business activities is mostly monitored by the National Agency of Petroleum, Natural Gas and Biofuels (ANP).

It is important to note that the oil and gas sector dominates the techniques of capture, transport and injection of gas in geological reservoirs. In other words, agents working in the oil and gas sector in Brazil have experience in using gas separation technologies in the production of natural gas that would be similar to the technologies used for capturing CO_2, for example. Therefore, it makes sense that the regulatory body that should adapt and supervise CCS projects in Brazil has expertise in regulation in the oil and natural gas sector (RATHMANN, 2017).

III. MONITORING OF OPERATIONAL PARAMETERS

The CO_2 monitoring practice involves several stakeholders, including the operator, the regulator, and other project stakeholders, including the general public.

Monitoring CCS activities is essential to support several crucial elements of safety and security and will involve a portfolio of monitoring techniques to detect the presence or absence of CO2 in primary formation storage, as well as in the storage complex and on the surface (NUNES; COSTA, 2019)

Monitoring CCS activities is essential to support several crucial elements of safety and security and will involve a portfolio of monitoring techniques to detect the presence or absence of CO2 in the primary formation storage, as well as in the storage complex and on the surface (IEA, 2010). The CO2 monitoring practice involves the operator, the regulator, and other project stakeholders, including the general public (IEA, 2010).

To this end, a Monitoring Plan must be built in order to formalize and register with the regulatory bodies and licenses a standardization to be followed in this phase. The standardization and disclosure of the Monitoring Plan gives robustness to the project, demonstrates the organization of the company, and shows investors and agencies confidence in the company's management structure and its commitment in the area of Quality, Safety, Environment, and Health (NUNES; COSTA, 2019).

The data obtained in the technical feasibility stage will allow a characterization and will provide the selection of suitable storage locations, with appropriate capacity, injectivity, and entrapment, as well as to design safe operational parameters, such as maximum injection rates (KETZER et al., 2016). Strict characterization is also necessary for a thorough risk assessment process, in order to demonstrate that the probability of any leakage event is very low and that any associated impacts can be properly identified, monitored and mitigated (KETZER et al., 2016).

Surface monitoring or close to the surface also needs to be performed before injection to provide reference data and also during/after injection to detect any changes or impacts that may arise in the unlikely event of a leak (KETZER et al., 2016). Several methods can be used for surface and subsurface environmental monitoring, such as chemical and biological analysis, markers, and remote sensing, among others (KETZER et al., 2016).

Therefore, the monitoring, measurement, and verification of CO2 in CCS projects go beyond the limits of the geological reservoir targeted by the injection, or the confinement seal rock, since all areas in which CO2 may migrate must be considered, including soil, water bodies and atmosphere (KETZER et al., 2016).

In addition, as provided by the International Energy Agency, for the CO2 storage to be properly framed according to international standards, it is necessary to

definitively trap the gas in an amount greater than 95% of the injected CO2 IEA (2010).

For surface components, standard monitoring techniques (for example, flow measurement and gas analysis) should be used to compile gas flow inventories, including estimates of avoided CO2 emissions and fugitive emissions, as well as for recording injected volume. / mass of CO2 (IEA, 2010). Good operational practice requires continuous monitoring at various locations to establish the mass of CO2 at the point of capture, the mass transferred for transport, the mass received at the injection site, and individual mass flow records in injection wells (IEA, 2010). This is likely to involve a combination of flow, temperature, and pressure measurements throughout the project and should be considered part of a standardized set of techniques (IEA, 2010).

The main objectives of subsurface monitoring include the following:

- Proper operation: to ensure that the agreed and permitted mode of operation is followed (for example, safe tank pressure).

- Early warning: to identify any irregularities in CO2 injection and migration, including any signs of potential leakage or unintentional migration, in order to initiate corrective measures and remediation.

- Validation and calibration of models: Validation of predictions of the CO2 level and destination behavior compared to the observed behavior is an essential part of the best practices for managing CO2 storage sites. Observations can provide new information on the characteristics of the subsurface that affect the behavior and fate of CO2 (for example, compartmentalization of reservoirs, hydrogeology, and geometry), allowing calibration of the model and reformulation of forecasts.

- Emission inventory: to quantify any leakage of CO2 in case it is detected. If the leak is detected, additional monitoring techniques may be needed to support the quantification of emissions.

These components are essential to establish the security of storage operations (IEA, 2010). Consequently, the establishment of monitoring requirements should be a key component of the frameworks for CCS. Site-specific factors, such as depth, surface characteristics, and geology, will determine precise technologies, techniques, and application frequencies to be used in monitoring (IEA, 2010).

Site-specific monitoring requirements (from the IPCC 2006 National Greenhouse Gas Inventory Guidelines) have monitoring technologies that have been developed and

refined over the past 30 years in the oil and gas industry, groundwater industries, and environmental monitoring. The suitability and effectiveness of these technologies can be strongly influenced by the geology paths and potential emissions at the storage sites, therefore, the choice of monitoring technologies will need to be made site by site (IPCC, 2006).

There are a variety of CCS monitoring technologies designed to monitor the reservoir, overload, the seabed, or the water column. The common objective is to detect, characterize, and quantify any leakage of CO2 from the intended storage location, but the choice of the right technical solution for a given project is not trivial. Seismic studies, for example, offer highly valuable information on the migration and development of the CO2 plume and changes in geophysical properties inside and above the reservoir, but they are expensive and rarely conducted research. Electromagnetic and gravimetric surveys were also used to monitor the stored CO2 plume, offering potentially useful but less detailed information. As shown in Figure 1, several studies highlight the need for a multidisciplinary, site-specific approach to surface CCS monitoring, also covering the overhead, the seabed, and the water column. (WAARUM, 2016)
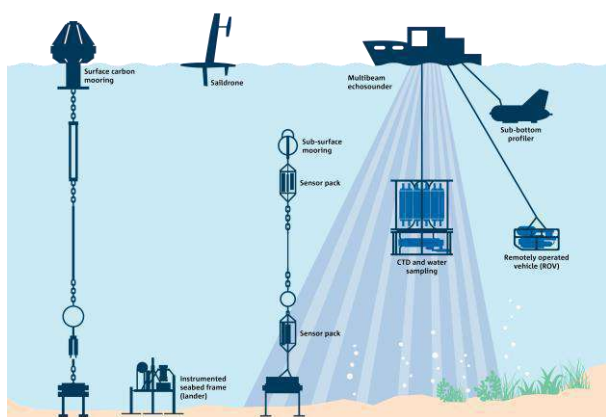
Fig.1 Equipment and technologies for monitoring carbon storage in marine environments

In this sense, the AUV - Autonomous Submarine Vehicle is an example of advances in monitoring technology. Due to the need to cover the storage reservoir area, in addition to taking into account the possible lateral migration of CO2 into the storage complex and the additional lateral movement as the CO2 goes through the overload (which is equivalent to a potentially several hundred square kilometers in area), an unmanned system that can be deployed for long periods is required. The AUV (for example, Fig. 2) can be programmed to follow a predetermined research pattern in high resolution and to house a range of sensors relevant for monitoring CCS leaks

(for example, chemical, acoustic, imaging products), having passive detection functionality (for example, chemical sensors and passive hydrophones) that could last for months or active detection (for example, acoustic sonar images on the seabed or subsurface), lasting in the order of days. (BLACKFORD et al., 2015)
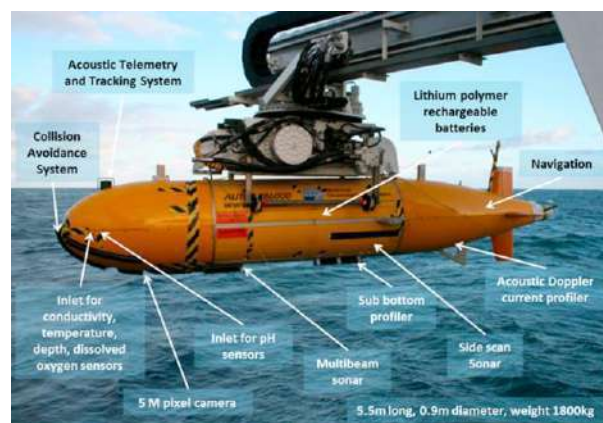
Fig.2 Example of an AUV, with Example of an AUV, with its associated power, navigation and sensor systems its associated power, navigation and sensor systems

Technological limitations, costs, frequency (continuous, annual, etc.), need for mapping and description of the storage location are factors that influence both the choice of technology to be used and the elaboration of the monitoring plan. (IPCC, 2006).

Another relevant aspect for study and monitoring is the natural variation in the conditions of the marine environment, since the biological activity, currents, turbidity, temperature, and water stratification causes the concentration of most substances in the water column to have natural fluctuations. These fluctuations will be the result of several overlapping fluctuations linked to diurnal, lunar, or seasonal changes. This leads to a complex pattern of variation in each of the parameters that makes it difficult to distinguish natural fluctuations from the initial conditions of a leak from CO2 storage. To interpret CO2, pH measurements, or to indicate leaks, it is necessary to have a baseline with natural fluctuations established over time, including daily and seasonal fluctuations. The monitoring of several parameters simultaneously can activate the identification of covariant patterns that characterize natural or leak-related changes and can be used to discriminate between them. (WAARUM, 2016)

Monitoring will also be necessary after the injection is stopped at decommissioning and possibly post-decommissioning. In these periods, the risk of leakage or

unintentional migration should reduce because the injection, which is the main force in processes and flows triggered by pressure on the subsurface, has ceased (IEA, 2010). In addition, the understanding of the subsurface must also have evolved over time from the initial injection because of the learning and historical process of the site (IEA, 2010). This means that the model's forecasts must converge more and more with the behavior over time. However, monitoring in the decommissioning and post-decommissioning phases may still be necessary, as CO_2 will continue to flow and disperse in the subsurface after the injection is stopped (IEA, 2010).

Over time the risk of processes under pressure causing leakage will be decreasing and the expected behavior converging with the observed behavior (IEA, 2010). If there is a high level of confidence that these conditions are being met, it may be possible to completely end any monitoring activity (IEA, 2010). Monitoring may need to start over in the event of events that may have an effect on storage stability (IEA, 2010).

IV. THE KEY ROLE OF MONITORING IN GUARANTEING THE INTEGRITY AND SECURITY OF INSTALLATIONS

Trapping mechanisms have the function of preventing the injected CO_2 from migrating back to the surface (ALVES, 2008). According to Alves (2008, p.32): "The pressure resulting from the depth required for its storage causes CO_2 to remain in the form of supercritical fluid", a physical state that provides its "fixation in the intestinal spaces of rocks", when, then, it will penetrate the existing pores, when the critical depth is reached. Part of this CO_2 is by Alves (2008, p. 32), "definitely blocked after the sealing of the injection holes, while another part may move for some years, until it reacts with existing fluids and rocks, mineralizing".

According to Gaspar (2014, p.37) "with the choice of a suitable location, a monitoring program to detect problems, a regulatory system and the appropriate use of corrective methods to stop or control any leakage of CO_2, the environmental risks of the CO_2 storage, the health of the local population and safety risks must be comparable to the risks of natural gas storage and oil extraction ".

For the operator to maintain continuous guarantees that CO_2 is being successfully stored, monitoring and reporting activities for CCS projects must be carried out (IEA, 2010). Also, the monitoring of activities should provide sufficient information to calculate the effectiveness of the project in

terms of tons of CO_2 stored and tons of CO_2 avoided. These calculations will provide the basis for awards and adjustments of credits or payments linked to emission reductions obtained by a project (IEA, 2010).

Generally, it is considered that a leak of 1% of CO_2 stored in a thousand years would be an acceptable value (KETZER et al., 2016). The flow of CO_2 injected into the subsurface can be modeled before injection by simulating CO_2 interactions with the reservoir and the rock layer in laboratory tests (KETZER et al., 2016). These experiments simulate subsurface conditions using samples of real rocks and fluids (KETZER et al., 2016). Simulations can also be performed using numerical modeling tools to predict the flow and chemical interactions at the storage location on geological time scales (KETZER et al., 2016). The observed flow of gas injected into the subsurface can be compared with the predicted paths, allowing the calibration of the experimental and numerical models (KETZER et al., 2016).

Bowtie is a method capable of previously identifying degraded barriers to maintain the integrity of the installation and proposing corrective barriers in the event of the occurrence of an unwanted event. The method provides a framework for systematic risk assessment of events with the potential to affect storage performance. The bow tie (Fig. 3) represents the relationship between the five key elements that make it up: (DEAN, 2017)
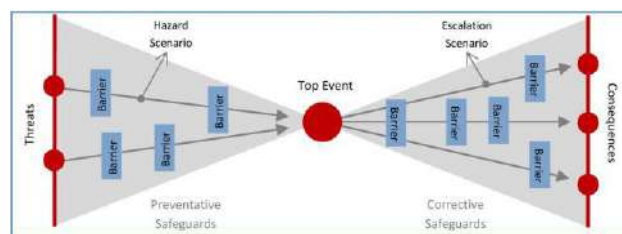
Fig. 5. Schematic diagram of the Bowtie Method

·   Main event: this is the unwanted event, placed in the center of the tie. In this case, the main event is the movement of the CO_2 cloud outside the storage complex;

·   Threats: these conditions can lead to the main event. For example, the presence of a system of permeable faults or fractures, injection-related stresses (pressure/thermal) or poorly connected abandoned wells;

·   Consequences: These are the possible adverse results due to the unexpected occurrence of the main event. For example,

the emission to the marine environment impacting the flora locally;

· Preventive safeguards: decrease the likelihood of a threat leading to the main event. For example, the effects of the injection pressure are likely to be small, as the injection is good and the storage location is under sub-hydrostatic pressure;

· Corrective safeguards: decrease the likelihood of significant consequences due to a top event. For example, the presence of a permeable formation under the seal of the storage complex provides alternative secondary storage;

Therefore, to guarantee the integrity of the CO2 storage facility, a process was developed within a risk management framework that is based on the well-established barrier (safeguard) approach. The objective is to identify the necessary monitoring tasks and their respective technologies to reduce storage risks to a minimum. The following is a step-by-step approach: (DEAN, 2017)

1. Assess site-specific storage risks: Establish definitions for loss of compliance and loss of containment. Identify potential threats and consequences associated with these risk events using the bow tie method.

2. Characterize geological safeguards: identify and assess the integrity of each geological seal inside and above the stored complex.

3. Select engineering designed safeguards: identify and evaluate engineering concept selections that provide safeguards against unexpected loss of well integrity. Assess these initial safeguards: Assess the expected effectiveness of these initial safeguards in relation to the identified compliance and containment threats and their possible consequences.

5. Establish monitoring requirements: Define monitoring tasks to verify the performance of these initial safeguards and, if necessary, trigger timely corrective measures.

6. Select monitoring plans: Select monitoring technologies considering leakage scenarios according to a cost-benefit ratio. The benefits are judged by the effectiveness of each technology in each task. This includes monitoring the baseline, as well as monitoring during the injection and closing phases.

7. Set performance goals: evaluate the expected monitoring capabilities.

8. Identify contingency monitoring: develop alternative monitoring plans to investigate suspected irregularities and establish clear criteria for when and how to implement these continents. The results of contingency monitoring should be included in a corrective action plan.

The regulatory structures of the CCS must enable the regulatory body to verify, through local audits, whether storage projects are being carried out as planned (IEA, 2010). Audits are not exclusive to CCS operations, occurring in most industrial operations, where they involve access to the locations of activities and documents. The auditing power granted by a regulatory CO2 storage structure can extend to access to third party property, that is, to properties beyond the location controlled by the operator (IEA, 2010). Audits are more likely to be needed at the beginning of a project's stage than later in the project's life cycle, as this is the period when less is known about the storage location.

The competent regulatory body can carry out routine and non-routine audits of a storage location, having access to any location that has been or is being used in connection with a project including the property of third parties (IEA, 2010). Audits may include research facilities, visits to injection facilities, assessment of injection activities, assessment of monitoring operations, verification of compliance of the storage location with the plan approved by the competent regulatory agency, and access to all relevant records (IEA, 2010). Audits can begin when an exploration authorization is granted and continue until the transfer of responsibility as well as its frequency varies, increasing if there is a significant leak, migration, or other irregularity in the storage location (IEA, 2010).

The International Energy Agency (2010) warns that audits should include, but not necessarily be limited to, direct site visits to examine the surface of facilities, verification of records regarding the mass of CO2 received, the mass of CO2 injected, activities shutdown, unplanned shutdowns or unintended incidents and results monitoring. The precise timing and frequency of inspections will vary according to particular practice in the region and depending on the site's performance history. However, good practice suggests, according to IEA (2010) combinations of the following:

• At least, annual reports on operational activities and review by the regulatory agency;

• At least routine annual or biannual inspections of operations;

• At least one third-party annual check, with supervision by the regulatory body;

• Non-routine inspections, in order to investigate any reports of leaks, unforeseen migration, significant irregularities, complaints or other situations, as needed;

Inspections must continue during the decommissioning period, although the frequency of inspections can be modified during this phase according to site-specific considerations and the level of confidence in the performance of the storage location achieved by the regulator (IEA, 2010).

It is generally accepted by the industry and regulators currently involved in CCS that the operator, as the entity that oversees the operation of a storage location, is the entity that is best positioned for any liability for damage caused by a storage location during exploration, operation and decommissioning (IEA, 2010).

V. FAILURES IN THE PARTIES MONITORING AND ACCOUNTABILITY PROCESS

An operator will generally be responsible for any damage caused to the environment, human health or other resources and be required to take any corrective or remedial measures associated with the storage location and its costs (IEA, 2010). If the operator has been given CO_2 incentives for CCS operations, the operator may also be responsible for compensating for any leakage of CO_2 into the atmosphere in the context of the incentive regime (IEA, 2010).

The leak or unintentional migration of CO_2 from storage sites can lead to a series of potential impacts (IEA, 2010), which can be categorized as:

- Local Impact: risks associated with health, safety and the environment (HSE) associated with CO_2 storage and unintentional leakage or migration. Such risks can be divided into:

- Impact on the surface: potential to cause asphyxiation and ecosystems (effects of CO_2 leakage on neighboring populations, worker safety and effects on the biosphere and hydrosphere, such as tree roots, terrestrial animals and the quality of ground and surface water) as well as problems associated with impurities present in the injected material.

- Impact on the subsurface: Contamination through the mobilization of metals or other contaminants that have an increased risk due to the presence of certain impurities. It also has physical effects such as soil surveying, induced seismicity, displacement of underground water resources and damage to hydrocarbon production.

- Global Impact: when CO_2 is released into the atmosphere due to the leakage of stored CO_2, it compromises the effectiveness of a CCS project as a technology to mitigate climate change (IEA, 2010).

Public opinion is always important and that is why governments and companies seek to minimize the negative impacts of their operations. About CCS monitoring, unwanted advertising can result, for example, from observations of CO_2 bubbles emanating from the seabed near a storage location or a change in the local marine environment. In such cases, it is beneficial for the operator to minimize damage to reputation by documenting that it has a robust and efficient monitoring process that can locate, quantify and characterize any leakage at an early stage. (WAARUM, 2016)

The absence or failure in monitoring can lead to the occurrence of major socio-environmental disasters, where an immediate drop in the value of the shares of the responsible companies is common. In this case, many investors are expected to sell their shares because of the associated risk and because it may take years for the causes of the accident to be known. (VARELA, 2014)

There must be a framework that addresses the issue of corrective measures, remediation measures and responsibility for the implementation of these measures to operators (IEA, 2010). Given the very specific nature of the corrective and remedial measures that may be necessary, the revised documents tend to confer discretion on the regulatory body to determine when corrective and remedial measures will be necessary and what they will entail (IEA, 2010).

In the event of a significant leak, unintentional migration or other irregularity, the operator must immediately notify the competent regulatory agency (IEA, 2010). The operator must take any corrective measures, as determined by the regulatory body, to protect the environment, human health, other resources and assets of third parties, including actions set out in the operator's corrective action plan, - approved by the regulatory body - as well as any remediation measures (IEA, 2010).

The regulatory body is responsible for taking corrective or repair measures at any time, including at the expense of the operator, while the responsibility for the storage location lies with the operator (IEA, 2010). The operator must update the corrective measures plan to reflect lessons learned and take corrective measures (IEA, 2010).

Corrective measures are needed to protect human health and the environment, and to maintain the effectiveness of a CCS project as a method of reducing CO_2 emissions (IEA, 2010). Remediation is necessary to resolve any damage associated with significant leakage, unintended migration or other irregularity in the operation

of a storage location. The best practice examples for such measures are those adopted in the oil field as well clogging techniques using heavy mud, as applied in the case of blowouts, standard well repair techniques in the event of well failure and interception of leaking fluids a nearby well to intercept the leak (IEA, 2010). Other measures may involve the partial removal of CO_2 from storage to reduce the pressure reservoir and remediation of groundwater in case of contamination (IEA, 2010).

Appropriate mechanisms should be designed to provide clarity about the entity to be responsible for global or local issues. The effects are vital when designing CCS regulatory structures (IEA, 2010).

Liability for any localized effects arising from CO_2 releases or storage can be legal / administrative (for example, violation of authorization conditions), criminal (for negligence, wrongful death and environmental crimes) or civil law itself (for example, through damages to third parties), in addition to the civil environmental (IEA, 2010).

The precise nature of the liability will depend on the laws in force in the local jurisdiction, the actions that give rise to any leakage event or unintentional migration (due to conditions of authorization by the operator, negligence) and the nature of any impacts of such events (or that is, level of damage) (IEA, 2010). In practice, it may depend on regulatory / administrative law, criminal and / or civil lawsuits (IEA, 2010).

When developing CCS regulatory structures, there are two main issues to consider (IEA, 2010). First, regulations must ensure that authorization processes establish powers for the competent regulatory body to investigate and file charges in case of violation of authorization conditions (IEA, 2010). Second, any existing laws relating to industrial, civil and environmental accidents, environmental protection and environmental liability must be carefully reviewed (IEA, 2010).

In Brazil, Law no. 9.605 / 98 (Environmental Crimes Law) and Decree No. 3.179 / 99, which regulates it, define the responsibility of the legal entity - administrative, civil and criminal - and also allows the individual responsible for the offense to be prosecuted. Inspection actions are performed by ANP - National Agency of Petroleum, Natural Gas and Biofuels in the form of audits, through samples and analysis of data and evidence, which aim to verify the operator's compliance with the requirements of the technical documentation regulated by the Resolution ANP 37/2015, which provides for the granting of a deadline for the treatment of non-conformities and the eventual elaboration of an infraction notice.

VI. CONCLUSION

According to the most accepted international concepts for project definition, the activity of monitoring CO_2 storage facilities can be considered as such, since it has a well defined and outlined scope, it brings requirements related to quality, schedule and budget well developed and detailed and, mainly, it has the predictability and dimensioning of resources to be used during the execution of activities and a robust risk analysis to bring security to the operation.

In this sense, the fact that the monitoring activity is developed as a project, it is possible to calculate and anticipate almost all the risks involved. Monitoring makes it possible to assess threats and anticipate measures to mitigate their effects even before the stage of granting authorizations for commissioning and operating storage facilities. In this way, it is clear and established all the risks involved in the project and how the monitoring will be carried out throughout the project.

For this purpose, the execution of the monitoring must follow the one approved by competent bodies and improved over time, managing and mitigating new risks that may be presented during the operation of the installation. Also, the monitoring plan must be strictly followed and constantly reviewed.

In this way, following the monitoring plan, periodically issuing the reports and performing critical analyzes of the process as a whole, it is possible to anticipate problems and facilitate decision making in an agile and efficient way, enabling preventive correction and preventing accidents such as large spills CO_2 quantities.

In this sense, in the event of a leak, a robust monitoring plan will bring tools capable of reducing the damage caused, such as bowtie, which provides all the necessary barriers to prevent the occurrence of events and, when they do occur, the barriers and actions capable of mitigating will be established. its consequences.

In this context, monitoring becomes essential to reduce the operator's exposure to the competent bodies and even to reduce costs in an eventual accident. The fact of obtaining tools that prevent accidents shows a degree of maturity and differentiated management.

The fact is, it is necessary not only to be whole, but also to appear to be whole. The reporting of failures through reports, the communication of any leakage events, regardless of the size and a routine of disclosing the results of the audits, increase the operator's reliability about the agents involved, including shareholders and the society itself.

Therefore, following the practices and recommendations related to monitoring and constituting such activity as fundamental within the project is essential for the operation of CO2 storage facilities safely and cost-effectively, serving the greatest purpose, the mitigation of climate change.

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Evaluation of The Influence of Rice Husk Bio-oil Use, as an Addition for Structural Concrete

Vinícius Rodrigues Neres[1], Dênis Cardoso Parente[2], Rafael Alves Amorim[3], Daniel Iglesias de Carvalho[4]

[1,2,4]Centro Universitário Luterano de Palmas - TO, CEULP/ULBRA, Brasil

[3]Universidade Federal do Tocantins, UFT, Brasil

Abstract—*This work seeks to evaluate the influences of the addition of rice husk bio-oil in the concrete mixture for structural purposes. In the first stage of the research, through the pyrolysis process, the fraction of bio-oil was obtained and in a second moment, its addition to the cement paste and the concrete mixture. With the use of oil obtained from rice husk, it was aimed to analyze the effects generated in cement paste and concrete in the fresh and hardened states, consequently seeking to evaluate the potential of the liquid as a surfactant addition to concretes. The study embraces the analysis of the physical and mechanical properties of the concrete mixt with the addition of the bio-oil. The results indicate that these properties undergo changes, which may enable the use of its by-product.*

Keywords— *bio-oil, rice hulls, rice husk, concrete.*

I. INTRODUCTION

Contrary to what is imagined, additions to composite materials mixtures, for structural goals, are quite old. It was already used by the Romans long before Portland cement, which is the most common type of concrete, nowadays [1].

Recently, the incorporation of residues in cement mixtures has growing significantly in research, in the field of civil engineering, due to presenting technical advantages and social benefits related to the reuse of organic materials available in the nature. Contributing with the sustainability [2].

Some alternatives are being studied by researchers, such as the use of residual biomass from the agriculture in the production of concrete.

The biomass of rice husk, the subject of this research, already has functionality in several industrial sectors, such as its use in biomass power plants, due to its high heat capacity and as a mineral addition to concrete, and its high silica content.

The by-product resulting from the grain processing corresponds to approximately 20% of rice total weight, meaning that the production of this cereal generates a large amount of waste [3] [4].

The use of rice husk as a source of silica and oil production has been widely discussed in scientific studies. Such product is one of the main readily available biomass resources, being an ideal fuel for electricity generation, activated carbon production and silica production, widely used as mineral addition for structural concrete [5] [6].

The yield of each by-product obtained in the hull pyrolysis process, depends on the biomass characteristics, besides the main parameters of the process, such as reaction temperature, heating rate, residence time and particle size of the biomass [7].

[8] showed, in his master's thesis, about rapid pyrolysis of rice hulls, that the bio-oil generated in the process proved to be rich in oxygenated compounds (phenols, ketones and carboxylic acids), the main components of plasticizer additives according to [9], thus there is an indicator that bio-oil may have a similar effect on concrete and cement paste.

In this context, the general objective of this study is to evaluate and to compare, the physical-mechanical properties of the cement and concrete mixed with the addition of rice hulls bio-oil.

II. METHODOLOGY

The activities for the development of this study were divided into two stages: Production of bio-oil and its application in concrete and cement paste.

2.1 Pyrolysis of rice husk.

For starting the pyrolysis it was necessary to make briquettes, cylindrical biomass, as shown in Fig. 1

Fig.1: Wet and processed rice husk briquettes.

The process consists in the fractionation of 200g of rice husk in a low-speed blender and its subsequent sieving in a standard 1.18mm mesh sieve. 100ml of water was added to the pass-through material and the hydrated biomass was pressed into a 20cm long and 32mm diameter tube. We used a low-speed blender to decrease the granulometry of the material, then sieve it with a 1.18mm sieve from the normal series. We produced 3 briquettes with that amount and the rest was discarded.

Subsequently, the hydrated biomass was pressed into a cylindrical pipe 20cm long and 32mm in diameter. The briquettes were dried in a heating chamber for 24 hours.

The adopted intermediate pyrolysis process, characterized by [10], occurs between 500 ℃ and 650 °C with a heating rate varying between 1 °C/min and 10 °C/min and residence time of 5 min and 15 min. Consequently, the pressure stays at 0.1 MPa during the process. Typically, the yields of products in this modality are between 40-60% bio-oil, 20-30% non-condensable gases and 15-25% biochar.

The thermal conversion of the biomass was made in a 100cm long, stainless steel fixed bed reactor with a 10cm outside diameter, operated in batch mode, with water vapor as the carrier gas, as shown in Fig. 2

Fig.2: Fixed bed reactor in stainless steel body.

For mass and yield balance purposes, after the reaction and cooling of the pyrolysis unit, the coal, gas and oil fractions obtained were weighed.

2.2 Dosage and addition of bio-oil to concrete

In this stage, concrete was produced with a referenced mix proportioned by the Brazilian Portland Cement Association (ABCP) method and the addition of the bio-oil.

This method consists of collecting data in the laboratory of the materials used in the production of concrete, they are: fineness modulus (FM), maximum characteristic length (MCL), humidity (h%), specific mass (γ) and unit (δ). From the data obtained, tables and graphs were used to support obtaining the appropriate proportions for the mix.

The fck (Feature Compression Know at 28 days) of 30 MPa was defined for an aggressiveness class II [11], moderate aggressiveness class and low risk of deterioration of the structure. Another characteristic adopted was a concrete slump equal to 50 ± 10mm.

Based on the concrete mix, the consumption of the necessary inputs for making 24 specimens for each bio-oil content was calculated, in the percentages of 0.5 and 1.0% of addition in relation to the cement mass of the mix.

III. RESULTS AND DISCUSSION

3.1 Preliminary Bio-oil Evaluation

In this research, it was used results of bio-oil characterizations made recently and similarly, for the development of the bio-oil for this research.

The data referring to the physical and chemical properties of rice husk oil can give strong indications about the quality, toxicity and stability of the product, as stated in [8]. According to the author, chromatographic and spectrographic methods are the main instruments for the characterization.

For [12] both the pyrolysis temperature and the properties of the raw material used, strongly influence in the properties of the liquid obtained.

Bio-oil, also called pyrolysis oil, is a liquid mixture of dark brown color and contains several organic compounds, such as: acids, alcohols, ketones, aldehydes, phenols, ethers, esters, sugars, furans and alkenes; in addition to nitrogenated compounds and various oxygenated compounds, as shown in Fig. 3 [13]

Fig.3: Bio-oil obtained from pyrolysis.

3.2 Concrete in fresh state (Slump-test)

For the slump-test, significant changes were observed, since they exceeded the admitted variation defined in calculation by the ABCP/ACI method (Portland Cement Brazilian Association/American Concrete Institute), (50 ± 10mm).

There was an increase of 9% and 23%, with the addition of bio-oil with proportion of 0.5% and 1.0% respectively. The Table 1 below shows the values obtained in the laboratory for the reference mixture and the respective additions.

Table 1. Results of Slump-test of cone trunk.

% Addition	W/C Ratio	Slump (mm)	Increase
0.00%	0.52	50	0.00%
0.50%	0.52	55	9%
1.00%	0.52	65	23%

3.3 Initial and Final Setting Time

Observing the setting time obtained via determination assay [14], there was an increase in the initial and final setting time. The table 2 below shows the values obtained.

Table 2. Setting time obtained via determination assay.

% Addition	W/C Ratio	Initial Setting Time	Final Setting Time
0.00%	0.30	2h45min	3h36min
0.50%	0.30	2h46min	3h56min
1.00%	0.30	3h10min	4h28min

It is possible to note that, both initial and final setting time of the sample, with the addition of 0.5% of the oil, increased on average 22.5min compared to the reference. The initial and final setting for the mixture with the highest percentage, increased 25 and 52 minutes respectively in relation to the reference mixture.

Fulfilling the requirements established in [15], with initial of setting $\Delta t \geq 90$ minutes and final of setting $\Delta t \leq 360$ minutes, the bio-oil is characterized as a plasticizing retardant additive.

The analyses of the chemical composition of the bio-oil show that the present compounds have carbon chains with hydroxyls (hydroxylated carboxylic acids), which according to studies developed by [16], affect the chemical reactions between cement compounds and water, delaying the setting. Still according to the author, the hydroxyl linked to the carbonic chain makes the medium more acidic, causing a delay in the setting without relation to plasticity.

3.4 Concrete in Hardened State

In the concrete axial compression strength test, 6 specimens of each sample were used for the ages of 7, 14, 28 and 90 days, in a total of 24 specimens tested. The results are shown in Table 3.

Table 3. Results of axial compression strength.

Average Compressive Strength (MPa)			
Age (days)	Ref.	0,5%	1,0%
7	25,0	23,9	19,4
14	30,1	27,4	22,78
28	30,9	29,2	25,5
90	31,5	29,1	28,5

It was observed that the concrete with additive (bio-oil), did not exceed the reference concrete (without additive) in

its resistance to compression at any age. However, it is known that the presence of hydroxyls and some acids in the compounds already detected in the bio-oil, can initially be attributed to this decrease in resistance gain in the early ages, knowing that acidic average cause the delay in hydration and cement setting time.

The average compressive strengths of the specimens with addition of 0.5%, at 7 and 28 days, reached more than 90% of the average compressive strength of the specimens prepared without addition, respecting the requirements of [17]. At 7 days the reach was 95.60%, and at 28 days the reach was 94.49%

When performing the analysis of variance (ANOVA), it was possible to identify, statistically that, there was a difference between the samples and by Tukey's test it was possible to identify where this variation occurred

For the age of 7 days, the variation factor obtained, number $F_{calculated}$, was equal to 10.29, in other words, there was a difference between the samples since the F_{tabled} was 6.36, with a 99% confidence level. The two mixtures with bio-oil influenced the results in the order of 57.84% in relation to the mixture without addition, however, between them there was no variation.

For 28 days a $F_{calculated}$ number obtained was equal to 4.497, a very close value to the F_{tabled}, thus, showing that the variations decreased, with variation only between the sample dosed with 1.0% in relation to the reference concrete. The influence of bio-oil, for this age, was 37.48%.

IV.   CONCLUSION

The analysis of data obtained from the compressive strength test, initial and final of setting time, can confirm the interference of the use of bio-oil as an addition to concrete. All results show significant changes in the setting time and compressive strength when compared to the reference concrete.

In the hardened state the specimens with bio-oil, despite not showing resistance gain in relation to the reference concrete (without bio-oil), it cannot be discarded, even if not very relevant, the resistance gain in advanced ages.

The results indicated that the addition of bio-oil showed improvements in the concrete in the fresh state, with an increase of 23% in the slump with 1.0% of bio-oil in relation to the weight of the cement, collaborating to justify the hypothesis that the bio-oil has a characteristic of a plasticizer additive.

Although the static analysis demonstrates that there were significant changes in the concrete with the addition of bio-oil. This is a preliminary study for a potential plasticizer additive and set retarder, with the need of others analysis and tests, especially with regard to the behavior in the microstructure of the concrete.

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Approximations and Distances between the Educational Systems of Brazil and Nigeria in the Dictatorial Period (1964-1985): Some aspects

Adekoye Giovanni Obasa, Rosa Lydia Teixeira Corrêa

Postgraduate Program in Education, PUCPR University, Brazil

Abstract— *The purpose of this article is to show some aspects about the educational system in Brazil and Nigeria, during the dictatorial period (1964-1985). In 1964, Brazil suffered a military coup, leading to the establishment of a civil/military dictatorship that lasted until 1985. This period, when the military used repressive means and torture to suppress the opposition, generated significant changes in the educational policies. Education was seen as an important part of economic development. The army had the intention of proceeding with the industrialization project, so that educational policies were focused on the development of human capital, that is, to create a technical class that could guide the country towards greater productive growth. At the same time, the first military coup to take place in Nigeria was in 1966, which led to a series of other coups in the country, ceasing only in 1999[i]. This regime saw education as a government initiative, which led the state to take on missionary schools. The Universal Primary Education (UPE) program was also launched, making primary education free, in order to reduce illiteracy in the country.*

Keywords— *Military dictatorship, Nigeria, Brazil, Educational System.*

I. INTRODUCTION

This article covers some aspects about the educational systems of Brazil and Nigeria, with the purpose of bringing data of approximations and distances between the two countries. Thus, there is no intention to make comparisons given the singularities of each of them, but as both lived concomitant dictatorial experiences, the curiosity to know about possible similarities and dissimilarities in the educational field of that period was manifested.

In fact, military interventions are the result of a complex mix of historical, political, economic, social, ethnic and cultural factors. Different theories can explain military intervention, such as the *organizational theory*, *custodian theory* and *socioeconomic development theory*, which contribute to characterize the dictatorial formations in those two countries.

In Brazil, the Brazilian army took over the government on March 31 in 1964, through a coup, under the justification of fighting the so-called communists and subversives. The military power lasted twenty-one years and sought to serve capitalist interests, based on the logic of modernization and economic development. With that, after the intervention in 1964, several agreements were signed in the educational field. Through the educational system, it would be possible to develop the skilled workforce needed for the growing industry. To this end, in 1965, agreements were signed between the Ministry of Education of Brazil and the United States Agency for International Development (USAID), in order to restructure the educational system in Brazil, since it would be necessary to make it able to meet the demands of the productive universe at the time (germano, 2000).

Thus, it is important to highlight that although it is the *organizational theory* that best explains the dictatorial regime in Brazil (1964-1985), it is possible to perceive, in the case of this country, an approximation with the *economic development theory*. The authors who presented this theory believe in the hypothesis that socioeconomic development reduces the chances of military intervention. Finer (1988) argues that "[...] the density of military interventions is more likely to decrease with an increase in the status of socioeconomic development and an increase in social mobility" (p. 87).

Putnam (1967), in turn, argues that nations with better socioeconomic status have a higher level of urbanization, industrialization and literacy and, therefore, greater mass participation in social activities. This author

presented five major indicators of social mobilization related to military influence in politics: urbanization, literacy rate, circulation of newspapers, distribution of radio sets and higher education.

From the perspective of the *organizational theory*, military organizations are institutions organized hierarchically by nature. In the army, commands are obeyed and not debated. A strong chain of command can only be found in a military institution. These characteristics give the military a distinct status, making it different from all other institutions (Finer, 1988).

According to Finer (1988), "[...] the armed forces have three enormous political advantages over civil organizations: a superiority in the organization, a highly emotional symbolic status and a monopoly on weapons" (p. 6), as well as nationalism and patriotism. In addition, a centralized chain of command, discipline and extensive communication makes military officers a cohesive group capable of organizing an effective coup (Finer, 1988). In another way, Huntington (1957) stated that military professionalism is inversely related to military intervention. He argues that the modern professional sense keeps the military away from intervention in the civilian government, while bringing them closer together, according to their demands on government revenue.

The military's role in politics is simply the maintenance and survival of the armed forces within a country, and this is often seen when trying to undermine the military hierarchy. This was what led to the coup in Brazil, when President Goulart tried to combat the power of high military officers and, consequently, he was overthrown by the military in April 1964 (Nordlinger, 1977).

Two years after the Brazilian military coup, the military coup took place in Nigeria. In 1966, it happened the first of a series of coups that have afflicted this country for decades. Political leaders of the northern part, including Prime Minister Balewa, were killed in the coup, while President Azikiwe (an Igbo[1]) was not in the country when the coup took place. General Aguiyi-Ironsi (Igbo) became Nigeria's military head of state. Northerners who have suffered most in the coup did not intend to remain passive while the eastern part of the country came to power, which led to the second coup in July 1966. General Gowon became Nigeria's Head of State and during this period, the Igbo attempted to secede from Nigeria creating Biafra, leading to civil war between 1967 and 1970. General

Gowon was overthrown in 1975 and Murtala Mohammed became Nigeria's Head of State, in 1975. Murtala Mohammed was later killed in a coup led by Colonel Dimka (Dummar, 2002).

In 1976, General Obasanjo became Nigeria's Head of State and later became the first military Head of State to transfer power peacefully to civilian rule in 1979 to Alhaji Shehu Shagari. However, the second republic was interrupted in 1983 by a coup led by Buhari, due to electoral irregularities and allegations of corruption. General Muhammadu Buhari was a Muslim, from the northern part of the country, and tried to implement Sharia law[2] at the federal level. In his regime, many government critics were arrested. He was overthrown in 1985 with a military coup led by General Ibrahim Babangida (Dummar, 2002).

The *Custodian theory* has the most significant impact on the incidence of coups in Nigerian politics. *Custodian theory* states that the armed forces are the guardians of the nation's constitution and, as such, are free to intervene when the constitutional property is being violated. Huntington (1969) states that the military would generally be willing to "return to the barracks" after a dispute is resolved. Thus, the military only acts as guardians to verify the activities of corrupt civilian administrators and to guarantee political stability. The author stresses that the military must intervene when the civilian government has no legitimacy due to an inadequate and ineffective electoral executive. Thus, for example, the Praetorian army will tend to replace weak and unstable political regimes (Perlmutter, 1969).

Finer (1988) argued that the most important cause of military intervention is the low or minimal political culture of the society in question. Such an interpretation for military coups can relate to the characteristics of the Nigerian army. More than that, Huntington (1969) emphasized the role of corruption in the intervention. In Nigeria, some members of ineffective civilian leaders were found to be corrupt and acted according to their personal interest. In contemporary society, however, the armed forces are no longer content to have leadership by proxy. With a relatively well-educated and highly trained workforce, and in the context of the prevailing crisis in Nigerian development, the army can consider itself a legitimate heir to state power and a legitimate recipient of public funds.

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[1] One of the largest African ethnic groups. They inhabit the east, south and southeast of Nigeria, as well as Cameroon and Equatorial Guinea and speak the Igbo language.

[2] Islamic law: body of laws based on the Koran and the religion of Islam.

After this introduction, aspects of the educational system in the two countries in question in the period chosen will be presented.

II. METHODOLOGY

Research of a historical nature in the field of History of Education. It was developed using bibliographic sources and educational legislation from both countries. About bibliographic research, for Severino,

> [...] it is the one that takes place from the available record, resulting from previous research, in printed documents, such as books, articles, theses, etc. It uses data or theoretical categories already worked on by other researchers and duly registered. The texts become sources of topics to be researched. The researcher works from the contributions of the authors of the analytical studies contained in the texts (2016, p. 131).

Legal sources, of documentary character, such as the legislation, will also be used, fundamentally aiming to understand the structuring of the educational systems in the two countries during the period chosen.

This work does not intend to be a comparative study. Far from it. The intention is to proceed with what we call approximations and/or distances between the educational systems of the two countries during a period in which they shared forms of authoritarian relations resulting from military coups.

An attempt was made, both through bibliographic and documentary studies, to carry out a dense interpretive exercise, relying on Geertz (1989), from where we bring the notion of dense interpretation to seek in this materiality to discern what we desire through the objectives previously set. It requires reflection both in the broad sense, for example, of international relations in which the two countries are inserted, as well as specific, from the perspective of their internal relations.

Aspects of the Educational System of Brazil and Nigeria during the military dictatorships (1964-1985)

As a result of the MEC/USAID agreements, mentioned before, two educational reforms were made in Brazil after the 1964 coup: that of higher education in 1968, through Law no. 5,540 and, later, in 1971, with Law no. 5,692, which reformulated primary and secondary education. Thus, according to Germano (2000),

The educational policy of the Brazilian military regime was an attempt to link education with economy, developing the 'human capital theory', which subordinated education to the demands of the production line or industry. The military wanted improvements in human capital, which can lead to new levels of productivity. Its strategy was to continue to induce growth by investing in the working class, in order to stimulate the country's economy to further growth (Germano, 2000, p. 105).

It is worth mentioning an important aspect that influenced educational policies, especially in higher education: student movements with protests in opposition to the military government, as well as for the defense of greater investments in education (Bethel, 2005). For this reason, educational policies during this period had two main objectives: one, previously mentioned, was to form human capital; the other, to control student movements. The year of 1968, in which the reform of higher education took place, was a period of growing opposition to the regime, with protests coming from workers and students (Bethel, 2005).

Thus, in December of that year, Institutional Act No. 5 was enacted. With the institution of that Act, coercion was consolidated in the name of the state of national security, violating the individual rights and fundamental guarantees of citizens, ignoring the precepts and determinations of Brazilian constitution and even disregarding one of the fundamental principles of the Universal Declaration of human rights: the right and freedom, fundamentally, of expression (Paulino; Pereira, 2006).

A year later, in 1969, Decree-Law No. 477 changed the rules imposed on activities related to Brazilian universities. Together, they eliminated the possibility of student movements with legal bases and, from that moment on, students would be really subject to the dictatorial government's "iron fist" control. The dictatorial state was concerned with maintaining political and ideological control, especially in the university environment, which, despite the harsh repressions, were centers for the development of knowledge and critical rationality (GERMANO, 1993). That is,

> [...] the military authorities used various ways to "decapitate" opposition movements within universities. They used ideological

demarcation, with so-called scouts or informants. Students complacent with the military were placed on courses, especially in the Humanities area, to report teachers who were considered subversive and dissatisfied student programs and opponents of the military regime (Germano, 1993, p. 105-106).

In this scenario, repression was strongly exercised, through the control of teachers and students and the expelling of those considered subversives, in addition to acts legitimized by the ideology of national security - which also functioned as an anti-intellectual movement in the name of anti-communism (Germano, 1993).

It follows that, at first, the Armed Forces used educational incentives for the development of the country. On the other hand, the contradiction became evident, since the state invested few resources for public education, and stimulated the private sectors, linked to the accumulation of capital, facilitating and directing towards the policy of privatization of education (germano, 1993).

Shifting the focus to Nigeria, in the 1960s, period of independence, the educational policy aimed mainly at the use of schools to train labor for economic development and the Africanization of civil service (Woolman, 2001). The legacy of colonialism reinforced nation-building problems since independence. This led to a fragile democratic base that resulted in the first military coup in 1966 and three counter-coups during such period. In addition, the educational policy was of limited scope and did not meet the hopes and aspirations of Nigerians. Criticisms of the educational policy include irrelevant curricula, obsolete methods, high dropout and repetition rates, in addition to the fact that many graduates from the school system were poorly trained (Imam, 2012).

In 1969, the National Curriculum Conference was called, reviewing the educational system and its objectives, identifying new national goals for Nigeria, which would determine the future and direction of education in the country. The conference was the first national attempt to change the colonial orientation of the Nigerian educational system and to promote national awareness and self-confidence through the educational process. Education as a social service and investment in labor received priority from the government (Taiwo, 1980).

In order to consolidate the gains derived from the Curriculum Conference in 1973, the federal government, or the military government of Nigeria, instituted a seminar with different expectations to deliberate on a truly Nigerian national educational policy, involving Muslim and Christian organizations in the country. The report of the results of the seminar indicated that, after due consideration by the states of the Federation and other groups of interest, the outline of the National Education Policy was presented. In addition, the period was marked by the military government assuming control of mission schools, since education was considered a huge public government enterprise and no longer a private matter (Fagbunmi, 2005; Imam, 2012).

In 1976, when the states of the Federation were increased to nineteen, each enacted a decree for the regulation of education and its provision and management. Each state also changed the federal education law when necessary, which resulted in all state decrees having common characteristics, such as state acquisition of schools from individuals and voluntary agencies, using a similar curriculum and the establishment of school management councils, as well as a unified teaching service (Fagbunmi, 2005).

That same year, due to the substantial improvement in income brought about by the boom in oil, the federal government of Nigeria developed an ambitious Universal Primary Education (UPE) program and expanded the access to higher education, increasing the number of unitary schools in the country. UPE sought to provide free primary education to all people between six and twenty-five years of age, aiming to narrow the educational gap and reduce the increasing levels of illiteracy in the country (Fafunwa, 2004).

Despite this, this program has failed to achieve its goals of eradicating illiteracy, largely due to inadequate planning. When schools were opened to register students, instead of the expected 2.3 million children, 3 million children were there to be registered (Fafunwa, 2004), that is, the classroom provision was underestimated. In addition, there was a lack of qualified teachers. For this reason, the majority of teachers recruited went through a one-year training program at the main colleges created by the government of the time (Imam, 2012).

The most significant change of the period was the government's acquisition of mission schools, resulting in the unified educational system 7-5-2-3: 7 years of primary education, 5 years of secondary school, 2 years of high school and 3 years of University education. In the final stages, students applied for external exams and were certified based on their performance. In addition, large-scale government funding for education included free university education and the context for a national education policy that is relevant and appropriate to people's needs (Fagbunmi, 2005; Imam, 2012).

In 1977, the National Education Policy, conceived during a period when Nigeria's national economy was at it's Zenith, an educational system modeled after the American 6-3-3-4 system was introduced: 6 years of primary education, 3 years of junior secondary school, 3 years of senior secondary school and 4 years of university education (Nwagwu, 2007).

Having made this presentation, the following item presents the approximations and distances between the educational systems of the two countries in question.

Approximations and distances between the educational systems of Brazil and Nigeria (1964-1985)

The purpose of this section is to bring approximations and distances between the educational systems of Brazil and Nigeria in the period highlighted in the present study.

During the period of Brazilian military government, education had an American influence. USAID agents, within the scope of MEC, guided proposals for the reorganization of primary and secondary education, in 1971, and higher education in 1968, aiming to adapt them to the demands of the labor market. In this sense, there is an approximation with the educational system of Nigeria, when the National Education Policy of 1977, conceived during a period when the national economy of Nigeria was at it's Zenith, introduced the educational system 6-3-3-4, modeled after the American system: 6 years of primary education, 3 years of junior secondary school, 3 years of senior secondary school and 4 years of university education (Germano 2000; Nwagwu, 2007).

In Brazil, concurrently with public schools, private institutions were encouraged by military governments to offer primary and secondary education and higher education, thus distancing themselves from Nigeria, which in this period was marked by the taking of power - by the military government - of private or mission schools, since education was considered a governmental enterprise and no longer a matter of private initiative. Thus, the Nigerian government enacted the decree no. 14 of 1967, which was used in the creation of twelve states, of the four existing regions. Each state enacted a decree for the regulation of education. For example: Education Law of the State of Lagos decree n. 11 of 1970, educational decree no. 5 of the Central-Eastern state, educational decree no. 20 of 1971 of the Southeast state, and educational decree no. 5 of 1973 of the Midwest state. These had a common characteristic: the acquisition of private schools by the state. These decrees were enacted in each state of the federation for the regulation of education. In addition to them, the UPE program was designed to give children free primary

education in order to reduce illiteracy in the country (Fagbunmi, 2005; Amaewhule, 2018; Germano, 1993). This also denotes characteristics of democratic management of education, given the principle of decentralization of decisions about education.

In Brazil, law no. 5,692, of August 1971, provided in article 45, corroborating the provisions of §2 of the 1967 Constitution, states:

> The educational institutions maintained by the private initiative will deserve technical and financial support from the Public Power, when their operating conditions are deemed satisfactory by the inspection bodies, and the supplementation of their resources is more economical to meet the objective (Brasil, 1971).

In addition, that same law in Article 1 states the following, in terms of the purpose of education:

> Primary and secondary education have the general objective of providing the student with the necessary training to develop their potential as an element of self-realization, qualification for work and preparation for the conscious exercise of citizenship (Brasil, 1971).

This legislation, due to its characteristics focused on technical training, aimed at the insertion of young people in the universe of work.

It should be noted that it was not possible to access the contents of the specific Nigerian laws of each state mentioned above; however, we bring some constitutional principles that give us an idea about the educational intentions of the leaders of that country, during the period chosen for this study. In the Nigerian Constitution of 1979, in article 18, emphasis should be given to the following principles:

> (1) The government should direct its policy to ensure that there are equal and adequate educational opportunities at all levels.

> (2) The government will promote science and technology.

(3) The government will endeavor to eradicate illiteracy; and to this end, the government must, however and whenever possible, provide:

a. Free, compulsory and universal basic education.

b. Free high school.

c. Free higher education.

d. Free adult literacy program (Nigeria, 1979).

From the data above, emphasis should be given to the claim of equal and adequate educational opportunities at all levels of schooling, that is, it is in conjunction with the desire to provide the population with free, mandatory and universal basic education. In this perspective, the eradication of illiteracy is aligned with free adult literacy programs and free higher education. In Brazil, similarly to Nigeria, the mandatory and free primary education that would be provided from 7 to 14 years of age (BRAZIL, 1971), here it can be understood in that basic education orientation, as a right to every citizen and equality of opportunities (Brasil, 1967, art. 168).

There is a commitment, both in the Nigerian and Brazilian cases, to the promotion of science and technology. In Brazil, being a prerogative aimed at higher education.

Another issue concerns the scarcity of qualified teachers. In Brazil, the expansion of the primary and secondary education and the consequent democratization of access also brought the need for teacher training, resulting in the so-called precariousness of teaching work, since it resulted in an accelerated teacher training and wage loss. Similar to Brazil, universal access to basic education in Nigeria led to a decline in the quality of public schools in the 1980s. Mission schools were also taken over, with force. Due to excess of oil on the world market, Nigeria's ability to finance its education has been affected (Fagbunmi, 2005).

III.   FINAL CONSIDERATIONS

The curiosity that motivated this study was to know possible similarities and dissimilarities in the educational field between Brazil and Nigeria, considering that both countries experienced dictatorial regimes that, although they contain particularities, occurred in concomitant periods.

Brazil and Nigeria were governed by dictatorial regimes, characterized by the elimination of civil and

political rights. This is an important approximation between the two countries, since it is a characteristic of exception regimes. Military regimes in both countries were responsible for extrajudicial killings, disappearances, torture, arbitrary detention and reduced freedom of expression (Fausto, 1999; Owo, 2000).

Constitutional approximations were noted in terms of universalization of primary or basic education, as well as being free of charge.

The military government in Brazil saw education as an important point for the country's development, since it wished to proceed with the industrialization and modernization project. To this end, the organization of the educational system took place based on human capital formation, and with the strengthening of private initiative in this regard. Thus, there is an important distance in terms of educational principles, since Nigeria understood education as a public, state issue, when it takes its responsibility, removing it from the hands of private initiative (Germano, 1993; Fagbunmi, 2005).

In addition, in Nigeria, the military government saw education as a social service, and considered it important to invest in work, in order to lead to the development of the country (Woolman, 2001).

Finally, there is a distancing from Brazil in relation to Nigeria when it constitutionally refers to the effort to eradicate illiteracy. Although in Brazil, during this period, this was an important topic, it goes beyond both the 1967 Constitution and Law no. 5,692/71.

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[i] For this study, we consider the period from 1966 to 1985, which coincides with the dictatorship in Brazil.

Influence of Particle Size and Fibre Content on the Dimensional Stability and Mechanical Behaviour of composites produced from *Cordiamillenii* and Recycled Polyethylene

Temidayo. E. Omoniyi

Department of Wood Products Engineering, University of Ibadan, Ibadan, Nigeria

Abstract— *The degradation of the environment by wood and plastic wastes has continued to attract serious attention. Utilisation of these wastes without additives and pre-treatment for the production of wood plastic composites will give credence to the fundamentals of compatibility and performance of the composites and also for economic reasons. Therefore, this study was designed to investigate the dimensional stability and strength properties of wood plastics composites produced from wastes of Cordiamillenii and recycled polyethylene at a target density of 920kg/m³. Three levels of wood particle size ($0.0 < 0.25, 0.25 \leq 1.0$ and $1.0 < 2.0$), three levels of wood/plastics ratio (30:70, 40:60 and 50:50) and three types of recycled polyethylene (LDPE, HDPE and LDPE/HDPE) were applied. The dimensional stability (Water Absorption (WA), thickness swelling (TS) and Linear Expansion (LE)) and strength properties (Modulus of Elasticity (MOE) and Modulus of Rupture (MOR)) were examined. The mean range of results obtained for the sorption properties (WA; 1.6-10.2%, TS; 0.14-2.07% and LE; 0.11-0.37%) indicated the composites are dimensionally stable. The mean strength properties values (MOE; 0.24-1.81GPa and MOR; 6.55-15.87MPa) compared favourably with those reported in literature. The composites produced with HDPE at 30% wood content had higher strength and lower sorption properties than other formations. Particle sizes, plastics types and mixing ratio had significant effect the dimensional stability and mechanical behaviour of the composites at $\alpha_{0.05}$ significance level. Acceptable WPCs were produced from Cordiamillenii wastes and recycled polyethylene for non-structural applications.*

Keywords— *Cordiamillenii, Dimensional stability, Modulus of elasticity, Recycled polyethylene, Wood plastic composites.*

I. INTRODUCTION

There has been a huge demand for wood for man's use which has led to destructive exploitation of trees especially in Nigeria despite the availability of large number of diverse tree species. Wood has been used since time immemorial for medicinal, fuel, cultural, construction, agricultural, and animal fodder putting pressure on the forest and resulting in extreme deforestation. Aina [1] observed that one of the factors that have contributed greatly to the spontaneous depletion of the country's timber resources is the large accumulation of wastes generated during log harvesting and processing. Waste wood is usually composed of sawdust, wood offcuts, wood chips, wood barks, and plain shavings. 1.8million tons out of the 5.2million wood wastes generated in Nigeria are

sawdust [2]. The wood wastes are used as landfill, sometimes disposed causing environmental pollution, or burnt which releases greenhouse gases into the atmosphere causing health issues. If wood wastes are maximally utilized and recycled, the number of trees cut yearly for lumber production and the negative effects on the environment would be reduced.

The environmental accumulation of plastic products wastes in form of pollution adversely affect wildlife habitat, aquatic habitat, humans and cause the degradation of the environments [3]. The popularity of plastic pollution correlates with plastics being cheap and durable, which makes it available to humans for use at high volumes. However, it degrades at a slow rate. Plastic wastes include Sachet water plastic, plastic containers (for food, water,

and, some other liquids) etc. These are found in large quantities littering the environment, water bodies and dumpsites across Nigeria.

Koranteng [4] reported that researchers across the world have focused attention on wood plastic composites (WPC) to curb the environmental impact of plastic wastes and over-consumption of forest wood. Wood-plastic composites (WPC) are composite materials consisting of wood fibre/ wood flour and thermoplastics; Low Density Polyethylene (LDPE), High Density Polyethylene (HDPE), Polypropylene (PP), Poly Vinyl Chloride (PVC), etc. [3, 5]. Stark [6], also reported that researchers are combining wood fibres with thermoplastic resin resulting in wood-plastic composites (WPCs) in order to increase the value of low-value wood resources to high-value products. The most common type of WPCs panels widely used in USA are produced by mixing wood flour and plastics to produce materials that can be processed to perfect plastic based products [7-10]. Due to the large benefits the WPCs materials exhibit, the use of the materials made of thermoplastics resins loaded with fillers rich in lingo-cellulosic fibres had increased over the years.

The geometry of wood particle as well as the ratio influenced the strength properties of WPCs from *Laran Species* [11]. The properties of WPCs were observed to have been affected by the particle size and fibre contents ([12 – 15]. This study was aimed at evaluating the influence of the particle sizes, fibre contents and polymer types (LDPE, HDPE and Mixture of LDPE and HDPE) on the dimensional stability and mechanical properties of WPCs produced from *Cordiamillenii*, without additives and pre-treatment, by extrusion and hot press processes.

II. MATERIALS AND METHODS

2.1 Material collection and preparation

2.1.1Wood residue

Cordiamillenii (Omo) was used in this experiment because it is widely used for constructional purposes and the residues from the wood are available in abundance [16]. The wood waste was collected from a local plant market at Sango, Ibadan, Nigeria as shown in Plate 1.

Plate 1. Sawdust of Cordiamillenii (Omo)

2.1.2 Recycled Polyethylene

Recycled plastic containers, grocery bags, water sachets and flexible bottles were collected from discarded municipal and commercial waste outlets and were graded as Low Density Polyethylene (LDPE) and High Density Polyethylene (HDPE).

2.1.3 Materials preparation

The wood wastes were milled and screened by sieving to three particle sizes of $0.0 < 0.25$, $0.25 \leq 1.0$ and $1.0 < 2.0$ by using mesh numbers 60, 18 and 10, respectively. The sieved particles were first sundried for one week and later oven-dried at $103 \pm 3\,^{0}C$ to a moisture content of 4.0% (Plate 2). The recycled LDPE and HDPE were thoroughly washed with detergent, well rinsed, and dried in convection oven at $60\,^{0}C$ for 12 hours. The dried samples were shredded and hammer milled (Plate 3) to granules of 0.2-0.5µm in diameter (Plate 4a: LDPE, and 4b: HDPE).

Plate 2: Saw-dust of Cordiamillenii

Plate 3: Milling of recycled Polyethyleyne

Plate 4a: Milled rcycled Polyehylene (LDPE)

Plate 4b. Milled rcycled Polyehylene (HDPE)

2.1.4 Composite Processing

The amount of wood flour was varied from 30, 40 to 50 wt% on the total weight of plastics wastes. The nomenclature and formulation of samples are shown in Table 1.0. The wood flour and the polymer matrix were blended using a laboratory scale mixer for 10 minutes. The blends were compounded in a single screw extruder (Plate 5). The temperatures of the extruder were controlled at mixing (120^0C), melting and mixing ($160 – 170^0$C) and metering (170^0C), the screw speed was 40rpm. The extruded strand was cooled and subsequently hot pressed to sheet of a nominal thickness of 10mm and 20 by 30 cm nominal dimensions using a laboratory hot press at 170^0C for 2minutes at a pressure of 3.5MPa (Plate 6). After hot

pressing, boards were kept in a cold press for 5min. The boards were later kept at room conditions for seven days before samples were cut for physical and mechanical tests.

Plate 5: Single Screw extruder

Plate 6: Hot Press

2.2 Tests for Physical Properties

Dimensional stability of samples was investigated by WA, TS and LE properties of the samples. The tests were carried out according to ASTM D570: [17] and British Standard 373 [18]. Measurements of mass (g), thickness (mm) and length (mm) of the samples were taken prior to treatment as initial parameters while the final measurements were taken after immersion in water for 24 hrs using electronic weighing balance, digital caliper and meter rule, respectively. The properties were estimated using equations (1), (2) and (3):

Water Absorption (WA (%)):

$$WA\ (\%) = \frac{W_2 - W_1}{W_1} \times 100 \qquad (1)$$

Thickness Swelling (TS (%)):

$$TS\ (\%) = \frac{T_2 - T_1}{T_1} \times 100 \qquad (2)$$

Linear Expansion (LE (%)):

$$LE\ (\%) = \frac{L_2 - L_1}{L_1} \times 100 \qquad (3)$$

Where: W_1, T_1, L_1 are initial mass (g), thickness (mm), and length (mm) before treatment and W_2, T_2, L_2 are final mass (g), thickness (mm) and length (mm) after treatment, respectively.

2.3 Tests of Mechanical Properties

The mechanical properties were assessed through bending and static flexural tests and were determined according to ASTM D 7031-04 [19] and ASTM D638-99 [20] specifications using an INSTRON testing machine (Plate 7). Nominal sizes of the samples produced were $200 \times 30 \times 10$ mm. with a speed loading of 10mm/min. MOR and MOE were calculated, three samples of each treatments were tested. All tests were carried out at room temperature (25 ± 2^0C) and constant relative humidity (65%). The specimens were conditioned at constant room temperature (25 ± 2^0C) and relative humidity (65%) prior to testing.

Plate 7: Flexural Test of WPC

Statistics Analysis

Data were analysed using descriptive statistics and Analysis of variance at 5% probability level to estimate the level of significance among the various parameters tested. The experiments were laid in $3 \times 3 \times 3$ factorial in completely randomized design as shown in Table 1. Three replications were produced for each composite formulation resulting into the production of 81 specimens

Table 1.0: Formulations of Samples (Research Design)

Factor A Size of Wood Particles (mm)	Factor B (Type of Plastics)	Factor C Wood/Plastic Ratios (w/w)
0.0< **0.25** (Fine)	LDPE	30:70
0.25≤ 1.0 (moderate)	HDPE	40:60
1.0<2.0 (Oversize)	Mixture	50:50

III.   RESULTS AND DISCUSSION

Plate 8 shows the samples of composites produced. The **dimensional** stability properties investigated were the WA, TS and LE, and the mechanical strength properties investigated were the MOE and MOR of the WPCs at the target density of 920kg/m^3 for all the specimens considered. The results are shown in Table 2.0.

Plate 8: Samples of Composites Produced

Table 2. Physical and mechanical properties of WPC as influenced by wood particle size, plastics type and wood-plastics mixing ratio

Particle size	Plastic Type	Wood plastic ratio (w/w)	TS (%)	WA (%)	LE (%)	MOE (GPa)	MOR (MPa)
Fine	LDPE	30W70P	0.35±0.03	3.8±0.14	0.11±0.01	0.95±0.05	10.87±0.05
moderate	LDPE	30W70P	0.39±0.05	5.5±0.09	0.13±0.01	0.68±0.03	10.12±0.04
Oversize	LDPE	30W70P	0.60±0.02	6.1±0.14	0.18±0.02	0.45±0.06	9.15±0.03
Fine	LDPE	40W60P	0.76±0.08	4.6±0.19	0.16±0.04	0.83±0.04	8.77±0.07
moderate	LDPE	40W60P	1.41±0.11	7.6±0.18	0.22±0.01	0.61±0.03	7.79±0.02

Oversize	LDPE	40W60P	1.96±0.09	8.0±0.26	0.29±0.03	0.41±0.07	7.74±0.08
Fine	LDPE	50W50P	0.89±0.01	6.5±0.14	0.24±0.02	0.67±0.04	8.25±0.12
moderate	LDPE	50W50P	1.82±0.07	8.9±0.09	0.3±0.01	0.53±0.07	6.91±0.08
Oversize	LDPE	50W50P	2.07±0.09	10.2±0.9	0.37±0.03	0.32±0.05	6.55±0.08
Fine	HDPE	30W70P	0.14±0.01	1.6±0.04	0.11±0.02	1.81±0.02	15.87±0.44
moderate	HDPE	30W70P	0.18±0.02	1.9±0.07	0.12±0.01	1.49±0.09	14.08±0.21
Oversize	HDPE	30W70P	0.46±0.06	2.3±0.08	0.17±0.06	0.93±0.03	10.1±0.15
Fine	HDPE	40W60P	0.55±0.03	2.2±0.04	0.12±0.01	1.46±0.08	12.43±0.09
moderate	HDPE	40W60P	1.20±0.07	2.8±0.03	0.14±0.03	1.03±0.04	10.45±0.05
Oversize	HDPE	40W60P	1.51±0.13	3.6±0.07	0.21±0.03	0.69±0.03	9.62±0.64
Fine	HDPE	50W50P	0.72±0.6	2.7±0.06	0.18±0.04	1.25±0.01	10.25±0.36
moderate	HDPE	50W50P	1.29±0.2	4.4±0.32	0.21±0.01	0.71±0.16	9.25±0.91
Oversize	HDPE	50W50P	1.67±0.4	6.5±0.99	0.28±0.02	0.48±0.02	8.99±0.25
Fine	MIXTURE	30W70P	0.29±0.02	2.9±0.17	0.11±0.02	1.18±0.07	13.01±0.73
moderate	MIXTURE	30W70P	0.35±0.03	3.5±0.21	0.13±0.01	1.0±0.06	12.33±0.22
Oversize	MIXTURE	30W70P	0.58±0.09	4.0±0.15	0.19±0.02	0.54±0.09	9.21±0.97
Fine	MIXTURE	40W60P	0.68±0.07	3.3±0.9	0.14±0.01	1.01±0.05	11.11±0.28
moderate	MIXTURE	40W60P	1.31±0.13	4.6±0.65	0.17±0.03	0.64±0.08	8.89±0.43
Oversize	MIXTURE	40W60P	1.87±0.08	5.8±0.21	0.2±0.01	0.47±0.08	8.47±0.88
Fine	MIXTURE	50W50P	0.79±0.01	4.9±0.07	0.21±0.01	0.79±0.03	9.31±0.71
moderate	MIXTURE	50W50P	1.36±0.06	6.0±0.12	0.24±0.03	0.51±0.04	7.74±0.23
Oversize	MIXTURE	50W50P	1.80±0.04	7.7±0.09	0.32±0.01	0.24±0.01	7.52±0.78

Values are average of three replicates and values after '±' are the standard deviations; While:

TS = Thickness Swelling; LE = Linear Expansion; WA = Water Absorption; MOE = Modulus of Elasticity; MOR = Modulus of Rupture; 30W70P = Wood: Plastics = 30:70; 40W60P = Wood: Plastics = 40:60 and 50W50P = Wood : Plastics = 50:50

3.1 Water Absorption

The mean water absorption ranged from 1.6±0.04 to 10.2±0.9 (Table 2.0). The lowest value was observed for fine particle size 0.0< 0.25, high density polyethylene and wood plastics ratio of 30:70 as shown in Fig. 1a., while the highest value was observed in oversized particle (1.0<2.0), low density polyethylene, and wood plastics ratio of 50:50 (Fig. 1b). The ANOVA test (Table 3) indicated that all the production variables (particle size, plastic type and wood plastic ratio) have significant effects on WA of the WPC produced. Also the interactions between the production variables except for particle size and mixing ratios have significant effect on WA of the WPC produced. The result indicated that water absorption increased with increase in particle size and increased with increase in proportion of wood content in wood/plastics ratio. This is in agreement

with the report of Rahman *et al* [21]. This could be due to the fact that wood is hydrophilic which exhibit poor resistance to moisture leading to high water absorption as the proportion of wood in WPC is increased. This is also in accordance with the reports of Goszdecki and Wilcysynski, [22]; Azeez, [23]; Oluyege *et al* [24]. Also wood contain natural substances such as pectin, lignin and waxes which interfere with wood adhesion with the polymer matrices. The fine particle sizes are easily dispersed in the polymer matrix and are fully encapsulated by the plastics at lower wood content hence they have low water absorption. The HDPE plastic type practically shows negligible water absorption, If well processed in WPC, the water absorbed is least compared with Nylon which attract water due to the presence of the polar groups (CO-NH), therefore water absorption by Nylon was relatively high, hence the highest water absorption was sample with oversized sample, LDPE

with wood/plastic ratio of 50:50 while the least was fine sample, HDPE with wood/plastics ratio of 30:70.
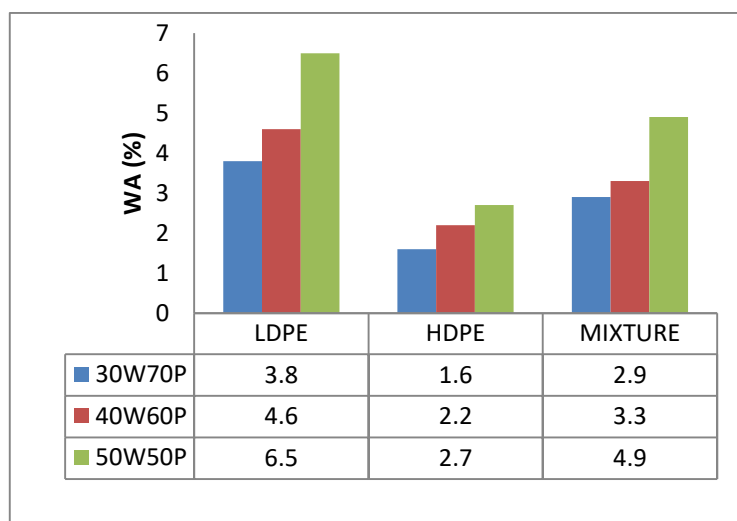
1a
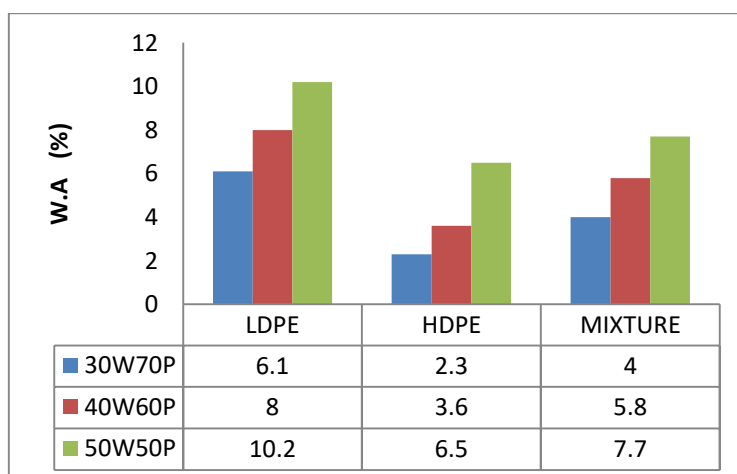
1b

Fig. 1: Influence of plastic type and mixing ratio on the WA of the WPC produced with fine and over-sized particle size

Table 3. Analysis of Variance for Water Absorption (%) at α$_{0.05}$

Source of Variation	SS	Df	MS	F	p-value	Sig.
Particle Size	26.41407	2	13.20704	110.4849	1.49E-06	Yes
Plastics Type	61.50296	2	30.75148	257.2548	5.5E-08	Yes
Mixing Ratio	38.49407	2	19.24704	161.0132	3.45E-07	Yes
Particle size x Plastics Type	2.257037	4	0.564259	4.720372	0.029883	Yes
Particle size x mixing ratio	3.365926	4	0.841481	7.039504	0.009861	Yes
Plastics Type x mixing ratio	0.623704	4	0.155926	1.304415	0.346093	No
Within	0.956296	8	0.119537			
Total	133.6141	26	5.139003			

Table 4: Analysis of Variance for Thickness Swelling (%) at α$_{0.05}$

Source of Variation	SS	df	MS	F (α)	p-value (0.05)	Sig
Particle Size	3.017266667	2	1.5086333	246.419238	6.50982E-08	Yes
Plastics Type	0.355755556	2	0.1778778	29.0544465	0.000214447	Yes
Mixing Ratio	5.414022222	2	2.7070111	442.161525	6.46058E-09	Yes
particle size x Plastics Type	0.023111111	4	0.0057778	0.94373866	0.486304785	No
particle size x mixing ratio	0.708377778	4	0.1770944	28.9264973	8.29271E-05	Yes
Plastics Type x mixing ratio	0.053488889	4	0.0133722	2.18421053	0.161194507	No
Within	0.048977778	8	0.0061222			
Total	9.621	26	0.3700385			

Table 5: Analysis of Variance for Linear Expansion (%) at α$_{0.05}$

Source of variation	SS	Df	MS	F	p-value	Sig.
Particle Size	0.039622	2	0.019811	148.5833	4.72E-07	Yes
Plastics Type	0.012022	2	0.006011	45.08333	4.41E-05	Yes
Mixing Ratio	0.068889	2	0.034444	258.3333	5.41E-08	Yes
particle size x Plastics Type	0.000889	4	0.000222	1.666667	0.249461	No
particle size x mixing ratio	0.001489	4	0.000372	2.791667	0.101082	No
Plastics Type x mixing ratio	0.005289	4	0.001322	9.916667	0.003434	Yes
Within	0.001067	8	0.000133			
Total	0.129267	26	0.004972			

3.2 Thickness Swelling (TS)

Table 2 presents the results of the TS of the composites produced from different wood particles (*Cordiamillenii*) sizes and LDPE, HDPE and a mixture of both after 24h immersion in water. The mean TS ranged from 0.14±0.01 – 2.07±0.09%. Composites produced from large sized wood particles and LDPE at 50% wood contents showed the highest TS value of 2.07%, while those produced from fine wood particles and HDPE at 30% wood contents showed the lowest value of 0.14%. Figure 2 showed how the particle size, plastic types and mixing ratios influenced the TS properties of the composites. Generally an increase in wood particle size and wood contents increased the TS values. The ANOVA test (Table 4.0) carried out on the TS values at 5% (p<0.05) probability showed significant differences as regards the particle size, plastic type as well as the mixing ratio. The results showed that there was a significant difference regarding the interaction of particle size and mixing ratio while the interaction between the particle size and plastic types, and plastic types and mixing

ratio showed no significance differences on thickness swelling.

	LDPE	HDPE	MIXTURE
■ 30W70P	0.35	0.14	0.28
■ 40W60P	0.76	0.55	0.68
■ 50W50P	0.89	0.72	0.79
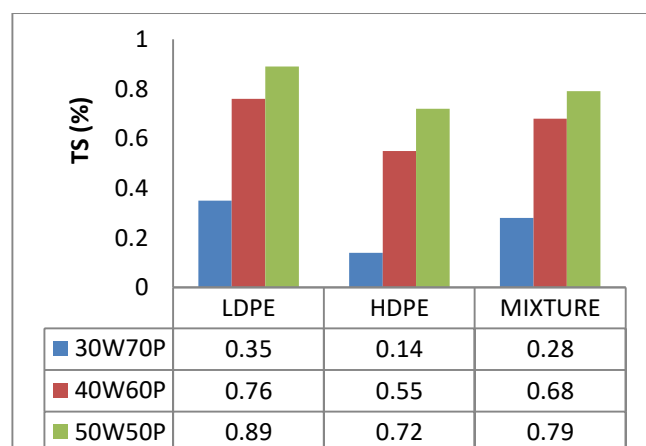
Fig. 2: Influence of plastic type and mixing ratio on the TS of the WPC produced with fine particles

3.3 Linear Expansion (LE)

The mean LE values for WPC produced from *Cordiamillenii* particles of different sizes with different plastic types at different wood/plastics proportions ranged

from 0.11±0.02 to 0.37±0.03% (Table 2). The least value (0.11%) of LE was observed for all the plastic types with fine particles (<0.25) of 30% wood contents. The highest value (0.34%) was observed for the composites produced from oversized wood particles, LDPE plastics type at 50% wood contents. Generally, values of LE in WPCs produced with HDPE were lower compared to those produced with LDPE and a mixture of both. Figure 3 shows the influence of plastic types and mixing ratio of the best performing particle size (fine) on the LE properties of the WPC produced. The ANOVA test results (Table 5) for the LE of the composites produced showed significant effect of the particle size, plastic types and mixing ratio on the overall LE properties of the composites. However only the interaction of plastic types and mixing ratio had significant effects on the LE while other interactions, particle size and plastic type; particle size and mixing ratio, had no significant effect on LE of the WPC produced.

	LDPE	HDPE	MIXTURE
■ 30W70P	0.11	0.11	0.11
■ 40W60P	0.16	0.12	0.14
■ 50W50P	0.24	0.18	0.24
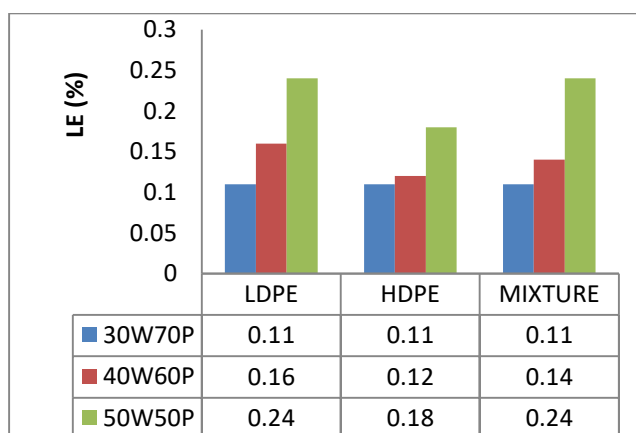
Fig.3: Influence of plastic types, and mixing ratio on the LE of the WPC produced with fine particles.

3.4 Modulus of Elasticity (MOE)

The mean values of modulus of elasticity (MOE) of the composites produced, as presented in Table 2, from the combination of wood (*Cordiamelanii*) particles of different sizes and plastics of different kinds at different wood and plastics proportion ranged from 0.24±0.01 to 1.81±0.02GPa. These values compared favourably with those reported in literature (0.46 – 1.79GPa) for WPCs produced from wood (*Ceibapentandra*) particles and different plastic materials by Oluyege*et al* [24], and those reported by Aina*et al* [25]. The values also compared well with the typical values revised by Chan *et al* [26]. The

values were less compared to the values reported by Adefisan and McDonald[27] for composites produced from mahogany and teak. This can be linked to the fact that coupling agent was used for the WPC whose MOE was reported. The lowest mean value of MOE (0.24GPa) was observed for the composites produced from the combination of large size wood particles (50%) and a mixture of LDPE and HDPE plastics (50%), while the highest mean value of the MOE (1.81GPa) was observed for the composites produced from the extrusion of fine wood particles at 30% and HDPE at 70%. Generally, as the wood particles' size increased the MOE values decrease, and similar trend was observed as the wood proportions increased The MOE also reduced. However, an increase in the proportion of plastic in the mixing ratio increases the MOE of the composite produced. These findings may be due to the high elastic nature of plastic which is better than that of wood. Another variable which had effects on the MOE of the WPCs produced is the type of plastic used; composites produced from HDPE had the highest observed mean MOE values, then composites produced from a mixture of both plastic types and finally the LDPE produced composites. Figure 4 shows the relationship between the production variables for the best performed produced WPC in terms of MOE.

	LDPE	HDPE	MIXTURE
■ 30W70P	0.95	1.81	1.18
■ 40W60P	0.83	1.46	1.01
■ 50W50P	0.67	1.25	0.79
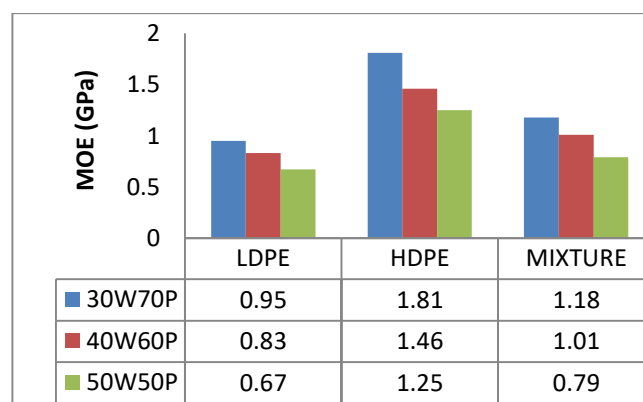
Fig. 4: Influence of plastic types, and mixing ratio on the MOE of the WPC produced with fine particles

The results (Table 6) of the ANOVA test carried out indicated that the particle size, plastic types and mixing ratio all had significant effect on the MOE of the composites produced. The interactions of the plastic types with the particle sizes and with the mixing ratio both had significant effects on the MOE, while the interaction of the particle size and mixing ratio had no significant effect on the overall values of the MOE of the composite produced.

Table 6: ANOVA for the MOE of Composites Produced at 0.05 Significant Levels

Source of Variation	SS	df	MS	F (α)	p-value	Sig.
Particle Size	1.632141	2	0.81607	254.0663	5.77E-08	Yes
Plastics Type	1.19503	2	0.597515	186.0236	1.96E-07	Yes
Mixing Ratio	0.693252	2	0.346626	107.9147	1.63E-06	Yes
particle size x Plastics Type	0.113259	4	0.028315	8.815221	0.004982	Yes
particle size x mixing ratio	0.03317	4	0.008293	2.581724	0.118144	No
Plastics Type x mixing ratio	0.131015	4	0.032754	10.19717	0.00314	Yes
Within	0.025696	8	0.003212			
Total	3.823563	26	0.14706			

Table 7: ANOVA for the MOR of Composites Produced at 0.05 Significant Levels

Source of Variation	SS	Df	MS	F	p-value	Sig.
Particle Size	28.25669	2	14.12834	36.72429	9.31E-05	Yes
Plastics Type	34.49216	2	17.24608	44.82832	4.5E-05	Yes
Mixing Ratio	51.39007	2	25.69503	66.78998	1.02E-05	Yes
particle size x Plastics Type	2.661822	4	0.665456	1.729741	0.23606	No
particle size x mixing ratio	6.412911	4	1.603228	4.167325	0.040951	Yes
Plastics Type x mixing ratio	0.873444	4	0.218361	0.567594	0.693668	No
Within	3.077711	8	0.384714			
Total	127.1648	26	4.890954			

3.5 Modulus of Rigidity (MOR)

Presented in Table 2 are the mean values observed for the MOR of the composites produced from the extrusion, at different proportion, of ***Cordiamillenii*** particles of different geometry and plastic types. The results showed the MOR values ranged from 6.55±0.08 to 15.87±0.44MPa. These values compared favourably with the 7.3 – 21.7MPa reported by Adefisan*et al* [28] and the 2.76 – 16.42MPa reported by Olugeye*et al* [24]. The highest mean MOR value (15.87MPa) was observed for the composite produced from the extrusion of fine particles <0.25mm at minima composition of 30% and HDPE while the least mean MOR value (6.55MPa) was observed for the composite produced from the extrusion of over-sized wood particles 1<2.0mm at 50% proportion with LDPE. The MOR values tend to increase with decrease in the particle sizes and proportion of wood in the composite. This may be due to poor interfacial adhesion, as described by Chan *et al* [26]. A significant change was observed as the plastic types were changed from LDPE to HDPE and LDPE + HDPE. The HDPE performed best of the plastic types. This may be due to the density difference in the plastic types which will invariably translate to the composites each produced. Figure 5 illustrates the effects of plastic types and mixing ratios on the composites produced with fine particles which gave the best tensile strength for the composites.

The WPCs produces showed a decreasing trend as the wood contents increased this may be due to disruption of the continuity of polymer matrix resulting into creation of several stress concentration points and therefore reduction in MOR. Also the larger the particle sizes the more the reduction in MOR. It was also observed that samples with fine particle size exhibited greater MOR than the oversized ones this could be as a result of better interaction and dispersion of fine particle sizes in the polymer matrices. The gradual loss in mechanical property could probably be attributed to an increased probability of flaws and defects in the composite matrix interface with reinforcing large particles.

	LDPE	HDPE	MIXTURE
■ 30W70P	10.87	15.87	13.01
■ 40W60P	8.77	12.43	11.11
■ 50W50P	8.26	10.25	9.31
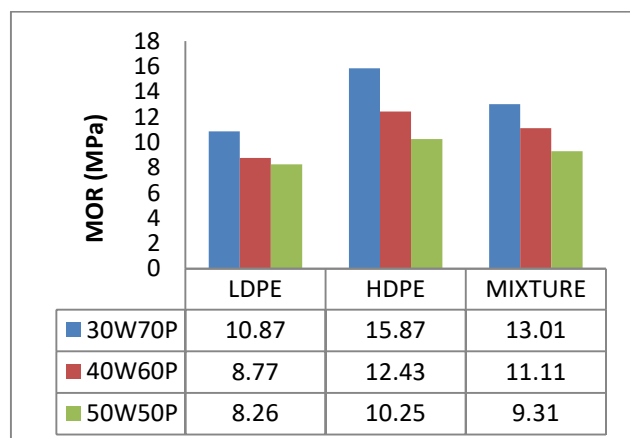
Fig. 5: Influence of plastic types, and mixing ratio on the MOR of WPC produced with fine particles

As presented in Table 7, the ANOVA test carried out indicated that the particle sizes, plastic types and mixing ratio all had significant effect on the MOR of the composites produced. The interactions of the plastic types with the particle sizes and with the mixing ratio both had no significant effects on the MOR, while the interaction of the particle size and mixing ratio had significant effect on the overall values of the MOR of the composite produced.

IV. CONCLUSIONS AND RECOMMENDATIONS

Wood plastics composite was produced from recycled polyethylene and *Cordiamillenii wastes.* The influence of wood particle size, plastic type and wood plastic mixing ratio on dimensional stability and strengths properties of wood composite boards was examined. The results obtained showed that:

i. Moderate wood particle size produced acceptable non-structural wood plastics composite for internal and external application however further increase in *Cordiamillenii* particle sizes led to overall reduction in mechanical properties and stability probably due to dispersion and stress concentration problems.

ii. The higher the wood content in wood plastic composite the higher the water absorption, thickness swelling and linear expansion of the composite which will invariably affect the mechanical properties.

iii. The use of recycled Low density polyethylene, high density polyethylene and the mixture of the two produced acceptable wood plastic composite for internal and external applications within the specified parameters.

The mechanical and stability properties of the wood plastics composite can further be enhanced by pretreating the wood and by adding coupling agents or compatibilizers to improve the compatibility. The use of recycled polyethylene and wood wastes may potentially reduce the pressure on the forest resources in the provision of furniture items and also reduce environmental pollution.

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Betel (Piper betle L.) leaf essential oil extraction using steam distillation

Mai Huỳnh Cang*, Phan Thị Bảo Nhi, Nguyễn Thị Cẩm Linh

Chemical Engineering and Processing Department, Nong Lam University, Ho Chi Minh city, Vietnam.
*Corresponding author

Abstract— *The highest essential oil content was obtained at distillation conditions as below raw material's moisture content of 81.72%, distillation time of 5 hours, NaCl concentration of 15%, the ratio of raw materials and solvent of 1:3 (w/v), and the material size of 0.5mm <d <1.5mm. The quality of essential oils was then refined by using different method such as crystallization, anhydrous Na_2SO_4 filtration and double distilling. By gas chromatographic mass spectrometry (GC-MS), the main chemical components in betel essential oil are identified includinging eugenol, aceteugenol, 4-allyl-1,2-diacetoxybenzene.*

Keywords— *betel leaf, essential oil,. Piper betle L., steam distillation.*

I. INTRODUCTION

Betel vine (*Piper betle* L.) belongs to genus Piper of the family Piperaceae. Leaves of Piper betle have several bioactivities properties and are used in traditional medicinal systems to cure indigestion, stomach ache, diarrhea, flatulence and to heal wounds, scales, burns, swelling etc. The leaves are nutritive and contain ant carcinogens, showing future opportunities in anticancer drugs. The main biochemical component betel leaf is essential oil and it contributes flavor to the leaf It is also reported that essential oil contributed to the medicinal property of betel vine [1]. The main ingredient in betel essential oil is phenols (Chavicol, Chavibetol, Eugenol, ..) along with some other phenolic compounds including beta-Caryophyllen, beta-Cadinen, 4-allyl-1,2-diaxetoxybenzen (27.51%) [2]. These phenol derivatives presented in betel leaf essential oil have multi biological effects such as antibacterial, antifungal, and antioxidant effects, etc. Betel leaf essential oil exhibits inhibitory activity against 3 strains of microorganisms: Gram (+) *Bacillus subtillis*, *Aspergillus niger* and *Fusarium oxysporum* molds with values of 100, 200 and 200 μg/mL, respectively [3]. In the previous research the essential oils of betel plants contain phenol group compounds such as safrol and eugenol which have insect repellent and insecticidal activity [4,5]. Compounds such as eugenol, limonene, terpinolene, citronellal, and camphor contained in volatile oils indicate rejection activity in mosquitoes and other biting insects, which can be used as an alternative mosquito repellent replace synthetic chemicals [6, 7].

In this study, extraction essential oil from betel leaves (Piper betle L.) by using steam distillation will be carried out. This objectif of study is evaluate different conditions for *Piper betle* L. essential oils extraction. The antibacterial and antioxidant activity of *Piper betle* L. essential oil are also evaluated in this study.

II. MATERIALS AND METHODS

2.1 Materials

Preparation of material samples: The material samples used for this study were collected in the region of Hoc Mon, Ho Chi Minh city in Viet Nam. The betel leaves were washed and dried at room temperature. Agrinder (LC-1416B, Alaska, Vietnam) was used to change the size of materials.

2.2. Essential oil extraction

The betel leaf essential oil was extracted by the steam distillation method. An instrument has five main parts, including a 1000 mL volume flask containing solvent, which was distilled water in this case, another flask of 500 mL capacity was used to contain material of lemon peels. The system was heated by a VELP heating device (Model: ARE, Italy) placed under the solvent flask. A condensing equipment was placed on the top of 500 mL flask containing materials, in order to condense the steam to collect the essential oils.

2.3. Experimental design

The chemical compositions of betel leaves were firstly identified including: carbohydrates, Glycoside,

Flavonoid, Phenol, Tannins, Saponin và Terpenoid. The moisture content, total solid content and color of raw material were also analysed.

In this study, four factors influencing betel essential oil distillation were investigated. The effect of raw material's moisture content on essential oil content was evaluated through different drying time of sample, which varies from 15 to 75 minutes of drying under temperature of 50ºC by using tray drying. Time of extraction varied at 60 minutes intervals from 60 to 360 minutes. Concentration of NaCl varied from 5 to 25%. A ratio of betel leaves and water varied from ½ to ¼ (w/v). All the experiments were repeated three times and average values were expressed.

The essential oil content was used to compared the efficiencies of different experiments. The obtained essential oil was dehydrated using different technique and calculated the content using the following equation:

Essential oil content (mL/g db)

$$= \frac{Volume\ of\ betel\ essential\ oil\ obtained\ (mL)}{Amount\ of\ betel\ leaves\ originally\ used\ (g)}$$

Chemical composition of essential oils was analysed using GC-MS method using THERMO SCIENTIFIC Trace GC Ultra – ISQ instrument. Antimicrobial activity of betel essential oil was evaluated through MIC value by using agar-well diffusion method. Antioxidant activity of betel essential oil was carried out using DPPH (1,1-diphenyl- 2-picrylhydrazyl) method.

III. RESULTS AND DISCUSSION

Physicochemical characterisation of raw material

Table 1: Chemical composition identification in betel leaf

Composition	Present	Absent
Carbohydrates		X
Glycoside	X	
Flavonoid		X
Phenol	X	
Tannins		X
Saponin	X	
Terpenoids	X	

Glycosides, phenols, sapiens and terpenoids are present in betel leaf (Table 1). Glycosides and terpenoids are ingredients that make the acrid taste and pungent aroma of betel leaves. Phenol and sapiens are the components that make up the bioactive of betel leaves, especially in betel leaves contain many phenol derivatives, so betel oil has good anti-inflammatory, antifungal and antioxidant activity. Moisture content and total solid content of betel leaf are 81.72 ± 3.45 %wb and 2.27 ± 0.18 %, respectively. The colour of betel leaf is present in Table 2.

Table 2: Physicochemical of betel leaf

Parameter	Result
Moisture content (%)	81.72 ± 3.45 % wb
Total solid content (%)	2.27 ± 0.18 %
Light side	$L^* = 43.46$ $a^* = -15.93$ $b^* = 20.15$
Colour	
Dark side	$L^* = 32.89$ $a^* = -10.45$ $b^* = 11.33$

Effect of moisture content of raw material on essential oil content

Essential oils are volatile compounds and may be evaporated along with steam. When increasing drying time, moisture content of the material decreases caused a reduction of essential oil content. At the moisture content of 81.72% (corresponding to the fresh sample), the highest concentration of essential oil was obtained.

Effect of extraction time on essential oil content

Table 5 shows that the content of essential oils varies with the distillation time. At 6h of steam distillation, the content of the essential oil tends to decrease. At 5h of distillation time, the content of essential oil is highest. This result is consistent with the results of Nguyen Nho Dung, 2011. The distillation time of 5h is used to conduct the further experiment.

Table 5: Effect of extraction time on essential oil content

Extraction time (hour)	2	3	4	5	6
Essential oil content (ml/g db)	6.753	9.709	13.236	**15.416**	10.044

Effect of NaC concentrationl on essential oil content

Table 6: Effect of NaCl on essential oil content

NaCl concentration (%)	0	5	8	10	12	15	20	25
Essential oil content (ml/g db)	7.274	9.603	12.309	12.758	15.513	**19.289**	14.923	12.031

The betel essential oil content varies with the concentration of NaCl added (Table 6). The essential oil content tends to decrease at the NaCl concentration of 20%. Using a high content of NaCl, the outer epidermis containing essential oils shrinks, preventing the diffusion of essential oils, results an decrease of essential oil content. At NaCl concentration of 15%, the highest content of essential oil. This result is consistent with the research results of Nguyen Thien Chi, 2016. NaCl concentration of 15% is used to conduct the further experiment.

Effect of raw material size and ratio of raw material/ solvent content on essential oil content

Table 7: Effect of raw material size and ratio of raw material/ solvent on essential oil content

Ratio of raw material/ solvent (w/v)	1:2		1:3		1:4	
Raw material size	Grinded	Non grinded	**Grinded**	Non grinded	Grinded	Non grinded
Essential oil content (ml/g db)	11.725	10.193	**20.678**	13.147	14.953	11.142

Table 7 shows that the essential oil content varies with the size of the material and the ratio of material/solvent. A grinned sample has a higher extracted essential oil than a non-grounded material. The contact surface between the grinded material and the solvent is larger which help the oil diffuse more easily. At the ratio of material/solvent at 1/ 3 (w/v), the highest content of essential oil is obtained.

Table 8: The suitable condition fo betel essential oil extraction using steam distillation

Raw material (g)	Moisture content of raw material (%wb)	Distillation time (h)	Distillation temperature (^{0}C)	NaCl concentration (%)	Raw material size	Ratio of material/solvent (w/v)
150	81.72%	5	100	15	Grinded sample	1/3

Chemical properties of betel essential oil

Table 9: Chemical composition of betel essential oil analysed by GC-MS

TT	Compostion	Hàm lượng
1	β-Phellandrene	0.840
2	Terpinolene	0.384
3	Sabinen	0.458
4	Eucalyptol	0.630

5	γ-Terpinene	0.779
6	Terpinen-4-ol	2.668
7	Terpineol	0.306
8	4-Allylphenyl acetate	0.825
9	**Eugenol**	**22.693**
10	β-Elemen	0.650
11	Caryophyllene	0.657
12	Humulene	0.406
13	γ-Muurolene	1.758
14	Germacrene D	1.343
15	α- Muurolene	1.086
16	γ-Cadinene	0.623
17	**Aceteugenol**	**27.503**
18	1,10-Diepicubenol	0.286
19	**4-Allyl-1,2-diacetoxybenzene**	**27.391**
20	δ-Cadionol	0.698
21	α- Cadionol	8.015

The major components in betel essential oil is phenol compounds (> 77.59%)including aceteugenol (27,503%), 4-Allyl-1,2-diacetoxybenzene (27,391%), and Eugenol (22,693%). Other chemical components of betel essential oil are terpene compounds (terpinen-4-ol, γ-Muurolene, Germacrene D, α-Muurolene, α- Cadionol, ..). The phenol derivatives present in the essential oil have good biological effects such as anti-inflammatory, antibacterial and antioxidant.

IV.   CONCLUSION

The suitable conditions for steam distillation of betel essential oil are as below the moisture content of raw materials of about 81.72% (fresh sample), distillation temperature of 100ºC, distillation time of 5 hours, NaCl concentration of 15%, the ratio of material/solvent of 1/3 (w/v) and the size of raw material varied from 0.5mm to 1.5mm.

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Application of the item Response theory in the Interpretation of Decision Profiles

Claudelino Martins Dias Junior[1], Rodrigo Speckhahn Soares da Silva[2]

[1]Department of Administration Science, Federal University of Santa Catarina, Florianópolis, Brazil

[2]Federal Institute of Santa Catarina, Joinville, Brazil

Abstract— A study whose intent to examine the correlation between two dimensions that comprise decision-making profiles – "Predisposition or aversion to risk" and "Intertemporality" - in a sample comprised of 310 (three hundred and ten) individuals (undergraduate students in Business Administration). Data were collected by means of a questionnaire with 20 (twenty) questions (items) of the type (right/wrong, yes/no). With an essentially quantitative approach, a clearance of the results from the respondents was conducted and Item Response Theory (IRT) was chosen as the main methodological instrument. Results obtained include the identification of questions (items) contained in the questionnaire, which does not display relevance in the profile categorization, allowing one to identify the items that present themselves as the most qualified to categorize them into each one of the dimensions, in this case a Predisposition/aversion to risk and Intertemporality in decisions. Dimensions which do not present, a priori, correlation within the researched universe.

Keywords— Decision-making, Intertemporality, Item Response Theory, Risk.

I.   INTRODUCTION

So-called "The Knowledge Era", regards the intellectual capital as an asset, considering that entire organization should enhance it to gain a competitive advantage and, consequently, an improved economic performance. Due to this fact, the job supply created for new executives is not translated into a guaranteed professional allocation, since these professionals must have required skills and acting profiles.

One should emphasize that experiences and knowledge of new managers are not divided into different blocks, in other words, they mutually take place under an interaction of knowledge, resulting in ideas and human actions [20]. Other authors, such as [13], [25], [19], corroborate the idea that this transformation of intellectual capital into intangible capital brings competitive advantages in a market regarded as global.

Another critical point that has been under discussion is that people and organizations are part of a context permeated by complexity. Therefore, managers have a crucial role in this process, because they need to mobilize their managerial skills as a transposition link of individual skills for the collective ones, something that may favor the enhancement of institutional skills [17]. Corroborating this

statement, [15] and [10] share a conception that individual skills should be collectivized in a organization.

[18] believe that a conceivable operational model for research could approach two relevant concepts on judging decisions process, which are intertemporal choices (related to impulsivity and to individual cognitive differences of temporal orientation) and risk-related choices (related to phenomenon of aversion and loss under risk when making decisions).

Therefore, one suggests the following research issue: is there a correlation between aversion-related decision profiles or predisposition to risk and intertemporal decisions?

To answer the research issue, this study has the intent to analyze profiles decision of a given sample, comprised of 310 (three hundred and ten) individuals (undergraduate students in Business Administration). To achieve its goal, criteria of analysis were: predisposition or aversion to risk, Intertemporality (preference for short or long-term decisions), relying on the IRT.

First models to answer the item emerged in the 50s. Up until that point, the Item Response Theory (IRT) had been widely used in several fields of knowledge, with special emphasis on the quantitative processes applied to educational assessment.

Also, methodology is obtained by analysis and interpretation of a data bank with psychological decision profiles of undergraduate students in Business Administration, relying on IRT to establish a latent trait in sample used, a latent trait that is a characteristic of interest that cannot be directly observed or measured. In other words, it is based on the observation of other variables related to it (secondary variables), one expects to infer the usual decisional behavior of future managers.

This present study presents itself as relevant due to the struggle in understanding how certain decision profiles affect planning execution, often choosing individuals without skills or attitudes that are deemed necessary for exercise of the function assigned to it. Furthermore, its relevance is prompted by a differential perspective on performance´s evaluation, believing that this will be attached to decisions related to individual profiles, up to some degree, intrinsic.

II. THEORETICAL FOUNDATION

For [2], decision-making process beginning is a identification that something is not in tune with what is expected, or the existence of a problem which needs to be surpassed. In this regard, the decision-making process can be summed up as a choice between two or more alternatives which allow a given outcome.

Decision-taking is the process in which the managers provide responses to opportunities and threats, relying on the analysis of possible options and on the choice of alternatives, while focused on the ultimate goals. One should also mention that, regardless of a type of decision, function performed, characteristic(s) of the problem(s) and degree of information available, managers need to take at least two sorts of decisions: the ones programmed, which comprise routine decisions, with a recurring character, with easy problems to solve and, in order to consummate themselves, already have established rules, as well as procedures and policies which need to be followed; and the non-programmed, those that emerge with new, non-ordinary problems, where there are no rules to be followed, in which decision must be taken based on information and manager(s) intuition, following his(their) influence(s) of situation´s judgement [12].

From final choice about possible alternatives, [23] proposes Theory I, according to which the logic of the decision-making process consists in the support between ends and means, and in consensus about achievement of organizational goals, whilst also being attached to maximization of profitability.

Theory II would be attached to quest for satisfactory results, to adequacy between ends and means, taking into account other factors that are not associated to decision, as, for instance, motivations and habits, and in this case, there would be room for a logic of consensus, a conciliation, a system of rewards and contribution, which are aimed at the achievement of sequential objectives [23]. Thus, when the decision-maker is in doubt and opts for a satisfactory and not "ideal" outcome, not maximizing profit, his decisions can bring consequences to his company.

Theory III implies an acknowledgement that part of individual's decisions is attached to work and the other part targets political activities, and, therefore, decisions will be the result of negotiations, struggles and demands, until one reaches the restructuring of the decision-making process [23]. With that understanding, it is observed that the decision-maker is far from obtaining satisfactory results, because he is conditioned by particularities.

[8] and [27] believe that decision-maker intuition is a challenge for a psychological research. According to [9], explanations for psychological ruses in decision-making process would be related to heuristics and cognitive biases such as:

− anchor: attaching oneself to long-gone data when taking present-day decisions;

− status quo: keep what has been done;

− immobilized capital: solely protecting decisions already taken;

− confirmation of evidence: see only what one wants to see;

− context: check the wrong problem;

− self-confidence: have too much confidence, based on feeling;

− emphasis on memory: focus only on the dramatic facts;

− basic rate: leaving aside valuable information;

− guessing: identifying a pattern where there is none;

− surprise: feeling impressed by casual situations, without interdependence.

According to perspective of [26], decision-taking is the responsibility of the manager and also a formalized skill, because, in addition to the information that you have at your fingertips, you use your own knowledge, such as: technical references; political, social and cultural influences; institutional traits; and perception that you have

on the problem. This way, one creates a conviction and makes a decision, mobilizing the resources that one needs.

To [6], human being's behavior is influenced by several subjective and objective factors which are interrelated and interfere with cognitive process and, therefore, end up affecting the decisions taken by individual.

Still according to [6] perspective, when taking part of a context of uncertainty, the decision-maker clings himself to elements that are outside of decision's scope, looking for a psychological comfort to cope with this uncertainty.

A previous experience of individuals is reflected in the assessments of a future decision-making process. Soon, trust developed by the decider can become a shortcut in the cognitive process of risk assessment in decision-making, particularly in an unknown environment [6].

[7] describe two types of decision making, the probabilistic one and the value judgment, where the latter is an indication of preferences, the position regarding the risk and values in a general way. The same authors clarify that the risk is a measure of uncertainty through which one has the possibility to assess probabilities associated with the expected events to see what will happen.

[11] apud [7], state that attitudes of individuals when facing risk may be different in two situations: when assessing prospects with high probability of earnings, they tend to go for a more conservative option to be sure there will be an earning; and, when exposed to choices in which there is a likelihood of smaller gains, decision-makers are likely to try to earn more, even if the odds are smaller. Therefore, authors mention existence of an effect of reflection, because, in the field of losses, individual's behavior is prone to risk, and, in the field of earnings, behavior is the opposite: the one of aversion to risk.

III. METHODOLOGY

For [28], research is an action necessary in science, because, through it, one pays attention to findings of reality, produces knowledge and seeks theoretical and practical answers.

The research here described is classified as of the applied type, in other words, it is suggested that its conclusions can be taken into consideration when similar practical contexts are analyzed. Regarding the approach, it is characterized as a qualitative research, because the observed data were based on human experience in circumstantial decisions with a business character, even if they have taken place in a controlled environment (simulated).

For data collection, a questionnaire was used as an instrument to set psychological decision profiles of graduate students in Business Administration.

According to [24], the questionnaire is a set of questions systematically articulated, with the intent of raising written information from the respondents or to know their opinion on a subject that is part of the study. For this research, 20 (twenty) questions were conducted to understand the individual decision profiles, in relation to predisposition or aversion to risk, and to intertemporality (preference for short or long-term decisions).

Initially, the data of 20 (twenty) items (questions) were analyzed using IRT as a single group of items. This preliminary analysis showed that such items could not be approached as a single dimension of latent trait of interest, i.e., "decision-making". Thus, items were divided into two dimensions: aversion or predisposition to risk and intertemporality (preference for short or long-term decisions).

[1] claim that, in organizational empirical research, the reliability of conclusions is directly related to validation of measuring instrument. They recommend using, in validation process, measures of internal consistency of scales (reliability), checking correlation of items with scales used (detailed analysis of every item) and if item can indeed measure what it proposes itself to measure (validity). In this study, a structured questionnaire (objective) was applied, with dichotomized responses within a subjective evaluation (open).

Initially, it was used the classical test theory (CTT), because this encompasses some useful tools to assess the quality of the measuring instrument. The biserial correlation coefficient and Cronbach's alpha coefficient, considering that first allows one to measure the degree of association between a dichotomized variable and a continuous variable, and second is useful to check the internal consistency of measuring instrument [3], [13].

In the analysis using IRT, logistic model was applied, which is based on fact that individuals with a greater ability (a latent trait of interest) have a higher probability of hitting an item. This model is defined by the Equation (1) and Fig. 1 presents the characteristic curve of three-parameter logistic model.

$$P_{ij} = P(U_{ij} = 1|\theta_j) = c_i + (1 - c_i)\frac{1}{1+e^{-Da_i(\theta_j-b_i)}} \quad (1)$$

Where:

i = 1,2,3,...,p representing each one of the items of the questionnaire; and

$j = 1,2,3,...,n$ representing the n respondent individuals in the questionnaire.
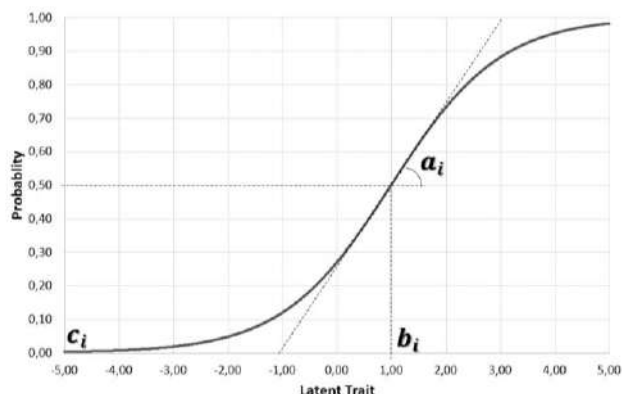
Fig. 1: The characteristic curve of an item using the 3-parameter logistic model

Source: Adapted from [3]

The parameter a_i indicates the "degree of discrimination" that an item establishes; in other words, the greater a_i, the greater will be its degree of discrimination in region of greater information and, therefore, the better item will be. By analogy, the better will values considered ideal ($a_i > 0.7$) will be;

The parameter b_i is called the "degree of difficulty". "It indicates the region, in the proposed arbitrary scale, where the item provides more information";

The parameter c_i is related to the "casual hitting". It represents the probability of low-skilled individuals to correctly respond to a certain item;

Based on a scale factor, constant and equal to 1, one uses the value 1.7 when the intent is to have the logistic function providing a result similar to that of normal ogival function;

θ_j represents the latent trait (ability) of the j-nth individual;

U_{ij} is a dichotomous variable which can assume values 0 or 1 when the j-nth individual answers the item i in accordance with the marking regarded as "correct", or 0 when a j-nth individual does not respond to the item i in accordance with the value regarded as correct.

Therefore, $P(U_{ij} = 1|\theta_j)$ is the ratio of responses according to the options regarded as "correct". In dichotomous items, one of the items must be considered correct for the purposes of carrying a calculation with IRT. In this study, there are no correct or incorrect items, and, because of that, there is no preference about the options which should be chosen as correct. The only restriction is

the choice made, in other words, one opted to consider as a reference standard the items associated with more risky and short-term decisions.

Thus, the basis for the analysis using this model lies on the fact that the individuals more prone (to take short-term decisions and with a greater risk) are more likely to mark the items reactive to that profile and that relationship is not linear, as shown in Fig. 1 [3], [14].

Considering that the type of questionnaire applied is comprised of dichotomous items, in other words, items of type Yes/No, Agree/Disagree, Apply/Does Not Apply, there is no logic in speaking about a casual hitting, because, as aforementioned, there are no right or wrong answers, and the c parameter is equal to zero [4]. The Equation (1) is reduced to Equation (2).

$$P_{ij} = P\left(U_{ij} = 1|\theta_j\right) = \frac{1}{1+e^{-Da_i(\theta_j - b_i)}} \quad (2)$$

In order to achieve that, it is necessary to establish a scale of measurement to measure the latent trait of interest (skill). [3] state that, in the IRT, the scale of measurement of the latent trait can assume, in theory, any real value between -∞ (less infinite) and +∞ (more infinite), in opposition to the classical tests, in which the scale takes only integer values. To define it, one needs to establish an origin and a unit of measure. These values should be chosen to represent, respectively, mean value and standard deviation of the abilities of the individuals in the studied population. In this scale, the parameter values typically vary between-2 and+2, and appropriate values for *a* parameter would be those greater than *1*.

For purposes of this study, a scale with a mean equal to zero and standard deviation equal to the unit is used. In IRT terminology, this scale is called (0.1). Authors also emphasize that this scale is arbitrary and the most important in it are existing order relationships between its points, and not necessarily its magnitude.

In addition, all data analyzes were conducted using R software with the assistance of packages: '*ltm*'; 'CTT'; '*irtoys*' and '*mirt*' [5], [16], [21], [22]. Using tooling available in these packages, routines were used to calculate classical analysis tests, for each of the dimensions, in other words the calculations concerning descriptive statistics and analysis using IRT. The default settings of parameters of these packages were used for all analyses.

IV. DISCUSSION AND ANALYSIS OF RESULTS

Table 1 displays behaviors results from items of each of the two groups. Column 0 [%] corresponds to percentage

of hits on items related to a more conservative profile, in other words, averse to risks and averse to short-term decision-making. And Column 1 [%] corresponds to percentage of answers related to a profile more prone to take more risky and short-term decisions.

Table.1: Proportion of responses for each of the dimensions

Predisposition and Aversion to Risk			Intertemporality		
Its.	0 [%]	1 [%]	Its.	0 [%]	1 [%]
01	0.4419	0.5581	11	0.9226	0.0774
02	0.6645	0.3355	12	0.8355	0.1645
03	0.5032	0.4968	13	0.1290	0.8710
04	0.7290	0.2710	14	0.5355	0.4645
05	0.5516	0.4484	15	0.7290	0.2710
06	0.8581	0.1419	16	0.5516	0.4484
07	0.3032	0.6968	17	0.3097	0.6903
08	0.6742	0.3258	18	0.7968	0.2032
09	0.7129	0.2871	19	0.6226	0.3774
10	0.3548	0.6452	20	0.6194	0.3806

Source: Compiled by the authors (Adapted from R software)

Fig. 2 and Fig. 3 display ratios of responses considered "correct", in other words, consistent with a profile more prone to risk and to take short-term decisions. Ordinates axis displays proportions of correct answers, in other words, hits related to a profile more prone to risk or to take short-term decisions, and, in x-axis, there is total number of hits recorded in two dimensions assessed which comprise this profile. For instance: using item 02 in Fig. 1, among respondents who obtained only two "hits" as a total score, of these, only 10% marked the option of a greater predisposition to risk.
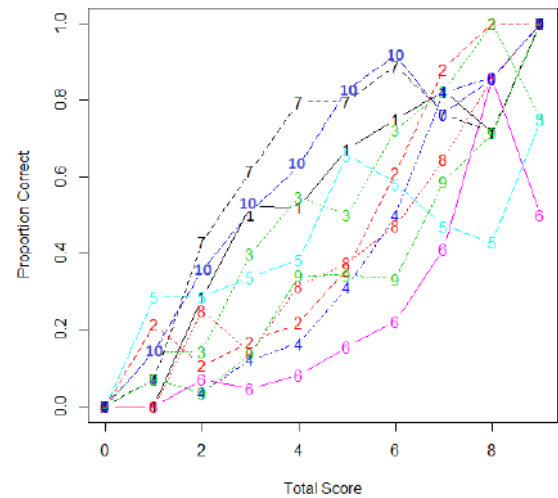
Fig. 2: Total scores and proportion for the items 01 to 10 (Predisposition/aversion to risk)

Source: Compiled by the authors (Adapted from R software)
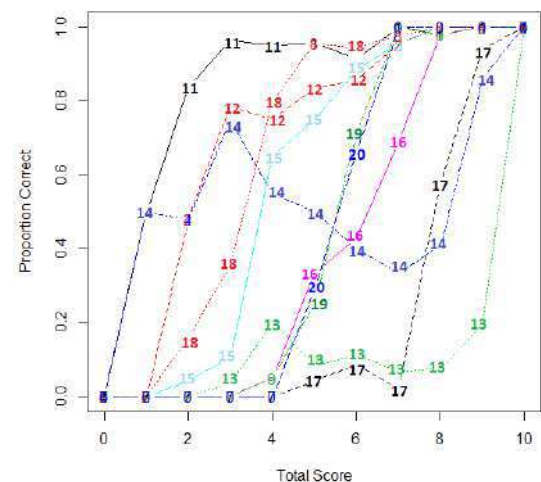
Fig. 3: Total scores and proportion for items 11 to 20 (Intertemporality)

Source: Compiled by the authors (Adapted from R software)

Fig. 4 and Fig. 2 highlight the items more and less marked for each dimension: Predisposition or Aversion to Risk and Intertemporality, respectively.
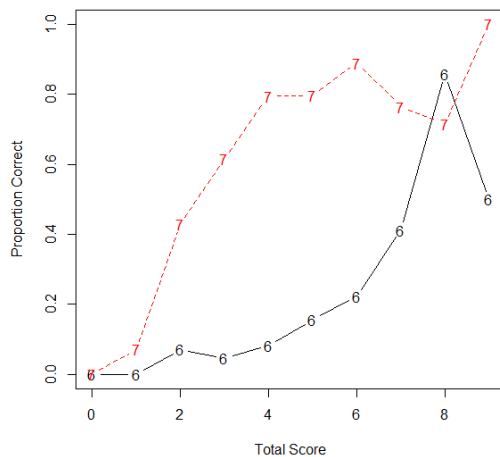
Fig. 4: Total scores and proportion of items 06 and 07 (Predisposition/aversion to risk)

Source: Compiled by the authors (Adapted from R software)

In the first group of items (1 to 10), displayed in Fig. 4, item more marked by those who have conservative profile was the item 6, with almost 86%, and item more marked for those with a profile more prone to the risk was the 07, with nearly 69.7%. Likewise, Fig. 5 presents items most marked by each profile in the second group of items (11 to 20). Item 11 was the most marked by those with a conservative profile (around 92%) and item 13 was the most marked by those with a profile more prone to take short-term decisions (approximately 87%).
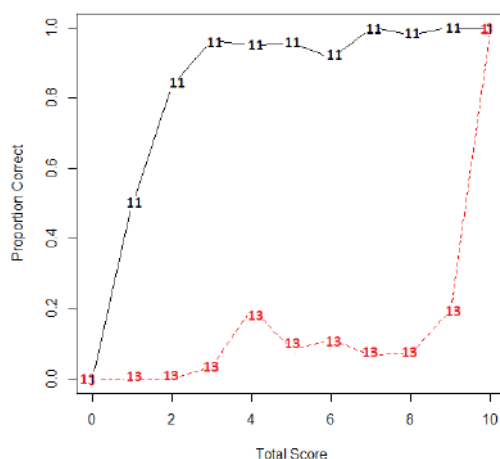
Fig. 5: Total of the scores and proportion of items 11 and 13 (Intertemporality)

Source: Compiled by the authors (Adapted from R software)

The Table 2 displays frequencies of number of "hits" in each of dimensions. Note that the larger concentration of answers is found in the intermediary items. At the edges, very conservative people (score equal to zero) or those very prone to risk (score equal to 10) correspond to only 7.7% of the group in the analysis.

Table.2: Frequency of the total scores

Score	Predisposition or Aversion to Risk (items 1 to 10)	Intertemporality (Items 11 to 20)
0	2	12
1	14	51
2	28	54
3	65	45
4	73	35
5	64	24
6	36	20
7	17	28
8	7	25
9	4	6
10	0	10

Source: Compiled by the authors (Adapted from R software)

The biserial correlation is a measure of association between performance of an item and performance of whole test (total gross score). In other words, it is the correlation between the ability to hit an item and the latent variable of interest, which is not directly measured.

Table.3: Biserial correlation (ρ) between the item and the total score

Predisposition and Aversion to Risk		Intertemporality	
Items	*Included*	**Items**	*Included*
01	0.3561	**11**	0.4376
02	0.4518	**12**	0.5724
03	0.3685	**13**	0.2680
04	0.4762	**14**	0.1716
05	0.2146	**15**	0.7747
06	0.3526	**16**	0.7799
07	0.3399	**17**	0.6546

08	0.3687	18	0.7226
09	0.3504	19	0.8374
10	0.4030	20	0.8437

Source: Compiled by the authors (Adapted from R software)

In Table 3, one observes that all items between 01 and 10 show a biserial correlation coefficient with a value below the desired ($\rho > 0.7$). Therefore, there is a very weak correlation between each of items and total score. From items 11 to 20, item 17 has a value close to reference of item 14 ($a_{14} = 0.1716$). Item 17 presented a coefficient very close to the one regarded as ideal ($a_{17} = 0.6546$) and items 15, 16, 18, 19 and 20 showed values higher than 0.7.

Table 4 presents the values of the Cronbach's alfa coefficient for each of the tests (*All*) and internal consistency of each group, excluding each of items. Internal consistency among items from 01 to 10 is very low ($\alpha = 0.2832$); in other words, the pattern of responses is random (there is no internal consistency). Among items 11 to 20, one can attest a significantly higher value ($\alpha = 0.8166$), there is an internal consistency in this group of items, as suggested by [13].

Table.4: Cronbach's Alpha Coefficient

Predisposition and Aversion to Risk			Intertemporality		
	Its.	Value		Its.	Value
All		0.2832	**All**		0.8166
Excluding	01	0.2787	*Excluding*	11	0.8140
Excluding	02	0.2150	*Excluding*	12	0.8036
Excluding	03	0.2728	*Excluding*	13	0.8295
Excluding	04	0.1953	*Excluding*	14	0.8589
Excluding	05	0.3521	*Excluding*	15	0.7779
Excluding	06	0.2435	*Excluding*	16	0.7766
Excluding	07	0.2747	*Excluding*	17	0.7958
Excluding	08	0.2622	*Excluding*	18	0.7861
Excluding	09	0.2670	*Excludin*	19	0.7665

			g		
Excluding	10	0.2458	*Excluding*	20	0.7653

Source: Compiled by the authors (Adapted from R software)

According to the estimates of parameters displayed Table 5, not all items have good discrimination ($a_i > 0.7$) as preconized by methodology. In the first group, only items 02, 04 and 06 showed good discrimination, allowing one to differentiate those with aversion to risk from those more prone to risk. Other items allow one to attest that difference between probabilities of answers (axis y) of two individuals, with abilities 1.0 e 2.0 (axis x), for instance, is very small. Taking item 03 as an example, one perceives that through this item is not possible to discriminate with the same accuracy two individuals who have a difference equal to 1 in their abilities. When visually assessing the graph in Fig. 6 one perceives that difference in probability to distinguish such individuals will be smaller than 0.2.

Table.5: Parameters of discrimination (a_i) and difficulty (b_i) and the respective standard errors ($std.err$) of items related to Predisposition/Aversion to Risk

Predisposition and Aversion to Risk				
Item	a_i	$std.err$	b_i	$std.err$
01	0.085	0.181	-2.736	5.937
02	1.323	0.380	0.685	0.168
03	0.129	0.179	0.101	0.897
04	1.654	0.550	0.875	0.182
05	-0.199	0.184	-1.049	1.110
06	1.330	0.411	1.754	0.365
07	0.304	0.206	-2.796	1.862
08	0.248	0.203	2.975	2.416
09	0.414	0.202	2.283	1.078
10	0.301	0.206	-2.026	1.385

Source: Compiled by the authors (Adapted from R software)

The Fig. 6 displays characteristic curves of items 1 to 10; one perceives that only item 5 has shown a behavior outside of expected, in other words, a parameter of discrimination less than zero. On top of that, only three items (2, 4 and 6) presented a parameter within range regarded as ideal ($a_i > 0.7$).
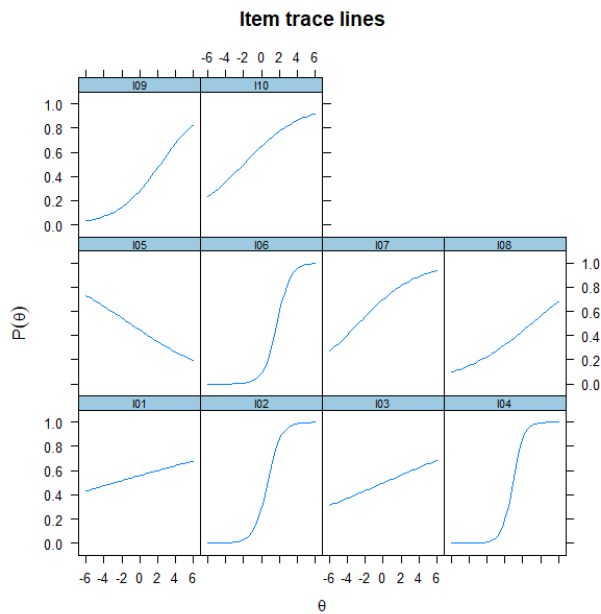
Fig. 6: Curve of items related to Predisposition/Aversion to Risk (items 1 to 10)

Source: Compiled by the authors (Adapted from R software)

With the IRT, it is possible to draw the curve of full information provided by the test. In Fig. 7 one can observe that the curve is higher, in other words, it presents a greater amount of information in the region between zero and two. This first group of items does a better assessment of individuals who are found between the mean (central position) and two standard deviations above the mean.
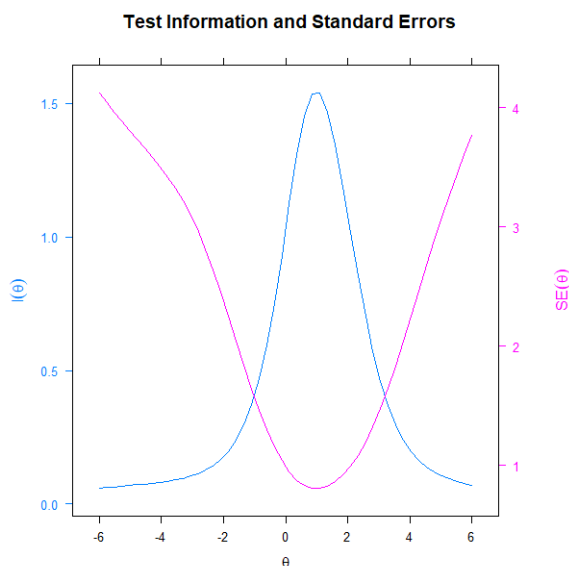
Fig. 7: The role of total information of items 01 to 10
Source: Compiled by the authors (Adapted from R software)

Fig. 8 displays the items that effectively contribute with information between items 1 to 10, related to dimension of Predisposition and Aversion to Risk. And, as shown in Table 5, items that presented the best power of discrimination were 04, 06 and 02. Thus, all relevant information provided in this dimension is concentrated in these three items.
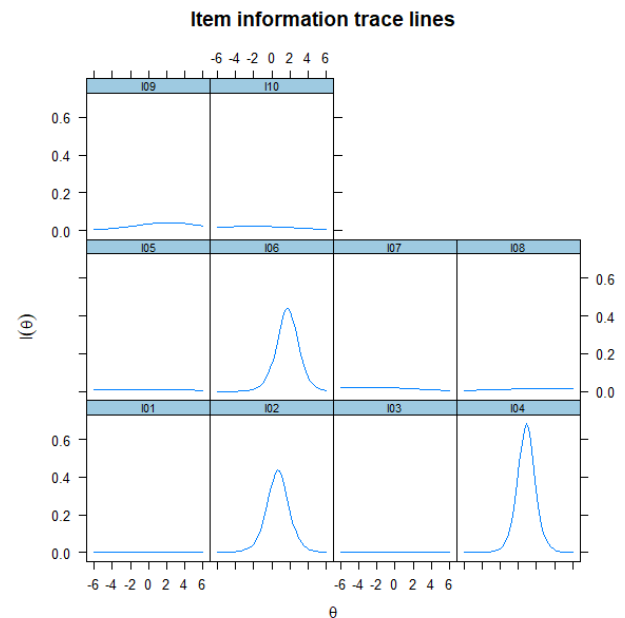
Fig. 8: The role of information of items 01 to 10
Source: Compiled by the authors (Adapted from R software)

Fig. 9 displays the positioning of the items in the scale created with IRT for the dimension Predisposition or Aversion to Risk. It is visible that the items were distributed throughout the scale, something regarded as positive. Nevertheless, only three items had significant information for the test. Therefore, it is suggested that, in a new application, new items should be added to the questionnaire, taking into consideration that most of the items used (01, 03, 05, 07, 08, 09 and 10) barely contributed with useful information for this analysis.

To do so, these new items should be prepared and calibrated, hence creating the possibility to assess other regions of the scale of redisposition or aversion to risk created by the IRT, therefore also increasing the power of discrimination of individuals with different profiles.
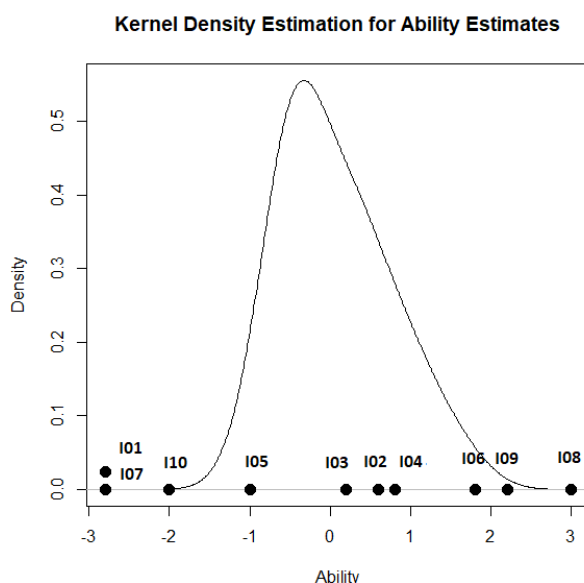
Fig. 9: Positioning of items on the scale of the test of items 01 to 10

Source: Compiled by the authors (Adapted from R software)

In the dimension related to intertemporality, items from 11 to 20, the ones that obtained a higher parameter, ai in other words, better power of discrimination were items 11, 12, 15, 16, 17, 18, 19 and 20, which can be attested in Table 6.

Table.6: Estimates of the parameters of discrimination (a_i) and difficulty (b_i) and the respective standard errors ($std.err$) of items related to Intertemporality

Intertemporality				
Item	a_i	$std.err$	b_i	$std.err$
11	1,588	0,337	2,186	0,295
12	1,717	0,284	1,431	0,162
13	0,523	0,197	-3,838	1,352
14	0,041	0,121	3,499	10,636
15	3,232	0,433	0,726	0,070
16	3,134	0,412	0,160	0,060
17	3,464	0,647	-0,558	0,078
18	4,396	0,851	0,939	0,077
19	10,031	1,851	0,281	0,058
20	21,354	93,102	0,133	0,582

Source: Compiled by the authors (Adapted from R software)

In Table 6, regarding estimates of parameters for this dimension, it is observed that items 13, 14, 19 and 20 displays values of discrimination a_i. outside the range deemed ideal ($0.7 < a_i < 7.0$), as per mentioned in the methodology. Items 11, 12, 15, 16, 17 and 18 are items with good power of discrimination in relation to this dimension of decision-making.

Items 13 and 14 presented very low values of discrimination (parameter $a_i < 0.7$), which did not allow a proper distinction between people with close values of intertemporality in this scale. Items 19 and 20, on the other hand, presented very high values of a_i above 7, and therefore they present very steep and characteristic curves (having the shape of a step). Items with such trait end up discriminating the respondents in only two groups: one below value of parameter b_i and another group with scores above that parameter. Thus, they also are items that do not properly assess latent trait. In Fig. 10, characteristic curves of items in this group are presented.
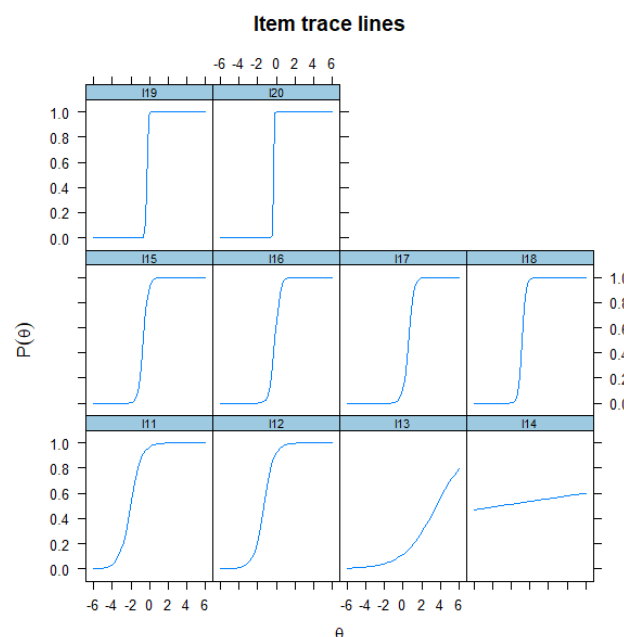
Fig. 10: Curve of the items related to Intertemporality (items 11 to 20)

Source: Compiled by the authors (Adapted from R software)

Fig. 11 presents an information curve whose peak is around the mean, indicating that there is a lot of information available in a very narrow range of scale for dimension of intertemporality.
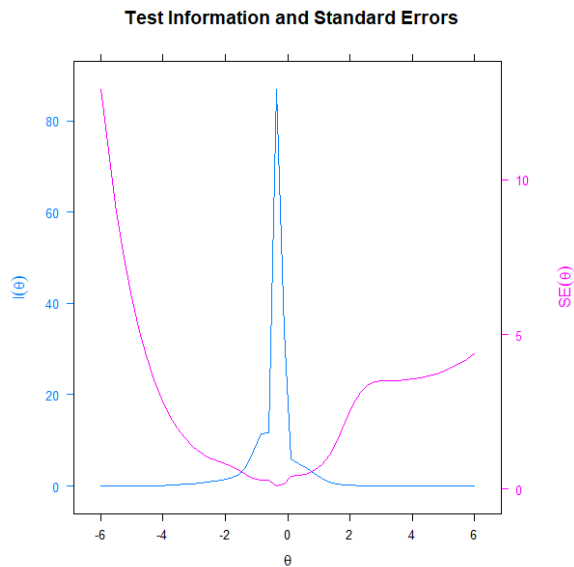
Fig. 11: The role of total information of the items related to Intertemporality

Source: Compiled by the authors (Adapted from R software)

Fig. 12 presents the contribution of information for each of items in this dimension, separately. Therefore, it is perceived that peak of information in Fig. 11 is attributed to the contribution of items 11 to 20, which, as already seen here, does not properly discriminate the decision-making profiles.
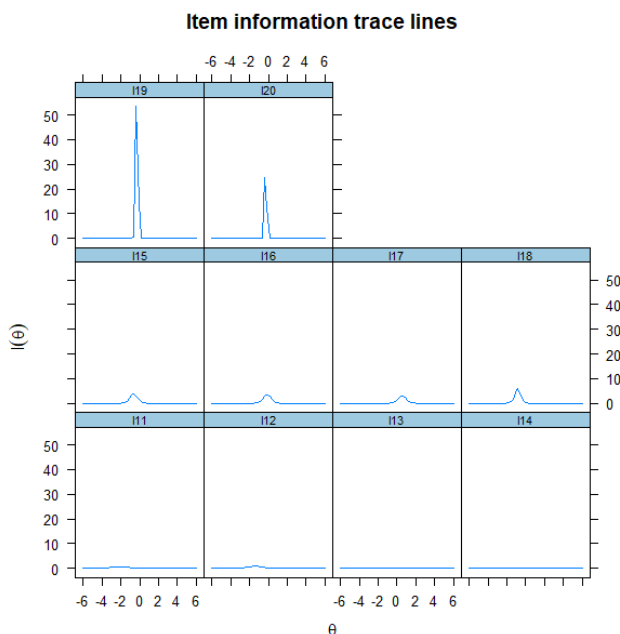
Fig. 12: Function of information related to Intertemporality

Source: Compiled by the authors (Adapted from R software)

Removing contribution of these two items, one can attest that items 11, 12, 15, 16, 17 and 18 contribute with information on a range of scale which happens to be a little wider (from −1 a +2. Thus, items of this dimension allow an assessment of individuals situated between average (central position) and one standard deviation below and two above mean, as shown in Fig. 13.
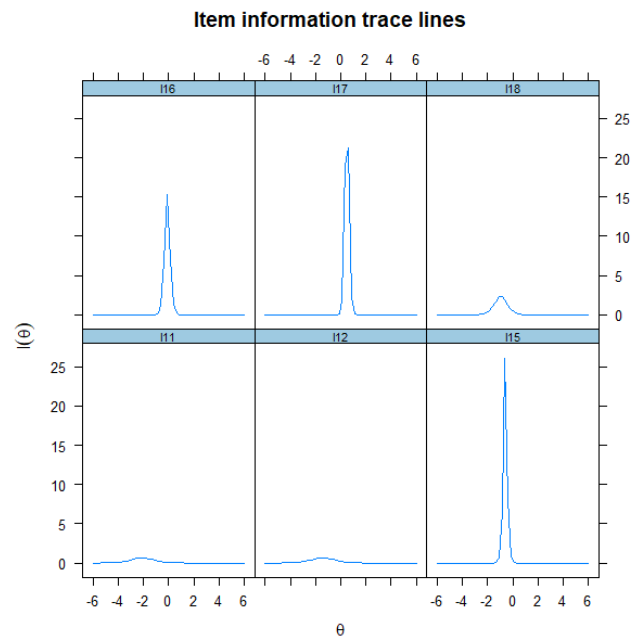
Fig. 13: Role of information of items 11 to 18

Source: Compiled by the authors (Adapted from R software)

Fig. 14 displays positioning of items in the scale of intertemporality dimension. Items 11, 12, 15, 16, 17 and 18, which presented greater information, were positioned around center of scale, allowing one to conclude that items 11, 12, 15, 16, 17 and 18 conduct a proper assessment of the profiles of individuals who are close to the mean, up to two standard deviations above or below the mean.
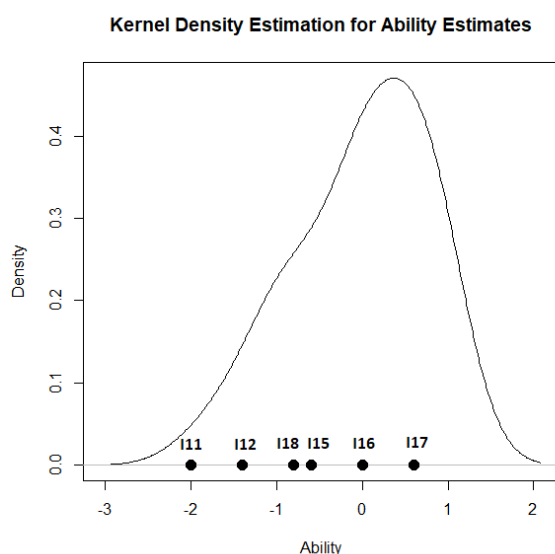
Fig. 14: Positioning of items related to Intertemporality

Source: Compiled by the authors (Adapted from R software)

In Fig. 15, each axis displays values of scores of predisposition and aversion to risk (axis x) and of intertemporality (axis y) of each of students assessed, allowing one to display position of each student within the scales of measurement created with IRT. Visually speaking, one notices that there is no apparent correlation between these two dimensions of decision-making.
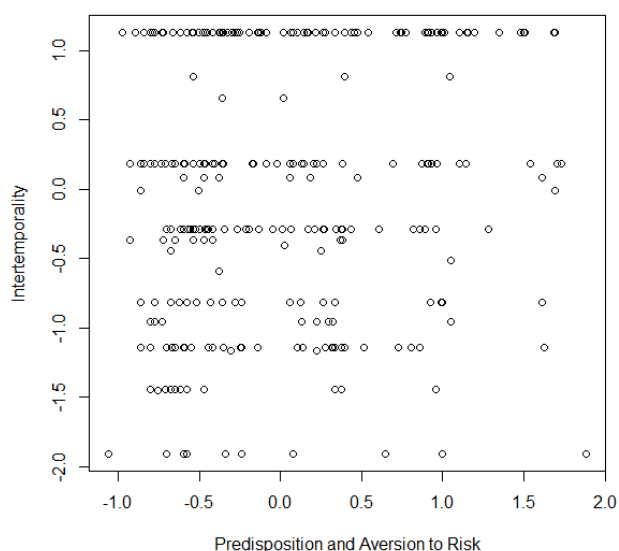
Fig. 15: Dispersion graph of the skills of respondents in each dimension

Source: Compiled by the authors (Adapted from R software)

The result obtained in the Pearson correlation among the proficiencies among each dimension was: value of t = 2.5455, with df = 308 degrees of freedom, probability value obtained was p= 0.0114 with a confidence interval of 95% equal to [0.03266561; 0.25092465]. Pearson's correlation coefficient obtained was equal to 0.1435401. Akin to what has already been inferred by analysis of the dispersion graphic shown in Fig. 15, and from obtained coefficient value of correlation, it can be stated that there is no correlation between the dimensions studied.

V. CONCLUSION

This study relied on models of analysis and interpretation suggested by IRT, aiming to find out the existence of a relationship between two dimensions of judgment in decision-making. Naturally, IRT suggests that original instrument of data collection (questionnaire) must be, beforehand, an object of analysis, to create and validate a scale of interpretation of results. To achieve that, sample comprised individuals who can assume positions of decision in the future; in this case, students from Administration course.

With effective creation of an interpretable assessment scale of profiles of decision-making, the advantages of applying IRT are now demonstrated, taking into consideration that: it was possible to assess each individual item that comprised the questionnaire; positioning them on a scale that represents the latent trait of each dimension analyzed (predisposition/aversion to risk and intertemporality).

With such placement, it was therefore possible to carry out an assessment based on the latent trait of interest and independent of the respondents. Furthermore, it also showed how the instrument can be improved, by discarding or replacing inappropriate items, to increase amplitude and sensitivity of assessment scale of profiles.

Thus, aiming to establish a new application of data collection instrument (questionnaire), one suggests deleting the items identified with a low power of discrimination, due to the loss of information related to those items would be minimal. And, the inclusion of new items calibrated with IRT, so that other regions of assessment scale originally proposed can be assessed. Regarding items to be included, one suggests that they should be less repetitive, and submitted to preliminary assessment of professionals in the field of behavioral studies, to detect possible inconsistencies in its formulation and minimize failures of interpretation from the new respondents.

Moreover, there is also the suggestion to expand the application of the instrument, already calibrated, to more heterogeneous groups, so that preliminary results can be compared to a different sample universe, whose goal is to obtain better positioning of the items and, as a consequence, set a pattern of probable decisions based on the interpretation and analysis of the scales created with the IRT.

Finally, when checking the Pearson's correlation among two dimensions (predisposition or aversion to risk and intertemporality), its absence was preliminary found, because scopes of analyzed items in each one of dimensions do not suffer a mutual interference. For future studies, one suggests inclusion of new items calibrated for both dimensions, with an analysis of dimensionality being applied. Given that IRT is often applied in instruments that presuppose existence of only a latent trait, in other words, use of a unidimensional instrument, unlike what is attested the items used in this study. Therefore, based on factorial analysis, it will be possible to verify how many dimensions are necessary to properly represent the items and the assessed individuals, and what skills and abilities the test is measuring.

Using multidimensional models still lacks a methodology that is consecrated in literature, which already appens with unidimensional IRT. Therefore, this study proposed itself to conduct some initial methodological trials with data used.

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Feelings Experienced by Women Undergoing Mastectomy

Mônica Olívia Lopes Sá de Souza[1], Rose Danielle Couto de Campos da Silva[2], Silviane Hellen Ribeiro da Silva[2], Uluanne do Socorro Viana da Silva[2], Jéssica Maria Lins da Silva[3], Glória Synara Lopesa Sá Holanda[4], Susi dos Santos Barreto de Souza[5], Camilla Castilho Maia[6], Daniele Rodrigues Silva[4], Rozivanha Sousa Mendes[7], Gilmara Lopes Vaz[8], Amanda Carolina Rozario Pantoja[4], Francinéa de Nazaré Ferreira de Castilho[9], Priscila Rodrigues Tavares[3], kleuvia Milene Ferreira de Oliveira[10], Joacy Pedro Franco David[11], Ewellyn Natalia Assunção Ferreira[10], Rafael Everton Assunção Ribeiro da Costa[12], Viviane Ferraz Ferreira de Aguiar[13], Dayara de Nazaré Rosa de Carvalho[14], Elisa da Silva Feitosa[15]

[1]Nurse. Master in Urban Environment Development from the University of the Amazon (UNAMA). Professor at Pan Amazônica Faculty (FAPAN) and Paraense Teaching Faculty (FAPEN).
[2]Nurse, Pan Amazônica Faculty (FAPAN).
[3]Nursing Student at the State University of Pará (UEPA).
[4]Nurse. State University of Pará (UEPA).
[5]Master in Oncology and Medical Sciences from the Federal University of Pará (UFPA).
[6]Doctor. Resident in Family and Community Medicine at the State University of Pará (UEPA).
[7]Nursing Student at the Pontifical Catholic University of Paraná (PUCPR).
[8]Nurse. Specialist in adult and neonatal intensive care unit at the Federal University of Pará (UFPA).
[9]Master in Business Management in Health from the Lusophone University of Humanities and Technologies.
[10]Nurse. University of the Amazon (UNAMA).
[11] Master's student in Health in the Amazon, at the Federal University of Pará (UFPA).
[12]Medical Academic, State University of Piauí (UESPI).
[13]Nurse. Doctoral student, Program in Tropical Diseases, Center for Tropical Medicine, Federal University of Pará (PPGdt/UFPA). Professor of Nursing Faculty/ICS/UFPA and University Center UNIFAMAZ
[14]Nurse. Specialist in Occupational Nursing. Master's student in Education and Nursing Technologies for Health Care for Individuals and Social Groups at the State University of Pará (PPGENF/UEPA).
[15]Nurse. PhD in Philosophy of Nursing from the Federal University of Santa Catarina (UFSC).
Corresponding Author: Dayara de Nazaré Rosa de Carvalho

Abstract— *The diagnosis of breast cancer brings with it the feeling of impotence and fear, because in addition to being a stressful fact for women, it also means psychological, physical, social and sexual changes, since there is a series of transformations in the organism, in addition to causing threat of mutilation of the breast. It is considered that one of the sequelae that most afflict women comes from mastectomy, so there was a need to study about the experience and feelings caused by mastectomy in women's sexuality. This is a descriptive, exploratory study with a qualitative approach, conducted with eight mastectomized women. Bardin's content analysis was used to explore the empirical data collected. Among the results obtained, two categories were evidenced, namely: The feelings experienced when being informed about the need for partial or total breast removal, and Feelings related to sexual life with your partner and the woman's self-esteem after mastectomy. In the first category, there are several reports on the loss of femininity, feelings of anguish and anxiety related to the surgical procedure, fear of being abandoned, feelings of denial and fear of death. The second category showed that the partner's support during treatment is paramount. In addition, there were reports of shame of the*

body after the surgery, as well as difficulties with self-acceptance and fear of the partner's reaction. Others also reported difficulty in the first sexual intercourse and perception of feelings of rejection on the part of the partner.

Keywords — *Women's Health, Mastectomy, Breast Neoplasms, Sexuality, Self-image.*

I. INTRODUCTION

Breast cancer, as well as other malignancies, results from an uncontrollable proliferation of abnormal cells, which increases the functions of genetic alterations, whether they are hereditary or purchased due to exposure to environmental or physiological factors. Therefore, these changes can cause changes in cell growth or programmed cell death, thus leading to the appearance of tumors (Ministry of Health (n.d.).

As evidenced by the National Cancer Institute [INCA] (2015), in recent decades, cancer has taken on a greater dimension, becoming an evident public health problem worldwide. Thus, it is assumed that in the year 2030, 27 million cancer cases can be expected, 17 million cancer deaths and 75 million people alive with cancer each year. Breast cancer is the one that most affects women worldwide. In four of the five Brazilian regions it is the most common type among women, without considering non-melanoma skin tumors: South (74.30 / 100 thousand), Southeast (68.08 / 100 thousand), Central-West (55, 87/100 thousand) and Northeast (38.74 / 100 thousand). In the North Region, it is the second most incident tumor (22.26 / 100 thousand) behind cervical cancer (23.97 / 100 thousand) (INCA, 2015).

Cesnik and Santos (2012), affirm that the diagnosis of breast cancer brings with it the feeling of helplessness and even the fear of death, because besides being a stressful fact for women, it also means changes, both psychological, social and sexual , because there is a series of transformations in the organism, in addition to causing the threat of mutilation of the breast. It is considered that one of the sequelae that most afflict women comes from mastectomy, which is the total or partial loss of the breast, associated or not with the removal of the lymph nodes from the axilla / axillary emptying.

Breast cancer is a public health problem whose mortality rates have been increasing in Brazil, despite having a good prognosis, most cases have been diagnosed in advanced stages (Medeiros, Bergmann, Aguiar, & Thuler, 2015). Since breast cancer is stigmatized as a death sentence and the cause of female mutilation, there was then a need to study the experience and feelings brought about by mastectomy in women's sexuality. Lotti, Barra, Dias and Makluf (2008), also state that, upon receiving the diagnosis, the woman experiences a moment of great anguish, suffering and anxiety. Considering the high incidence and the disruption that this diagnosis entails in a woman's life, there has been a greater emphasis on research that links the quality of life with the diagnosis and treatment that this woman will undergo, and this research can help in identifying the needs each patient.Paiva,

Sales, Scanduzzi and Anjos (2001), corroborate the above, demonstrating that some studies have been carried out to assess the quality of life of patients diagnosed with breast cancer, the problems with the highest incidence in these studies are those related to sexual satisfaction and the problems related to the upper limb, which often presents lymphedema and limitations of its use, causing a greater dependence on this woman in daily tasks. Thus, this study aimed to identify the feelings experienced by women undergoing mastectomy.

II. METHODOLOGY

This study is characterized as descriptive, exploratory with a qualitative approach, being carried out in a referral hospital in the treatment of cancer in the state of Pará. To this end, 08 mastectomized women who were undergoing treatment and / or follow-up in the hospital participated, after release of the educational institution's ethics committee. For the definition of the sample, the inclusion criteria were chosen: Women over 25 years old mastectomized, regulated in the hospital and who are undergoing treatment and / or monitoring. In addition to having an active sex life before and / or after surgery. The exclusion criteria are women who do not fit the inclusive criteria.

For data collection, a semi-structured interview script with open questions was applied, elaborated based on the objectives of this study. For a more reliable analysis, the interviews were recorded on audio with authorization. Participants were informed about the guarantee of anonymity and were instructed on the possibility of giving up the research. Those who agreed to contribute signed two copies of the informed consent form, one that would remain with the student team, and the other with the participant.

Bardin's content analysis was used to explore the empirical data collected, characterized as a set of communication analysis techniques that uses systematic and objective procedures to describe the content of the

messages, consisting of the following steps: pre-analysis, material exploration with data coding and treatment of results and interpretations (Castro, Abs, & Sarriera, 2011). After the transcriptions carried out, if a reading criteria and data analysis, create empirical categories broken down by subject, respecting the similarities of the answers.

In order to comply with Resolution 466/2012 of the National Health Council, the anonymity and confidentiality of the data were guaranteed, replacing the names with alphanumeric codes. The Free and Informed Consent Term (ICF) was read and delivered in writing, before the collection procedure to the participants, to enable them to know the conditions that permeate the research with human beings.

III. RESULTS AND DISCUSSION

As mentioned in this study, 08 women who underwent mastectomy and registered at the referral hospital for treatment and oncological follow-up, located in the city of Belém-PÁ, where all the interviewees reported residing in the metropolitan region of Belém, took part in the research. Characterization of women with emphasis on information general as: Age, education, marital status, profession, religion, cases of cancer in the family, post-operative time, if breast reconstruction had already been performed.

Regarding the age of the interviewees, it was possible to identify the average of 40.2 years. When asked about the marital situation, only two (02) women reported being married, the four (04) women claimed to be single, two (02) women are in a stable relationship. Regarding the women's educational level, three (03) reported having completed high school, one (01) had not completed high school, three (03) had completed higher education and one (01) had incomplete higher education.

As for the interviewees' profession, they were varied, being one (01) administrative assistant, one (01) nurse, one (01) massage therapist, one (01) psychologist, one (01) nurse, one (01) nutritionist and one (01) librarian, who, in relation to the profession of each interviewee, the result was varied.

When we asked if they had any religion, four (04) of the interviewees were catholic, two (02) called themselves evangelical practitioners and two (02) said they had no religion, therefore, for this research, 50% of the interviewees were Catholic.

Furthermore, with regard to the history of breast cancer and heredity in the women interviewed, it was possible to observe the average of the interviewees who had cases of cancer in the family of 50% with a total of

four (04) interviewees. When asked about the postoperative period, responses ranged from eighteen (18) days to five (05) years. As for breast reconstruction, only two had undergone surgery.

Among the results obtained in this research, two categories were evidenced about the main feelings reported by the women participating in the study, namely: The feelings experienced when being informed about the need for partial or total breast removal, and Feelings related to sexual life with your partner and the woman's self-esteem after mastectomy. The categories, as well as the results and discussions on the topic, follow below.

In the first category, there are several reports on the loss of femininity, feelings of anguish and anxiety related to the surgical procedure, fear of being abandoned, feelings of denial and fear of death. However, other participants reported facing the moment naturally, due to the awareness of the need for treatment, as well as reinforcing that speeches about dysfunctions in sexuality linked to the breast may be more linked to the concept of aesthetics imposed than the woman herself and her relationships, as shown in the following reports:

"Actually, I felt that I was going to lose my identity, a little of my feminine identity. I had already lost it because of hair loss and then because of the loss of the breast. " (P7)

"It was a terrible thing with several sleepless days and nights. The person who loses a breast is losing part of the appearance of his body, this brings many feelings of loss until you get used to it ... "(P2)

"The feeling that my husband would not want me anymore, that he would no longer see me as a woman, would see me as a mutilated woman, would live as a mutilated woman was no longer desired, you know? ... "(P1)

"The loss of a breast is a great feeling". (P6)

"First, it is notorious that you think you are going to die, soon after, the next day, you are dead and this feeling of denial, right? I am not sick ...." (P8)

"First thanks to God. And try to see a matter of aesthetics as a normal thing. "(P3)

"Everything within my treatment I have always seen very naturally and I knew it could happen, I believe that women have the power of seduction, whether or not they have the breast". (P5)

"I was not so surprised by the confirmation, as there was already science." (P4)

The diagnosis of breast cancer brings with it the feeling of impotence and even the fear of death, because in addition to being a stressful fact for women, it also means changes, both psychological, social and sexual, as there is a series of transformations in the body , in addition to causing the threat of breast mutilation (Cesnik & Santos, 2012).

Sousa, Santos and Costa (2014), describe that breast removal is one of the safest ways to guarantee the extinction of breast cancer, and this is a procedure that can be performed in several ways, depending on the degree of the disease, tumor size, among other characteristics. As a primary treatment, surgical intervention is usually performed, which can be restricted to the tumor, reach surrounding tissues or even total breast removal (radical mastectomy) and also the removal of lymph nodes in the axillary region and pectoral muscles (Cesnik & Santos , 2012; Santos & Vieira, 2011).

Many women, when undergoing surgery, find themselves feeling very lost after this process, due to the absence of their breast. Gasparelo, Sales, Marcon and Salci (2010), show that mastectomy brings to the woman a very modified body image, mainly due to the emphasis that is given to the breast and because it represents femininity, which can directly interfere in the interactions that the woman has with others and with herself, often generating insecurities and fears, which must be worked on to provide them with a better quality of life.

The second category, which deals with the main feelings related to sexual life, as well as the woman's self-esteem, showed that the partner's support during the treatment is paramount, since he acts directly on the woman's libido. In addition, there were reports of shame of the body after the surgery, as well as difficulties with self-acceptance and fear of the partner's reaction. Others also reported difficulty in the first sexual intercourse and perception of feelings of rejection on the part of the partner, as reported below:

"I think kissing is very important at a time like this, understand? So when you have a good partner everything fits". (P5)

"Yes, right at the beginning yes, I had difficulty undressing, especially in the first intercourse after the mastectomy, it was not something I could find normal or find myself sexy or because of the lack of the breast". (P7)

"It is a mixed feeling. If I tell you that I am a person who did not feel anything, I will be lying. Because yes, it is in our heads the acceptance of the man, how the man will look at you, how the first sex will be, but when you start to find solutions and not put more problems where you already have, everything is solved". (P5)

"Look, it sucks! Because not feeling that your partner wants you, makes you, unable to have that desire for him, so in your head you are already suffering from the trauma of mastectomy". (P1)

"Right at the beginning it was very difficult, you know, taking off your clothes for your partner knowing that you have a scar here, how could he understand the fact that you were mastectomized, there are many who do not understand and you are ashamed". (P8)

Sexuality is an experience expressed in thoughts, fantasies, desires, beliefs, attitudes, values, behaviors, practices, roles and relationships. Although sexuality can include all these dimensions, not all of them are always expressed or felt, being influenced by the interaction of biological, social, economic, political, cultural, legal, historical, religious and spiritual factors (Silva et al., 2012).

Based on the fact that sexuality is seen as a human condition that begins to form in childhood, it continues to be built in adolescence and manifests itself differently in the various stages of life (Rheaume & Mitty, 2008; Van-Haute, 2005). This, according to Freud, should not be neglected, since this can cause a mixture of negative feelings, affecting several areas of the individual's behavior and self-image (Brenner, 2007).

Sexuality reflects the entire emotional expression of the experience, while incorporating the influence of the moment experienced. This "emotional expression" can also be manifested by verbal silence, often built due to the impositions of the social environment, which carries with it secular normative and regulatory attitudes of aspects of sexuality, mainly concerning the female sex, promoting aesthetic concepts that make many women feel displaced because they do not fit into standards (Ressel & Silva, 2001).

IV. CONCLUSION

From the data collected, the importance of treating the feelings resulting from the mastectomy surgery for the woman was evidenced, since in this process there is a mixture of feelings that can directly influence both the treatment, as well as the woman's self-image and self-esteem, being able to be responsible for triggering negative feelings and assigning obstacles to treatment.

In this way, the role of professionals in supporting this woman is emphasized, as well as in identifying the needs that she may have as a result of the procedure, both

individually and in the family. The importance of the partner in the support given to the woman was also evidenced, since the latter has great representativeness with regard to the woman's self-acceptance.

The guiding question developed for this research was answered, since the feelings identified after the mastectomy were explained. As for the objectives, these were achieved, since when analyzing the sexuality of women who underwent mastectomy and unveiling their feelings through interviews, it was identified that there were direct interferences in their quality of life after breast removal, most women said they perceived notable changes related to sexual life.

Finally, it is noteworthy that even though it is an extremely invasive and life-modifying procedure for women, mastectomy can be viewed naturally and coped with in a healthy way, when the woman receives support and a good base, both family and professional, about the surgery , actions that should be encouraged aiming at the well-being and quality of life of these women.

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Document of Forest Origin (DFO) and its Relevance in Civil Construction

José Roberto Moreira Ribeiro Gonçalves[1], Gabriel dos Anjos Cruz[2], Marcelo de Jesus Rodrigues da Nóbrega[3], Fabiano Battemarco da Silva Martins[4], Flavio Maldonado Bentes[5]

[1]Master in Agricultural and Environmental (UFFRJ), Professor at IBMR Laureate and UNISUAM, Rio de Janeiro, Brazil
[2]Graduating in Civil Engineering from UNISUAM.
[3]Post-Doctor in Civil Engineering (UERJ), Doctor in Engineering (PUC-Rio), Master in Technology (CEFET/RJ). Professor at UNIGAMA, CEFET-RJ and Universidade Santa Úrsula, Rio de Janeiro, Brazil.
[4]Master in Agricultural and Environmental (UFFRJ), Professor at UNIGAMA and Santa Úrsula University, Rio de Janeiro, Brazil.
[5]Doctor in Mechanical Engineering (UFRJ), Master in Mechanical Engineering (UnB) and Senior Researcher (FUNDACENTRO), Rio de Janeiro, Brazil.

Abstract— Studies show that deforestation in the country has advanced in recent years and the sustainable use of forest resources has become increasingly necessary. Brazil is the second largest when it comes to vegetation cover in the world, but it is one that has a higher rate of deforestation. Deforestation has consequences for the environment and society, such as greenhouse gas emissions, disintegration of traditional populations, pollution, destruction of protected areas, among others. To prevent rampant deforestation from reaching the native forest regions and control deforestation, Brazil has created a mechanism called the Forest Origin Document (DFO) that monitors them from extraction to final consumption. This article aims to relate the exploitation of native wood with a state procedure can regularize illegalities to avoid deforestation, bring more clarity of procedures and tools in a simple way for a better understanding of companies that need the timber system, regarding the emission of DFO.

Keywords— deforestation, native a forest and sustainable use.

I. INTRODUCTION

Wood is a material produced from the woody part of the tree and formed by cellulose fibers and vessels conducting raw sap. The trees that produce wood are long-lasting and woody, characterized by the presence of logs. The diversity of wood is quite comprehensive, and its characteristics vary in density, resistance to decay and fire, among others. These differences determine the use of wood in each case. Wood is a widely used input due to its wide variety of applications, such as in construction, furniture making, among others. However, the rate of deforestation in Brazil is still a major threat to forests. Even with environmental agencies working and the relevant legislation on the subject, deforestation is still an obstacle for the Brazilian forest administration. To prevent the exploitation of wood from being predatory, impacting the environment, the Ministry of the Environment (ME) has instituted a mandatory license, DFO, for the extraction, transportation, and sale of native forest raw material. [2], [4], [5].

DFO was created by Ordinance No. 253, August 18th, 2006 [4], that defined it, in its Article 1, as:

> § 1 DFO is the mandatory license for the transport and storage of forest products and by-products of native origin, containing information on the origin of these products, generated by the electronic system called System-DFO.

DFO aims at the sustainable ecological traceability of native species forests by monitoring transport and storage through an electronic system. This system requires a series of data to track from the sale to the final consumption of the product. All people involved in the process are registered in the IBAMA system, and this contributes to users using wood of legal and sustainable origin. The trees are identified with a code by the forestry concessionaire, and that same code follows the wood to its destination. This makes it possible, through a system that brings all location information about the respective wood, to verify the legality and origin of the wood. This consultation can be made through the IBAMA website, and whoever is

consulting needs to know the DFO issuing body and the control code. [1], [8], [16], [20].

In civil construction, wood is widely used either as a building or decoration component. If the wood used in the construction is of native origin, the construction company must follow all legal procedures required by Organs inspection agencies. This article, based on a bibliographic reference analysis, aims to simplify the information regarding the issuance of the DFO, so that companies that have difficulties in adopting the procedure in a legal and correct way can understand, in a lean way, how to proceed in activities involving native wood. The DFO system is a way to control the input from the extraction to the lumber and from the lumber to the destination, be it use or disposal. DFO is a procedure for traceability and guarantee of legal wood. [6], [11], [12], [13], [15].

II.   DOCUMENT OD FOREST ORIGIN (DFO)

The DFO System, created by the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA), is primarily responsible for controlling the movement of native forest inputs. This system reduced the falsification of papers used for illegal removal of native inputs from forests, and after improvements to the tool, citizens can access data with complete transparency and help control the entire wood production chain. Only some products need DFO emission, such as the raw forest product that is the one in the fresh state, the processed forest product that has been manipulated, live plants and essential oils originating from the flora. [7], [8], [9], [13].

Access to the DFO requires that the individual or legal entity has:

Type A3 digital certificate, is registered in the Federal Technical Register of Potentially Polluting Activities and/or Users of Environmental Resources (CTF/APP) and has declared at least one activity relevant to the DFO and is in a regular situation with IBAMA. [7], [16].

DFO Issuance

According to Ordinance No. 253, of August 18, 2006 (ME), forest products and by-products of native origin require the issuance of DFO. [4]. Are they:

I. Forest product (found in the raw or in natural state):

- Wood logs.
- Shoring.
- Plump platforms.
- Sleepers in the extraction / supply phases.
- Stakes and fence posts.

- chips and splinters.
- Planks unfolded with chainsaw.
- Block or fillet, log in polygonal format, obtained from the removal of coastal.
- Firewood.
- Heart of palm.
- Xaxim.
- Essential oils.

II.   Forest by-product (one that has undergone manipulation):

- Lumber in any form, laminated, and cut.
- Wood industry residues (shavings, coastal, chips and other wood processing and industrialization residues) when destined for the manufacture of coal.
- Sleepers and posts in the exit phase of the industry.
- Coal from wood industry residues.
- Packaged native charcoal, in the post-exploration and production phase; and
- Xaxim and its artifacts in the phase of leaving the industry.

On the other hand, not all woods need this license, some species, such as products and by-products of exotic origin, do not need to be traced. Some examples of woods that do not need DFO emission are:

- Finished and packaged by-products such as: door, ceilings, agglomerated sheets, cushioned or plywood door, window, industrialized composite floors, furniture, agglomerated, pressed, plywood and fiber sheets.
- Pine and Eucalyptus.
- Cellulose, gum-resin and other wood pastes.
- Vegetation planted for any purpose.
- Charcoal.
- Native forest products of exploitation in rural property and the use is integral in the same property.
- Bamboo and related species.
- Exsiccate for scientific research.
- Live plants of Brazilian native forest not threatened with extinction.
- Woody material for urban pruning.

• Sawdust, wooden toys and pallets, straw and palm fibers, leaves, leaves of planted essences, bark, and coal from coconut shell, mill and charcoal toys.

Types of DFO

Special DFO: issued when the forest product is subject to a Special Authorization.

Retail trade DFO: when the activity of individuals or legal entities does not require registration with CTF in the forest control category.

Export or Import DFO: when the product of native origin is subject to commercialization.

The individual or legal entity that wants to obtain the DFO must be registered in the Federal Technical Register of Activities Potentially and / or Users of Environmental Resources (CTF/APP) and declare at least one activity related to the DFO, be with a valid Certificate of Regularity and in regular situation with IBAMA and mandatory Type A3 digital certificate. The A3 digital certificate is acquired through purchase, and encryption is done in a different way from others, and thus offers more information security. It is available in a token or card version generated by an encrypted key pair, which can be used on any computer, but not at the same time. This certificate is valid for 1 to 3 years and is a safe and increasingly used choice. CTF is regulated by Law 6938/81, which defined it as: Art. 17. The following is instituted, under the administration of the Brazilian Institute of the Environment and Renewable Natural Resources - IBAMA: Federal Technical Register of Potentially Polluting Activities or Users of Environmental Resources, for mandatory registration of natural or legal persons engaged in potentially polluting activities and/or the extraction, production, transport and commercialization of products potentially dangerous to the environment, as well as well as fauna and flora products and by-products. Individuals or legal entities that carry out activities subject to environmental control and inspection are required to register with the CTF/APP. This register identifies the person in the National Environmental System (SISNAMA) and generates information for the Brazilian environmental administration. The registration is done by the person himself, according to Table 1. [7], [16], [19], [20].

Table 1 - DFO activity in CTF

Category	Code	Description - Normative Instruction IBAMA n°11/2018
Wood industry	7-1	Sawmill and wood split
	7-2	Wood preservation
	7-3	Manufacture of sheets,

		chipboard, pressed and plywood
	7-4	Manufacture of wooden and furniture structures
Uso de Recursos Naturais	20-2	Economic exploitation of wood or firewood and forest by-products
	20-22	Import or export of native Brazilian flora
	20-60	Silviculture - Law No. 12,651 / 2012: art. 35, §§ 1st, 3rd
	20-61	Forestry - Law
	20-63	nº 12.651 / 2012: art. 35, § 1º
Atividades sujeitas a controle e fiscalização ambiental não relacionadas no Anexo VIII da Lei nº 6.938/19	21-48	Industrial consumption of wood, firewood, and charcoal - Law nº 12.651 / 2012: art.34
	21-49	
	21-50	Transport of forest products - Law No. 12,651 / 2012: art. 36
	21-67	Storage of forest products - Law nº 12.651 / 2012: art. 35, § 2
	21-68	Wholesale trade of wood, firewood, and other forest products -Law nº 12.651 / 2012: art. 37

Source: Normative Instruction No. 11/2018

If these conditions are accepted, the DFO is issued electronically and filled out by the user according to instructions present in the IBAMA system and accompanies the product from its origin to its destination. Environmental control and inspection fee (TCFA) Companies that carry out polluting activities or that use natural resources need to make the quarterly payment of the TCFA. This fee is a kind of tax to control and inspect these activities. TCFA is regulated by Law 6938/81: Art. 17-B. The Environmental Control and Inspection Fee - TCFA is hereby established, the operative fact of which is the regular exercise of police power conferred to the Brazilian Institute for the Environment and Renewable Natural Resources - IBAMA to control and inspect potentially polluting activities and users of natural resources . At the time of enrollment in the CTF/APP, the person selects an option in the Activity Table, after this enrollment the TCFA is automatically generated and it is up to the payer to issue the Union Collection Guide and pay every three months. The TCFA value varies according to two criteria, economic size and Polluting Potential and

User of Natural Resources (PPGU). The criteria (Table 2) are defined in Law 6938/81. [17], [19].

Table 2 - TCFA values

Porte PPGU	Person	Micro enterprise	Small business	Medium-sized company	Large-sized company
	(R$)				
Small	Free	Free	289.84	579.68	1159.35
Medium	Free	Free	643.74	927.48	2318.69
High	Free	R$128,00	579.67	1159.35	5796.73

Source: Law 6938/81

This work had its development carried out through scientific research that took other scientific articles, monographs, dissertations, and norms as a basis, to give legal validity to address the subject in question. These searches were carried out during the months of July 2019 until May 2020. The process of collecting the data that was found in these files and, after that, the analysis of them to find out if they were coherent with each other, was carried out through searches.

It is recommended that, before starting the work, if there is provision to use hardwood, every company that needs to buy or sell wood of native origin must be registered with the CTF / APP and this register must be active, have an environmental license and a registered yard IBAMA and approved by Inea. If the construction is only expected to use pine and eucalyptus, these procedures are not necessary because they are reforestation wood and not hardwood. [1], [3], [6], [9].

In the purchase process, the company responsible for the work goes to the lumber company, verifies that it has a record and is authorized to issue DFO in the IBAMA system, requests the purchase of the necessary quantity of wood. After this procedure, the timber company issues a DFO in the IBAMA system with all the information about the wood, the respective quantity requested and the requesting company. Subsequently, it is the company's turn to buy access to IBAMA's system and accept the DFO issuance, if true, the information from the lumber company. The person responsible for transporting the product in this case is the lumber company, which does so with the DFO throughout the journey. Right after the delivery of the wood, the applicant confirms the DFO and the wood received in the IBAMA system. If the construction is only expected to use pine and eucalyptus, these procedures are not necessary because they are reforestation wood and not hardwood. [1], [6], [11], [13].

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It is advisable for a construction company to have someone responsible for checking product entries and downloads in the yard, because the yard balance registered with the responsible agency must be the same physical balance. As to use or enter the wood, the yard's balance must be updated in IBAMA's control system. A scrap of wood from the work also needs DFO, in this case, whoever issues the DFO is a construction company and who accepts the receipt and issue of the DFO is a company that executes or discards. A company that discarded a wood must have a yard registered and approved by Organs competent bodies. If a construction has removed a tree, it will be necessary to issue a special or qualified DFO after an environmental plant suppression license. Although the DFO is well structured, there are risks that cause fraud in the registry, due to the lack of standardization of security procedures and human interference in the process. According to the Federal Audit Court (TCU), there are flaws in the communication of the DFO system with state systems. "As the following inconsistencies in the system's databases were detected by crossing data from IBAMA systems with other public administration systems (IRS and DENATRAN) using the Audit Command Language (ACL) software: a) 11000 companies registered in the DFO with divergent size registered with the Federal Revenue, generating a direct impact on the collection of the Environmental Control and Inspection Fee (TCFA), which is used in functions of the company's size, resulting in a loss of collection greater than 390 thousand reais per year. These companies being moved to data extraction data above R$ 2 billion in forest products, with the use of

DFOs. b) 4 companies whose CNPJ is not included in the revenue base issued by DFOs, moving more than 700 thousand reais in forest products. c) 90 companies in an irregular situation in the moved revenue, compared to DFOs, more than R$ 480 thousand in products. d) 270,618 DFOs, worth no more than R$ 2 billion, with irregularities in relation to the registration of the vehicle responsible for transporting forest products in relation to the records of the DENATRAN system." Also, according to the TCU, there are flaws in the organization of environmental and equipment taxes. TCU also made recommendations to IBAMA for adjustment or DFO system based on international IT security standards. [14], [15], [16], [18], [20].

III. CONCLUSIONS

Thus, environmental inspection is necessary so that, through coercion or sanction or other means permitted by law, society's behavior is adapted to legislation and habits are changed in relation to Environmental awareness. With proper application and inspection, the DFO System is a tool that proves to be suitable for controlling native wood. Allied to this system, to ensure greater effectiveness, the integration, with better communication, between the state systems and the DFO System must be made, inspectors must be better trained and qualified to carry out the due inspection and establishment of partnerships between entities can also make the system more effective. [9], [12], [16].

It is concluded that the inspection actions are of extreme importance for the preservation of forests of native origin, in order that the production activities of the most varied forms do not cause significant impacts on the nature, jeopardizing the current and future generation.

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Cheap zeolite catalyst (Na₃PO₄/NaX) for toluene/methanol side chain alkylation

Faraz Ahmad[1,#], Yueli Wen[2,#], Bin Wang[1*], Chunyao Hao[1], Walzli Yousaf[2], Yuhua Liu[1], Wei Huang[1,3*]

[1]Key Laboratory of Coal Science and Technology, Taiyuan University of Technology, Ministry of Education and Shanxi Province, Taiyuan, 030024, Shanxi, China.

[2]College of Environmental Science and Engineering, Taiyuan University of Technology, Taiyuan, 030024, Shanxi, China.

[3]Coal Conversion Technology & Engineering Co., Ltd., Taiyuan University of Technology, Taiyuan, 030024, Shanxi, China.

#Faraz Ahmad and Yueli Wen are co-first authors who have equally contributed to this work.

*Corresponding author Email address: wangbin@tyut.edu.cn (Bin Wang); huangwei@tyut.edu.cn (Wei Huang)

Abstract— A new zeolite catalyst (Na₃PO₄/NaX), which is low in cost, environment-friendly and also gives higher conversion of methanol, was prepared by the impregnation method and catalytic performance was tested for side-chain alkylation of toluene with methanol. From the characterization of the catalysts by Temperature-programmed desorption (TPD-CO₂), X-ray diffraction (XRD), scanning electron microscopy (SEM) and Brunauer-Emmett-Teller (BET) method we found that when the concentration of Na₃PO₄ was 0.1 mol/L, the yield of styrene and ethylbenzene, and conversion of methanol reached 39.4% and 100%. It was determined that as the loading of Na₃PO₄ onto the NaX surface enhanced, the amount and the strength of middle base sites significantly increased, which is favorable for the toluene/methanol side chain alkylation.

Keywords— zeolite catalyst, side-chain alkylation, middle base sites, styrene.

I. INTRODUCTION

Styrene is a significant chemical material that might be used to produce a wide range of polymers that are utilized in many applications, including toys, food packaging, medical equipment, and paper coverings [1]. Sidorenko et al. first reported styrene production by toluene/methanol side-chain alkylation [2]. Since then, this reaction has involved wide-ranging attention because this method of producing styrene offered economic benefits [3,4] and was supposed as a reliable one step substitute for the existing two-step method over alkylation of benzene with ethylene and followed by the catalytic dehydrogenation of ethylbenzene [5,6].

Many scientists have explored the mechanism of toluene/methanol side-chain alkylation reaction to invent an efficient catalyst for the toluene/methanol side chain alkylation [7]. It is usually recognized that the alkylation of toluene with methanol over basic zeolites can catalyze side-chain alkylation while acidic zeolites can catalyze to the ring of toluene [8]. Toluene/methanol side chain alkylation is a well-known acid-base synergistic catalysis process [9-11]. Usually, acidic sites can stabilize and adsorb toluene; however the function of base sites is to trigger the carbon atom of the side chain of toluene followed by the methanol to formaldehyde

dehydrogenation. Formaldehyde formed by the dehydrogenation of methanol acts as an actual alkylating agent for side-chain alkylation [12] and it can decompose into CO and H_2 on-basic sites [13,14]. A series of side reactions occur during toluene/methanol side chain alkylation process. Ethylbenzene was supposed to produce through the hydrogenation of styrene with hydrogen, which in turn produced by methanol dehydrogenation to formaldehyde and auxiliary formaldehyde decomposition [15]. It was suggested from previous research that the main reaction pathway for ethylbenzene formation is the hydrogenation of styrene with methanol [16]. Besides xylene formed through toluene disproportionation during the ring alkylation with methanol that existed at acid sites must not be ignored either [17].

There has been extensive study of catalysts for toluene/methanol side chain alkylation [18]. A noble catalyst for toluene/methanol side-chain alkylation was reported to have the following characteristics (1) appropriate strength of base to dehydrogenate methanol to formaldehyde, (2) polarization and stabilization of methyl group of adsorbed toluene, and (3) balanced reactant sorption stoichiometry [3,19]. From previous studies it was found that the catalyst prepared by CsX modified by K_3PO_4 could enhance the amount and strength of the

middle base on the catalyst and reduce the number of acid sites leading to the improved catalytic effect in toluene/methanol side chain alkylation [20]. Although this system (CsX modified by K_3PO_4) was energy-efficient however, the major drawback for using K_3PO_4 was the higher cost of the raw materials.

In order to solve the problem of raw materials cost we supposed to use Na_3PO_4 modified NaX molecular sieve in our current study, which is cheaper than K_3PO_4 system and investigated the effect of Na_3PO_4/NaX in the toluene/methanol side chain alkylation for the production of styrene. The results of our study showed that as the concentration of Na_3PO_4 increased, the amount of middle base sites also increased leading to the higher yield of ethylbenzene and styrene signifying that the strength and amount of middle base sites is a crucial factor for the toluene/methanol side chain alkylation.

II. EXPERIMENTAL SECTION

2.1 Materials:

Zeolite NaX (Si/Al = 1.25) was attained from Nankai University's Catalyst Plant. Methanol, and Toluene, with a purity of 99%, were obtained from Tianjin Kemio Chemical Reagent Co., Ltd.

2.2 Catalyst Preparation:

A series of Na_3PO_4 catalysts were produced by loading different concentrations of Na_3PO_4 on NaX zeolite (SiO_2/Al_2O_3 = 2.4) at 80°C. Procedures followed are described below:

Different concentrations of Na_3PO_4 solution (solid/liquid ratio, 10g/100ml) were loaded three times on 10g of NaX at 80°C for 2 h. The Buchner funnel was used to filter the slurry. The cake obtained as a result of filtration was absorbed again in an aqueous solution of Na_3PO_4 (100 ml, 0.5M) and agitated for 2 h at the same temperature. Filtration and absorption processes were repeated further two times. The resulting residue was filtered. The mixture was dehydrated at 80°C for 12 h followed by the calcination at 3 K/min. After 3 hours of calcination at 500°C, the resulting powder was crushed, pelletized and sieved to obtain the zeolite catalyst with a size between 40 mesh and 60 mesh. The powder obtained was ready for reaction and referred to as Cat-n, where n is the concentration of Na_3PO_4 in the catalyst.

2.3 Characterization of Catalysts:

The X-ray diffraction (XRD) of catalysts were recorded on a Rigaku D/max 2500 X-ray diffractometer using Ni-filtered Cu Kα radiation (λ = 0.15406 nm), activated at 100 mA and 40 kV. A 10°/min scanning rate was used for Bragg's angles 2θ = 5-80°.

Temperature-programmed desorption (TPD) of adsorbed CO_2 was done on a TP-5080 to analyze the basic sites. The sample (0.1 g) was pretreated at 450°C for 103 min in a He stream before taking measurements and cooled down to the required temperatures. The samples were exposed to pure CO_2 at 100°C for 30 min. The samples were heated to 810°C with a temperature ramp at 10 °C min^{-1} after purging with helium.

A Quanta-chrome Autosorb QDS-30 physical adsorption analyzer system at −196°C was used to attain N_2 adsorption-desorption isotherms. The samples were degassed under vacuum at 200°C for 4 hours prior to taking a measurement. Pore volumes and Specific surface areas were determined by BJH method and Brunauer-Emmett-Teller (BET) method separately.

Scanning electron microscopy SEM images of catalysts were obtained by a JESOL JSM-6010PLUS/LV scanning microscope. The samples were loaded onto the sample holder, seized with conductive aluminum tape and vacuum coated gold film with Cressington sputter ion coater prior to taking SEM photographs. Magnification was 5000, with an acceleration voltage of 20kV.

2.4 Catalytic Tests:

For the toluene/methanol side chain alkylation, Na_3PO_4/NaX powder was crushed, pressed, and sieved (40-60 mesh). A fix bed reactor was used to carry out the reaction, and 1.2 g of the catalyst was positioned in the center of a stainless-steel tube having 7 mm inner diameter, and the catalyst was supported by quartz sands at the outlet of the reaction tube, and separated by quartz cotton at both ends to prevent catalyst from blowing into GC columns. Nitrogen was the carrier gas and the flow rate was 10.0 mL/min, the molar ratio of toluene to methanol was 5:1, and the mass space velocity was 1.0 h^{-1}. The catalyst was activated at 450°C for 2 h under an atmospheric nitrogen atmosphere and then lowered to 425°C for evaluation. The reaction products were quantitively examined online by Haixin GC950 gas chromatograph equipped with an HP-FFAP column (0.53 mm × 50 m), and the products were detected by a hydrogen flame ionization detector (FID). Since the access of toluene in the reaction system was used, the conversion rate, product selectivity, and yield were calculated based on methanol given in the equation below.

$$X_{MET} = \left(1 - \frac{MET\ outlet}{MET\ inlet}\right) \times 100\%$$

$$S_X = \left(\frac{X}{MET\ inlet - MET\ outlet}\right) \times 100\%$$

$$Y_X = S_X \times C_{MET}$$

III. RESULTS AND DISCUSSION

3.1 TPD-CO₂

To examine the base properties of the catalysts, we conducted Temperature-programmed desorption (TPD) experiments of CO_2, and TPD-CO_2 spectra of all catalysts such as NaX, cat-0.01, cat-0.05, cat-0.075, cat-0.1 were shown in Fig.1. Three kinds of desorption peaks were seen for all catalysts. The first region was at a low-temperature range between 50°C-250°C correspond to the weak base site; the second region ranges between 250°C-500°C indicates a middle base site while the third region is the strong base site at around 500°C-800°C. As the loading of Na_3PO_4 enhanced, the CO_2 desorption peak area of the middle base site increased and shifted towards higher temperature while the desorption peak area decreased at low temperatures indicating that during the impregnation process, the amount of base sites of support enhanced. It can be elucidated from these results that a suitable amount of Na_3PO_4 may considerably increase the amount and the strength of middle base sites on the surface of the catalysts.

3.2 XRD Diffraction

Fig. 2 depicts the XRD patterns of different catalysts (NaX, cat-0.01, cat-0.05, cat-0.075, cat-0.1). It could be perceived from our results that all the catalysts showed diffraction peaks of the faujasite framework signifying a typical arrangement of X-zeolite. However, in comparison with NaX zeolite, the relative diffraction peak intensity of cat-0.05, and cat-0.1 slightly decreased at 26.7°. This might happen because the zeolite structure was slightly damaged in the process of impregnation. Except for zeolite X, there were no other noticeable peaks seen in all XRD patterns, suggesting that the assembly of NaX was not destroyed during the catalyst preparation process, and Na_3PO_4 has well dispersed on the surface of NaX zeolite.

3.3 SEM

Fig 3 shows SEM images cat-0.01, cat-0.05, cat-0.075, cat-0.1. All the catalysts had same size distribution and irregular octahedron structures. The catalysts were mainly made up of crystallites having size about 2 to 3 µm and small particles. SEM images of cat-0.01 (a) and cat-0.075 (c) are similar. Fig. 3.4(d) represents that there were a huge number of white particles which showed the loading of Na_3PO_4 on NaX zeolite surface and also represented a uniform mixing which might be the reason of stability and high catalyst performances. Based on the results we elucidated that more the dispersion of the particles on the surface, higher the performance of the toluene/methanol side chain alkylation.

3.4 BET

The pore volume, pore diameter, and total surface area of all the catalysts are given in Table 1. It can be perceived from these results that pore volume and catalyst surface area was considerably reduced with an increase in the concentration of Na_3PO_4 as displayed in Fig 4. It might be because Na_3PO_4 occupied some parts of the zeolite pores. Combined these results with the catalytic performance, catalyst with concentration 0.1 mol/L showed best ability to catalyze the reaction indicating that small pore volume having microporous structure might be suitable for the toluene/methanol side chain alkylation

IV. FIGURES AND TABLES
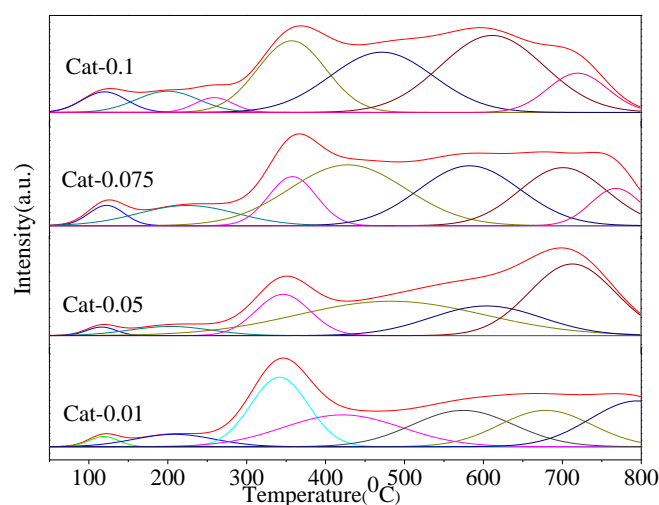
Fig 1. TPD-CO₂ profile of catalysts cat-0.01, cat-0.05, cat-0.075 and cat-0.1
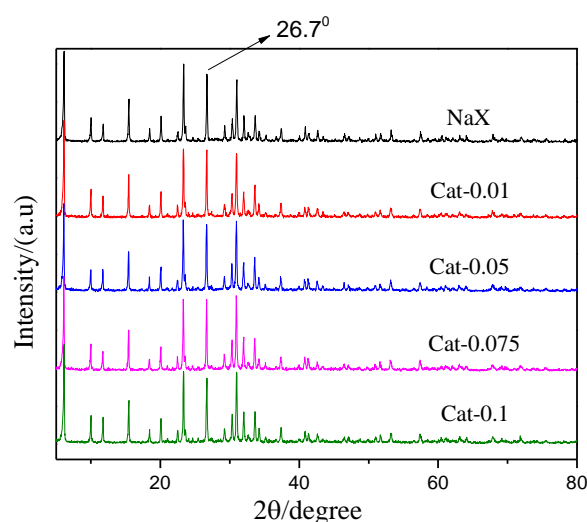
Fig 2. XRD patterns of catalysts NaX, cat-0.01, cat-0.05, cat-0.075, and cat-0.1
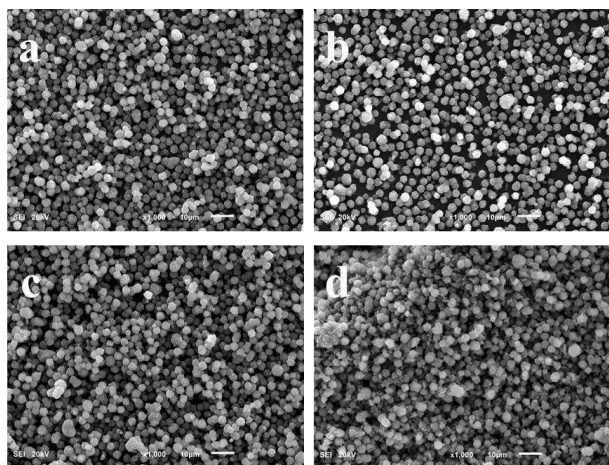
Fig 3. SEM images of catalysts (a) cat-0.01, (b) cat-0.05, (c) cat-0.075, and (d) cat-0.1
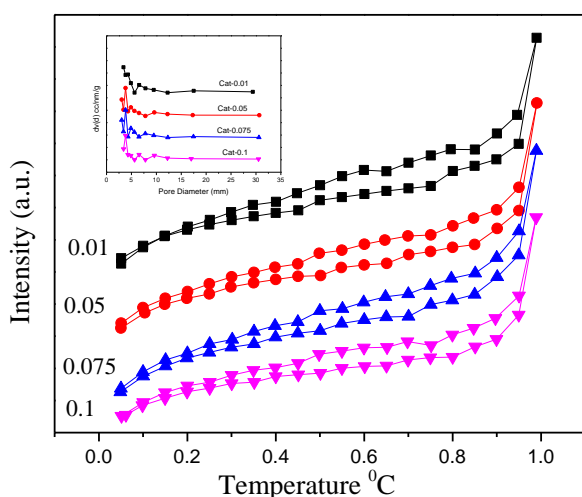
Fig 4. BET images of catalysts cat-0.01, cat-0.05, cat-0.075, and cat-0.1

Table.1: Textural properties of different catalysts

Catalysts	Pore Volume cm³/g	Pore Diameter nm	Total surface area m²/g
0.01M	0.032	3.408	595.85
0.05M	0.029	3.819	553.79
0.075M	0.033	3.825	610.66
0.1M	0.025	3.820	541.14

Where: M= mol/L, cat-0.01=0.01M, cat-0.05=0.05M, cat-0.075=0.075M, cat-0.1=0.1M

Table.2: Performance of Catalyst

Catalyst	Reaction Temp(°C)	MET conv%	Selectivity of products (%)		Yield of products (%)		
			S_{EB}	S_{STY}	Y_{EB}	Y_{STY}	$Y_{(EB+STY)}$
0.01M	425	96.9	18	2.2	17.9	2.1	20
0.05M	425	100	23	3.8	23.5	3.8	27.3
0.075M	425	100	15	2.6	15.3	2.6	17.9
0.1M	425	100	31	7.5	31.9	7.5	39.4

Where: M= mol/L, cat-0.01=0.01M, cat-0.05=0.05M, cat-0.075=0.075M, cat-0.1=0.1M

V. CATALYTIC REACTION

The reaction performance for the toluene/methanol side chain alkylation over a series of catalyst Cat-n (n represents loading of Na_3PO_4) is shown in Table 2. Ethylbenzene and styrene were regarded as the main products for the toluene/methanol side chain alkylation while there exist some byproducts such as methane and xylene. With the loading of Na_3PO_4 by impregnation method, methanol conversion reached up to 99%, and the selectivity and yield of styrene and ethylbenzene were also expressively increased. The activity of the catalyst and the yield of styrene and ethylbenzene were enhanced considerably when the concentration of Na_3PO_4 was 0.1 mol/L, i.e., yield (Ethylbenzene + Styrene) 39.4%. At this concentration of Na_3PO_4, the conversion of methanol was 100%.

The catalytic activity data in Table 2 and TPD-CO_2 (Fig. 1) showed that selectivity (ethylbenzene + styrene) and the activity of the catalyst has improved with an appropriate amount and strength of middle base sites, which suggested the middle base sites were advantageous for the toluene/methanol side chain alkylation reaction.

VI. CONCLUSION

In this work, a cheap and new zeolite catalyst containing different concentrations of Na_3PO_4 supported on NaX has successfully synthesized and characterized by TPD-CO_2, XRD, SEM, and BET. The TPD-CO_2 results revealed that as the loading of Na_3PO_4 on NaX zeolite emhanced, the amount of middle base sites also increased which led to the higher yield of ethylbenzene and styrene i.e, the yield of ethylbenzene and styrene, and conversion of methanol reached 39.4% and 100% signifying that the presence of amount of middle base sites on the surface of the catalyst was crucial factor for the toluene/methanol side chain alkylation.

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Design and Dynamic Analysis of Kinetic Energy Recovery System for Toyota Hilux 4X4

Fitsum Tadesse Soramo[1], Goftila Gudeta Sirata[2] and Iyasu Tafese Jiregna[3]

[1]Department of Mechanical Engineering, Wolaita Sodo University, Ethiopia
[2,3]Faculty of Mechanical Engineering, Jimma University, Ethiopia

Abstract—*In the present scenario, the energy crisis is one of the main challenges in the real world. The fossil-fuel resources are being depleted at a tremendous rate due to their excessive consumption. This has put forth the widespread assumption that if resources are being used at the current rate, the time is no longer when all our resources will expire. Thus, there is a need to develop technology that saves energy from getting wasted. Traditionally, regenerative braking with the ability to generate energy has been promising, but the amount of energy saved was highly insignificant. A considerable amount of energy, which is generated by the engine, is lost while braking even in case of regenerative braking. The regenerative braking involves direct conversion of the Kinetic energy to Electrical Energy; however, a promising alternative is present while storing the Kinetic Energy of the Vehicle in the form of Mechanical Energy of a rotating cylindrical flywheel. This paper states the advantages of storing the Kinetic Energy of the Vehicle in Mechanical form rather than direct conversion. For the design of this kinetic energy storing device, some calculation has been done for the vehicle at different resistance load, torque, speed, and calculation for selection of the planetary gear, design of flat spiral spring is considered and also using SOLID WORK software some parts of the system are designed. By taking the velocity of the vehicle from 8.34m/sec to 27.8, the kinetic energy loss of the vehicle is increasing with the increase of velocity, but the efficiency of the kinetic energy recovery system will decrease. Braking the vehicle with the velocity of 8.34m/sec has 219KJ of kinetic energy loss, and energy stored by flat spiral spring is 201.4KJ, and the system has efficiency of 91.9% and can save 0.00464L of fuel from 0.005L which will be consumed at 8.34m/sec. But the vehicle moving at 27.8m/sec, the kinetic energy loss is 2434.4KJ, and the stored energy is 201.4KJ, and the kinetic energy recovery system has efficiency of 8.3%. So, using flat spiral spring kinetic energy recovery is useful and recommendable for the vehicle, which has a high stop and goes times.*

Keywords— *Flat spiral spring, Kinetic energy recovery, Planetary gear, Vehicle brake*

I. INTRODUCTION

A **kinetic energy recovery system** (**KERS**) is an automobile system which is used to recover the kinetic energy of a moving vehicle during deceleration (braking). The recovered kinetic energy is stored in a reservoir and reused during acceleration. The main aim of the KERS is to extract the kinetic energy during braking and resupply it as additional power to the vehicles. It is a great advantage for the driver [1]. Therefore, the two sources of power for moving vehicle are the engine and the stored kinetic energy. If this kinetic energy of the vehicle is not recovered, it may be wasted during braking since kinetic energy is converted into heat energy and sound energy, which are dissipated to the environment [2–4].

The proper mechanism of KERS helps to store the kinetic energy inside the vehicles before the kinetic energy

is converted to heat and dissipated to the environment. It gives the vehicle additional power to increase the speed when required. There are two main types of KERS systems, i.e., mechanical KERS and electrical KERS. The main difference between these two types of KERS is the way they convert and store energy inside the vehicle Mechanical KERS uses a rotating flywheel to store the kinetic energy of the vehicle while electrical KERS uses an electromagnet to convert kinetic energy to electrical energy, which slowly transforms into chemical energy and is stored in a battery [5,6]. Battery requires several energy conversions with corresponding efficiency losses. The recent study shows the overall energy conversion efficiency of the batteries is in the range of 31 and 34 percent when energy is reused in the driveline. However, the flywheel stores the kinetic energy and minimizes

various energy conversions [1]. Thus, it provides more than 70 percent of overall energy conversion efficiency, more than twice the efficiency of an electrical KERS system [7].

Additionally, using a battery for storing energy is sometimes at risk. It is susceptible to battery fires and may result in electric shocks. Therefore, using electric KERS is not safe [8].

The Kinetic Energy Recovery System, which is associated with the flywheel, is commonly used in a sports car. The concept of this system is to prevent energy losses in any other form by storing and then reusing this stored energy again when needed. Various Kinetic Energy Recovery Systems are different from each other because of the different storage elements used. The below-discussed KERS system uses Flat Spiral Spring as an energy-storing element and planetary gear system for power transmitting between the spring and the shaft [9,10].

At the time of introduction, many road car manufacturers were beginning to offer hybrid cars that used a similar principle to harvest and reuse energy and so the concept of KERS was one that the public could quickly understand and appreciate [11].

Several vehicle industries started to provide a hybrid vehicle using a similar principle for storing and reusing energy. Therefore, the KERS concept is surprising that it can be easily understandable by scholars. It provides the opportunity of reusing the vehicle kinetic energy. The aim of this study is to design and analysis of the kinetic energy recovery system for Toyota Hilux 4X4.

II. WORKING PRINCIPLE OF THE KINETIC ENERGY RECOVERY SYSTEM

A. When the vehicle is accelerating

The sun gear which is mounted on the axle will rotate with the same direction to the axle. The planet gears are meshed with the sun gear and rotate on the ring gear, but the ring gear is idle, means no power is transmitted to the ring gear, and also the drum and the flat spiral springs are idle [12].

B. When the brake is applied

The sun gear rotates to the direction of the axle. Still, the planetary gear rotates on the carrier pin due to the baking effect the carrier is locked, and the carrier pin, which connects the planet gear and the ring gear, takes advantage and rotate the planet gear because of bearing on the planet and locking key on the carrier side. At this time, the planet transfer the power to the ring gear and the ring gear rotate in the direction of the planet, which is opposite to the

direction of the sun gear. The drum and flat spiral springs are mounted on the ring gear, so the flat spiral spring spins and stores the lost kinetic energy
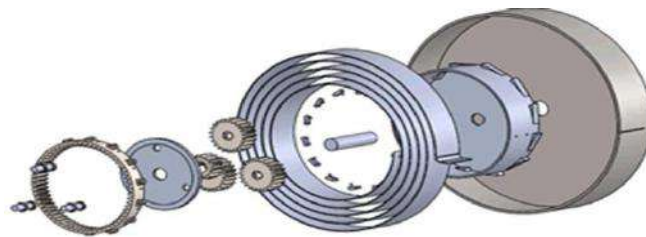
Fig.1: parts of the flat spiral kinetic energy recovery system

C. One-way clutch (Ratchet) application

The ratchet is used in this system as the guiding to the flat spiral spring. The ratchet on the ring gear is used to resist the rotation of spring to the direction of the vehicle while accelerating.
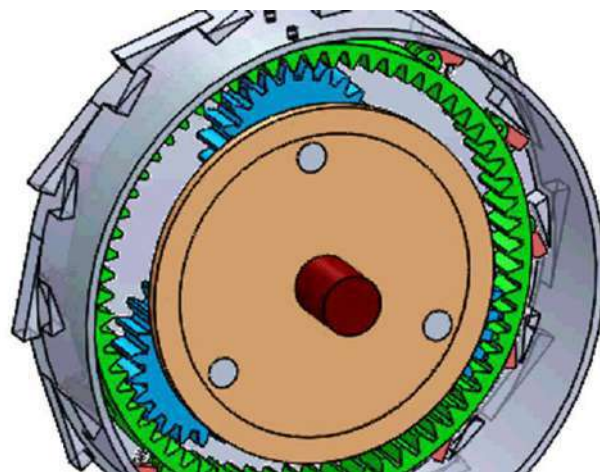
Fig.2: Rachet system

when the vehicle brakes and the spring starts to wind, the ratchet allow the spring. The next ratchet is the one used to guide the final terminal of the spring to the groove of the housing which is designed to protect the over tightening of the spring which results to failure [13,14].
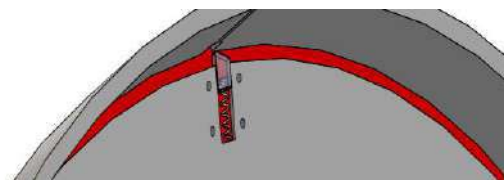
Fig.3: The groove on the drum

III.   DESIGN OF SPRING

In this section,, the design of the flat spring, which is the storing device for the lost kinetic energy of the vehicle, is presented. As shown in Figure 4, a flat spring is a long , thin strip of the elastic material wound like a spiral. These springs are often used in watches and gramophones, and so on. When the outer or inner end of this type of spring is wound up in such a manner that there is a tendency to increase the number of spring spirals, the energy of the strain is stored in its spirals. This energy is used in any useful manner as the spirals slowly open out. The inner end of the spring is usually clamped into an arbor while the outer end may be fixed or tightened. Since the curvature radius of each spiral decreases when the spring is wound up, therefore, the spring material is in a pure bending state [15].

Material Specifications

- Stainless steel wire, hardening 17-7, NiCr,A2E6
- Young`s modulus (E) = 208Gpa
- Density (ρ) = 8.03g/cc
- Maximum service temp = 3230C
- Factor of safety =2
- Tensile strength (σt) = 1800Mpa
- Assumption for design purpose of spring
- Width (b)   = 44mm
- Thickness (t)   = 1.5mm
- Internal diameter (d)   = 183 mm
- External diameter (D)   = 310mm

Fig.4: Flat spiral spring
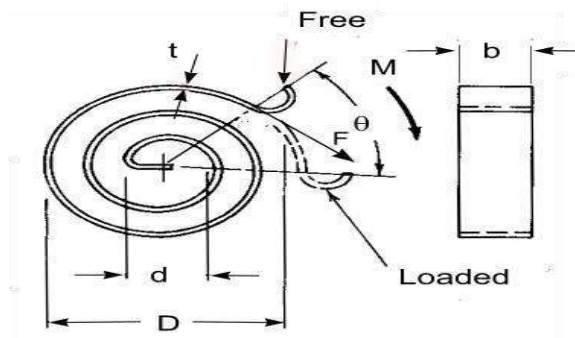
Fig.5: The dimension of flat spiral spring

Let W= Force applied at the outer end A of the spring, y = Distance of center of gravity from the outer end of the spring A,

y =D/2

$$Z = \frac{1}{y} = \frac{b t^3}{12 \times t/2} = \frac{b t^2}{6} - - - - - -(1)$$

$$Z = \frac{44 \times 1.5^2}{6} = 16.5 \, mm^3$$

$$I = \frac{b.t^3}{12} - - - - - - - - - - - - - - -(2)$$

Where, l = the strip length forming the spring, b = spring width(mm) t = spring thickness (mm)

When the force W pulls the end A of the spring, then the bending moment on the spring at a distance y is given by:

$$M = W \times y \text{-------------------}(3)$$

The largest bending moment occurs at B in the spring, which is at maximum distance from the application of W.

Bending moment at B,
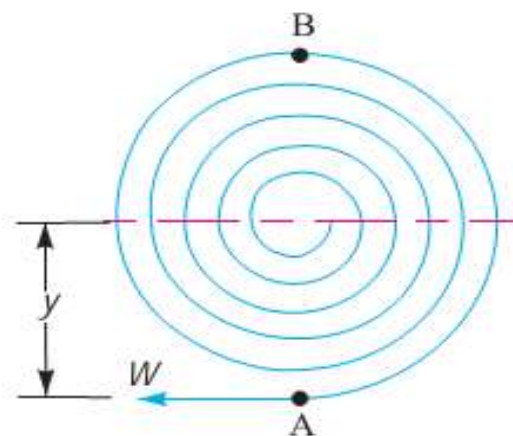
Figure 6 bending moment occurrence point

$$M_B = M_{max} = W \times 2y = 2W.y =$$
$$2M \qquad\qquad\qquad --(4)$$

Maximum induced bending stress in the spring material,

$$\sigma_b = \frac{M_{max}}{Z} = \frac{2W \times y}{bt^2/6} = \frac{12.W.Y}{bt^2} = \frac{12M}{bt^2} ---(5)$$

Assuming that both ends of the spring are clamped, the angular deflection (in radian) of the spring is given by Equation (6)

$$\theta = \frac{M.l}{E.I} = \frac{12M.l}{Eb_t^3} --------(6)$$

$$= \frac{12 \times 455374.5l}{208 \times 10^3 \times 44 \times (1.5)^3} = 0.18l$$

$$\delta = \theta \times y = \frac{M.l.y}{E.I} -------(7)$$

The strain energy stored in the spring

$$ES = \frac{\sigma_b^2}{24E} \times b.t.l = \frac{\sigma_b^2}{24E} \times volume ---(8)$$

$$ES = \frac{(55196.91)^2}{24 \times 208000} \times 44.1.5.l$$

$$E_S = 40280.87l$$

Where

D = Outside diameter of spring (m)

M = Moment/torque on spring = F.D / 2(Nm)

L = Length of strip (m)

G = Modulus of Rigidity (N/m²)

d = Inside diameter of spring (m)

n = Number of turns of spring

E = Young's Modulus (N/m²)

θ = Deflection (radians)

y = distance from neutral axis to outer fiber of wire/strip = D /2 (m)

IV. RESULTS AND DISCUSSION

This section presents the results obtained from the numerical analysis of flat spiral spring, and SOLIDWORK software was used for the numerical analysis of drum, carrier, carrier pin then the results obtained from the numerical and analytical results are compared.

a) *Energy absorbed by the brake*

The energy absorbed by a brake depends on the type of motion of the moving body. The motion of a body may be either a pure translation or a pure rotation or a combination of translation and rotation. Kinetic energy is the energy corresponding to these motions.

Let us consider these motions as follows:

Consider a body of mass (m) moving at a velocity U m / s when the body's motion is a pure translation. By applying the brake let its velocity be reduced to V m / s. Thus, the change in the kinetic energy of the translating body or the kinetic energy translation, on equation (7)

$$KE = (1/2) m [(u)^2 - (v)^2]$$

Gross vehicle mass = 3150 Kg from car specification

Let assume vehicle speed ranges from (0-100Km/hr)

The brake must absorb that energy. When the vehicle is stopped after applying the brakes, then the final velocity (V) = 0, and from equation (3.38).

$$KE = (1/2) m (U)^2$$
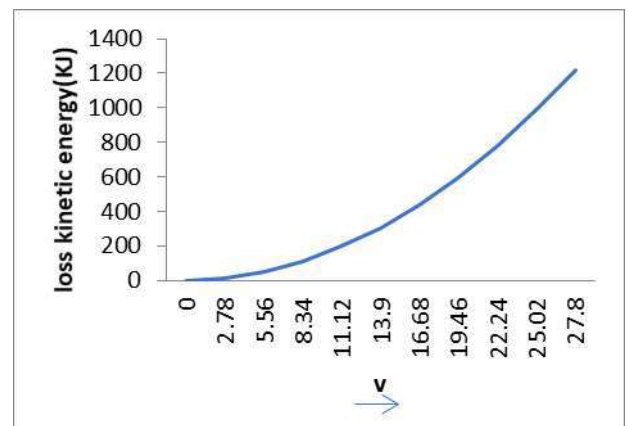
Fig.7: Kinetic energy when final velocity equals zero

For a vehicle moving with a velocity of 27.78m/sec, the kinetic energy loss of Toyota Hilux 4x4 is about 2430.74KJ, but the calorific value of Diesel is approximately 44800 kJ/kg [3]. This means 2430.74/44800 = 0.0543 kg or 54.3 gms of Diesel equivalent energy was lost as heat. While for some, these might be insignificant values; however, they become huge numbers over the lifetime of the car. Therefore, the regenerative braking feature is essential to evolve for having sustainable transport.

Energy stored on Flat spiral spring

The spiral spring is subjected to a torque applied in such a way that the relative shaft–housing rotation causes bending

of the turns the spiral strip. It is assumed that the spring housing is fixed using a driver-controlled lever and the inner shaft is loaded by a torque (during vehicle braking) about the spring axis, the spiral spring will thus deform and stores the kinetic energy of the vehicle as elastic potential energy. This stored energy can then be utilized to provide an instant boost to the vehicle.

Carrier is one part of the kinetic energy recovery system which is design to hold the carrier pin with the planet gear.
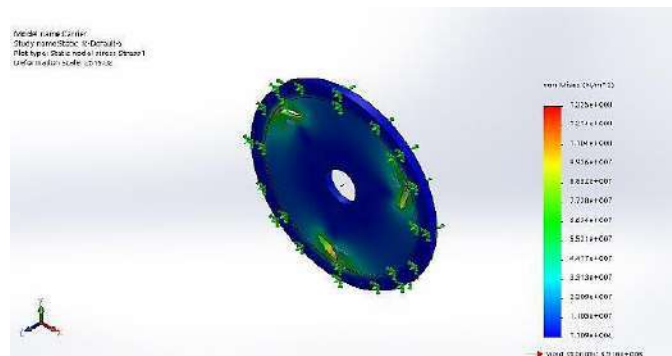
Fig.8: Carrier-Static 1-Stress-Stress1

Figure 8 shows the simulation result of von mises stress for a carrier, which has minimum value $1.109*10^4$ N/m^2 and maximum value $1.325*10^8$ N/m^2 and selected material yield strength is $3.516*10^8$ N/m^2. This shows the carrier is safe for application because yield strength is higher than the von mises stress.
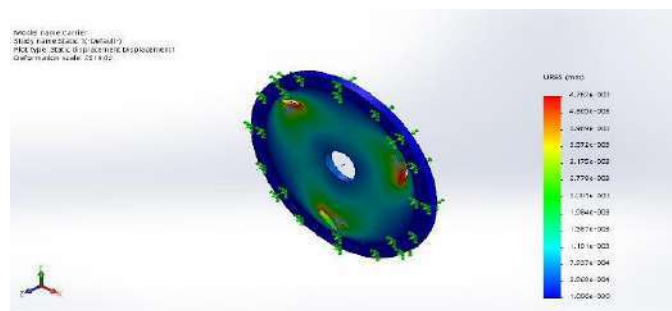
Fig.9: Carrier-Static 1-Displacement-Displacement

The deformation scale is 2519.82, which indicates the carrier is too far to deform with the applied torque.
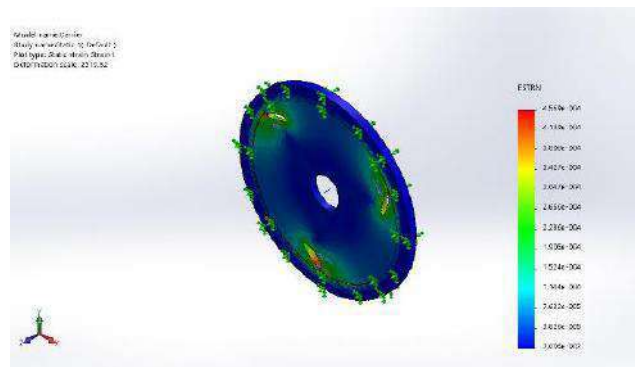
Fig.10: Carrier-Static 1-Strain-Strain1
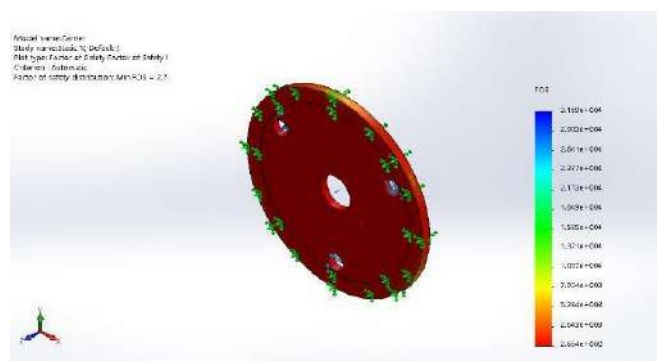
Fig.11: Carrier-Static 1-Factor of Safety-Factor of Safety1

Carrier pin(shaft) is used to connect the carrier(arm) with the planet gears.
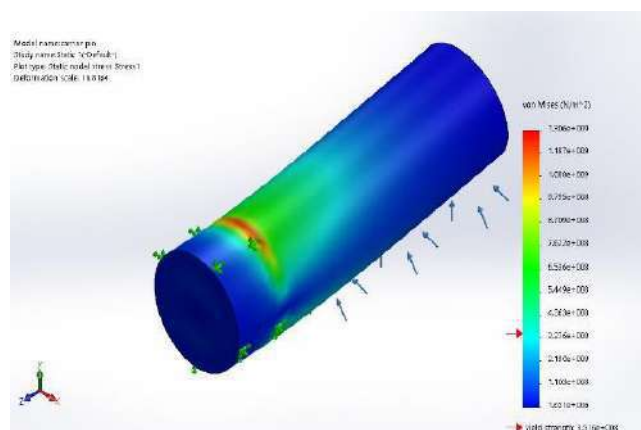
Fig.12: Carrier pin-Static 1-Stress-Stress1
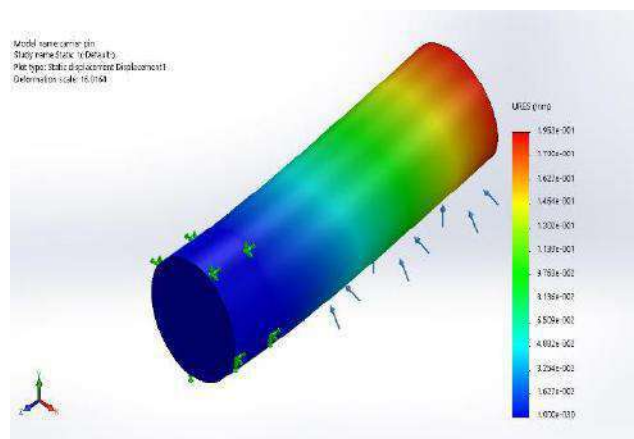
Fig.13: Carrier pin-Static 1-Displacement-Displacement1
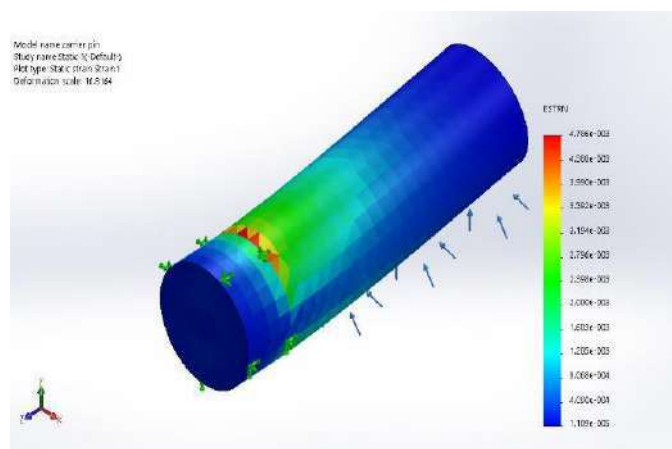
Fig.14: Carrier pin-Static 1-Strain-Strain1
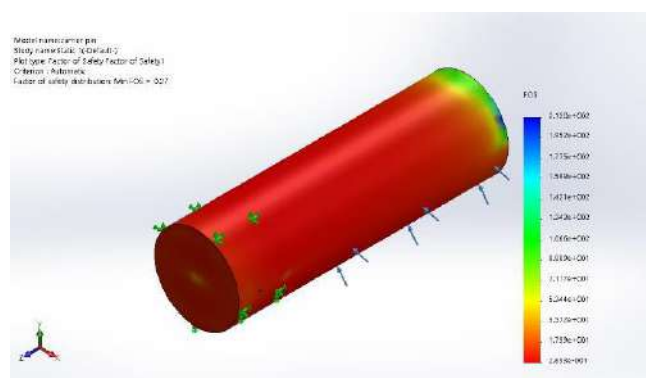
Fig.15: Carrier pin-Static 1-Factor of Safety-Factor of Safety1

The one-way clutch is a ratcheting device onto which the drum is mounted. The one-way clutch ensures that the motion or energy is not transmitted to the drum during idling or braking.
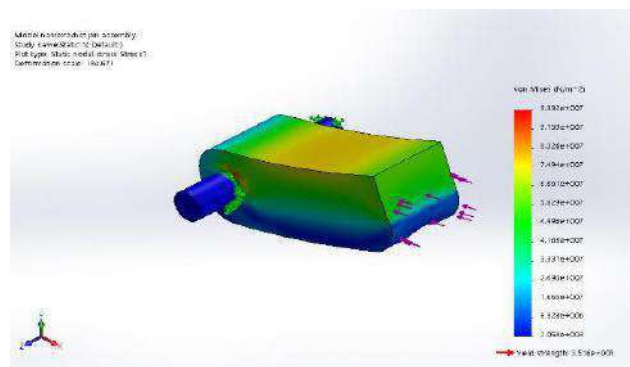
Fig.16: Ratchet pin assembly-Static 1-Stress-Stress1
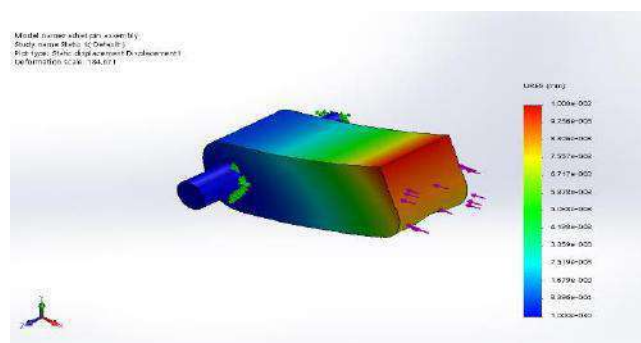
Fig.17: Ratchet pin assembly-Static 1-Displacement-Displacement1
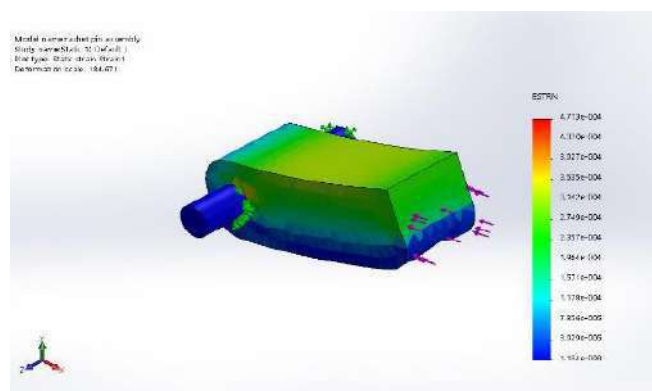
Fig.18: Ratchet pin assembly-Static 1-Strain-Strain1
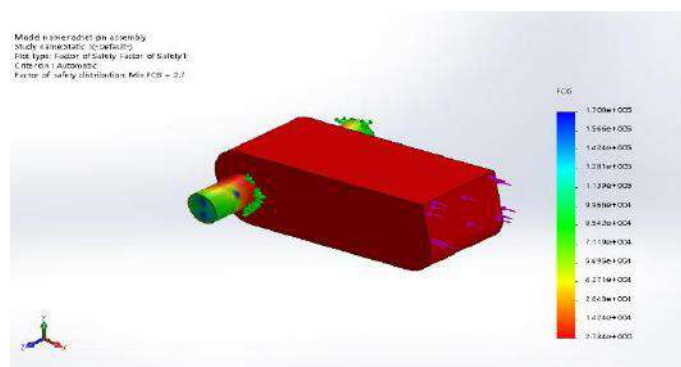
Fig.19: Ratchet pin assembly-Static 1-Factor of Safety-Factor of Safety1
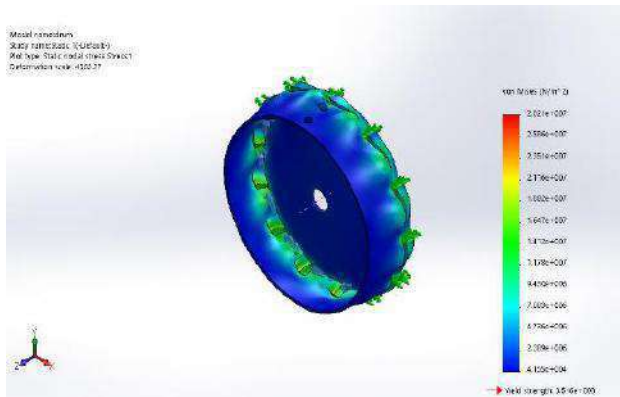
Fig.20: Drum-Static 1-Stress-Stress1

Fig.21: Drum-Static 1-Displacement-Displacement1

Fig.22: Drum-Static 1-Strain-Strain1
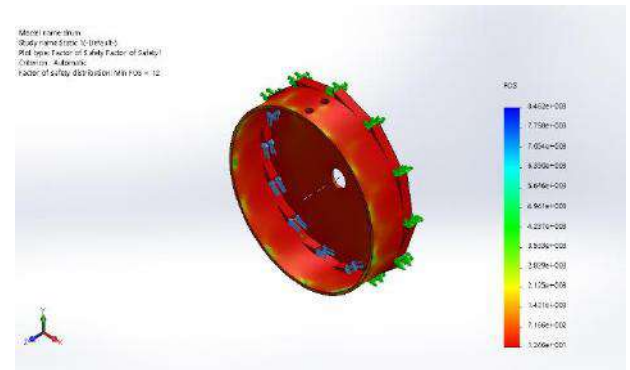
Fig.23: Drum-Static 1-Factor of Safety-Factor of Safety1

V.   CONCLUSION

A flat spiral spring-based mechanical regenerative braking can use the flat spiral spring to slow the vehicle while storing energy as well as accelerate the vehicle while releasing energy from the spring. This concept was designed to be placed on the planetary gear assembly of the vehicle.

The axle only rotates in one direction while the vehicle is in forwarding motion; thus, the design allows for this single direction of motion during both the regeneration mode and assist mode. In most strain devices, the deformation and relaxation cycle involves a reversal in direction. The flat spiral spring regenerative system mechanism is intended to function only when the vehicle is moving forward; thus, it must account for the reversal of the storage element.

The regenerative braking and assist modes should only be active while the car is accelerating or decelerating; when the vehicle is at a constant speed, the device should be inactive. Ideally, the device should produce minimal effects on the vehicle while not in use. Thus, this device must engage and disengage from the axle.

By taking the velocity of the vehicle from 8.34m/sec to 27.8, the kinetic energy loss of the vehicle is increasing with the increase of velocity, but the efficiency of the kinetic energy recovery system will decrease. Braking the vehicle with a velocity of 8.34m/sec has 219KJ of kinetic energy loss, and energy stored by flat spiral spring is 201.4KJ, and the system is 91.9% and can save 0.00464L of fuel from 0.005L which will be consumed at 8.34m/sec. But the vehicle moving at 27.8m/sec, the kinetic energy loss is 2434.4KJ, and the stored energy is 201.4KJ, and the kinetic energy recovery system is 8.3%. So using flat spiral spring kinetic energy recovery is useful and recommendable for a vehicle that has high stop and goes times.
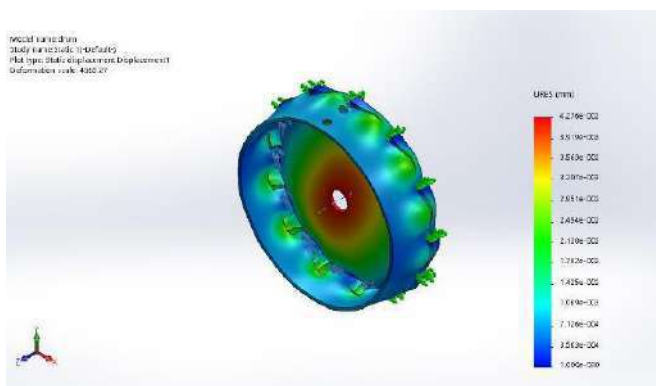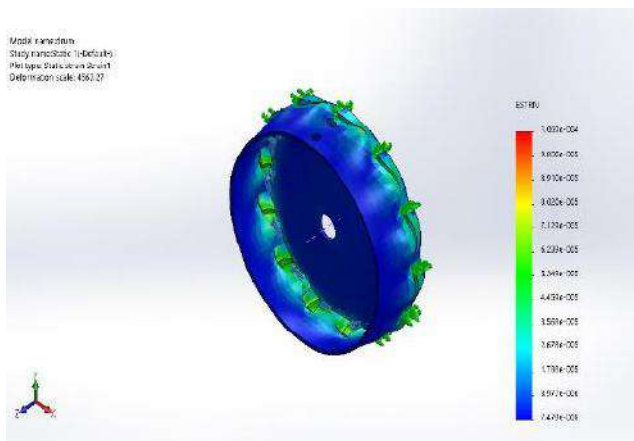
In the coming days, the spring-based regenerative system will gain more attention with the advancement in spring design and spring material. The vehicle with the start-stop cycle of driving will be affected the most with the introduction of this technology. The kinetic energy recovery using a flat spiral spring is good even though it needs more improvement and electronic integration into the system.

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Food Botulism: Nursing Actions to the Patient that Evolved with Acute Kidney Insufficiency in the Intensive Care Unit

Jéssica Dos Santos Souza[1], Julliana de Souza Rodrigues[2], Fernando Augusto Pinheiro[3], Angela Antunes de Morais Lima[4], Sheila Carminati de Lima Soares[5], Aline Brito Lira Cavalcante[6], Rittiela Rocha da Silva[7]

[1]Nurse by São Paulo College – FSP (2018). Intensive Care Resident – ICU by the Health's Secretary of the State of Rondônia. SESAU/RO under intermediate of the Multi-professional Residence Committee – COREMU in the Cacoal Regional Hospital Complex – COHREC.
[2]Nurse by Cacoal Biomedical Sciences College – FACIMED (2018). Intensive Care Resident – ICU by the Health's Secretary of the State of Rondônia. SESAU/RO under intermediate of the Multi-professional Residence Committee – COREMU in the Cacoal Regional Hospital Complex – COHREC.
[3]Nurse by Cacoal Biomedical Sciences College – FACIMED (2008). Specialist in Adult and Pediatric Intensive Care by Cacoal Biomedical Sciences College (FACIMED, 2017). Specialist in Urgency and Emergency with emphasis on ICU by Grupo Athenas, (2011). Tutor in the Multi-professional Health Residency Program at the Regional Hospital of Cacoal. Lecturer at the Pimenta Bueno College – FAP.
[4]Nurse. Graduated by Mato Grosso do Sul Federal University (UFMS, 1999) and specialist in Family Health from the University of Rondônia (UNIR, 2002) and in health surveillance by SírioLibanês (2017). Tutor in the Multi-professional Health Residency Program at the Regional Hospital of Cacoal.
[5]Nurse by State University of Oeste do Paraná (1998), Master Degree in Health Sciences by Brasília University (2007) Tutor in the Multi-professional Health Residency Program at the Regional Hospital of Cacoal.
[6]Nurse by Cacoal Biomedical Sciences College – FACIMED (2017). Specialist in Gynecology and Obstetrics by São Paulo College – FSP.
[7]Nurse by Cacoal Biomedical Sciences College – FACIMED (2015). Tutor in the Multi-professional Health Residency Program at the Regional Hospital of Cacoal

*Abstract— It is understood that botulism is a serious disease, whose toxin released by the bacterium Clostridium botulinum causes a neuroparalitic action, requiring that the affected patient needs intensive care. As a consequence of the long period of hospitalization, the patient is subject to complications, which include risk of shock and electrolyte imbalance resulting in Acute Renal Failure (ARF). **Objective:** This study aims to present the clinical complications developed by the patient that occurred from botulism poisoning and to identify the clinical causes that led the patient with botulism to ARF, establishing the relationship of these causes with the signs, symptoms and laboratory results. **Materials and Methods:** A descriptive, cross-sectional, retrospective and qualitative study was conducted based on secondary data collection, with documentary data collection in the form of a case study regarding a patient admitted to the ICU of the Regional Hospital of Cacoal - RO, victim of food poisoning. **Results:** The gastrointestinal symptoms characteristic of botulinum disease, arise in hydroelectrolytic disorders (Renal Hypoperfusion), where added with extended hospitalization and septic conditions are conditions for complications and ARF within intensive care. **Final Considerations:** It is noted that botulism associated with kidney disease can become a serious condition with imminent risk. In the Intensive Care Unit, a skilled and active nursing team becomes a differential in order to avoid conditions that further aggravate the patient's clinical condition.*

Keywords— Botulism. Acute Renal Failure. Intensive Nursing. Intensive Care.

I. INTRODUCTION

Botulism is a sickness caused by the action of a strong neurotoxin produced by the gram-positive endospore bacteria: *Clostridium botulinum,* which is mainly related to canned food with low rates of acid such as the case of corn, beet, green beans and asparagus among other (Bezerra *et al.*, 2016).

The first scientifically proved case of botulism happened by the end of the 16th century at Central Europe where an intoxication happen after the consumption of sausages, which in Latin means *botulos,* thus originating the name of the pathology. the disease-causing microorganism was once more identified in 1897 at Belgium, when 23 people got sick and 3 died due to complications of the pathology, the type A toxin was identified in them. A couple of years after, in 1904 the type B toxin was identified .

The symptoms that can initially show include gastrointestinal symptoms (nausea, vomiting, diarrhea and abdominal pain) and neurological symptoms (headache, vertigo and dizziness). The descending flaccid motor paralysis can also show, which is related to the widespread autonomic impairment. The symptoms begin in the nerves and evolve downward through the body, which grants the botulism a differential when related to the Guillain Barre syndrome where a severe paralysis shows upwardly. Compromising the cranial nerves, comes the blurred vision, Uni or bilateral eyelid ptosis, difficulty converging the eyes and diplopia, as there is paralysis of the extrinsic musculature of the eyeball. In the evolution of the disease, the muscles of the trunk and limbs are paralyzed, which can lead to dyspnea, respiratory failure and flaccid quadriplegia. The toxin causes neuromuscular block, so the deep or osteotendinous reflexes are reduced. A peculiar characteristic related to botulism is the preservation of the level of consciousness (Ministry of Health BRAZIL, 2006).

Due to be a sickness which demands intensive care for the recovery of the sick, there is the possibility that comorbidities related to clinical manifestations and hospitalization period to show. Therefore, we have the Acute Renal Failure (ARF) as study subject, since it is related to the hydro-electrolytic imbalance present in those patients, being of high incidence in Intensive Care Unit (ICU) (Santos &Marinho, 2013).

The complexity of the care is a striking factor of an Intensive Care Unit, which creates uncertainty conditions related to the clinical condition faced, and frequently related to a cold, aggressive and traumatizing environment. Due to the physical characteristics of the ICU with equipment, materials and technologies in general, a mechanized behavior can show in the team, marked by the absence of simple attitudes such as a smile or a handshake (Abrão*et al.,* 2014).

In the face of those problems, the nurse along its team should provide care under a clinic reasoning, evaluating the client as a whole and identifying possible complications trying to reduce incoherence (Santos &Marinho, 2013). The care offered by the nurse is fundamentally based on necessities, thus the nursing method and process comes from Basic Human Needs (BHN), which can be provided by an attentive and trained caregiver, in order to grant the survival of the individual or group (Petersen *et al.,* 2016).

Despite the advances in technology related to the serious patient care and the dialysis techniques, the Acute Renal Failure is considered one of the most important complications related to hospitalization. Due to the characteristics of the patients seen in the ICU, the place registers the largest number of Acute Renal Failure incidence (20 to 40%), when compared to an intermediate care location (1 to 7%). Among the admitted to the ICU, 5,7% evolve to Acute Renal Failure and demand dialysis. Through recent years there was a drop in the mortality rate by the sickness, although the level is still high, reaching an average of 50%, this happened due to late diagnosis, absence of risk factors identification and lack of knowledge about the factors related to the mortality (Ponce *et al.,* 2011).

The early identification of the sickness becomes a challenge to the public health, because it presents many etiologies, conducting to azotemia, which configures as an increase of the plasma urea and creatine levels, due to the reduced glomerular filtration level. It can be caused by hemorrhage, heart failure, sepsis, myocardial infarction (pre-renal causes), nephrotoxic agents, prolonged ischemia, infectious processes (intra-renal causes) and obstruction of the urinary tract (post-renal cause). According to Acute Kidney Injury Network the serum creatinine levels and urine output are criteria to define the Acute Renal Failure diagnosis (Santos e Marinho, 2013).

According to Luft *et al.*(2016), the patients in intensive care are frequently submitted to vasoactive drugs, such as the vasoconstrictors which are one of the possible causes of kidney injury. The hemodynamic instability caused by these medications generates a risk factor of mortality in intensive care.

Therefore this research will contribute on determining the relation between botulism, the received treatment and the acute renal failure in a young woman seen at a referral

hospital from the State of Rondônia. By that means the nursery team and other health professionals will be able to early identify and better determine the best conduct, specially when related to botulism which is a low-incidence and high severity disease, that carries the possibility of drastic complications. The acting team in the ICU will be able, with this material, to have a better understanding of how the ARF appears and determine measures to avoid the emergence of or to minimize the complications.

Knowing that, this study becomes necessary for the objective to reveal the clinic case of a patient with exogenous botulism intoxication, who developed Acute Renal Failure (ARF) in the ICU, the complications from the botulism intoxication and the nursery assistance provided through hospitalization. Identifying the causes that took the botulism patient to the acute renal failure, establishing the relations of these causes to the signs, symptoms and laboratory results.

II.   METHODOLOGY

This is a descriptive documentary, transverse, retrospective and qualitative study that occurred based on secondary data gathering, in the form of case study. The research was based on a specific fact, being the patient chosen due to a singularity of the presented Botulism clinical condition and her evolution to the treatment, providing the research with a relevance content on the face of the unexpected situation that the sickness brings.

Initially it was presented to the patient and her responsible the objective of the study and the Informed Consent Form (ICF) for manifestation of concordance from her over the publication of the referred study. Following that the research project was submitted to evaluation and subsequent approval by the Ethics and Research Committee (CEP) – [Translator's note: Brazilian abbreviation], FACIMED, on the Brazil Platform, option n° 3.470.587. After that, the researchers contacted the General Directorate from the HRC [TN: Regional Hospital of Cacoal], presenting the relevance and the objective of the study, besides the necessary documents to obtain the authorization for the data collection.

III.   RESULT

3.1. Case Report

The reported case with evidences from the Epidemiological and Health Surveillance of the State of Rondônia verified the relevant information about the present conditions of the intoxication at the residence of the patient's relatives, this report described below is based on the report sent by the Rondônia State Health Surveillance Agency (ANGEVISA, 2019) – [TN: Brazilian abbreviation].

21 years old female patient, resident of São Miguel doGuaporé city, she participated at February 10th 2019 (Sunday) in a barbecue along eight people in a county house at the same city. Around 10:00 am they ingested home made fresh sausage as beer appetizer. From 11:00 am to 12:00 pm, the lunch for eight people was served (six adults and two children), composed by: rice, beans, roasted meat / barbecue, cooked free-range chicken, homemade mayonnaise with industrialized corn, seasoned with free-range egg, lemon and oil. Latter a packed lunch was made for 1 (one) more person. An elder (the father of the house owner) who lives alone at the urban area, and didn't participated in the barbecue. By the end of the lunch only the mayonnaise was stored in the refrigerator. At 5:00 pm dinner was served with the leftovers from lunch in which only five people ate. Around 6:30 pm, the referred patient and her husband, along the invited friends (two adults and two children) returned to their houses at the urban area, and around 11:00 pm the neuroparalitic symptoms started (diplopia, eyelid ptosis, difficulty swallowing, dysarthria, dyspnoea, respiratory failure), looking for medical care in the city of origin with further transference to a referral hospital.

3.2. Hospitalization

Patient under study at the 20th day of hospitalization presented hemodynamic stability, without sedation since February 20th, tachycardic, normotensive, without use of vasoactive drug (VaD), breathing with help of mechanic ventilation through tracheostomy. Spontaneous eye opening; responsive to verbal commands, returning part of the muscle tone, maintaining a nasogastric tube (NG tube) diet with good tolerance, peripheral venous access in hydration, in the physical examination evaluated by the nurse, she presented a distended and hyper-tympanic abdomen, back without injuries, diuresis by bladder catheter delay of concentrated appearance and in great volume (hyperpolyuric), present evacuation of pasty and liquid aspect with 5 episodes within 24 hours, thus closing the negative water balance in -2.816ml.

The medical diagnostic established in the ICU was Food Botulism and Severe Acute Neuroparalysis. The nursing diagnostics based on Nanda International Nursing Diagnoses (Herdman & Kamitsuru, 2018) were: risk of infection related to invasive procedures; impaired spontaneous ventilation related to a clinical picture of acute respiratory failure, evidenced by tracheostomy /

mechanical ventilation; risk of impaired skin integrity related to impaired immobilization and hypothermia related to low ambient temperature and inactivity, evidenced by cold skin to the touch and tachycardia.

At the 23rd day of hospitalization the patient presented a large volume gastric return through the NG tube, with a significant drop in urine output between the last two days, but maintaining evacuation of diarrheal characteristic. There was a decrease in the level of consciousness, an abrupt drop in blood pressure and tachycardia, requiring central venous access in the right subclavian to introduce noradrenaline. At the 24th day of hospitalization remaining hemodynamically unstable, using vasoactive drug, she presented gastric return through the NG tube with the

presence of blood, persistent hyperthermia and central venous pressure of 5cmH2O. At the 25th day of hospitalization there was an increase in nitrogenous scoria and hyperkalaemia, in which a femoral catheter was introduced to start hemodialysis. At the 27th day of hospitalization hypotensive patient with vasoactive drug, presented several hypoglycemic episodes, evolves to a cardiorespiratory arrest, performed a cardiopulmonary resuscitation maneuver with response after one cycle.

The laboratory exams inside the ICU corroborate diagnostics ends along with the patient's clinic. The following chart presents the results from these exams that contributed to direct the therapeutic conduct (**Figure 1**).

Fig.1: Laboratory exams from the patient as part of the routine in intensive care, ICU/HRC Cacoal/RO [TN: RO stands for: Rondônia], 2019.

	Na$^+$	K$^+$	Urea	Creatine	Blood glucose	Hemoglobin	Leukocytes	Lactate
01/03/19	149,8	3,9	24	0,7	116	10,1	11230	12
03/03/19	150	4,4	20	0,6	132	10,5	14000	
04/03/19	146	4,6	21	0,5	120	10,8	29000	
05/03/19	143	4,2	20	0,4	156	11,2	16970	
06/03/19	145,3	5	52	1,6	89	12,4	23510	14
07/03/19	149	7,1	119	4,3	55	11,7	24400	22
09/03/19	141	5,1	150	3,6	99	8,2	26.800	23
12/03/19	134	5,2	103	4,9	94	6,3	20310	
15/03/19	130,8	4,2	49	1,9	88	9,3	25970	21
20/03/19	133,4	3,8	69	2,6	114	8,8	22300	
27/03/19	135,8	4	79	1,6	94	7,4	12460	15

Source: (ICU, HRC\SESAU, 2019).

The Figure 2 displays a chart exemplifying how the registration of hydric balance (HB) happened which is part of the nursery routine in ICU. The data reflects the relation between the body gains and the losses of the studied client, being them the ingestion and infusion of medicines considered as inputs and the physiological eliminations as losses.

It is observed that at the beginning point of the chart there was a considerable difference between gains and losses, the eliminations exceeded the normal physiological values, the volume replacement not being performed thus closing the negative hydric balance. A drop in the volume of diuresis happened lately and consequently the ARF, which was also a period when the patient was hemodinamically unstable thus needing hemodialysis. It is perceived that thanks to the ultra-filtered from the dialysis

sessions, it was possible to eliminate the overload of liquids due to renal failure and from March 20th at the 38th day of hospitalization, it was noticed an important return of the renal function and following that the establishment of balance in the physiological processes, organism homeostasis after all.

Through March the patient presented great hemodynamic instability, being registered by the daily nursery notes as well as by the medical prescriptions for the use of noradrenaline with a flow reaching 6,4 mcg/kg/min by which provoked skin lesions, making necessary daily care with techniques that could provide improvement of wound conditions and protection of intact skin. It evolved to a sepsis and subsequent septic shock with an unclear focus; due to low hemoglobin rate, a blood transfusion was required; the gastrointestinal immotility

confirmed by the propaedeutics of the physical examination, resulted in receiving parenteral nutrition; underwent 14 hemodialysis days, 12 of which were ultrafiltered. From the 33rd day of hospitalization on, she did not need vasoactive drugs to maintain average blood pressure and on the 38th day of hospitalization she stopped being anuric, with the removal of the Shilley catheter on the 45th day of hospitalization.
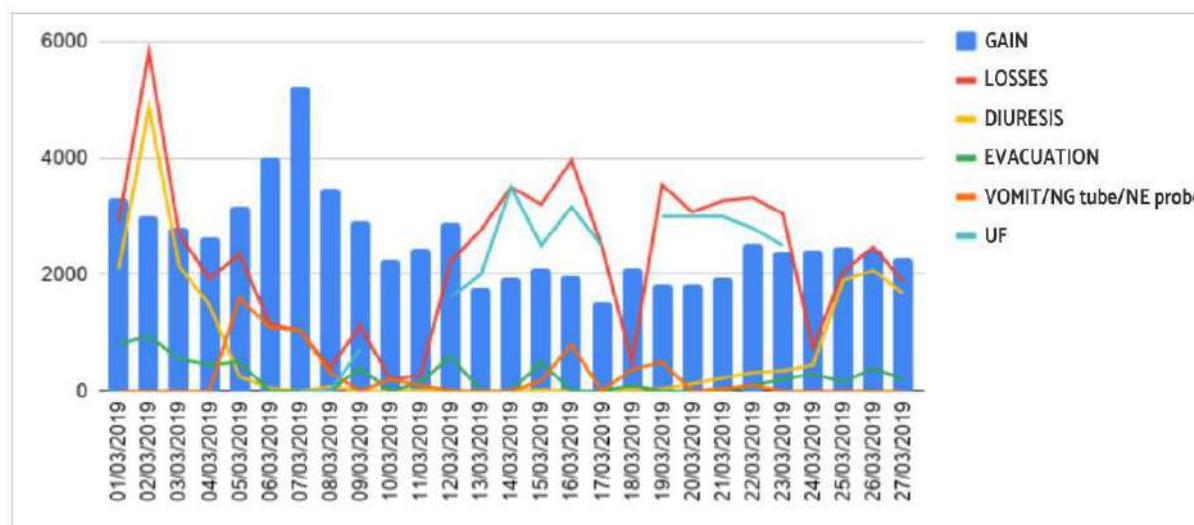
Fig.2: Water balance measured in ml from the patient's gains and losses in the last 24 hours. UF (Ultrafiltrate). ICU / HRC Cacoal / RO, 2019.

Source: (ICU, HRC \ SESAU, 2019)

IV. DISCUSSION

The actions of botulinum neurotoxins consist of acting on motor neurons, blocking their transmission. As a result, symmetrical flaccid paralysis occurs from the cranial nerves (Rosen et al., 2015). The paralysis caused by botulism is long, extending for weeks to months. The patient depends on diligent and high quality intensive care, ensuring continuous monitoring and ventilatory support (O'Horo et al., 2017).

In a study by Rao *et al.,* (2017) refers to a high level of botulism cases that showed diarrhea and vomit symptoms. Based on that study it is possible to know that the food poisoning caused by *Clostridium* will provoke those symptoms in acute level, expressing clinically through excessive loss of water and electrolytes from those eliminations (Health Ministry BRAZIL, 2012).

That excessive loss of liquid without the right reposition provokes hypovolemia, which will activate the release of the antidiuretic hormone and aldosterone. Thus a decrease in urinary output and changes in the internal balance of water and sodium(Peres*et al.*, 2010). This hydroelectrolytic disorder is also related to negative outcomes such as long periods of hospitalization and the need to stay in the ICU, with high mortality rates (Rocha, 2011).

The high risk factors for Acute Renal Failure in the ICU include: ischemic, nephrotoxic, infectious, obstructive events, hypotension, shock (hypovolemic, cardiogenic, septic), cardiovascular, hepatic and respiratory insufficiencies, neoplasms and mean hospital stay longer than 7 days. Among which sepsis is the main etiological factor, followed by drug nephrotoxicity (Iodine Contrast), postoperatively due to Systemic Inflammatory Response Syndrome (SIRS) and / or renal hypo perfusion (C.M.S. da Silva *et al*., Romano, 2015).

According to the magazine Hospitals Brazil-BR (ILAS, 2016), 55% of the patients under sepsis in the ICU die in Brazil. In order to reduce these data it is necessary to grant security protocols of the patient and quality in the offered service.

During septic shock, the use of vasopressors is essential for blood pressure control. The most widely used is Norepinephrine Hermitartarate, as a sympathomimetic agent, it has fast action, acting on cardiac inotropism, peripheral vasoconstriction and, consequently, blood pressure recovery (Pacori& Duque., 2018). The high dose established by the manufacturer can reach 68 mg of norepinephrine daily, varying according to the patient's response. However, high concentration and duration of therapy can lead to tissue hypoxemia and ischemic injury (D. Castro, 2018). It is essential to know the risks this drug

can present, even if, at caveat moments there is the necessity to use sufficiently high doses(Pacori & Duque., 2018)

Considering that sepsis is a fatal disease it is pertinent that the characteristic signs and symptoms be identified by the nursery team. From measuring and trustworthy notes of the urinary output and hydric balance (HB), which can contribute on detecting the renal dysfunction of the septic patient (Viana*et al*., 2017).

The ARF diagnostic is frequently late and uncertain, which usually delay the beginning of the therapeutic measures. When the ARF is identified the joint hemodynamic management with pressure control and use of VaDis of fundamental importance (Romano, 2015).

Studies have shown hypotension as the most frequent complication within dialysis sessions, where hemodynamic instability is characterized as one of the main intradialitic complications. This requires the nurse to establish specific and systematic care in addition to those exercised in the routine(A. F. S. Silva et al., 2018).

The decision to start Renal Replacement Therapy (RRT) in patients who developed ARF in the ICU is still a matter of doubt for nephrologists and intensivists (Romano, 2015). Nursing's contribution consists of keeping this patient with ARF metabolically stable, having a holistic view of preventing possible complications that arise from dialysis sessions, which are often serious or fatal(C. M. S. da Silva et al., 2016).

To use the diagnostic and systematization of the nursery assistance is a singular foundation to facilitate the decision making and direct the interventions when facing the identified problems(C. M. S. da Silva et al., 2016). The nurse has the responsibility to manage his team, in a manner so that the given assistance be individualized, granting the quality of attendance and minimizing damages, based in the scientific knowledge practice.

V.   CONCLUSION

In reflection we can observe three possible clinical conditions that could take the patient to a condition of hemodynamic instability and ARF as consequence, being them the dehydration due to hydric loss, the sepsis condition and the long period of hospitalization.

Such conclusions were based on the daily nursery notes as well as daily laboratory results inside ICU, to which was possible to evidence the pathophysiological changes that progressively happened and aggravated the clinic condition. It is worth to highlight that although such

complications happened through a short period of time, they could have had a different closure.

Since monitoring and supervising the notes and care taken by the technicians is among other nurse duties, which implies closing and evaluating the day and night "Hydric Balance". The nursery actions when done from systematization, serve as guideline for identifying signs and symptoms that indicate complication over the hospitalization in a Intensive Care Unit. That is why the need for constant scientific technical improvement, in order to improve the future perspective acting on a preventive point of view.

Thereby it is worth to consider that there is a lack of publications emphasizing the nursery care before the patient stricken by food botulism in the country. This report aims to highlight the need for the health team to show competence to provide the survival of these patients that depend on the intensive care, in order to revert the complications reflecting the hospitalization.

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Research on the Causes and Prevention of Enterprise's Budget Slack

Huang Yede

Shandong University of Technology, Zibo, Shandong, P.R C 255049, China

Abstract— Enterprise budget management plays an important role in modern enterprise management. It has the functions of planning, coordination, communication, and control, and the occurrence of budgetary slack has weakened the role of budget, which has caused the management of the company to deviate from the realistic estimation of income and cost, harming the overall interests of the enterprise, and bringing long-term development to the enterprise. Here comes the serious impact. This article is trying to put forward some preventive suggestions for the problem of enterprise budget slack. Based on the analysis of the causes of enterprise budget slack, this article puts forward some countermeasures and suggestions to deal with the problem of budget slack.

Keywords— cause of budget slack, budget slack prevention.

I.   INTRODUCTION

As a set of systematic systems and management tools, budget management has been used and developed in many enterprises. Since the 1990s, China has been implementing this system on a large scale from state-owned enterprises, and has gained important experience. It has the functions of planning, coordination, communication and control, which greatly facilitates the management's decision-making and control. However, while the budget management system promotes the standardization of enterprise management, it also has design difficulties and defects in the enterprise system. There are problems that plague the enterprise. Budget slack is one of them. The existence of budgetary slack provides managers with a flexible space to cover mistakes, which affects the correct analysis of budget differences and the objectivity of performance evaluation. The performance evaluation and incentive model based on budget slack will force the responsible department to hide the real information to some extent, which not only affects the effectiveness of the group 's budget management, but also fundamentally enables the group to make business decisions and long-term development. The strategy lacks a

solid and reliable foundation. In addition, a large amount of budget slack will also encourage employees to dishonest behaviors. The phenomenon of "paying for the liar" has made it easier for those who deliberately understate the budget to get rewards, but honest and hardworking employees can't get rewards. This kind of dishonest behavior will directly destroy the foundation of integrity within the organization and threaten the long-term development of the company. How to solve the problem of budget slack faced by enterprises, the author believes that it is necessary to analyze the causes of budget slack first, and take appropriate measures according to the causes of budget slack to find a solution.

II.   THE CONCEPT OF SLACK BUDGET

Different scholars have explained the definition of budget slack from different angles. Schiff and Lewin pointed out that if the compensation of the budget owner increases as the pre-difficulty decreases, the budget owner may use budget participation to distort the communication information with the boss and determine the budget at a level that is easier to achieve, thus Budget slack appears,

and the budget is determined to be within its expected capacity. It can be seen that in Schiff and Lewin's view, budget slack exists only in budget preparation, which refers specifically to the self-interest behavior in the budget preparation process. In order to get more remuneration, the person in charge of the budget should try to determine the budget number at a lower level. Merchant defines budget slack as the portion of a budget whose budget exceeds its actual needs. This is the budget slack defined from the perspective of investment and expense budget. Young's explanation of budget slack is put forward from the perspective of performance evaluation. His definition is: when employees have the opportunity to choose their performance evaluation standards, employees underestimate the part of their capacity. Lukka believes that the so-called slack budget is a budget phenomenon relative to honest budget estimates. Dunk and Nouri combined the above definitions and defined budget slack as: intentionally underestimating income or capacity, overestimating costs or resources when completing a certain budget task. This definition has a more comprehensive summary of the budget slack content, and it is clearly what happened when a certain budget task was completed. In addition to analyzing the slack in budget preparation, Chow, Cooper and Waller also analyzed the two behaviors of the budget owner in budget execution.First, when the budget can be completed, do it according to the budget, not exceeding the budget; second, when When the budget cannot be completed, it is not to find a way to maximize performance, but to let it go. These two behaviors are not all efforts in budget execution, which can be called slack in budget execution. Of course, the premise of these two behaviors is that there is no appropriate incentive plan to match the budget.When the incentive plan design does not consider the coordination with the budget, in the case that the current budget can be completed, if the current period greatly exceeds the budget, then It may mean that the budget for the next period will be overweight, so the best choice for the budget owner is to just complete the budget for the current period; in the case where the budget for the current period cannot be completed, if the incentive plan is not appropriate, only the completion of the budget is considered, not considered When the budget is completed, the person in charge of the budget will not find a way to improve performance as much as possible, but just

let it go. This may strive for a goal that is easier to achieve when the budget is determined for the next period. It can be seen that budget slack includes slack during budget preparation and slack during budget execution. This article refers to the former as preparation slack and the latter as execution slack.

This article only studies slack budgeting. And mainly referring to the definition of budget slack made by Dunk and Nouri, it is believed that budget slack refers to the deliberate underestimation of revenue and production capacity and the overestimation of the cost and resources of completing the budget when preparing the budget.

III.   THE CAUSES OF BUDGET SLACK

(1) Budget slack makes budget executors profitable

There are two conditions for making the budget slack and profitable: one is information asymmetry, and the other is budget participation. The modern enterprise system requires many contracts to participate. The budget is actually an agreement negotiated and compromised between the upper and lower levels of the enterprise. The core part of this agreement is the input of resources and the reward for completing the contract.

From the perspective of resource input, one of the purposes of enterprise budgeting is to better use and allocate internal resources of the enterprise and achieve the maximum utility of resources. Having more resources than other departments or achieving budget goals can make performance goals easier to achieve, and on the other hand, it can bring huge control rights benefits for managers. The superiors have less information on the amount of resources to complete the budget than the budget executors. There is information asymmetry between the upper and lower levels. When the budget executors participate in budget preparation, there will be Preemption of resources. They regard enterprise resources as free resources, and benefit more, especially those enterprises that do not incorporate the indicator of resource consumption into the performance evaluation system, not to mention that some resources are difficult to measure and control, such as human resources. In order to occupy as many scarce resources as possible, enterprises create budgetary slack in the preparation of budgets and exaggerate the demand for resources.

From the point of view of remuneration for contract completion, if an important condition for budgetary subordinates to obtain contractual remuneration is to complete budget performance evaluation standards, then budgetary subordinates have an incentive to generate budgetary slack to achieve more remuneration and good budget credibility. In the case of information asymmetry (actually due to the difference in the scope of professional knowledge and business familiarity between the upper and lower levels and the lack of transparency of information, the situation of information asymmetry is widespread), lower budgets have more than management The richer budget information is the catalyst for budgetary slack based on this motivation. In companies that participate in the budget system and use budget results as the evaluation criteria, the budget executor provides information to participate in budget preparation, and this and the higher standards determine the performance evaluation criteria of the budget executor in turn. Obviously, the remuneration of the lower-level budget will decrease as the budget target and budget difficulty increase. At this time, the executor will determine the performance that can be completed according to his own strength, and provide information on the budget target lower than the actual performance; if the budget target is lower than The real potential of the executive department, then the budget executive department can exceed the budget goal, get management's approval, get more reputation and promotion opportunities, and the most important thing is to get a higher incentive reward. In other words, through this budget slack, it can bring higher utility to budget executives.

(2) The budget executor needs to deal with uncertain risks

This uncertainty risk is mainly manifested in two aspects, one is the uncertainty of the future operating environment. On the other hand, the budget examination and approval department improves the business objectives and reduces the resources.

1. The need to deal with the uncertainty of the future operating environment

The preparation of the budget is a subjective grasp made by the budget preparation department based on the performance of the enterprise in the past operating period and the estimation of future risks and benefits. However, the accuracy of risk measurement in the actual preparation process will decrease or even be unpredictable with the diversification and complexity of business operations and the changes in the situation during the estimation process, so if the enterprise accepts the results of the existing budget preparation, it will bear certain Risk, the lack of flexibility of the budget system of our country's enterprises has also exacerbated this risk. In the face of future risks and uncertainties, in order to avoid possible events affecting the effectiveness of budget executors, on the premise of budget executors participating in budget preparation, relaxing the budget slack has become an objective of their participation in the budget. A slack

Of the budget can distribute the direct risks faced by the budget executor to other departments or minimize the budget responsibility as much as possible, and the greater slack can also leave room for the execution of the budget to offset the changing effects of the objective environment, thereby Avoid over budget risks caused by uncertainty.

2. Respond to the needs of the budget approval department for the improvement of business objectives and the reduction of resources

The budget information provided by the budget subordinates and the referenced budget operation target does not mean that the budget target has been established, and the establishment of the budget target requires the review of the budget responsibility center. In order to cope with the possible improvement of business objectives or reduction of resources by budget review agencies, budget subordinates will have the motivation to reduce various budget indicators based on the expected budget difficulty.

If this kind of motivation is used by budget review agencies as a consideration for reviewing whether budget targets are reasonable, then stricter budget cuts and increased difficulty in implementation may occur, eventually leading to a vicious cycle of budget slack.

IV. PREVENTIVE MEASURES FOR BUDGET SLACK

(1) Strengthen budget information sharing and corporate senior participation

Regardless of what causes the budget slack, asymmetric

information is an important condition for budget slack, and strengthens the smooth flow of information within the enterprise (between upper and lower, between departments). An effective budget information system can reduce the intensity of information asymmetry between the upper and lower levels in budget execution. Through the application of information network technology, an effective budget information system can be established in the enterprise budget management to achieve the maximum degree of information sharing, providing as many as possible, detailed, and same budget information to the executives at all levels of the enterprise, weakening Operational drawbacks due to information asymmetry. The participation of all employees of the enterprise in the formulation of the budget is the biggest feature of participatory budget management. However, in the budget preparation process of the enterprise, the most senior managers do not participate in a real sense. They have a sudden impact on the cost, price, market supply and demand of products. The possibility and severity of the situation, the various preferences of the executors, etc. did not personally participate in the investigation and understanding, so while strengthening information sharing, superior budget makers should actively participate in, by grasping more information, to make the unfavorable budget Relaxation is minimized.

(2) Enhance the rationality of performance evaluation standards

If the single evaluation criterion is whether the budget target is reached or not, it will often induce enterprises to form budget slack. If the enterprise uses the result of slack budget determination as an important evaluation criterion for a long time, it will encourage the vested interests to support the existing budget determination method, thus allowing slack Has not changed its budget. Therefore, in the performance evaluation of an enterprise, not only the completion of budget goals should be used as the performance evaluation standard, but more methods and indicators should be adopted, and various methods and indicators should be organically combined and rationally used to construct an objective, fair, Perfect performance appraisal system, thus weakening budget executives' motivation to prepare slack budgets.

(3) Adopt the joint cardinal number determination

method to prepare the budget

The joint determination of the cardinality method means that the superior and the budget executor each report a target cardinality according to their own target function, and then determine the target cardinality by a weighted average of certain weights. If the actual operating results of the budget executor are greater than those proposed by the budget executor The goal is to appropriately punish the underreported part. If the budget executor overstates, it will not be rewarded; if the budget executor's actual operating results exceed the target base set by both parties, the excess part of the profit shall be rewarded. The final reward and punishment result is determined by the algebraic sum of reward and punishment. To a certain extent, it inhibits the incentive of budget executors to understate the budget, and promotes the budget value to be more realistic.

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Feeding in the Immature Phase Affects the Reproductive Performance of *Diaphaniahyalinata* L. (Lepidoptera: Crambidae)

José Romário de Carvalho[1,2*], Luis Moreira de Araujo Junior[2], Alixelhe Pacheco Damascena[2], Regiane Cristina Oliveira de Freitas Bueno[3], Dirceu Pratissoli[2]

[1]Secretary of Education of the State of Espírito Santo, Rua Daniel Camboni, n° 200, CEP.: 29550-000, Jerônimo Monteiro, ES, Brazil.
[2]Nucleus in Scientific and Technological Development in Phytosanitary Pest Management (NUDEMAFI), Center for Agricultural Sciences and Engineering at the Federal University of Espírito Santo (CCAE-UFES), Mailbox 16, CEP.: 29500-000, Alegre, ES, Brazil.
[3]UniversidadeEstadualPaulista (UNESP), Faculty of Agronomic Sciences, Department of Protection of Plants, CEP.:18610-034, Botucatu, SP, Brazil.
*Corresponding Author

Abstract—-*Diphaniahyalinata L. (Lepidoptera: Crambidae) is an insect of agricultural importance, considered pest-key family Cucurbitaceae. Knowledge of reproductive parameters of this insect can enable a better understanding of its biology, assisting in integrated pest management programs pests. Thus, this study aimed to evaluate the influence of different food substrates consumed in the immature stage of D. hyalinata on reproductive parameters of their respective adult. Four foods were tested: pumpkin cultivar "Jacaré", cucumber cultivar "Japanese", zucchini cultivar "Caserta" and artificial diet. After the emergence of adults were evaluated reproductive parameters of insects and made fertility life tables. The highest average production of eggs per female was observed for adults from the food substrates cucumber (175.7 eggs/female) and artificial diet (173.0 eggs/female). The zucchini substrate showed the lower values of population growth and greater range of values between generations and doubling time. Thus, it is concluded that food substrate zucchini was unfavorable to the reproductive performance of D. hylinata.*

Keywords—***Alternative hosts, Antibiosis, Egg production, Fertility.***

I. INTRODUCTION

Cucurbit borers, *Diaphania* spp. (Lepidoptera: Crambidae), are polyphagous insects, however, they prefer species from the Cucurbitaceae family [1]. These lepidoptera are pests of economic importance, occurring from the southwestern United States, Central and South America to the Caribbean islands [2]–[4]. In Brazil, insects of this genus are reported in all regions producing cucurbits [5]. *Diaphaniahyalinata* L. caterpillars are voracious broachers, attacking all vegetative and reproductive parts of the plant, including fruits, which in turn are unsuitable for commercialization and human consumption [6], [7].

Currently, there are few studies related to the investigation of biological parameters of *D. hyalinata*.

These studies are fundamental for understanding the behavior and biology of the insect, thus offering support for programs related to Integrated Pest Management (IPM)[8]–[10]. One of the bases of the MIP is the sampling of pests and knowledge of the biology of the insect in association with the host culture (food), providing subsidies that enable a more careful definition of control tactics [11].

Significant results on the biology of *D. hyalinata* were obtained by Pratissoli et al. [7]. However, information on the performance and behavior of the adult phase, considered as the first indication of the presence of the pest in the crop [11], is still scarce. In addition, knowledge of the oviposition behavior and the biotic potential of the

insect pest, when associated with a given host plant, may allow predicting the distribution and the possible number of descendants as a function of time. For this purpose, the use of the fertility life table allows the understanding of the population dynamics of the species, showing to be an excellent method for inter and intraspecific biological studies [12], [13].

Thus, the present study aimed to evaluate the reproductive performance of *D. hyalinata* from different food substrates, under laboratory conditions.

II. MATERIAL AND METHODS

Rearing of *D.hyalinata*. *Diaphaniahyalinata* caterpillars were obtained from the creation of a stock in the entomology sector of the Nucleus for Scientific and Technological Development in Phytosanitary Management of Pests and Diseases (NUDEMAFI) at the Center for Agricultural Sciences and Engineering at the Federal University of Espírito Santo (CCAE-UFES) and created according to the methodology proposed by Pratissoli et al. [7].

Bioassay. Caterpillars of 1st instar were collected from rearing stock and divided into groups being created on different food substrates for two generations, to avoid pre-imarginal conditioning. The substrates used as larval food were: pumpkin cultivar "Jacaré", cucumber cultivar "Japanese", zucchini cultivar "Caserta" and an artificial diet recommended for the rearing of *Diatraeasaccharalis* (Fabr.) (Lepidoptera: Crambidae) proposed by Hensley and Hammond [14]. For each substrate, 200 *D. hyalinata* caterpillars were used. On natural substrates, the caterpillars were packed in pairs in gerbox-type plates (6 x 2 cm) with the substrate and a filter paper disc at the bottom. Cubes (2 cm edge) of pumpkin and zucchini and slices (1 cm thick) of cucumber were offered. The gerboxes were cleaned and the food replaced every two days. In the artificial diet, approximately 10 mL were deposited in test tubes (2.4 x 8.5 cm) and two *D. hyalinata* caterpillars were placed per tube. After larval development, pupae obtained from different substrates were placed in plastic boxes (25 x 15 x 10 cm) for 24 h, when they were sexed with the aid of a stereoscopic microscope.

With the emergence of adults, couples were formed, totaling 40 couples of each food substrate. These were individualized in cages made with PVC tubes (10 x 10 cm), paper towels, styrofoam, honey solution (food) 10% (w / v), each repetition consisting of a cage. The eggs were collected daily, removing the paper disc that was offered as an oviposition substrate. The number of eggs was counted

on the paper disks and then stored in plastic boxes (25 x 15 x 10 cm) until the larvae completely hatched.

The observed parameters were: daily and total fecundity, female survival and longevity, incubation period of eggs and percentage of egg emergence. For the evaluation of the incubation period and percentage of emergence, a daily aliquot of eggs was removed from each couple/substrate that represented the respective repetitions.

Based on the daily fertility, survival and longevity values of the females, the life tables were calculated based on Silveira Neto et al. [15] and Townsend, Begon and Harper [16]. Using the values of age intervals (x), specific fertility (m_x), survival probability (l_x) of the life fertility tables, the fertility life table was made based on the Jackknife estimate [17], [18], the following parameters being determined: Net reproduction rate (R_o) (Eq.1); time interval between each generation (IMG) (Eq.2); innate capacity to increase in number (r_m) (Eq.3); finite rate of increase (λ) (Eq.4); and the time required for the population to double in number of individuals (Td) (Eq.5).

$$R_o = \sum (m_x \cdot l_x) \text{...(Eq. 1)}$$

$$IMG = \sum (m_x \cdot l_x \cdot x) / \sum (m_x \cdot l_x) \text{……............(Eq. 2)}$$

$$r_m = \ln(R_o) / IMG \text{ ....(Eq. 3)}$$

$$\lambda = e^{r_m} \text{ ....(Eq. 4)}$$

$$Td = \ln(2) / r_m \text{ ....(Eq. 5)}$$

Data analysis. The daily fertility data obtained were subjected to non-linear regression analysis, while for the parameters total fertility, net reproduction rate, time interval between each generation, innate capacity to increase in number, reason finite increase and time required for the population to double in number of individuals the data were subjected to analysis of variance (ANOVA), and the means compared by the Tukey test at 5% probability when there is significance. All analyzes were processed in the computational environment R [19].

III. RESULTS

For all food substrates tested, the daily fecundities of *D. hyalinata* adjusted to the logistic model, with high levels of significance and coefficients of determination (P <0.0001; R^2> 85.00%) (Figure 1). Regardless of the type of food substrate, daily fertilities showed similar behavior. The peak of daily oviposition occurred on the second day for all evaluated food substrates. The highest estimated daily fertility was observed for the cucumber substrate between

the first and second days of oviposition. The zucchini substrate showed the lowest daily fertility value (Figure 1).
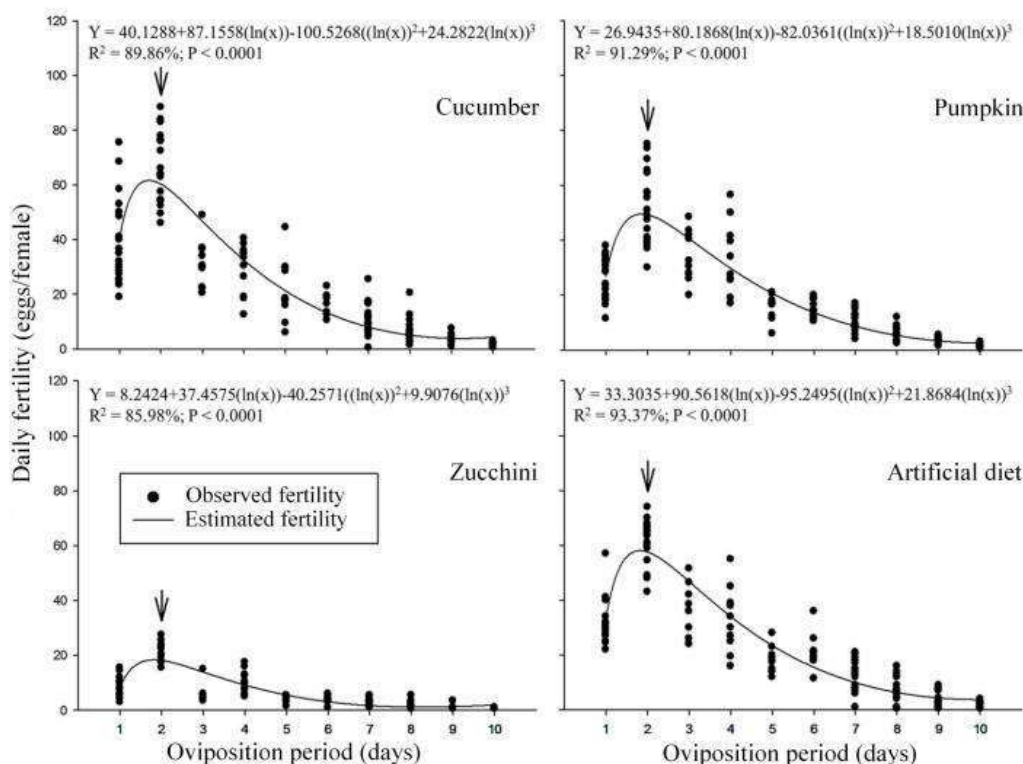
Fig. 1. Daily fecundity of adult female Diaphaniahyalinata from caterpillars reared on different food substrates (Temperature 25 ± 1 ° C, relative humidity 70 ± 10% and photophase 14 hours). The arrows indicate maximum daily fecundity.

The total fecundity of *D. hyalinata* varied significantly between the tested food substrates (F = 124.60; p <0.001) (Table 1). The highest average egg production per female was observed for adults from cucumber (175.7 eggs / female) and artificial diet (173.0 eggs/female) substrates. Again, zucchini food substrate showed the lowest egg production (86.4 eggs/female).

Table. 1: Total fecundity, incubation period and viability of Diaphaniahyalinata eggs from adults from caterpillars reared on different food substrates (Temperature 25 ± 1ºC, relative humidity 70 ± 10% and photophase 14 hours)

Food Substrates	Total fecundity (eggs/female)	Incubation period (days)	Egg viability (%)
Cucumber	175.7 a	4.0 a	89.7 a
Pumpkin	148.3 b	3.5 b	91.9 a
Zucchini	86.4 c	4.0 a	68.0 b
A. diet	173.0 a	4.0 a	90.7 a
CV (%) [1]	16.12	4.36	4.65
F	124.6	3.33	333.27
DFR [2]	156	156	156
p	<0.001	0.02	<0.001

Means followed by the same letter in the column do not differ by Tukey test (*p = .05*);

[1] Coefficient of variation;

[2] Degrees of freedom of the residue.

The incubation period for *D. hyalinata* eggs was influenced by food substrates (F = 3.33; p = 0.02) (Table 1). Despite being statistically different, the variation was small (3.5 to 4.0 days). The pumpkin substrate had the shortest incubation period, differing from the other food substrates.

The viability of *D. hyalinata* eggs were affected by the food substrates (F = 333.27; p <0.001), varying between 91.9 and 68.0% (Table 1). There was no significant

difference between the cucumber, pumpkin and artificial diet substrates, with only a difference between these food substrates and the zucchini substrate (89.7; 91.9; 68.0 and 90.7%, respectively).

The net growth rate (R_o) suffered a significant variation (F = 277.61; p <0.001) (Table 2), ranging from 22.73 to 80.26 females/female. The food substrates cucumber, pumpkin and artificial diet differed only from the substrate zucchini.

Table. 2: Fertility life table parameters of Diaphaniahyalinata adults from caterpillars reared on different food substrates (Temperature 25 ± 1°C, relative humidity 70 ± 10% and photophase 14 hours)

Food Substrates	R_o	r_m	λ	IMG	Td
Cucumber	79.28 a	0.156 a	1.169 a	28.00 b	4.44 c
Pumpkin	74.28 a	0.143 b	1.154 b	30.14 a	4.85 b
Zucchini	22.73 b	0.104 c	1.110 c	29.97 a	6.65 a
A. diet	80.26 a	0.145 b	1.157 b	30.15 a	4.77 b
CV (%)	16.41	3.75	0.52	1.19	4.13
F	277.60	780.33	762.42	356.21	872.28
DFR	156	156	156	156	156
p	<0.001	<0.001	<0.001	<0.001	<0.001

Means followed by the same letter in the column do not differ by Tukey test ($p \le .05$);

R_o = net rate of reproduction;

r_m = innate ability to increase in number;

λ = finite rate of increase;

IMG = time interval between each generation;

Td = time required for population to double in number of individuals.

The innate capacity to increase in number (r_m) was affected by food substrates (F = 780.33; p <0.001) (Table 2), with a variation between 0.10 and 0.15. Likewise, the finite rate of increase (λ) was also affected by the food substrates (F = 762.42; p <0.001) (Table 2). Regardless of the difference observed for the parameters r_m and λ, the values were positive, demonstrating that the food substrates provided an increase in the populations of *D. hyalinata*. The cucumber food substrate obtained the highest values of r_m (0.15) and λ (1.17 females/female/day).

The time interval between each generation (IMG) differed statistically between the tested substrates (F =

356.21, p < .001), but the variation was not significant (28.0 to 30.1 days) (Table 2). The time required for the population to double in number of individuals (Td) was significantly affected (F = 872.28, p < .001). For both IMG and Td, caterpillars fed with the cucumber substrate had the lowest values (28.0 and 4.4 days, respectively) (Table 2).

IV. DISCUSSION

Egg production by *D. hyalinata* was affected by the food. The daily fertility curves of the food substrates cucumber, pumpkin and artificial diet showed the highest angular and linear coefficients, which implies greater egg production when *D. hyalinata* is raised on these substrates. The reproductive performance of this insect may be directly influenced by the nutritional constitution of the food. Raw cucumber is, among the natural food substrates evaluated, the one with the lowest amounts of calories, proteins, lipids, carbohydrates, minerals and vitamins and the one with the highest percentage of moisture [20]. Thus, it can be assumed that due to the fact that this food does not have high nutritional values, as a measure of survival, *D. hyalinata* intensified its egg production in order to guarantee the survival of its descendants. Such behavior of presenting an expressive increase in order to prevail the species in unfavorable circumstances is considered by some authors as hormone [1], [21], [22]. Hormesis is based on providing favorable biological responses to organisms when exposed to stressors in small amounts or underdeveloped conditions, such as stimulatory effects. However, confirmation of this event requires detailed studies about chemical analysis for biological organisms with greater complexity, such as insects.

Another hypothesis to be considered is the presence of secondary metabolic agents that may be directly or indirectly affecting the acceptance and / or consumption of these natural substrates, such as phage stimulants and deterrents [23]–[26]. Plants have secondary metabolism which can promote a type of resistance in the plant that directly influences the insect's food and development, and in some cases can lead to death [24]–[28]. On the other hand, the fact that *D. hyalinata* occurs naturally in cucurbit cultures, makes it possible to assume that this insect is adapted to these secondary metabolic processes of these plants [7]. However, the occurrence / absence and, or difference in the concentration of these compounds can affect the behavior of the insect, the same eating habit [28].

Some reproductive and biological parameters, such as egg production and larval survival, can be influenced by physical or chemical differences in the food, or by the

amount ingested in the larval phase [8], [27]. From this perspective, the influence of food acting on reducing the survival of caterpillars has already been reported for *D. hyalinata* when fed with the food substrate cucumber [7]. However, the planting around the zucchini has been suggested, since *Diaphania* spp. has a preference for this plant [5]. In this circumstance, this plant is used as trap plants.

The fact that the substrate zucchini had the lowest percentage of emergence implies the possibility that secondary substances are affecting the embryonic development of *D. hyalinata*. Regarding the possibility of transovarian action, some substances are easily translocated and accumulated, which implies the possibility of reducing the viability of eggs due to the death or malformation of embryos [26].

The net growth rate (R_o) was similar for the cucumber, pumpkin and artificial diet food substrates. When the immatures of *D. hyalinata* were fed with these substrates, adults could increase in number, on average, 77.94 times per generation, whereas when fed with the substrate zucchini this insect increases in number only by 22.73 times per generation. Although in the present study *D. hyalinata* was created on the respective food substrates for two generations in order to break some pre-marginal conditioning of these insects, the results for an artificial diet were expressive when compared to natural substrates. This possibly be associated with the absence of secondary substances in the artificial diet, a fact that, according to some authors, directly and indirectly influence the development and performance of insects [23], [24], [26]–[29].

The innate capacity to increase in number (r_m) the finite rate of increase (λ), although affected by the substrates, presented positive values which implies a greater speed of population growth [13], [15], [16]. For the cucumber substrate, the values of r_m and λ were higher, a fact that implies a greater population growth in *D. hyalinata* in less time. The values obtained for the time interval between each generation (*IMG*) and the time required for the population to double in number of individuals (*Td*) reinforce this result.

V. CONCLUSION

The food consumed during the immature phase of *D. hyalinata* affected the reproductive performance of adults;

The evaluated food substrates did not influence the oviposition behavior of *D. hyalinata*, but on the daily and total fecundity;

The zucchini food substrate negatively affected the reproductive performance of *D. hylinata*, while the cucumber, pumpkin and artificial dietary substrates were favorable for *D. hyalinata*, so they can be used as a food source in mass breeding of this lepidopteran.

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On the numerical simulation of wellbore pressure in gas reservoirs incorporating the phenomena of slippage, formation damage and wellbore storage

Ricardo Zagos Hermida Garcia de Queiroz[1], Rebeca Costa Dias do Rosário[1], Grazione de Souza[1] and Helio Pedro Amaral Souto[1]

[1]Departamento de Modelagem Computacional, Universidade do Estado do Rio de Janeiro, Rua Bonfim, 25, Vila Amélia, 28625-570 - Nova Friburgo, RJ, Brazil
Emails: rzagos01@gmail.com, rebecacostadias@gmail.com, gsouza@iprj.uerj.br, helio@iprj.uerj.br

Abstract — *In this work, we consider the effects of gas slippage and wellbore storage in shale gas reservoirs. We use the Finite Difference Method for the discretization of the nonlinear governing equation, and the iterative Gauss-Seidel method is applied to obtain the solution of the algebraic system. We also perform pressure tests in the producing well through the use of numerical simulation using cylindrical coordinates. The results, obtained in the well testing analysis context, show the relevance of the introduction of the slip, formation damage and wellbore storage on the flow simulation in shale gas reservoirs.*

Keywords — *Natural gas, Numerical reservoir simulation, Numerical well testing, Shale gas, Slip flow.*

I. INTRODUCTION

Archaeological records show that ancient civilizations in different parts of the world used oil. Incas and Babylonians used the oil to lay bricks, to pave roads, and to waterproof ceramic artifacts [6, 34]. However, it was only in the 20th century that oil began to stand out as economic activity on the world stage, with the emergence of the large automotive industries and oil companies, with the latter beginning the search for more oil reserves. On the other hand, natural gas has been in the background for a long time, mainly due to its specificities concerning transport and storage. However, this situation has changed, mostly in the transition between the 20th and 21st centuries.

The market for natural gas of fossil origin has grown worldwide for several reasons, such as the discovery of new deposits, the lower degree of pollution that its burning causes, when compared to oil, and its diversity of applications. The economic relevance of natural gas was evident in the years 1973 and 1979 when the Organization of Petroleum Exporting Countries (OPEC) raised oil prices to a level that led to changes in hydrocarbon exploration and production and the general dynamics of generation and con-

sumption of energy in the world. As a consequence, activities associated with natural gas increased [4]. In this context, Fig. 1 presents the Brazilian energy matrix in the 1970s and 2010. In this figure, we can see that the consumption of natural gas increases from 3 to 9%.

In Brazil, in 1941, natural gas began to appear in the economic scenario due to the discovery of the first commercial oil field in Candeias, Bahia, the industrial sector being its first destination. Due to the adverse effects of the two oil shocks, there was an increase in the production of natural gas due to the exploration and development of the Campos Basin in Rio de Janeiro [9]. At the end of the 1990s, with the completion of the construction of the Bolivia-Brazil gas pipeline (GASBOL) [7], the import of natural gas from Bolivia began, and it consolidated itself as a representative energy source in the Brazilian energy matrix, leaving aside the oil by-product label.

Currently, with the discoveries of pre-salt reserves in the Santos Basin [32], interest in natural gas reserves in Brazil has been growing even more rapidly in recent years. Figure 2 shows the growth of gas production over the years and the dependence on Bo-

livian gas imports, which is necessary to supply national consumption. However, the Energy Research Company (EPE) disclosed, through its National Energy Plan [14], that the national natural gas supply will be adequate to meet the demand of all the commitments assumed until 2030, thus making self-sufficient Brazil in the sector.

Energy Matrix 1970

Energy Matrix 2010

Petroleum · Steam coal · Natural gas · Metallurgical coal · Uranium U308 · Firewood · Hydraulic energy · Sugarcane products · Other primary energy
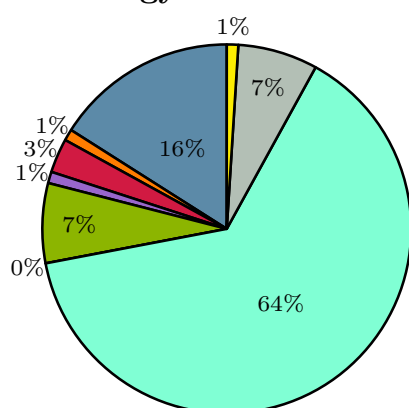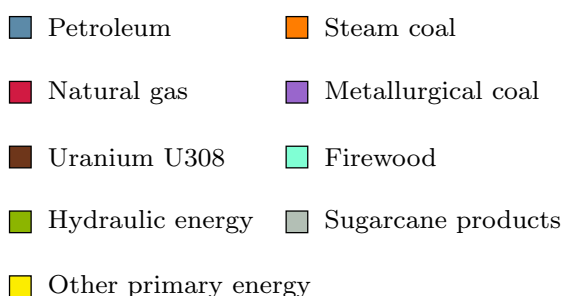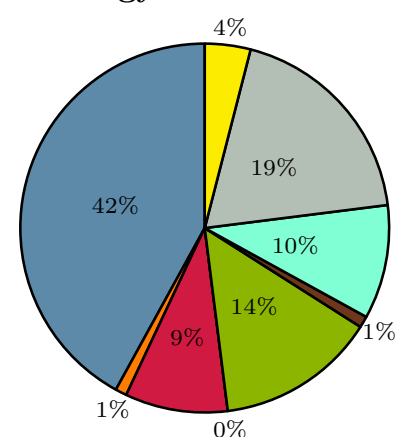
Fig. 1: *Brazilian energy matrix in the 1970s and 2010 [15].*
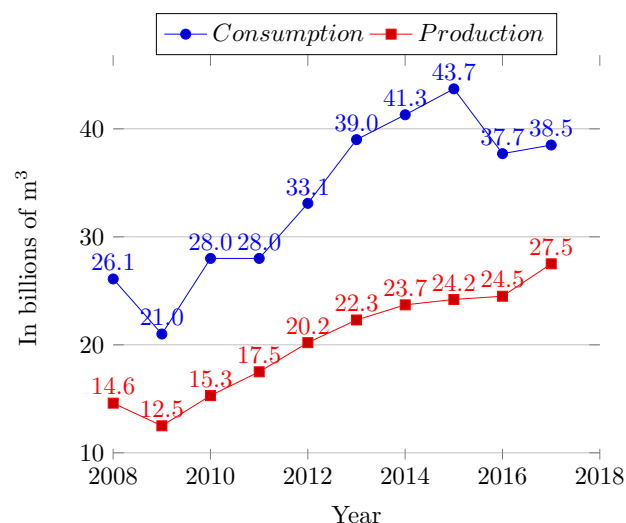
Fig. 2: *Gas production and consumption in Brazil between 2008 and 2017 based on the National Energy Balance [19].*

1.1. Obtaining natural gas

We define a reservoir of natural gas as a deposit that presents a mixture of hydrocarbons in the gaseous state [17]. As stated by Ezekwe [17], we can classify gas reservoirs as a reservoir of dry gas, wet gas, or retrograde condensation gas, according to the type and behavior of the fluid. When there are no molecules heavy enough to form liquid hydrocarbons after surface separation processes, we say that the reservoir is to be dry gas. We call the deposit a wet gas reservoir when it produces a certain amount of liquid in the well and/or in the surface facilities. In turn, as we produce gas from a retrograde condensation gas reservoir, the pressure decreases, and the temperature remains approximately constant. Thus, there is a liquid phase formation in the reservoir through the condensation of the gas.

Another classification that can be applied is that of conventional and unconventional reservoirs. In conventional gas reservoirs, it is possible to produce from vertical wells while it is required specific production techniques for unconventional reservoirs. For example, we can cite the horizontal wells and hydraulic fracturing since there is higher resistance to the gas flow due to the lower absolute permeability of the reservoir. However, with the advancement of technological development, the gas of unconventional origin began to gain prominence in the world economic scenario. India [21], Brazil [27], and USA [40] are among the ten

nations with the largest reservoirs of shale gas in the world, a type of unconventional reservoir. The trend is that gas of unconventional origin will be essential in the world economy in the coming decades.

Unconventional gas reservoirs can be of different types: deep gas reservoirs (located beyond 4,500 meters in depth); low permeability (tight gas); shale gas; gas adhered to coal veins (coalbed methane); gas from pressurized zones (at very high pressure when compared to other reservoirs with the same depth); and underwater and Arctic hydrates (methane hydrates) [2]. The focus of this work, however, is the shale gas reservoirs.

1.2. Shale gas reservoirs

The shale gas reservoir sedimentary rock has a fine granulometry and very low permeability [22]. Also, the shales have quite variable mineralogical formation, with a predominance of brittle minerals such as quartz, carbonates, and feldspars [20]. Although it has characteristics of unconventional reservoirs, its exploitation has increased over the years.

Hasan et al. [21] has shown that two-thirds of the world's hydrocarbon reserves are unconventional and that this fact is directly related to the growing importance of shale gas in the world energy matrix. On the other hand, Gomes [19] claims that technological advances in the sector are allowing its production to become attractively economical. It has been drilled more than 50,000 wells over two years in gas reservoirs in the United States [28], making the country's hydrocarbon production almost double.

Countries such as the USA and Brazil have a large number of gas reservoirs, which is very important in economic terms and of influence in the international socio-political framework. As a result of the growth in non-conventional gas exploration, these countries' dependence on the world's largest oil and gas producers, such as Venezuela and Russia, can end.

Despite the environmental concern with fossil fuels and the rapid growth in the use of fuels from renewable sources, Jia et al. [22] believe that fossil energy should still account for 78% of global energy consumption in the year 2040. Even though natural gas of fossil origin is not renewable, technological advances in the area and the growth of discoveries of shale gas reservoirs guarantee its use for still many years. Knudsen et al. [24] show that in recent years

the United States has been reducing the use of coal-fired power plants and replacing them with natural gas in the generation of electricity. In part, we can explain this by the desire to reduce emissions of polluting carbon dioxide, which harms the environment so much.

Wellbore Testing Analysis studies the pressure and flow changes as a function of production time, through measurements at the bottom of the well and the flow at the surface. From the measured pressure response, it is possible to determine the reservoir properties useful for production planning [41]. In a well test, a transient pressure response occurs due to a production/injection flow. Depending on the objectives of the test, we record the response of the well over a relatively short period when compared to the productive life of the reservoir. In this work, in addition to a sensitivity analysis, well pressure tests using numerical simulation is also done.

II. POROUS MEDIA GAS FLOW

Petroleum is a mixture of hydrocarbons, which has its physical state-properties determined, in general, by its composition, temperature (T), and pressure (p). According to Ezekwe [17], oil is the part that remains in the liquid state when a mixture of hydrocarbons is brought from the reservoir conditions to the surface conditions, while the natural gas presents the gaseous state in the surface conditions. Under reservoir conditions, natural gas can be present in gaseous form or dissolved in oil.

Regarding the composition of natural gas, the amount of each component can vary depending on the type of reservoir and its characteristics, for example, the location (land or sea), the type of soil, and the geological formation process of the basin, among other factors [30]. However, as can be seen in Table 1 which presents the typical composition of a natural gas reservoir, it is evident that the primary component is methane, which may represent an amount of 70 to 98% of the total natural gas, and in smaller quantities, considered as impurities, carbon dioxide, hydrogen sulfide, and nitrogen. Besides temperature and pressure conditions, another fundamental parameter for calculating the properties of the gas is its relative density (or specific gravity), γ, which is the ratio between the molecular mass of the gas, M, and the molecular mass of air, M_{air}. In this work, it is considered a reservoir of dry gas, produced without the

appearance of liquid at any time of production.

Table 1: *Typical chemical composition of natural gas*

Component	Composition
N_2	up to 15%
CO_2	up to 5%
H_2S	up to 3%
He	up to 5%
CH_4	70-80%
C_2H_6	1-10%
C_3H_8	up to 5%
C_4H_{10}	up to 2%
C_5H_{12}	up to 1%
C_6H_{14}	up to 0.5%
C_{7+}	up to 0.5%

For gas mixtures of hydrocarbons, we use the pseudo-critical pressure and temperature coordinates, p_{pc} and T_{pc}, respectively, to determine the so-called pseudo-reduced coordinates [26], and we use them to calculate the physical properties of natural gas.

Sutton [38] presents, depending on the gas density, the correlations that we apply here to obtain the pseudo-critical pressure and temperature, which are fundamental for the reservoir simulations [16]. We use them in determining, for example, the compressibility factor (Z), volume formation factor (B) and viscosity (μ) [37]. From Z and the universal gas constant, R, it is possible to determine the density, ρ, from the equation of state for a real gas, $\rho = pM/ZRT$.

The gas volume formation factor is the relationship between the volumes it occupies under reservoir conditions (V) and standard conditions (V_{sc}) (pressure, p_{sc}, and temperature, T_{sc}, in standard conditions) [16]. Thus, $B = p_{sc}ZT/pT_{sc}$ whereas $Z_{sc} \approx 1$.

On the other hand, we calculate the viscosity of natural gas using the correlation suggested by Lee et al. [25], widely used in reservoir simulation.

Here, the effective porosity (ϕ) varies depending on the pressure [16]:

$$\phi = \phi^0 \left[1 + c_\phi \left(p - p^0 \right) \right] \tag{1}$$

where ϕ^0 and p^0 are, respectively, the porosity and pressure in the reference conditions. c_ϕ is the coefficient of compressibility of the rock, and we assume

that the compressibility of the rock is small and constant.

In addition to porosity, the economic viability of a reservoir also depends on the permeability of the rock. This property is a measure of a porous material's ability to allow fluids to pass through its pores. We usually represent the absolute permeability by the tensor $\mathbf{k}$.

2.1. Slip in gas flow

Studies and predictions about the flow of gas in porous media are more difficult to carry out than those of liquid because the gas properties generally depend more strongly on pressure and also due to the different mass transport mechanisms that can be present [28, 31]. Therefore, in some cases, the classic Darcy's law does not adequately describe the flow physics, and experimental data suggest corrections for the calculation of permeability and, thus, we introduce a modified Darcy's law [28]

$$\mathbf{v} = -\frac{\mathbf{k}_a}{\mu} \left(\nabla p - \rho g \nabla D \right), \tag{2}$$

where $\mathbf{k}_a$ is the apparent permeability tensor, $\mathbf{v}$ is the surface velocity of the fluid, g is the acceleration of gravity and D is the depth.

Specifically for gases, the slip flow regime occurs when the average free path of the gas molecules has a scale comparable to the pore size [18]. So, both the reservoir and fluid properties influence the determination of apparent permeability. We can mention, among the non-Darcy effects, that we can incorporate in the apparent permeability, high flow rates (inertial and turbulent effects), non-Newtonian fluid flow (for liquids), and slip flow, which occurs only for gas under certain reservoir conditions [5].

When the fluid is a gas, the Klinkenberg effect shows that the permeability measurements made in the laboratory result in values higher than the absolute values, due to the slipping of the gas on the walls of the porous medium. This slip results in a higher flow and leads to a correction of the apparent permeability [23],

$$\mathbf{k_a} = \left(1 + \frac{b}{p} \right) \mathbf{k} \tag{3}$$

where b is the Klinkenberg parameter and $\mathbf{k}$ the absolute permeability tensor.

In reality, the mass is transported in the porous medium by a variety of mechanisms, one of which is the so-called Knudsen diffusion. The Knudsen number measures the relationship between the mean free path of the molecules, λ, and the characteristic pore length, R_h, so that $Kn = \lambda/R_h$, where $\lambda = (\mu/p)\sqrt{\pi ZRT/(2M)}$, $R_h = 2\sqrt{2\tau}\sqrt{k/\phi}$, and τ is the tortuosity of the porous medium.

The slip flow regime occurs for $10^{-3} < Kn < 0.1$ and we can also introduce a different model for determining apparent permeability [28]

$$\mathbf{k_a} = \left(1 + \frac{4Kn}{1+Kn}\right)\mathbf{k} = f(Kn)\mathbf{k}. \tag{4}$$

2.2. Governing equation

In obtaining the partial differential equation (PDE) that governs the isothermal flow of a gas in a porous medium, we employ the mass conservation equation and the modified Darcy's law. We also take into account the effects of slippage, wellbore storage and formation damage, disregarding the phenomenon of gas adsorption, the gravitational force and non-Darcy behaviors related to inertial effects.

As it takes time to the hydrocarbons in the reservoir to reach the surface, in the first moments, we produce the fluid initially stored in the well. This effect is called wellbore storage. The formation damage concerns the reduction of permeability in the region close to the well, caused by wellbore fluids used during drilling and completion.

According to Li et al. [29], mass conservation for the flow of gas in porous media can be described, excluding the adsorption effects and source terms [3], by

$$\frac{\partial}{\partial t}\left(\frac{\rho_{sc}\phi}{B}\right) + \nabla \cdot \left(\frac{\rho_{sc}\mathbf{v}}{B}\right) = 0. \tag{5}$$

Then, replacing Eq. (2) in Eq. (5) and ignoring the effects of gravity due to the low specific gravity of the gas and the thickness of the reservoir,

$$\nabla \cdot \left(\frac{\mathbf{k_a}}{\mu B}\nabla p\right) = \frac{\partial}{\partial t}\left(\frac{\phi}{B}\right). \tag{6}$$

We can rewrite the term $\partial(\phi/B)/\partial t$ if we take into

account the fluid and rock properties [13]

$$
\begin{aligned}
\frac{\partial}{\partial t}\left(\frac{\phi}{B}\right) &= \frac{1}{B}\frac{d\phi}{dp}\frac{\partial p}{\partial t} + \phi\frac{d}{dp}\left(\frac{1}{B}\right)\frac{\partial p}{\partial t} \\
&= \left[\frac{c_\phi\phi^0}{B} + \phi\frac{d}{dp}\left(\frac{1}{B}\right)\right]\frac{\partial p}{\partial t} \\
&= \Gamma_p\frac{\partial p}{\partial t},
\end{aligned} \tag{7}
$$

where we also employed Eq. (1).

To study the flow dynamics in the region close to the producing well, we assume a two-dimensional flow in cylindrical geometry in the rz-plan and a diagonal permeability tensor, so that:

$$\frac{1}{r}\frac{\partial}{\partial r}\left(\frac{k_{ar}}{\mu B}\frac{\partial p}{\partial r}\right) + \frac{\partial}{\partial z}\left(\frac{k_{az}}{\mu B}\frac{\partial p}{\partial z}\right) = \Gamma_p\frac{\partial p}{\partial t}. \tag{8}$$

where k_{ar} and k_{az} are the apparent permeabilities in the r- and z- directions, respectively.

As we are considering the effects of storage in the well, the production flow in it is given by [29]

$$Q_{sc} = q_{sc} + C_{sc}\frac{dp_{wf}}{dt}, \tag{9}$$

where q_{sc} is the flow from the porous medium, C_{sc} is the storage coefficient (that already incorporates B) and p_{wf} the pressure in the well. The flow rate q_{sc} is calculated by [35]

$$q_{sc} = -J_w\left(p - p_{wf}\right), \tag{10}$$

where J_w is the productivity index.

Finally, as an initial condition we impose

$$p(r, z, t = 0) = p_{ini}(r, z) = p_{ini}, \tag{11}$$

where p_{ini} represents the initial pressure before the reservoir undergoes any changes due to fluid production/injection.

On the other hand, the external boundary conditions are of null flow at the external borders,

$$\left(\frac{\partial p}{\partial z}\right)_{z=0,L_z} = \left(\frac{\partial p}{\partial r}\right)_{r=r_e} = 0, \tag{12}$$

where L_z is the thickness of the reservoir and r_e is the outer radius of the reservoir. In turn, for the internal boundary condition,

$$\left(\frac{\partial p}{\partial r}\right)_{r=r_w} = -\frac{q_{sc}B\mu}{2\pi k_{ar}hr_w} \tag{13}$$

where h is the thickness of the production region considered and r_w is the radius of the well.

III.   NUMERICAL RESOLUTION METHODOLOGY

We employ a computational mesh of centered blocks [1, 5, 10, 16] and the cylindrical coordinate system (r and z), Fig. 3, and we also assume the angular symmetry of the flow. We obtain the numerical solution in the nodes of the computational mesh, located in the centers of the cells, with n_r and n_z being the numbers of cells in the r- and z- directions, respectively. We also use fractional indexes $i \pm 1/2$ and $k \pm 1/2$ to indicate cell interfaces of the computational mesh.
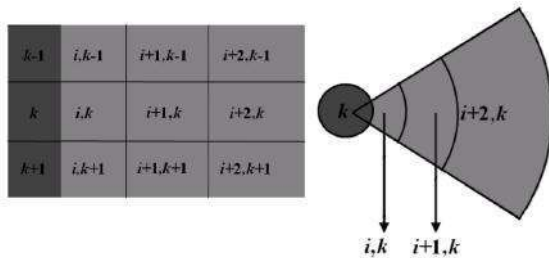
Fig. 3: *Two-dimensional cylindrical domain discretized.*

So, for the cell i, k and the time $n + 1$ we can write that

$$V_{i,k} \left(\Gamma_p \frac{\partial p}{\partial t} \right)_{i,k}^{n+1} = V_{i,k} \left[\frac{1}{r} \frac{\partial}{\partial r} \left(\mathbb{T}_r \frac{\partial p}{\partial r} \right) \Delta r \right.$$
$$\left. + \frac{\partial}{\partial z} \left(\mathbb{T}_z \frac{\partial p}{\partial z} \right) \Delta z \right]_{i,k}^{n+1} \quad (14)$$

where the governing equation was multiplied by the volume of the cell, $V_{i,k}$, and $\mathbb{T}$ stands for the transmissibility.

Following the techniques traditionally applied in reservoir simulation [5, 16] and employing centered differences

$$V_{i,k} \frac{\partial}{\partial r} \left(\mathbb{T}_r \frac{\partial p}{\partial r} \right)_{i,k}^{n+1} \cong \frac{V_{i,k}}{\Delta r_{i,k}} \left[\left(\mathbb{T}_r \frac{\partial p}{\partial r} \right)_{i+\frac{1}{2},k} \right.$$
$$\left. - \left(\mathbb{T}_r \frac{\partial p}{\partial r} \right)_{i-\frac{1}{2},k} \right]^{n+1} \quad (15)$$

and

$$V_{i,k} \frac{\partial}{\partial z} \left(\mathbb{T}_z \frac{\partial p}{\partial z} \right)_{i,k}^{n+1} \cong \frac{V_{i,k}}{\Delta z_{i,k}} \left[\left(\mathbb{T}_z \frac{\partial p}{\partial z} \right)_{i,k+\frac{1}{2}} \right.$$
$$\left. - \left(\mathbb{T}_z \frac{\partial p}{\partial z} \right)_{i,k-\frac{1}{2}} \right]^{n+1} . \quad (16)$$

Similarly, for the discretization of pressure derivatives in the r-direction,

$$\left(\frac{\partial p}{\partial r} \right)_{i+\frac{1}{2},k}^{n+1} \cong \frac{p_{i+1,k}^{n+1} - p_{i,k}^{n+1}}{\Delta r_{i+\frac{1}{2},k}} \quad (17)$$

and

$$\left(\frac{\partial p}{\partial r} \right)_{i-\frac{1}{2},k}^{n+1} \cong \frac{p_{i,k}^{n+1} - p_{i-1,k}^{n+1}}{\Delta r_{i-\frac{1}{2},k}} \quad (18)$$

where $\Delta r_{i\pm1/2,k}$ is the distance between nodes of cells i, k and $i \pm 1, k$. We can obtain approximations for the derivatives in the z-direction analogously.

In the case of the accumulation term, we employ a conservative expansion [16]

$$\Gamma_{p_{i,k}}^{n+1} = V_{i,k} \left[\frac{1}{B^n} \frac{d\phi}{dp} + \phi^{n+1} \frac{d}{dp} \left(\frac{1}{B} \right) \right]_{i,k} , \quad (19)$$

where Δt is the time step.

Next, we obtain a totally implicit formulation for Eq. (14) using a backward Euler approximation,

$$\left(\frac{\partial p}{\partial t} \right)_{i,k}^{n+1} \cong \frac{p_{i,k}^{n+1} - p_{i,k}^n}{\Delta t} . \quad (20)$$

3.1.   Grid refinement

For an accurate determination of the pressure gradient, we use to construct the non-uniform mesh in the r-direction (where we suppress k for simplicity of notation) [16],

$$\alpha = \left(\frac{r_e}{r_w} \right)^{n_r - 1} \quad (21)$$

such as:

1. we space pressure calculation points using

$$r_{i+1} = \alpha_{lg} r_i \quad (22)$$

   where $i = 1, 2, ..., n_r - 1$;

2. we define cell boundaries through

$$r_{i+1/2} = \frac{r_{i+1} - r_i}{\log_e (r_{i+1}/r_i)} \quad (23)$$

   where $i = 1, 2, ..., n_r - 1$; and

3. we calculate cell volumes employing

$$r_{i+1/2}^2 = \frac{r_{i+1}^2 - r_i^2}{\ln (r_{i+1}^2/r_i^2)} . \quad (24)$$

In the case of the z-direction, we use $\Delta z = L_z / n_z$.

We now introduce the definitions of transmissibilities:

$$\mathbb{T}_{r,i\pm\frac{1}{2},k}^{n+1} = \left(\frac{\mathbb{G}_{r,i\pm\frac{1}{2},k}^{n+1}}{\mu B}\right)_{i\pm\frac{1}{2},k}^{n+1}, \qquad (25)$$

and

$$\mathbb{T}_{z,i,k\pm\frac{1}{2}}^{n+1} = \left(\frac{\mathbb{G}_{z,i,k\pm\frac{1}{2}}^{n+1}}{\mu B}\right)_{i,k\pm\frac{1}{2}}^{n+1}, \qquad (26)$$

where, considering that the total angle is 2π and the apparent permeabilities [16],

$$\mathbb{G}_{r,i\pm\frac{1}{2},k}^{n+1} = \frac{\pi \Delta z_k}{\frac{1}{k_{ar_{i,k}}} \log_e\left(\frac{r_{i+\frac{1}{2}}}{r_i}\right) + \frac{1}{k_{ar_{i+1,k}}} \log_e\left(\frac{r_{i+1}}{r_{i+\frac{1}{2}}}\right)} \qquad (27)$$

and

$$\mathbb{G}_{z,i,k\pm\frac{1}{2}}^{n+1} = \frac{\pi\left(r_{i+\frac{1}{2}}^2 - r_{i-\frac{1}{2}}^2\right)}{\frac{z_{k+\frac{1}{2}} - z_k}{k_{az_{i,k}}} + \frac{z_{k+1} - z_{k+\frac{1}{2}}}{k_{az_{i,k+1}}}}, \qquad (28)$$

and we apply arithmetic mean to calculate the fluid properties [16].

3.2. Numerical approximation for storage

When we consider the wellbore storage effect, the total flow rate is determined as proposed by Li et al. [29] and Tavares [39]:

$$Q_{sc} = -\sum_{i=K1}^{i=K2} (q_{sc})_{i,k}^{n+1} + C_{sc}^{n+1}\left(\frac{p_{wf}^{n+1} - p_{wf}^n}{\Delta t}\right) \qquad (29)$$

with

$$J_w = \frac{k_{ar}\Delta_z T_{sc}}{p_{sc}T \ln\left(\frac{r_o}{r_w}\right)} \qquad (30)$$

where

$$r_o = \sqrt{r_{1+\frac{1}{2}} r_w}. \qquad (31)$$

3.3. The solution of the system of equations

After the process of discretizing the governing equation, as the resulting algebraic equations are non-linear, we must apply a linearization technique,

and we chose the method of Picard [33]. So this results in

$$
\begin{aligned}
&\mathbb{T}_z\Big|_{i,k-1/2}^{v,n+1} p_{i,k-1}^{v+1,n+1} + \mathbb{T}_r\Big|_{i-1/2,k}^{v,n+1} p_{i-1,k}^{v+1,n+1} \\
&+\ \mathbb{T}_r\Big|_{i+1/2,k}^{v,n+1} p_{i+1,k}^{v+1,n+1} + \mathbb{T}_z\Big|_{i,k+1/2}^{v,n+1} p_{i,k+1}^{v+1,n+1} \\
&-\ \left[\mathbb{T}_z\Big|_{i,k-1/2}^{v,n+1} + \mathbb{T}_r\Big|_{i-1/2,k}^{v,n+1} + \left(\frac{\Gamma_p}{\Delta t}\right)_{i,k}^{v,n+1}\right. \\
&+\ \left.\mathbb{T}_r\Big|_{i+1/2,k}^{v,n+1} + \mathbb{T}_z\Big|_{i,k+1/2}^{v,n+1}\right] p_{i,k}^{v+1,n+1} \\
&=\ -\left(\frac{\Gamma_p}{\Delta t}\right)_{i,k}^{v,n+1} p_{i,k}^n
\end{aligned} \qquad (32)
$$

where the index v refers to the previous iterative level when obtaining the pressure. As we can see, the properties and coefficients of the discretized equation are determined at the iterative level v and used after to calculate the new pressure values at the iterative level $v+1, n+1$.

In the case of cells in direct contact with the well, we determine its pressure (p_{wf}) through Eq. (10) for a prescribed flow rate.

In solving the linearized system, to obtain the pressures in the porous medium and the well, it was chosen to use the Gauss-Seidel iterative method [16, 36].

IV. NUMERICAL RESULTS

In all numerical simulations, we adopted an arrangement consisting of a vertical producer well, of length L_{wf} and centered on the $r\theta$-plane, a maximum production time (t_{max}), and an initial time step (Δt_{ini}). The time step can vary depending on the growth rate ($\delta_{\Delta t}$). This methodology allows a growing time step, and we use it until the final time step (Δt_{max}), pre-established, is reached. It is of general use in reservoir simulation [1, 16]. We aim to enhance the accuracy of the calculated well pressure in the initial moments when the pressure drop is more accentuated.

We obtain the results using a standard set of data, based on the non-Darcy model discussed in Li et al. [29], in which the authors incorporated the slippage effect into the apparent permeability. Table 2 shows the parameters for the standard case, and we choose the physical properties as stated by Li et al. [29] (shale gas), and by de Souza [12], which simulated the flow of natural gas, using cylindrical coordinates, to assess

the pressure of a producer well (vertical). As a simplification, we took C_{sc}^{n+1} as constant and equal to C_{sc} (we intend to modify this in future work).

Table 2: *Parameters for the standard case.*

Parameter	Value	Unit
c_ϕ	$1.0 \ 10^{-6}$	psi^{-1}
C_{sc}	0.7	scf/psi
k_r and k_z	$4.0 \ 10^{-6}$	Darcy
L_r	1,250	ft
L_z	40.0	ft
L_{wf}	40.0	ft
n_r	40	–
n_z	3	–
p_{ini} and p^0	4,500	psi
p_{sc}	14.65	psi
Q_{sc}	$-1.0 \ 10^4$	scf/day
R	10.73	ft^{3}psi/R lbm-mol
t_{max}	375	day
tol	$1.0 \ 10^{-6}$	psi
T	609.67	R
T_{sc}	519.67	R
γ	0.6	–
$\delta_{\Delta t}$	1.1	–
Δt_{ini}	0.0001	day
Δt_{max}	10.0	day
τ	1.41	–
ϕ and ϕ^0	0.12	–

4.1. Numerical verification

We employed different meshes in the study of numerical convergence: Meshes 1, 2, 3, and 4 with n_r = 10, 20, 40, and 80 cells, respectively. We kept, in all simulations, n_z constant and equal to 3.

Figures 4 and 5 bring the results for the four meshes mentioned in the last paragraph. The results show the pressure in the well as a function of time, obtained considering a production time equal to 375 days. For this purpose, we use specialized and diagnostic graphics, respectively. By the way, in this work, on the diagnostic plots, continuous lines represent pressure drop, and dashed lines represent Bourdet derivative [8].

From the figures, we can see that we achieve numerical convergence as the number of cells n_r increases, with the consequent overlap of pressure curves. Then, as a consequence of the results ob-

tained, the 40 cells mesh was adopted as the standard (lowest computational cost). From the pressure curves in Fig. 4, we realize that we capture two typical regimes: a nearly horizontal line that corresponds to the storage in the well and an inclined straight line related to the transient flow regime. However, the effects of external borders are still absent, reflecting the fact that the pressure at the reservoir frontier ($r = r_e$) remains equal to the pressure p_{ini}. From the Bourdet derivative (Fig. 5), we can more clearly distinguish the two distinct flow regimes. First, we observe the inclined line related to the wellbore storage and after a straight line corresponding to the transient flow regime, without boundary effects.
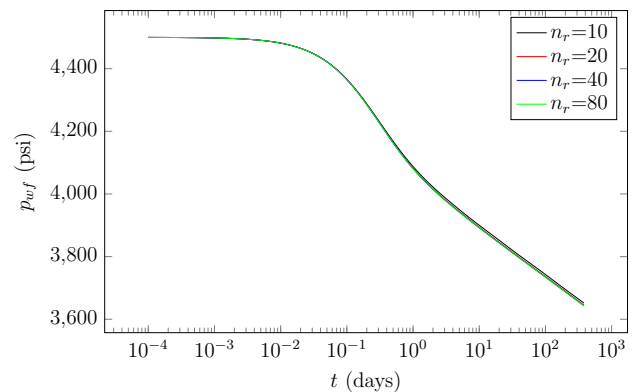
Fig. 4: *Numerical convergence under grid refinement, specialized plot.*
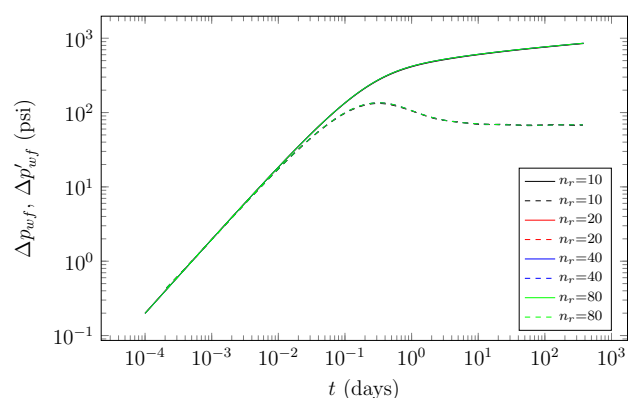
Fig. 5: *Numerical convergence under grid refinement, diagnostic plot.*

We also carried out tests to observe the behavior of the solution concerning the variation of the time step $\Delta t^{n+1} = \delta_{\Delta t} \Delta t^n$. We consider two situations for prescribed Δt_{ini} and Δt_{max}: numerical simulations

with $\delta_{\Delta t} = 1$, Figs. 6 and 7, and pressure curves calculated with a variable $\delta_{\Delta t}$ ($\delta_{\Delta t} \neq 1$), Figs. 8 and 9, respectively.
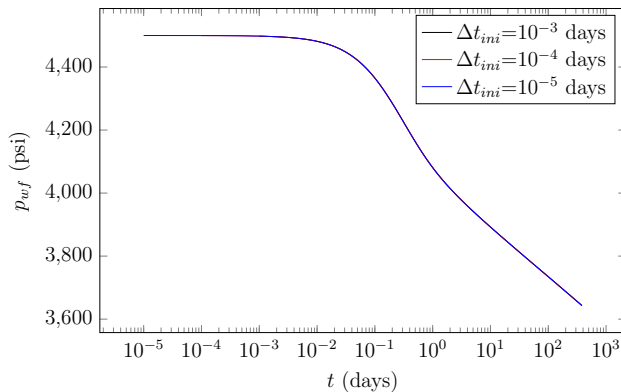
Fig. 6: *Wellbore pressure variation as a function of time step, specialized plot.*
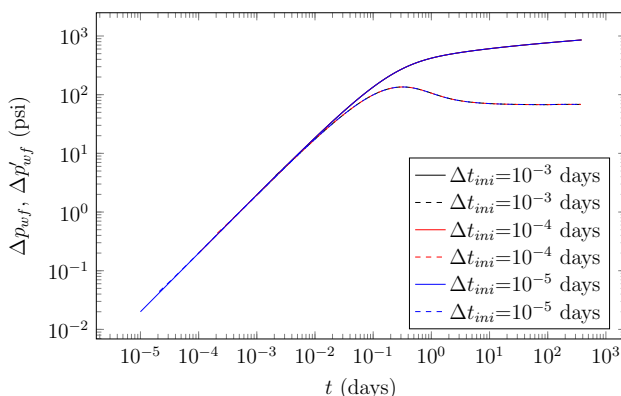
Fig. 7: *Wellbore pressure variation as a function of time step, diagnostic plot.*
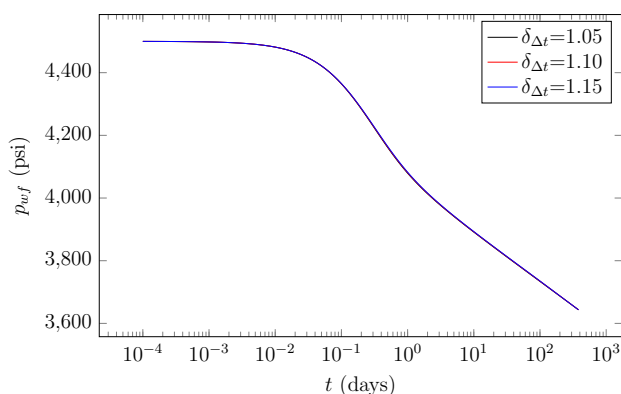
Fig. 8: *Wellbore pressure variation due to the growth of Δt, specialized plot.*
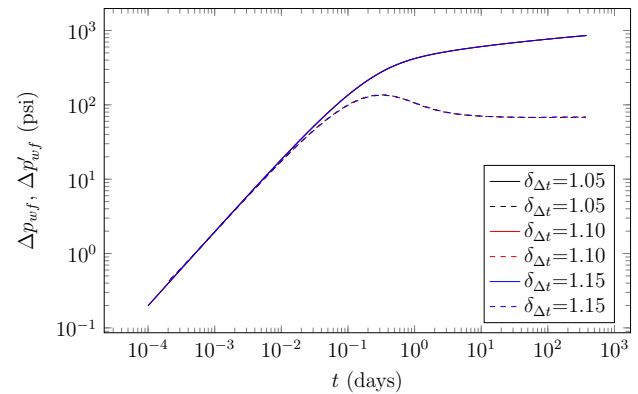
Fig. 9: *Well pressure variation due to the growth of Δt, diagnostic plot.*

As we can see from these figures, the results did not show significant variations concerning changes in the well pressure and pressure derivative when we employ these Δt_{ini} and δt values. Based on this verification, we established the standard values for the initial time step, the growth rate, and the maximum time step of Table 2. As already mentioned, the use of a small initial time step contributes to enabling the analysis of the pressure variation in the initial moments of production (typical in Well Test Analysis using numerical simulation).

We also studied the effect of the tolerance used to stipulate convergence in the internal (Gauss-Seidel method) and external (Picard method) iterations. Figures 10 and 11 present the results, which corroborate the choice of tolerance for the standard case since we did not detect significant differences in the results.
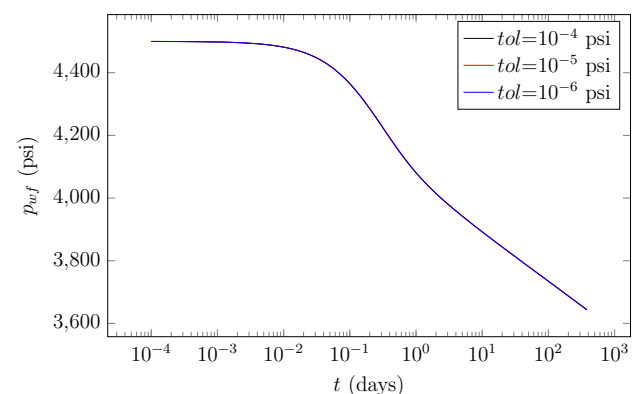
Fig. 10: *Wellbore pressure variation as a function of tolerance, specialized plot.*
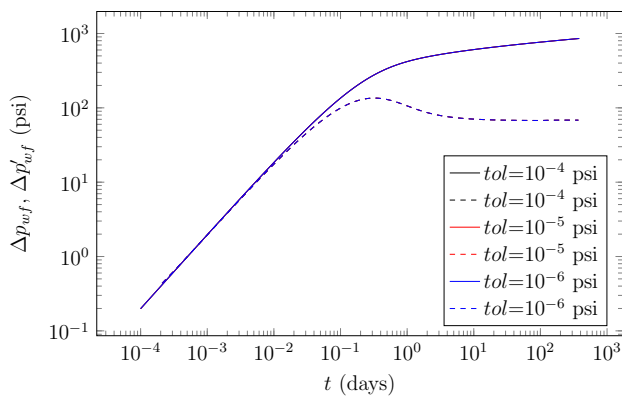
Fig. 11: *Wellbore pressure variation as a function of tolerance, diagnostic plot.*

As an additional check, Figs. 12 (specialized plot) and 13 (diagnostic plot) show our results obtained with higher values for porosity and permeability, 0.2 and 1.0 10^{-3} Darcy respectively, and without taking into account the phenomena of slippage, formation damage, and wellbore storage.
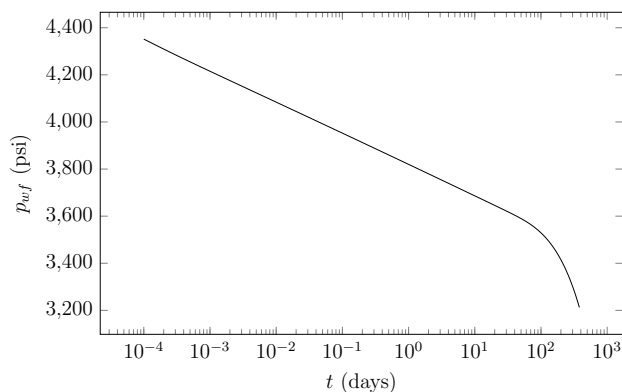
Fig. 12: *Well pressure variation for higher permeability and porosity, and Darcy's flow, specialized plot.*

This simulation is the same as those performed by de Souza [12] for the flow considering only the classic Darcy law, whose results were verified through a direct confrontation with those obtained with the commercial simulator IMEX/CMG [11]. IMEX is a commercial simulator widely known and used in reservoir simulation.
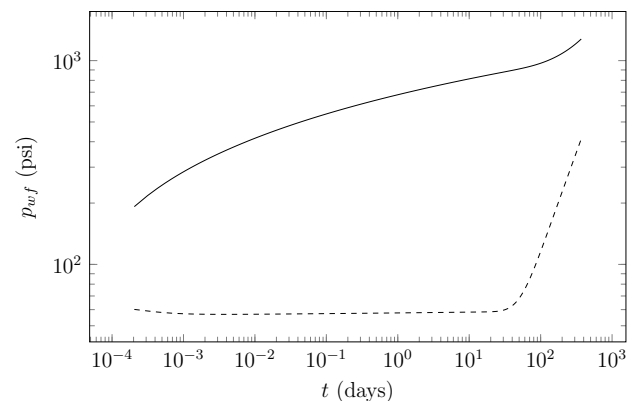
Fig. 13: *Wellbore pressure variation for higher permeability and porosity, and Darcy's flow, diagnostic plot.*

The values here numerically calculated accurately reproduce those determined by de Souza [12]. Therefore, indirectly, it was possible to validate our simulator in the case of flow governed by the classic Darcy law, without the effects of slippage, formation damage, and wellbore storage.

4.2. Sensitivity analysis

We begin by the sensitivity analysis of the effects on the wellbore pressure when we change the reservoir's permeability. In Figs. 14 and 15, we can observe the specialized and diagnostic plots for wellbore pressure variation.
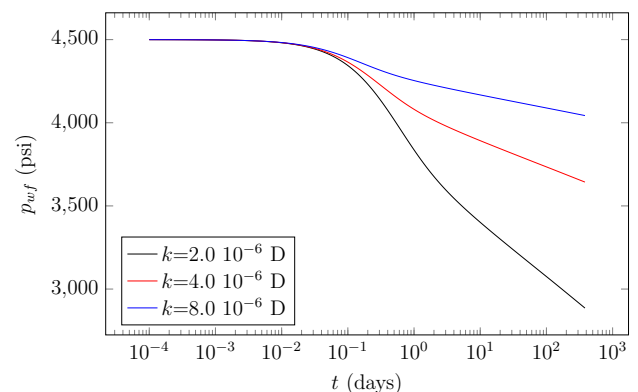
Fig. 14: *Wellbore pressure variation as a function of absolute permeability, specialized plot.*

The higher the permeability, the lower the pressure drop, following the modified Darcy's law. It is worth mentioning that permeability has a significant impact on flow in porous media, and is often responsible for defining the economic viability of the reser-

voir, including decision making on a hydraulic fracturing operation. In the case of reservoirs, where the slip flow regime occurs, the permeability value also influences Kn, and the Knudsen number increases if we decrease it, with a consequent increase in the apparent permeability value. We also noticed that the higher the permeability, the shorter the duration of the transition for the transient regime.
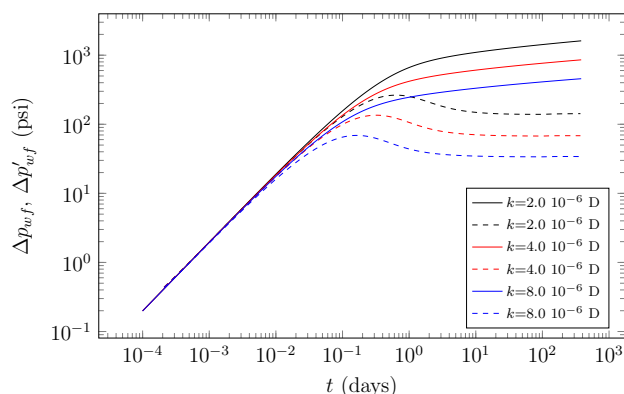
Fig. 15: *Wellbore pressure variation as a function of absolute permeability, diagnostic plot.*

In this test, and for all curves, we note that boundary effects are absent. We can verify this by inspecting the end of the transient flow regime curve, in the specialized plot, and the curve corresponding to the transient flow regime in the diagnostic plot (Bourdet derivative). Besides that, we can highlight that wellbore storage physically depends on permeability in a way that for lower permeability, wellbore storage effect is more prolonged.

Just as we did with permeability, we used different porosity values to check its influence in the wellbore pressure variation. We show the results in Figs. 16 and 17.

However, for the porosity values that we retained, we only note small variations in the well pressure curves (p_{wf}). From the figures, we observe that higher porosity values lead to lower pressure drop for maximum production time, and this is due to the higher volume of gas that we can produce. Therefore, in this situation, the well pressure drops less for a fixed production flow rate. Porosity also influences the value of the Knudsen number but acting in the opposite direction. Regarding the boundary effects, the smaller the porosity, the shorter the transient flow regime. Moreover, as expected, more significant well-

bore storage effects occur for lower porosity values, although we only capture slight differences for the values used in simulations.
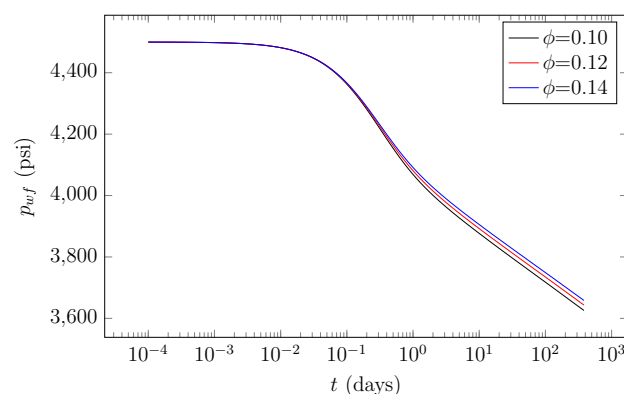
Fig. 16: *Wellbore pressure variation as a function of porosity, specialized plot.*
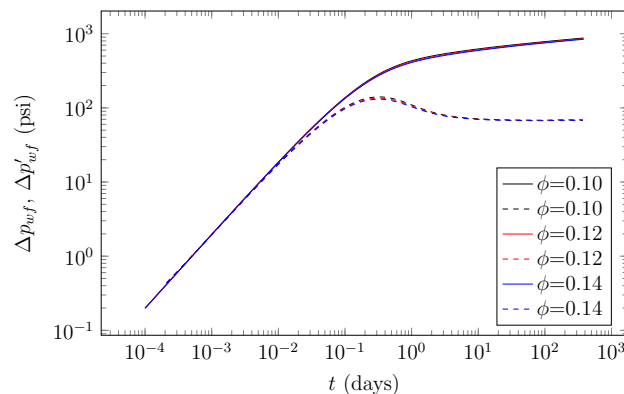
Fig. 17: *Wellbore pressure variation as a function of porosity, diagnostic plot.*

On the other hand, changing the tortuosity leads only to slight changes in the pressure values for the range that we considered (see Figs. 18 and 19).

We note from the results in Fig. 18 a higher pressure drop as the value of tortuosity increases. This is consistent with the fact that the higher the tortuosity of the medium, the lower the apparent permeability must be and, therefore, the higher the flow resistance.
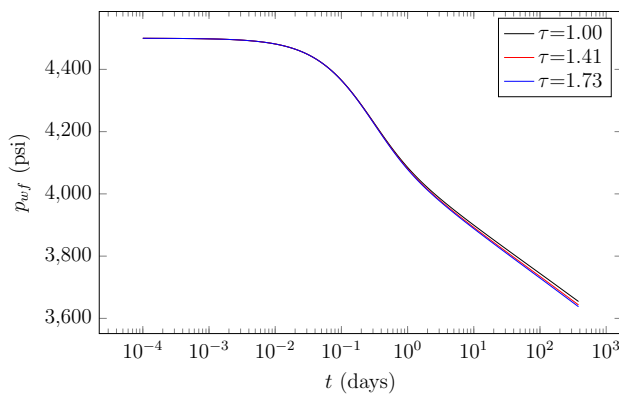
Fig. 18: *Wellbore pressure variation as a function of tortuosity, specialized plot.*

Fig. 20: *Wellbore pressure variation as a function of storage, specialized plot.*

From the results shown in these figures, we realize that we did not detect significant differences in the Bourdet derivative for this input simulation data.

The diagnostic plot (Fig. 21) shows that the wellbore storage strongly influences the results in the initial times, in both the pressure drop and pressure derivative. The higher the wellbore storage, the smaller the pressure drop and the later the transient flow regime will be.

Fig. 19: *Wellbore pressure variation as a function of tortuosity, diagnostic plot.*
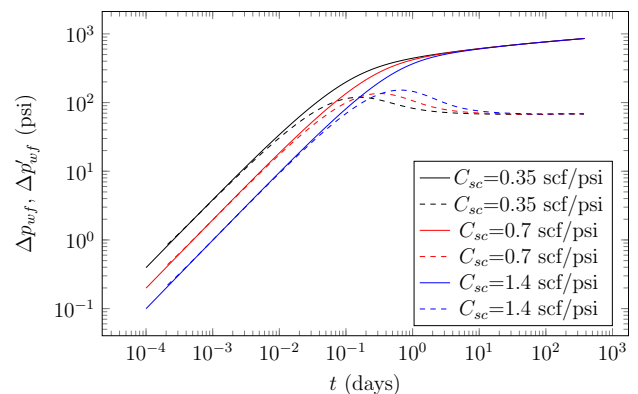
Fig. 21: *Wellbore pressure variation as a function of storage, diagnostic plot.*

4.3.   Well Test Analysis

We now focus on the specific cases of well test analysis. The initial transient response, during a well test, comes from the pressure difference applied to the volume of fluid initially present in the well.

Figure 20 shows the storage effect on pressure behavior in the well. The higher the storage effect, the smaller the representative range of the transient flow regime. This means that a well test must be long enough for the storage effects to disappear so that the flow recorded in the well test identifies the transient regime of reservoir production. In practice, it is from the well test that we obtain the data for the characterization of the well-reservoir system.

We also notice significant results when comparing the pressure variation for the flow without ($\mathbf{k}_a = \mathbf{k}$) and with the slippage effects ($\mathbf{k}_a = f(Kn)\mathbf{k}$). The same simulation conditions and parameters were maintained for both models, varying only the property of interest.

Initially, only the responses resulting from the slip flow effect are studied, Fig. 22. Despite presenting a similar initial behavior (storage and transition to the transient regime), the model taking into account the phenomenon of slippage presents a lower pressure drop as production time increases. We can explain

this by the increase in apparent permeability due to the change in the Knudsen number.
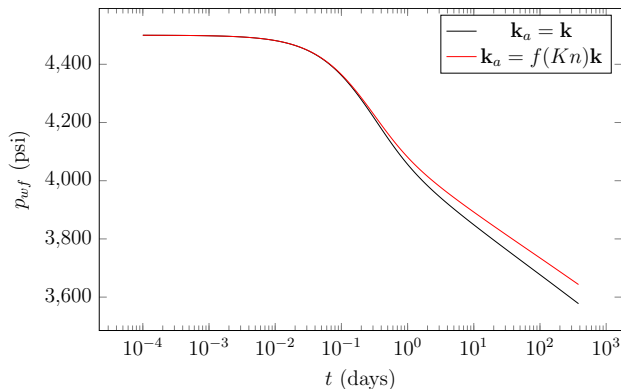
Fig. 22: *Well pressure variation depending on gas slippage, specialized plot.*

Based on the results in Fig. 23, we note that the use of the classical Darcy's law (lower apparent permeability) leads to wellbore storage more significant in magnitude and duration.
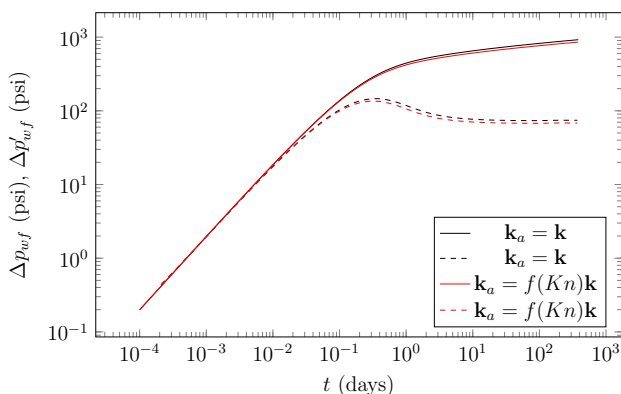
Fig. 23: *Well pressure variation depending on gas slippage, diagnostic plot.*

We present now the results corresponding to three different flow rates in Fig. 24. We only change the flow rate values: -5,000, -10,000, and -20,000 scf/day. We call attention to the fact that we show the results in the form of the pressure variation (Δp_{wf}) divided by the production flow rate (Q_{sc}), a graph applied in the area of well test analysis. We perceive non-linear behavior through the variation of pressure curves as time progress.
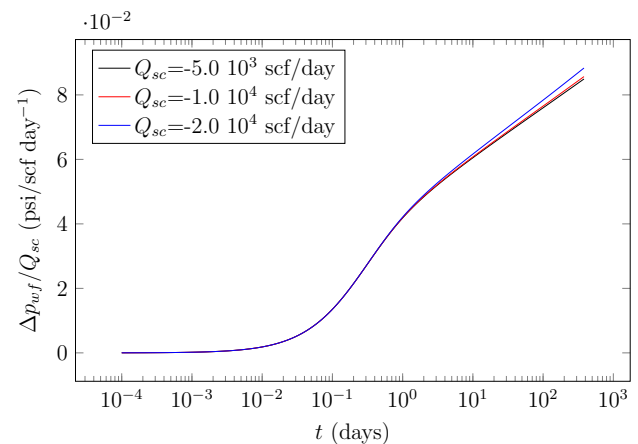
Fig. 24: *Variation of the ratio $\Delta p_{wf}/Q_{sc}$ as a function of flow rate.*

Figures 25 and 26 display pressure variation curves in a region damaged by contact with fluids external to the reservoir during drilling and completion, and, as a consequence, we have a decreased permeability in this region (it was applied the Hawkins' formation damage model [39]). We assumed that the damaged region measures 2.77 ft in all tests run.

After the beginning of the transient regime, we can verify a significant variation in pressure drop as the damage increases (the relationship between the permeability of the damaged region, k_s, and the non-damaged region, k). Furthermore, we observe that the effect of storage has a longer duration and magnitude for higher formation damage values (as a result of reduced permeability around the wellbore).
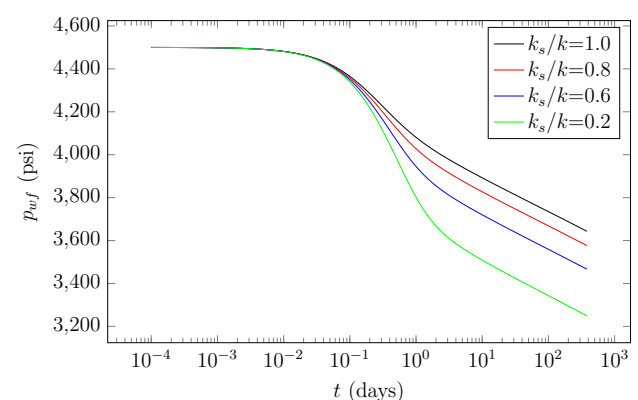
Fig. 25: *Well pressure variation due to damage to formation, specialized plot.*
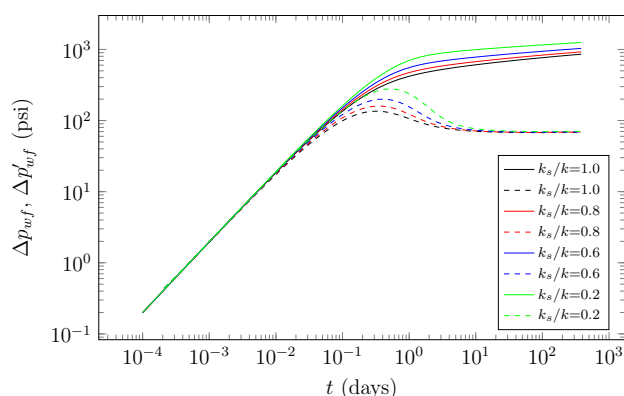
Fig. 26: *Wellbore pressure variation due to damage to formation, diagnostic plot.*

Finally, to show the appearance of the border effects, even for a shale gas reservoir, we performed a numerical simulation using the data presented in Table 2, except for the following three values: t_{max}=4,280 days, Q_{sc}=-5,000 scf/day and L_r=625 ft.

Therefore, at the end of 12 years of production and after the transient regime, we realize that the pressure curve changes its inclination (downward curvature), Fig. 27, as a result of the emergence of border effects. As we can see, the border effects can (in some cases) appear only after a long period of time. This fact shows the practical difficulty of carrying out well pressure tests, which can take from a few days, in general, to months when long-lasting. Finally, we can also detect the same effect in Fig. 28. It corresponds to the change in the curve slope in the final simulation times, after the horizontal line for the Bourdet derivative.
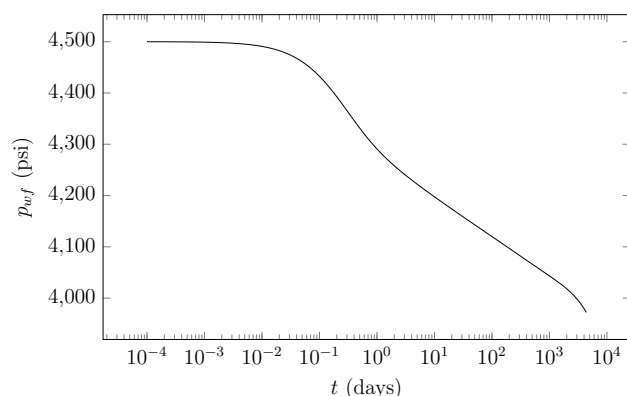
Fig. 27: *Well pressure variation due to the appearance of border effects, specialized plot.*
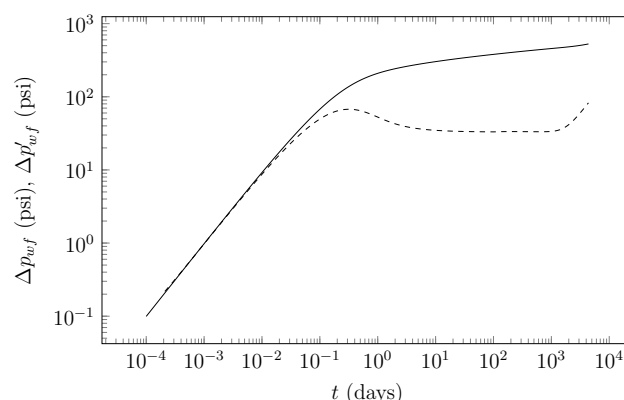
Fig. 28: *Wellbore pressure variation due to the appearance of border effects, diagnostic plot.*

In all tests performed, the Knudsen number kept its value at $Kn \leq 10$, outside the range of molecular flow.

V. CONCLUSION

We carried out a study to better understand single-phase flow in petroleum reservoirs, aiming to maximize hydrocarbon recovery. The numerical simulation allows testing different production scenarios in less time so that we can choose an optimized production plan that leads to economically viable exploration.

The results of this work showed the importance of applying a complete model (including the effects of slippage, formation damage and wellbore storage) to study single-phase flow in shale gas reservoirs. The use of the classic Darcy's law can lead to well pressure results that do not correspond to reality due to the non-consideration of these effects. This is essential information that must be taken into account if we are to have reservoirs producing and generating profits.

From pressure tests in vertical wells, we could obtain the reservoir properties by solving an inverse problem using the physical model of this work. Therefore, depending on the results, the use of horizontal wells or hydraulic fracturing could make production viable for some reservoirs.

As expected, the nonlinear behavior of the results was adequately detected, especially in cases where we varied the permeability values, which appear explicitly in the governing partial differential equation. Also, we captured the wellbore storage and formation damage effects, expanding the scope of this study, and we verified the influence of these phenomena on

the appearance of the transient flow regime and border effects.

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Perceptions of people with diabetes mellitus about the disease and its complications

Widson Davi Vaz de Matos[1], Miquéas Farias Rodrigues[2], Anna Clara Damasceno Jardim[2], Phâmela Ingrid de Jesus Ferreira[2], Ketlen Maiara Neves Silva[2], Rayana Pereira Monteiro[2], Bianca Maia de Lima[2], Bianca Kelly Pantoja da Silva[2],Alinne Larissa de Almeida Matos[3], Cláudia Rafaela Brandão de Lima[3],Thayza Rodrigues Fernandes[4], Francisco Sales Quaresma Barata[4], Aldo da Trindade Rodrigues Neto[4], Marcia Ribeiro Santos Gratek[5],Samuel Oliveira da Vera[6],Odaléa Larissa dos Santos Neves[7],Cecilia Gabrielle Jaques de Souza[7]Sheila do Socorro dos Santos Miranda[8],Natália Dias Rodrigues[9], Gisela Pereira Xavier Albuquerque[10], Tássio Ricardo Martins da Costa[11],Letícia Pâmela Garcia Ribeiro do Nascimento[11],Ana Caroline Guedes Souza Martins[12], Maicon de Araújo Nogueira[13],Antônia Margareth Moita Sá[14], Patrick Nascimento Ferreira[15]

[1]Resident Nurse, Oncology Nursing Residency Program, Federal University of Pará (UFPA), Belém, Pará, Brazil.

[2]Nursing Academic. University of the Amazon (UNAMA), Belém, Pará, Brazil.

[3]Nursing Academic. Pará State University (UEPA), Belém, Pará, Brazil

[4]Nurse. University of Amazonia (UNAMA)

[5]Nursing Academic. Gamaliel Faculty of Theology, Philosophy and Human Sciences (FATEFIG). Belém, Prá, Brazil.

[6]Nurse, Higher Education Association of Piauí. Specialist in Obstetric and Oncological Nursing. Master in Epidemiology and Health Surveillance, Instituto Evandro Chagas. Belém, Pará, Brazil.

[7]Nurse, University of Amazonia (UNAMA), Post Graduation in Adult and Neonatal Intensive Care Unit. Belém, Pará, Brazil.

[8]Nurse, Federal University of Pará. Specialist in epidemiology and infection control, Belém, Pará, Brazil.

[9]Nurse University of Amazonia (UNAMA), Specialist in multidisciplinary oncology. Belém, Pará, Brazil.

[10]Nurse linked to the Hospital Complex of the Federal University of Pará. Master in Nursing, Federal University of Pará (UFPA), Belém, Pará, Brazil.

[11]Nurse, State University of Pará (UEPA). Belém, Pará, Brazil.

[12]Nurse, Master in Health Education in the Amazon at the State University of Pará. Professor at the State University of Pará, Belém , Pará, Brazil.

[13]Nurse, Master in Health Education in the Amazon, PhD student, Stricto Sensu Postgraduate Program, Professional Doctorate in Health Education in the Amazon (ESA), State University of Pará (UEPA). Professor at the University of the Amazon (UNAMA), Belém, Pará, Brazil.

[14]Nurse, PhD in Nursing, Federal University of Rio de Janeiro (UFRJ). Permanent member of the faculty in the Stricto Sensu Graduate Program, Master and Professional Doctorate in Education and Health in the Amazon (ESA), State University of Pará (UEPA), Belém, Pará, Brazil.

[15]Medical academician, Federal University of Pará (UFPA), Belém, Pará, Brazil.

Abstract— Objective: to verify the perceptions of people with diabetes mellitus about the disease and its complications in a treatment center for diabetics in the city of Belém, State of Pará. Method: descriptive, exploratory study with a qualitative approach, developed in a non-governmental organization in Belém , State of Pará, Brazil, from September to October 2018. The sample consisted of five users attended at the non-governmental organization

"Casa do Diabético", through semi-structured interview. Semi-structured interviews were used as a data collection technique, having as an instrument for collection an interview script prepared with open questions, and for analysis, the methodological framework proposed by Bardin. Results: it was shown that people with diabetes mellitus react and faced the disease in multiple ways, some needing psychological support, others in a more positive way, accept the limitations imposed by the disease. Despite the way of coping, everyone tried to adapt to the lifestyle changes necessary to achieve better health conditions. Regardless of the way of coping, the speeches allowed to verify the awareness about the importance of changing eating habits, the practice of physical exercises, as well as the correct use of medications or insulin therapy, aiming at the control of blood glucose, thus avoiding the possible complications arising disease. Conclusion: it is extremely important that nursing professionals dedicate themselves to providing the correct care to people living with diabetes mellitus, performing a continuous process with regard to health education actions, encouraging good health practices, changes in style of life and self-care.

Keywords—Diabetes mellitus. Self-care. Nursing care.

I. INTRODUCTION

Diabetes Mellitus (DM) is part of a group of metabolic diseases characterized by hyperglycemia, motivated by complications or errors in insulin secretion and / or its action. Hyperglycemia presents peculiar symptoms that involve polyuria, polydipsia, weight loss, polyphagia and blurred vision, in addition to acute complications that can lead to life-threatening, such as: diabetic ketoacidosis and non-ketotic hyperosmolar hyperosmolar syndrome. Without adequate control and therapy, chronic hyperglycemia can lead to micro and macrovascular damage associated with dysfunction and failure of various organs such as eyes, kidneys, nerves, heart and blood vessels, directly impacting quality of life (QOL) [1].

Diabetes is classified into types I and II, the first is characterized by the absolute deficiency of insulin secretion caused by the destruction of pancreatic beta cells in the islets of langerhans, of an autoimmune or idiopathic order, which is indicated through pharmacological treatment. insulin therapy. Type II, on the other hand, is characterized by chronic hyperglycemia, resulting from varying degrees of decreased secretion and insulin resistance [2].

According to data from the International Diabetes Federation, the prevalence of DM reaches approximately 8.8% of the world population with a projection of 380 million people for the year 2025. In addition, the Brazilian Diabetes Society (SBD) estimates that about 26 millions of people have the pathology, and Brazil has about 13.7 million diagnosed Brazilians, placing the country in fourth place in the ranking of the 10 countries with the highest number of people with DM. It is important to consider that approximately 5.7 million Brazilians have the disease without diagnosis [3].

In view of the chronic nature, the forms of palliative follow-up and the need for changes in lifestyle and reconfiguration of activities of daily living that favor a good pathological prognosis, it is considered that the efficacy of treatment for both diabetes control and its complications they do not depend exclusively on professional intervention. The knowledge of the patient about his pathological condition, the incentive and encouragement to the main care and the participation of the family, are fundamental to encourage more regular care and better coping with the disease. Therefore, for the promotion and maintenance of QOL, as well as the prevention of subsequent injuries, it is necessary to have acceptance and awareness about the disease and effective coping with complications [4].

In this sense, health education emerges as an effective tool and mechanism in training for self-care, a scenario in which patients need to be active actors in the control of the condition, where the professional relationship between patients works as a means for the development of the individual's confidence. in their own capacities, maximizing available resources and providing patients with the knowledge, skills, attitudes and responsibilities capable of effecting changes in postures, capable of strengthening the coping process and improving health [5].

In view of the above, the following research questions emerged: what is the perception of people with DM about the disease, its complications and limitations? What are the feelings of individuals regarding the diagnosis of the disease? What is the importance attached to nursing care for self-care and glycemic control from the perspective of the person with DM?

Thus, this study aimed to verify the perceptions of people with diabetes mellitus about the disease and its complications in a treatment center for diabetics in the city of Belém, State of Pará, Brazil.

II. METHOD

Descriptive, exploratory study with a qualitative approach, carried out in a non-governmental organization "Casa do Diabético", located in the metropolitan region of Belém, State of Pará, Brazil, from September to October 2018.

The study population consisted of five users who agreed to sign the Informed Consent Form (ICF), which was made explicit individually. The participants were identified with the following names: "P 1", "P 2", "P 3 ..." respectively, where "P" represents "Person" and the number the order in which they were interviewed, with the objective of preserve the anonymity and confidentiality of information.

The sampling closure occurred according to the saturation sampling method. In this, the researcher closes the group when, after the information collected with a certain number of individuals, new interviews start to present a number of repetitions in their content[6].

The inclusion criteria of the participants were: people diagnosed with DM I and II, of both genders, aged between eighteen and eighty years, whose drug treatment was insulin, oral antidiabetic and / or associations of these, and who perform consultations, examinations and treatment in the organization.

Users diagnosed with Diabetes Insipidus, Diabetes Mellitus Gestacional (DMG) and people with limitations in spoken communication were excluded from the study and who had interrupted treatment in the last 12 months.

Data collection was carried out on the premises of the Casa do Diabético, through semi-structured interviews recorded in audio and as an instrument an interview script, with five open questions prepared by the researchers.

The content of the interviews was transcribed in an original way, preserving the expressions used by the participants. However, to use them as a unit of analysis, orthographic corrections were made, excluding language vices, exchange or absence of letters, but maintaining the linguistic vices that have meaning in the context of speech.

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The categories were previously delimited due to the thematic axes of the interview script, being confirmed after analysis and construction of the data.

The project was analyzed and approved by the Research Ethics Committee CEP of the University of the Amazon (UNAMA), CAAE: 94975218.0.0000.5173, with opinion number 2.825.061. Resolutions no. 466/2012 and 510/16 of the National Health Council (CNS) and the National Research Ethics Commission (CONEP).

III. RESULTS

The corpus of the study made it possible to organize the content into three empirical categories: Perceptions and feelings related to the diagnosis of the disease, possible complications and limitations; Understanding about changes in lifestyle after diagnosis and Understanding and meaning attributed to nursing care; the categories being grouped later according to the theme extracted from the responses.

FIRST CATEGORY - PERCEPTIONS AND FEELINGS RELATED TO THE DIAGNOSIS OF THE DISEASE, POSSIBLE COMPLICATIONS AND LIMITATIONS

In the first category, all users revealed their trajectory of health care, from the moment of diagnosis, to the impact on everyday life, in relation to complications and limitations. The testimonies obtained allowed us to perceive the change in the mood state, with feelings ranging from the feeling of sadness and depression, to the acceptance and effective coping with the therapeutic regime, as can be seen in the statements:

"[...] I felt like depression, I couldn't sleep, I woke up thoughtful, then when I took diabetes tests, I took the medication, I got better, then I got back to normal". (P1)

"[...] Normal, my life remains the same, it hasn't changed anything, neither psychologically nor emotionally, everything is normal, of course I started policing myself about what I ate, I started taking my medicines". (P2)

"[...] At first I felt a little sad, because there is no cure, but after talking to my doctor and the nurse, they told me that it has no cure, but if you control it, you can live normally , so from then on it didn't shake me anymore ". (P3)

In this study, all respondents were aware that the complications arising from DM are real and understood that they needed to adhere to the care and treatment plan, in addition to making lifestyle changes, so that these complications were avoided. It was possible to observe

that some of the patients needed psychological assistance due to their states of melancholy. After a better understanding of the disease in different aspects and its form of control, the patients got used to it and showed acceptance regarding the diagnosis, as can be seen in the following statements:

"Look, in my case, I accepted, my father was already diabetic, we were already researching; and the first time I came here to see me, the doctor always said that because my father was diabetic, I already had the seed inside me, so I already hoped that one hour this would happen ". (P4)

"I felt really bad, I went to the psychologist, and I didn't accept it, I didn't want to accept it, until one day my brother died of diabetes! And I said that if one day I had this disease, it was risky to shoot myself in the head, because I wouldn't accept it ". (P5)

When asked about their feelings about the disease, 90% of the interviewees affirmed the absence of difficulty in living with the diagnosis; moreover, it was found that, among these, there is no understanding of a direct association between mood changes and feelings experienced with the disease. However, it was noticed that at certain times, patients feel frustrated, mainly because they worry about the future and the possibility of serious complications.

It was evident that the interviewees are aware of the possible complications and limitations that DM can cause, knowledge acquired from educational actions carried out by the multidisciplinary team, as can be seen in the statements:

"The person feels weak, does not sleep at night, eats a lot, does not leave the house, pee a lot". (P1)

"It is a tr   eacherous disease! (Silence) Either we take care of ourselves or she breaks up with us, because she is something from the inside out, she is acting and we think everything is fine, but it is not, now I am having this awareness, later the first lecture, after the second today ". (P2)

"There are several complications, as long as you don't take care of her, you can have it, but if you take care of it, you won't have it." (P3)

"Limitations are like you say, if you don't get treated, you can lose one of the limbs, like my father who lost one of his legs." (P4)

"From what I've been through, lately it has given me pain in my legs, weaknesses, I felt very bad". (P5)

SECOND CATEGORY - UNDERSTANDING OF LIFESTYLE CHANGES AFTER DIAGNOSIS

With regard to changes in lifestyle in view of the risks of developing DM, whether due to diet or hereditary factors, the participants' awareness of the need for changes in lifestyle and healthy habits to control glycemia is noted, thus providing better QOL. Some already had good habits, others are sensitized to improve from the recognition of this need, as noted in the speeches:

"[...] Change the diet, do physical activity and take the right medicine". (P1)

"[...] Normal, I am aware that I have to change, exercise, I was extremely sedentary, I know that I have to change the issues of eating habits, because until then, I ate everything!". (P2)

"[...] When changing my lifestyle, I don't feel much difference, because it is necessary to do it, then it has to be done! But sometimes we feel the need to eat something, but we cannot, then we have to conform, there is no use regretting it ". (P3)

"[...] Food is essential, when things got more serious, glucose was over the limits, I cut the drink, I never smoked, because it is a cause of complication, and I keep food as regularly as I can". (P4)

"[...] Now, I'm walking, taking insulin, exercising, regulating food". (P5)

It was evident from the speeches that there are significant and real changes in the lifestyle of the participants, and that these were essential to effectively control blood glucose, generating an increase in QOL. It was found that such changes occurred gradually, based on the understanding that, in order to improve the clinical condition, it is of utmost importance to assume healthy habits, such as good nutrition, practice physical activities, correct medication dosage, as observed in the statements:

"[...] Change was precisely the question of food, and now a month ago I started an exercise, a walk". (P2)

"[...] The daily routine for sure, I had a very heavy diet, today I have a moderate diet, trying to maintain the pattern of eating food every 3 hours, so as not to have very low blood glucose". (P4)

"[...] I started to work less, eat on time and other things, I went to the nutritionist, who gave me some recipes, I stopped eating what is not to eat, today I feel good about it". (P5)

Despite the difficulty, all participants seem to understand the need to change their lifestyle, despite all the obstacles to be faced, aiming to have control of the disease, as reported below:

"[...] I found it a little strange, a little difficult to adapt to the change, but it was necessary to change, I was forced to change". (P1)

"[...] The food that can no longer eat what I could, today is half and exercise! Before I didn't do it, then I felt the need to do it, but the rest is going well! [...] ". (P3)

THIRD CATEGORY - UNDERSTANDING AND MEANING ASSIGNED TO NURSING CARE

In this category, reports about the meanings attributed to the nursing care offered at the institution where they do health monitoring are described. The professionals were praised by the interviewees, although some did not express so many words, there was an absence of dissatisfaction regarding the care offered by nursing professionals. Despite the speeches not being explicit about the real care provided by these professionals, there is a consensus that the nursing team works properly and the praise of their importance in the process of caring for people with DM was notorious, as was observed in the following statements:

"[...] They treat me well". (P1)

"[...] Very good, the staff is very attentive, very human, it's not that automatic thing, they talk to you, try to understand you". (P2, (P3)

"[...] Here is 100%". (P4)

"[...] Very good, calm! Only they treat me well, have an education, they all have it "

"[...] "All are good". (P5)

IV. DISCUSSION

The findings of this study related to the first empirical category evidenced, reveal that the perceptions about a disease are never the same for different people, thus occurring manifestations, understandings and reactions unique to each case. Some people manage to overcome the challenge and maintain a good relationship with the disease, which allows them to have a healthy and harmonious life. However, others see the disease as a burden, failing to develop a good relationship of well-being and QOL.

In the meantime, this research is in line with another study in which it showed that of the 32 participants in their research, 68%, managed to live in an acceptable way with the diagnosis, while the other 32% had difficulties or psychosocial shocks in the face of pathology[8].

Regarding the understanding of patients about the limitations generated by diabetes, Rodrigues[9] evidences that the low perception presented by 45 of the total of 78 participants in his analysis, led to a low adherence to the treatment imposed for diabetes, thus corroborating with the present study, demonstrating that the perception of complications of diabetes strengthens in the patient the need for treatment and coping with the disease.

As for the data on lifestyle changes after diagnosis, we observed that this component behaved as a fundamental characteristic for improving QOL and therapeutic success. This result corroborates with a survey carried out with 106 young people between 15 and 17 years old, where strategies were applied with individual guidance on the importance of changing lifestyle, promoting physical activity, changing eating patterns, guidance for parents and other family members. After six months of study, improvements in beta cell function were identified, improving insulin resistance and DM2 prevention. In addition to the decrease in C-reactive protein levels and a significant reduction in waist circumference[10].

In contrast, a qualitative, exploratory and descriptive study involving eleven people with diabetes, two male and nine female, aged between 42 and 80 years in the city of Ijuí / RS, made it possible to identify that diabetics experience changes of their daily lives for stability of the disease, however they express some indignation regarding the prescribed diet, accumulating some resistance and not fulfilling what is recommended. Other factors reported by the interviewees include changes on their own in the dosage of the prescribed medication, lack of follow-up of the rotation of insulin application and absence of physical activity[11].

The maintenance of satisfactory metabolic control guarantees the diabetic a reduction in the risk of these complications in addition to an increase in QOL, preventing the occurrence of microvascular and macrovascular complications. For this to occur, it is necessary that these individuals have access to quality health services, in addition to the patient's own contribution to maintaining and carrying out the therapeutic conducts planned by the multidisciplinary team.

It is important to note that monitoring through nursing consultations contributes to the control of DM and excellence in care, as it allows a continuous assessment of the patient's real needs. Nursing consultation is a private activity of nurses, as determined by the Federal Nursing Council (COFEN) through Law No. 7,498, of June 25, 1986[12].

The treatment of DM requires some precautions such as improved nutrition, physical activity, self-monitoring

of capillary glycemia, insulin management, storage of inputs, correct insulin application technique, rotation of application sites, handling of syringes and needles , care with homogenization, subcutaneous fold, correct disposal of inputs, among others[13].

Within this importance of care mentioned above, the nursing process stands out, which is a planned series of actions that aim to execute the purpose of nursing, achieve pre-defined goals and thus maintain the most satisfactory degree of well-being of the client, and if that state changes, provide the totality and quality of nursing care that this situation requires to direct it back to well-being; if this cannot be fully achieved, the nursing process must collaborate for the client's QOL by maximizing resources in order to achieve the highest levels of health. . In this context, many patients recognize the importance of nursing in the process, and this has become more noticeable over time, allowing to change that view that only the medical professional has the responsibility and competence to take care of the patients' health[14].

In this study, one of the patients reported that nursing care is as important as that of the doctor, making the perception of reality concrete, which fosters the reflection that more and more nurses are present in the routine of providing patient care. with DM demonstrating its scientific value.

V.   CONCLUSION

The objective of verifying the perceptions of people with diabetes mellitus about the disease and its complications was achieved according to the data presented.

We believe that living with a chronic disease means facing numerous constant challenges, since it requires knowledge about the disease and changes in daily habits. In the case of people with DM, it is necessary to know their perception about the disease in order to improve coping and avoid complications.

The results showed that knowledge about DM and complications is strongly associated with the person's own experiences with the disease or acquired through contact with close people affected by some complication.

We found that the participants did not have the necessary information to be able to make their choices on how to control DM, to monitor the evolution of this disease and the possibility of early detection of complications before monitoring at the institution.

We have evidenced that the acquisition of knowledge about the cause, symptoms, duration of treatment,

consequences and limitations on DM are essential for adherence to the therapy used aiming at the metabolic control with increased QOL.

We consider it extremely important that nursing professionals dedicate themselves to providing quality care to people living with DM, carrying out health education practices, related to the knowledge of the disease, encouraging good health practices and self-care, also providing humanized assistance, which generates better quality in health production and greater user satisfaction, leading patients to become informed about diabetes, its complications and care, making them autonomous and emancipated.

We reinforce the need for health professionals to develop educational activities considering the individual experiences, beliefs and values of people with DM. It is important to highlight that this role of educator should not be restricted to the "traditional" model of knowledge transmission, where the nurse assumes the role of transmitting concepts and guidelines. This needs to build a committed posture to understand the context in which people with DM are inserted, the popular knowledge, the difficulties experienced and how each information is learned. This education must be based on a mutual exchange of knowledge and experiences, in this way, specific and personal doubts can be more easily understood and dealt with integrally and individually.

The findings reveal the difficulty of people with DM to change old eating habits and permanently accept a restricted diet, as they often feel frustrated for not being able to effectively control the desire to eat something they cannot.

We consider it pertinent to point out some limitations of this study, such as the reduced number of participants, compared to the total population of people diagnosed with diabetes monitored at the Casa do Diabético. This limitation places some obstacles to the generalization of the research results, in addition to all the people who participated in the study being linked to health centers, so we understand that they had the opportunity to receive some guidance, differently from those who have diabetes and are not linked health services.

Finally, we believe it is essential to institute investigations and methodological practice in the field in question as a way to optimize and consolidate knowledge during academic training, and educational intervention studies focused on health education in the context of people with DM, which may be the subject of other studies.

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A Study of technologies to further research in Health Care Data Security in Medical Report using Block Chain

Shaina Arora[1], Dr. Vikas Lamba[2]

[1]Assistant Professor (CSE) VIT College, Jaipur, India
[2]Professor (CSE) VIT College, Jaipur, India

Abstract— In today's healthcare system one of the most important requirement is to protect the data of patient's medical report against potential attackers. This is basic to secure information that can just approve people can get to the patient's medical report. To grant the security for the data of the patient we proposed Block Chain technology. Which is decentralized architecture, where data is stored in from of blocks for processing. In this health care sector the security of patient data is to be maitained. This block chain is composed in three phases: 1. Authentication– we use Quantum Cryptography, 2. Encryption – we use AES and for, 3. Data Retrieval – we use SHA algorithms are used to resist the frequent attacks. This framework ensure the protection of the patients and moreover keeps up the security and trustworthiness of the health care system.

Keywords— Block chain , Medical Report Data , Security, Privacy, Authentication, Encryption, Data Retrieval.

I. INTRODUCTION

The Block chain is the fastest growing technology through various applications in a secure manner. The various implementations make use of block chain technology among stakeholders. Blockchain could be a public ledger for all committed transactions and is stored in a list of blocks. The blockchain technology contains some key features such as decentralized, open source, immutable, transparent, persistency and anonymity. Anonymity is when each user can interact with the blockchain with a generated address, which does not reveal the real identity of the user.

Blockchain is a new technology that supports sharing of values. In recent years, it has been applied in various areas, the most important is the financial one. Blockchain is a digital ledger where there are stored all the executed transactions. When the transaction is done again, the chain will grow continuously. It does not use any third party tools for any transaction or for any other process. From a business perspective, the blockchain is an exchange network for moving transactions, value and assets between peers. The blockchain is a technology to validate the transactions and replacing trusted entities.

Block chain technology plays a major role in the medical and healthcare system. Because of the decentralized and distributed technology, Block chain provides security services in healthcare. The centralized design in current health care services is not so secure among the various medical services, which provides a delay in accessing the data and it has a major risk in leakage of information. In such a case, the medical reports can be archived without the knowledge of the patient. Accessing the data in a secure manner within the network is the major issue in current health care maintaining system.

For accessing the data, Block chain is the efficient way and a promised technology. In block chain technology, the information is stored as a ledger feature which can monitor the patients in accessing the medical records.

II. LITERATURE REVIEW

A literature review is necessary to know about the research area and what problem in that area has been solved and what need to be solved in future. A proper literature review provides solid background for a noble research work. A good literature review is comprehensive, critical and contextual. It provides a theory base, a survey of published works that is in consideration to the investigation, and an

analysis is of that work. It is a critical, factual overview of what has gone before. A good literature review shows awareness of reviewer in the field. One has to start initially with preparing a knowledge base and then its sub parts and while doing study of literature narrow down the domain to specific point of its various issues to decide upon. Literature survey includes the study of various sources of literature in the area of research. It includes finding the related material from magazines, books, research articles, scientific research papers published in various conferences, journals & transactions. One may take few days to a few weeks to understand a research paper published in standard peer reviewed journals. The researchers need to adopt a certain path for doing literature review of such literature. There has been many procedures and process defined by the researchers to undergo through and arrive at certain conclusions of research objectives. The five stages of the review process adopted are discussed in this chapter. It also includes categorical review, common findings, strengths, weaknesses of researchers, gaps, problem statement and objective in various sections & sub sections.

A detailed review of research papers on Health Care using Block Chain, published within the period of year 2017 to the year 2020 is presented in this section

In these papers discussed about the health care services industry is always showing signs of change and supporting new advancements and advances. One of the predominant requirements in today's health care systems is to protect the patient's medical report against potential attackers. Hence, it is basic to have secure information that can just approve people can get to the patient's medical report. So, in these papers discussed about Block chain technology for medical report of a patient.

Table 1 Comparative Analysis of Research Works Reviewed

Technique Used	I/P Parameters	Output						
Block Chain	Validation of Blockchain 1) Pow 2)PoS 3)PoA 4) DPoS	1.Identity management 2.Transaction process 3.Insurance claim management						
	Smart Contracts							
Block Chain	It's composed of three phases 1.Authentication, 2.Encryption and 3.Data Retrieval using Block Chain technology. For authentication – Quantum Cryptography, for Encryption – AES and for Data Retrieval – SHA algorithms are used to resist the frequent attacks.	Feature	Helth-Com	Mederc	Med-Share	Bbds	Our Proposed System	
		Scalability	Y	N	Y	Y	Y	
		Doctor/Patient Authentication	N	N	Y	Y	Y	
		Integrity	N	Y	Y	N	Y	
		Confidentiality	N	Y	Y	N	Y	
		Access Control	Y	Y	Y	Y	Y	
Block Chain	Biosensor nodes in the Bio Sensor Network	In the paper we merged the BSN and the health blockchain, and used the biosensor nodes in the BSN to propose a lightweight backup and efficient recovery scheme for keys of health blockchain. The scheme has the following advantages: (1) Biosensor nodes in the BSN are in charge of generation, backup and recovery of the keys of health blockchain, and it will increase the security of these keys. (2) In the scheme each block on the blockchain can be encrypted by a distinguished key with lower storage cost and high performance, and it will greatly improve the security of privacy physiological data on the health blockchain.						

IOT & Blockchain	IoT and blockchain network integration with three main actors : wearable sensing devices, gateway device and IoT-blockchain platform.	The result and analysis of the testing performed to the proposed IoT blockchain platform in term of privacy, data synchronization and write latency testing. As the testing environment, we deploy peers into three different virtual machines

III. BLOCKCHAIN

Blockchain technology is one of the most important and disruptive technologies in the world. Multiple industries are adopting the blockchain technology to innovate the way they function. One of the industries that are looking to adopt the blockchain is the healthcare industry.

The blockchain is generally defined as a sdecentralized system in which transactional or historical records are recorded, stored, and maintained across a peer-to-peer network of personal computers called nodes.

The blockchain is a technology that's already getting massive attention in healthcare. In fact, as we mentioned before, 40 percent of health execs see blockchain as top 5 priorities. Furthermore, the global healthcare market spend on blockchain is expected to hit $5.61 billion by 2025, according to a report by BIS Research. The adoption of the blockchain technology could save the healthcare industry up to $100-$150 billion per year by

2025 in data breach-related costs, IT costs, operations costs, support function costs and personnel costs, and through a reduction in frauds and counterfeit products. When all's said and done, blockchain in healthcare is ALL about removing the middleman. This article will talk about various middlemen that can be removed and mistakes that can be avoided when the healthcare industry adopts blockchain at scale.

Blockchain in Healthcare Industry and Innovation

No matter what we say, it will be impossible for us to overstate the importance of the healthcare industry. Having said that, this is easily one of the slowest growing industries in the entire space. We realize that this is a very controversial thing to say, however, the proof is in the pudding.

Compared to two decades ago, hospitals, overall, still function pretty much the same way. The reason, as Richie Etwaru says, states is its lack of innovation. This is actually pretty surprising when you consider the fact that this space, in particular, has some of the smartest and well-educated people in the entire world.

Blockchain and Decentralization

In order to understand why the concept of decentralization and running a trustless system is important, you need to understand the relationship that we humans have had with trust since the beginning of time.

Early cavemen learned the importance of trusting each other. It was literally a matter of life and death. A caveman by himself had 0 chance of surviving.

Think of all the elements in the nature that could have killed them, from wild beasts to changes in the weather. A man had to learn how to live in communities with people that they can trust, just to survive.

As time moved on, you could see this trust evolve in a lot of interesting ways.

Firstly, we had the barter system, wherein people trusted each other to give them a product of value to exchange with theirs in order to carry out transactions. However, as time went on, our transaction system became infinitely more complex.

Our population exploded thanks to improved medical care in a large part and our businesses became a lot more complex. As a result, we moved from trusting an individual, to trusting a centralized institute, like a bank. However, as time grew, these banks became more and more powerful.

With the number of responsibilities that these banks were dealing with a point had to come where they were going to fail so badly, that people would have to look for an alternative financial system.

This point came in the 2008 financial collapse. Many banks, and Lehman Brothers, in particular, were guilty of excessive risk-taking which plunged the whole planet into the worst recession since the 1930s great depression.

Disillusioned by the centralized banking system, an anonymous person(s) named Satoshi Nakamoto came up with the idea of Bitcoin. Bitcoin was the world's first decentralized cryptocurrency which was powered by blockchain technology.

So, how is the blockchain decentralized?

It really is a pretty simple concept. All the records that are stored within the blockchain, isn't saved inside one centralized storage unit. There are multiple computers running within the network who own a copy of all the data in the blockchain. This is why, whenever anything is

updated in the blockchain, all the nodes in the network get notified of this at once.

This is what we mean by decentralization. There is no single source that is in charge of all the data anymore.

IV. ADVANTAGES OF BLOCK CHAIN

Amazing Advantages of Block Chain are:

- Since the blockchain is Immutable and traceable, patients can easily send records to anyone without the fear of data corruption or tampering.

- Similarly, a medical record that has been generated and added to the blockchain will be completely secure.

- The patient can have some control over how their medical data gets used and shared by the institutes. Any party which is looking to get the medical data about a patient could check with the blockchain to get the necessary permission.

- The patient can also be incentivized for good behavior via a reward mechanism. Eg. they can get tokens for following a care plan or for staying healthy. Also, they can be rewarded by tokens for giving their data for clinical trials and research.

- Pharma companies need to have an extremely secure supply chain because of the kind of product they carry. Pharma drugs are consistently stolen from the supply chain to be sold illegally to various consumers. Also, counterfeit drugs alone cost these companies, nearly $200 billion annually. A transparent blockchain will help these companies to enable close tracking of drugs to their point of origin and thus help eliminate falsified medication.

Exhibit 1
Damage from counterfeit goods, by industry
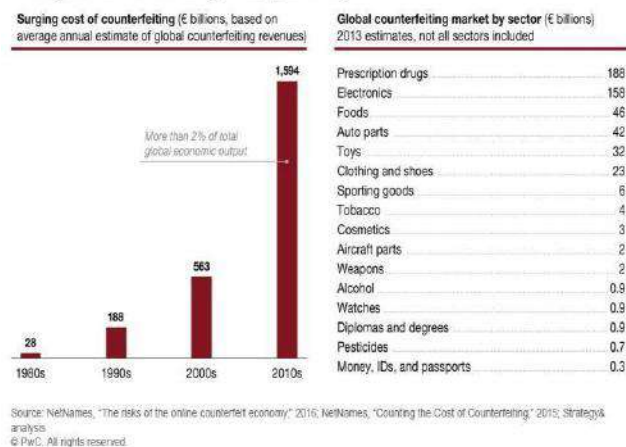
- Various medical institutes around the world conduct their own research and clinical trials on various new drugs and medications. A blockchain will help create a single global database to collect all this data and put them in one place.

- Insurance fraud is a major problem that is affecting the healthcare industry. This happens when dishonest providers and patients submit false claims/information to receive payable benefits. To get an understanding of how serious this problem is, try to wrap your head around this: According to Boyd Insurance, Medicare fraud in the U.S. alone costs about $68 billion a year.

V. CONCLUSION

The health blockchain is a good solution to address the problem of monopoly of physiological data and improve the robustness of storing these data, and has a broad application prospect in the area of healthcare system. Block chain in medicinal services frameworks has gotten gigantic open doors terms of not just giving secure and productive data putting away, sharing and access yet additionally creates a potential degree in the social insurance business for an assortment of partners. However, before the popularization of the health blockchain, we must address the problem of protecting private physiological data. The core problem is designing an effective key management scheme.

The future is to conduct depth investigation in block chain and make it better in security and storing data of medical data in healthcare infrastructure, and try to make it in level of international level infrastructure for medical data storage.

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Network management by Smartphones Sensors thresholds in an integrated Control system for Hazardous materials Transportation

Luiz Antonio Reis, Sergio Luiz Pereira, Eduardo Mario Dias, Maria Lídia Rebello Pinho Dias Scoton

GAESI- Department of automation technologies and management processes-Polytechnic School, USP – Universidade de São Paulo – São Paulo –SP- Brazil

Abstract— *Hazardous materials are dangerous but necessary goods and must be transported into big cities. Tracking of trucks is expensive and difficult to standardize under government surveillance. The proposed solution to solve the lack of an integrated control system is network management based on virtual fences using smartphone sensors to monitor and advise any exceeding threshold, which leads to accident avoidance, faster detection time of accidents, and consequently, reduction in traffic jams, damage to human health and environment.*

Keywords— *hazardous materials transportation, mass notification system, mobile applications*, *threshold, tracking system*.

I.   INTRODUCTION

According to Brazil's National Transport Confederation, road transport is responsible for 61% of cargo transportation, and practically 100% of dangerous cargo transportation in an urban environment is made by road. Dangerous goods or hazardous materials are substances that can endanger human lives, health, and the environment [1].

Possible accidents involving hazardous materials can cause serious consequences for the population [2] and increase problems related to urban mobility [3]. Thus, the greater the control and standardization of operating procedures for this type of transport, the better and safer it will be for society.

There are 12 million citizens, 8, 3 million vehicles, and 17,000 km of roads in the city of São Paulo. Its geo-economic characteristics cause a large flow of vehicles with a significant amount of cargo to cross the city and to be able to transport dangerous goods it is necessary to have authorization from Municipality, which receives more than 45,000 annual applications.

According to the São Paulo State Public Security Department, between 2001 and 2015 there was an annual average of 200 accidents involving dangerous cargo in the state of São Paulo, at about 10% of them happened in the city of São Paulo.

Another critical factor for mitigation of existing problems is the reduction in detection and actuation time, only 5% of the streets in São Paulo city has any kind of surveillance. The inspection process of government entities is not able to track 100% of cargo transport. This fact doesn´t allow them to take preventive measures and increases the time of identification and containment of a possible accident. In case of an accident, firefighters put their lives in danger by adopting standard procedures with basic protective equipment which is sometimes incompatible to hazardous substance and don't solve the problem.

This paper proposes an evolution in dangerous goods transportation surveillance considering the need for real-time tracking and cargos privacy.

The implementation in trucks tracking considers smartphone applications to track trucks and control their routes.

Section 2 introduces the Integrated Operations Center, vehicle tracking by mobile networks, fault management, and problem management.

Section 3 shows the proposed hardware and software architecture in an integrated control system to hazardous materials transportation. Section 4 shows the proposed configuration. Section 5 concludes the paper. Section 6 possible future directions.

II.   RELATED WORK

2.1 Integrated Operations Center

More developed cities have Integrated Operations Centers that are made up of different government departments with

their legacy system. Despite several departments work in the same environment, not all information is shared. The lack of integration between different legacy systems thrusts aside the possibility of optimized transport route planning and increases the response time for abnormal conditions. Information and communication technologies are transforming transportation systems [4].

2.2 Tracking technologies

Many companies offer their services of tracking systems, which are proprietary systems with high costs of acquisition and maintenance. They often require the installation of an on-board device inside the vehicle, which is difficult to be installed and costs a lot of money. Smartphone application to track vehicles is a non-intrusive and cheaper solution.

Mobile 5G technology is considered the IoT generation that can connect virtually any type of device, including smartphones and vehicle-embedded modems. The 5G, as the next mobile network technology, promises to transfer core-to-edge functions; it will significantly reduce latency in critical mission operations, such as collision avoidance functionality [5] and, will make feasible the connection between two smartphones, the D2D –Device to Device function [6] which can reach a throughput of 3.5 Mbps at 20m distance.

2.3 Smartphone sensors

Smartphones have location sensors like accelerometer, speed, compass, altitude, latitude, and longitude.

Two location features in smartphones are used to georeference:

a) The *GNSS_Provider* uses Global Navigation Satellite System-GNSS, it is accurate but slow.

b) The *Network_Provider* uses the cellular mobile network, it is faster but isn't as accurate as GNSS_Provider.

The feature *FusedLocationApi* optimizes the two smartphone features and avoids excessive battery drain.

Security vulnerabilities for tracking solutions have privacy concerns that analyze United Nations patterns using dangerous goods classification [8].

2.4 Smartphone application interface

There are development platforms used to support applications to collect data from smartphone sensors and handle statistical data [8].

There are four main data acquisition APIs:

a) *SensorApi* - Read sensor data

b) *RecordingApi* - Provides data collection and storage on servers.

c) *SessionsApi*- Provides the application to manage user activity sessions.

d) *HistoryApi*- Provides access to the database with data insertion, deletion, and reading capabilities.

2.5 Virtual Fences

The combination of digital maps and tracking signals creates constrains areas with many applications like fleet management, when a truck driver breaks from his route, the dispatcher receives an alert [9].

2.6 Fault management

FCAPS (Fault, Configuration, Account, Performance, and Security) is a standard defined by ISO – International Standardization Organization [10].

Fault detection in sensor networks depends on the type of applications and the type of failures [10].

According to OSI - Open System Interconnection recommendation the alarms reporting functions are classified considering their severity and criticality [12] and according to ITIL (Information Technology Infrastructure Library) faults are classified as incidents [13].

2.7 Problem management

Isaca.org [13] defines problem management as recording recurring incidents, mapping their root causes, and determining standardized actions with registered and pre-programmed procedures for each situation, to improve decision-making and solve problems more assertively and efficiently [13].

Figure 1 illustrates the ITIL problem management workflow.
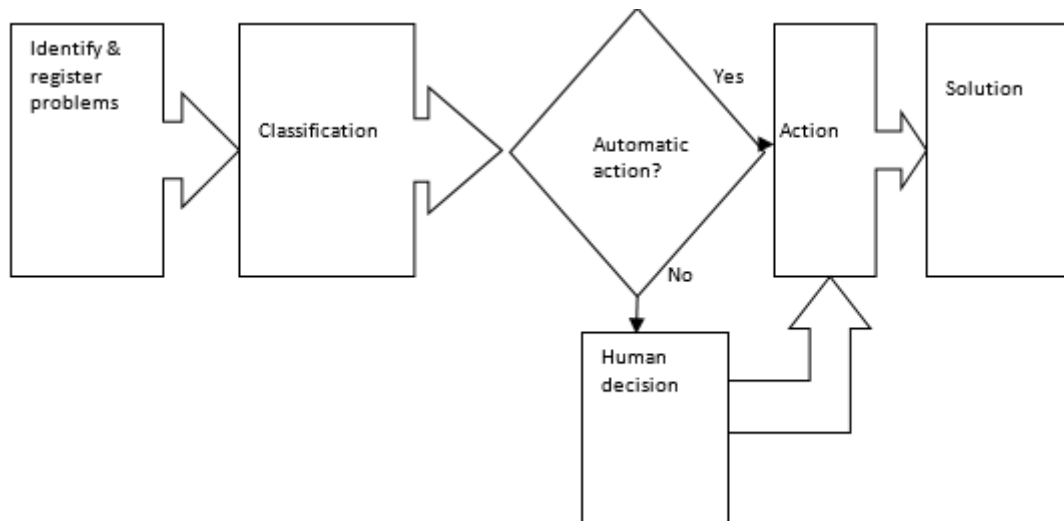
Fig.1: ITIL problem management workflow, with adaptation.

Table 1 presents the classification of automation levels [15], the higher the automatic level is, the more efficient and dedicated to greater intellectual capacity activities the human actions will be[14].

Table 1. Classification of automation levels

Level	Description
1	The automatic system does not provide any assistance; the operator must perform all tasks by himself.
2	The automatic system offers a complete set of action alternatives.
3	The automatic system shows some of the action alternatives.
4	The automatic system suggests one action.
5	The automatic system carries out an action in case there is an approval from the operator.
6	The automatic system programs an automatic action that can be canceled by the operator within a specific period.
7	The automatic system executes an action automatically and informs the operator.
8	If the operator wants, the automatic system informs him about the completion of the action.
9	The operator is informed about the completion of the action if the artificial intelligence system decides to do it.
10	The system takes all decisions by itself and acts automatically, completely ignoring the operator.

2.8   Decision making

According to Fisher et al [16] ETL – Extract Transform Load – figure 2 shows the four steps to populate the data warehouse:

a)   Extract: Extracts data from the source system
b)   Transform: Apply functions to conform data to a standard dimensional schema
c)   Load: Load the data into the data mart for consumption
d)   Process: Load the data from the data mart into the cube for browsing and analyses the information on cube view at OLAP – On-Line Analytical Processing
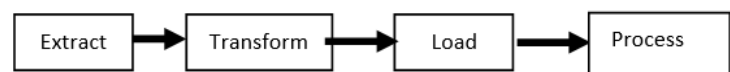
Fig.2: ETL workflow

Knowledge management, presented in figure 3 consists of three main steps:

a) Data: Sensors and transactional systems collect the data.
b) Information: The organization and summarization of the data, become information.
c) Knowledge: The information is analyzed and synthesized, becomes knowledge to support decisions.
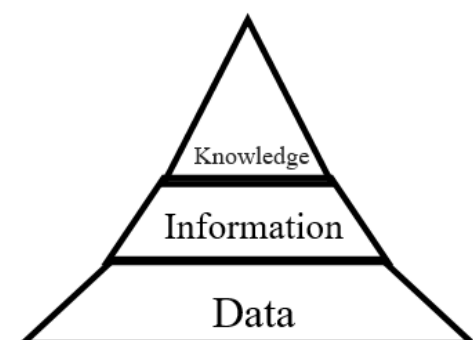
Fig.3: Knowledge management

III.   PROPOSED SOLUTION

The proposed solution considers integrate dangerous goods transportation authorization requests with all the databases of the municipality that are relevant for route planning and optimization. Smartphone applications use sensors as a source of collecting information about the vehicles, and it is possible to track them without the need to install any embedded devices. It is much easier and economical for every hazardous cargo driver to carry a smartphone with a tracking application than to use an on-board equipment of difficult installment, maintenance, and standardization.

3.1 Proposed functional diagram for hazardous cargo transportation management

São Paulo city has an Integrated Operations Center with several areas of expertise: Police, civil defense, road Traffic Company, and medical emergency. Each department has its legacy system, but without integration with the same data source. Considering that the major problem in hazardous cargo transportation is the lack of surveillance, using smartphones to collect data, the driver behavior and traffic conditions analyze to decision making is a reliable solution, including the case of loss of communication the smartphone can collect data offline and send it as soon as the communication is reestablished.

The identification from smartphone identification and vehicle identification information, as well as vehicle location, latitude, longitude, x-axis, and y, z acceleration information collected from the sensors by the GNSS_Provider and Network_Provider modules, which are transmitted through the base stations coverage area and forwarded to the servers by the packet data networks. From web map API it is possible to track vehicles in real-time and view them graphically. Any route change can be sent from the operations center control room to the driver.

3.2   Smartphone sensors

Georeferenced location data by smartphones' sensors is the best ready-made solution considering other communication technologies including VANETs, vehicle ad hoc networks that are still a bet [17]. Smartphones are always connected and in case of lack of communication, smartphones can collect data offline and send it as soon as the communication is reestablished. Smartphone and vehicle identification information, as well as vehicle location, latitude, longitude, and acceleration information collected from the smartphone sensors by the GPS_Provider and Network_Provider modules, are transmitted by commercial mobile operators' base stations, which provide a coverage area and forward the information central servers through the packet networks. Web maps API allows tracking vehicles in real-time and view them graphically. Figure 4 illustrates the process of data collection and tracking of vehicles.
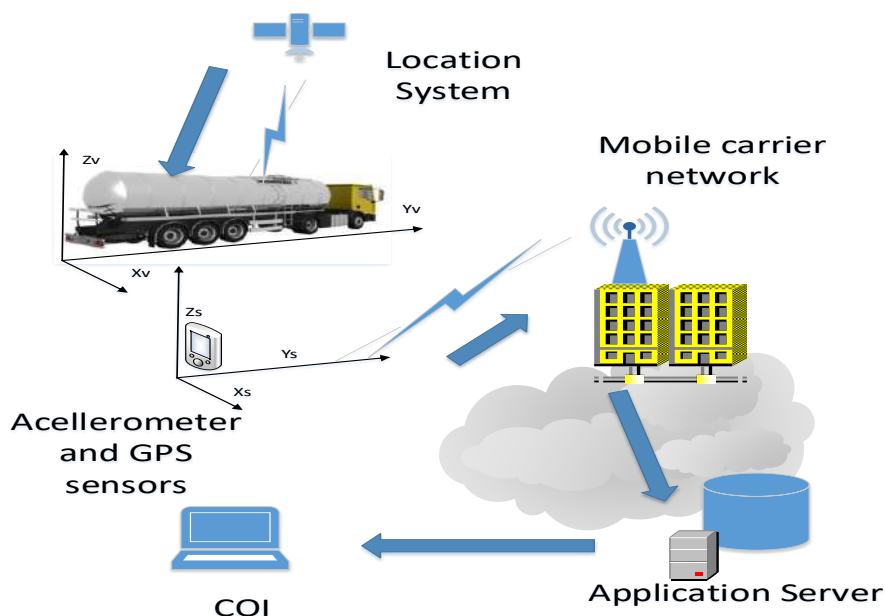
Fig.4: The process of data collection and tracking of vehicles.

3.3   Route optimization

Figure 5 illustrates the proposed functional diagram for hazardous cargo transportation management. When a hazardous cargo transport is authorized, the route planning module determines the best route to be traced. During transportation, the data is collected, the driver´s behavior and traffic conditions are analyzed to decide case some abnormalities are detected, including by other sources of information, and require corrective actions.
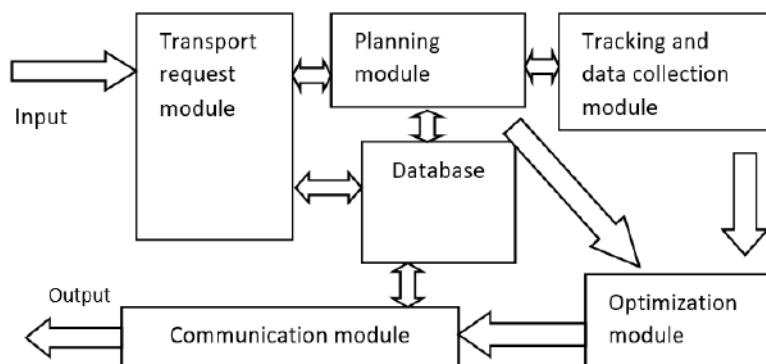
Fig.5: The proposed functional diagram for hazardous cargo transportation management.

Figure 6 illustrates a sample of the network using the critical path method to calculate the best road route considering time and road capacity [18].
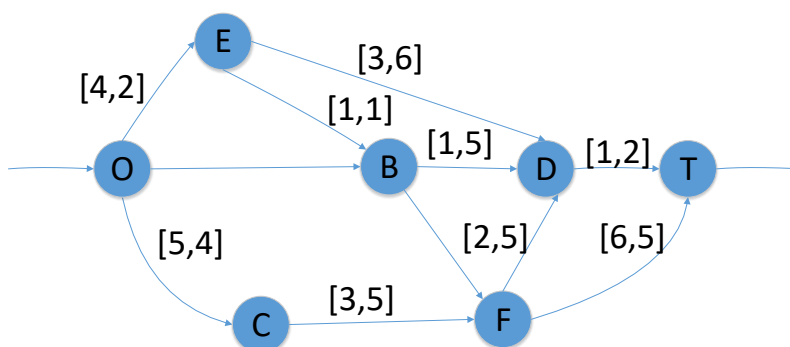
Fig.6: Critical path method used to calculate the best road route considering time and road capacity.

The optimal cost is the minimum value from all travels considering all origin and all destinations according to track time and track capacity.

$$\text{Min} \sum_{i=1}^{m} \sum_{j=1}^{n} t_{ij} c_{ij} \qquad [1]$$

Where:

    m, i: destinations

    n, j: origins

    t_{ij} : track time

    c_{ij} : track capacity

There are at least six database sources: (1)Tracking systems; (2)Crowd application; (3)Social networks; (4)Phone calls; (5)Police Department and (6)Municipality control. Track systems consider the data collection from smartphone sensors such as three-dimensional accelerometers and GPS data that allow tracking vehicles, their speed, and location with precision. After analysis, the collected data is compared with the planned routes. In case of relevant divergence, the threshold alerts can be sent to the Integrated Operations Center. Figure 7 presents the functional diagram for comparison between tracking data and planned routes.
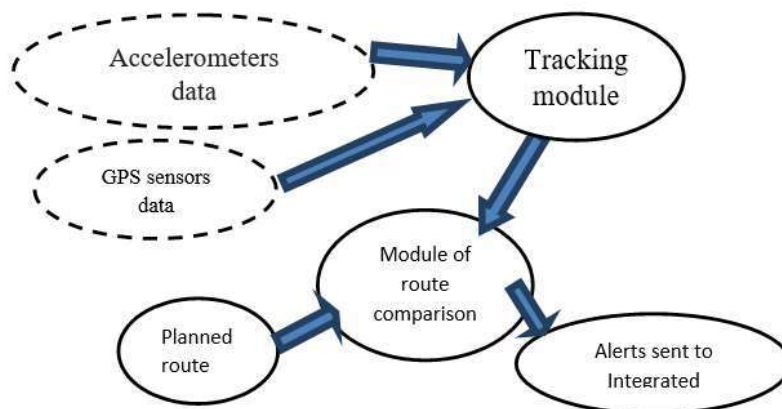
Fig.7: Functional diagram for comparison between tracking data and planned routes.
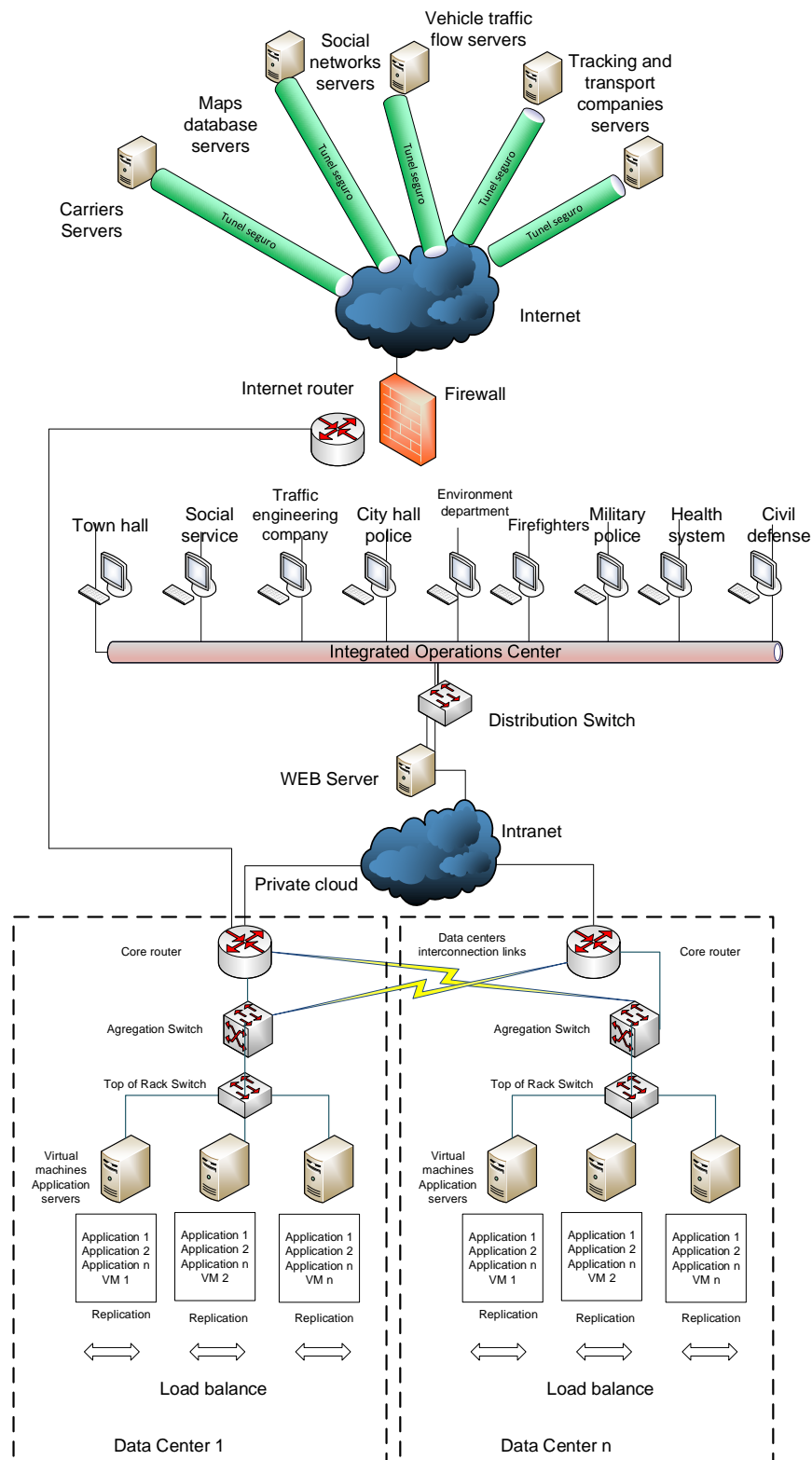
Fig.8: Proposed hardware architecture.

Route planning consists of analyzing all information relevant to vehicle flow between the route´s points of interest, including geographical zones, time restriction, road capacity, etc.

Dynamic route optimization consists of analyzing the behavior of a track with a planned route and proposing changes whenever a more favorable condition is possible. Route restrictions can be entered into the system manually or automatically if incidents that cause an impact on the

transportation of hazardous materials such as accidents, tree falls, or flooding are detected.

In computer terms, all the bifurcations or corners are considered to be vertices that are regarded as a point of decision.

One dynamic optimization technique is the Rolling Horizon where k intervals divide one stage, named projection stage or projection horizon. In the projection horizon, the first r intervals are the head and after this the tail of the horizon. Using the head is possible to estimate the behavior of the tail. According the time passes the head advances into the tail and calculates new behavior [19]. New behaviors update the thresholds.

Comparing the planned route and the tracked transport if deviations are higher than the defined thresholds, the system will alert or perform scheduled actions, which are set according to the level of automation required by the Integrated Control Center [14], so human actions can be devoted to activities of major importance that require greater intellectual capacity.

3.4 Proposed hardware architecture.

Hardware and software architectures were built-in function of the cloud computing concept [20] and SOA service-oriented architecture [21], which considers moving multiple legacy systems to a common barring service in the Integrated Operations Center.

The packet data network must have a firewall to limit access to external servers of tracking companies, transport companies, telephone operators, map databases, social networks, and vehicle traffic metering servers. The hardware structure considers at least two data centers with redundancy and load balancing. Virtual machines are considered to be a solution for obtaining a higher computational efficiency and application re-establishment capability. User access provided by a private cloud, which grants access from any location to all integrated services. Figure 8 illustrates the proposed hardware architecture.
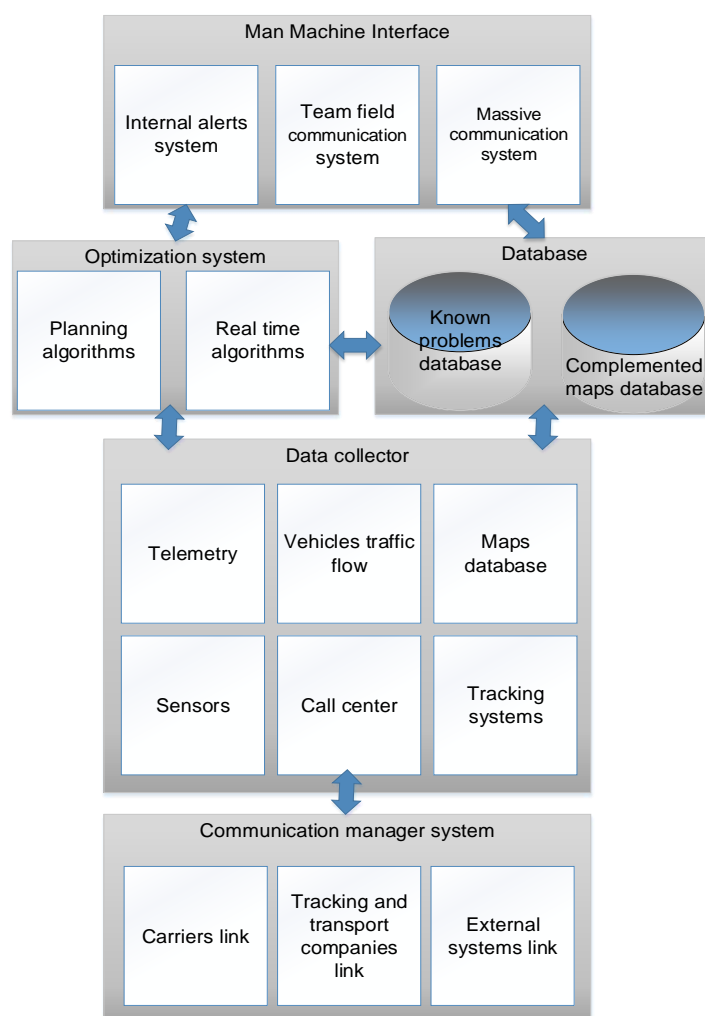
Fig.9: Proposed software architecture divided into five blocks.

3.5   Proposed Software Architecture

The proposal of the software architecture takes into consideration the concept of service-oriented architecture, which enables the integration of multiple legacy systems in a staggered manner, avoiding abrupt migrations and without interrupting users´ systems.

The software architecture is divided into five blocks: Human-machine interface; Optimization system; Database; Communication system; Data acquisition system.

Figure 9 illustrates the proposed software architecture divided into five blocks.

The Proposed Software Architecture integrates information from legacy systems of different architectures, protocols, and databases, which do not exchange information with each other. The use of service-oriented architecture is based on integrating different legacy systems in a single service barring. Figure 10 illustrates SOA integration with different legacy systems using a service barring.
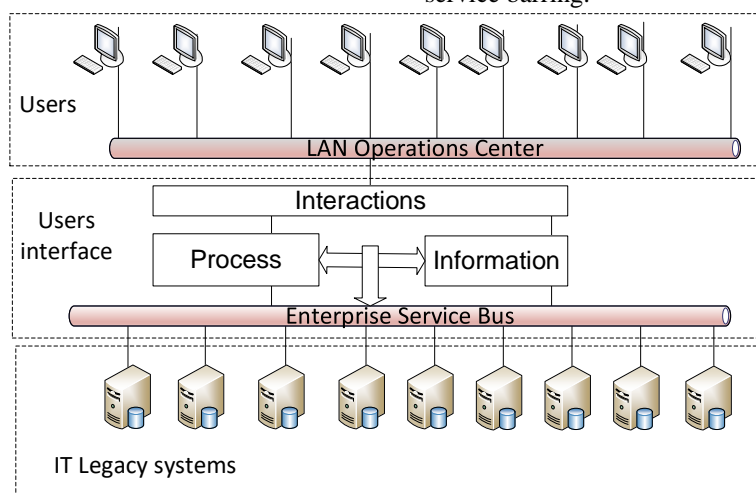
Fig.11: SOA integration with different legacy systems using a service bar. [10]

3.6   *Alerts*

There are two operational situations:

a) Normal Situations

b) Crisis situation

3.6.1   Normal situations:

Normal situations when, after examination of the information, including route optimization, there is no occurrence of any type of accident. According to MITRA [22], normal situations are reported with four indicators:

3.6.1.1   Identification of the cargo;

3.6.1.2   The current position of the vehicle;

3.6.1.3   The current speed of the vehicle;

3.6.1.4   Risk probability according to the function of location, type of cargo, time, and traffic situation.

Figure 12 illustrates a map with tracking points as heart bits. The threshold could be the meters between each time interval or the distance from the planned route.
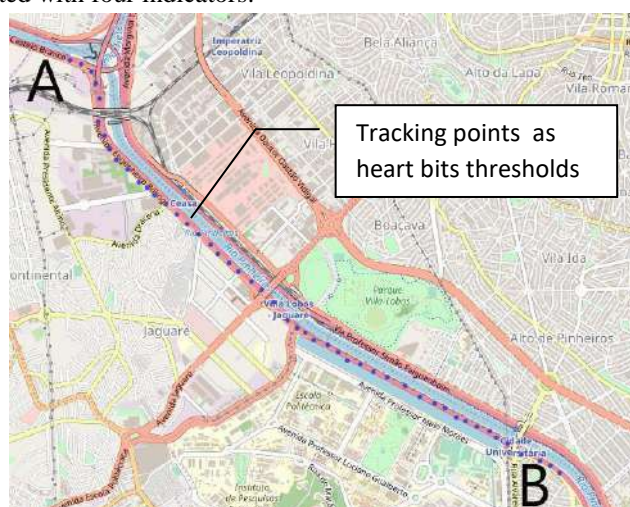
Fig.12: Tracking map.

Source: https://www.openstreetmap.org/export#map=14/-23.5563/-46.7212

Figure 13 illustrates a real coverage area of fourth-generation base stations, in which the mobile station is over point x, the cell site 1 is the best server and the other six base stations are candidates. The map considers Mobile Country Code of Brazil (MCC=724), Mobile Network Code carrier Claro (MNC=5), type=LTE, location (An avenue near USP) latitude=-23.55003881438536, longitude=-46.72997760884627.
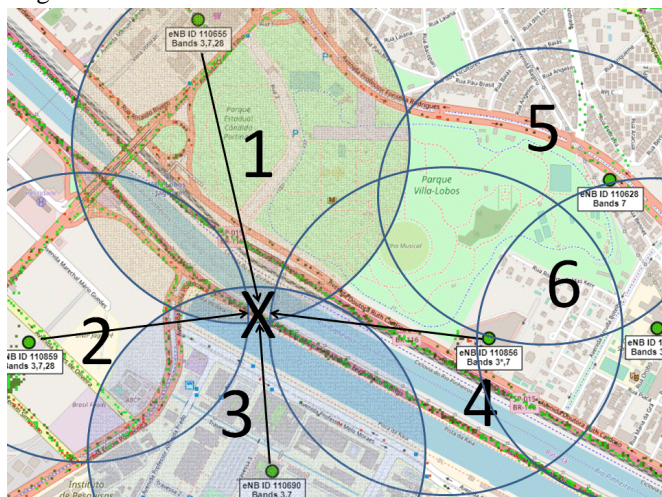
Fig.13: A real coverage area of 4G base stations,
Source: https://www.cellmapper.net/map

3.6.2 Crisis situation, alerts:

A normal situation indicates that the situation is under control, but it can be changed in case if an accident or any situation requiring action beyond the driver's control occurs. It means that a crisis situation was reached, and it can be detected by telemetry sensors that indicate changes to the planned route, the sudden reduction of speed, interruption of information transmission, or pressing the panic button by the driver if the vehicle is equipped with this type of device.

The alert system informs the Integrated Control Center, so it can execute procedures for containment actions and eventually trigger alerts to citizens of the affected region. The communication and alerting system takes into consideration integration into the database of nine government departments: (1)Fire Department; (2)Municipal Guard; (3)Civil Defense; (4)Military Police; (5)Highway Police; (6)Municipal Health System; (7)Traffic Engineering Company; (8)Social Service; (9)Subprefecture. Figure 14 illustrates the nine departments of an Integrated Operations Center.
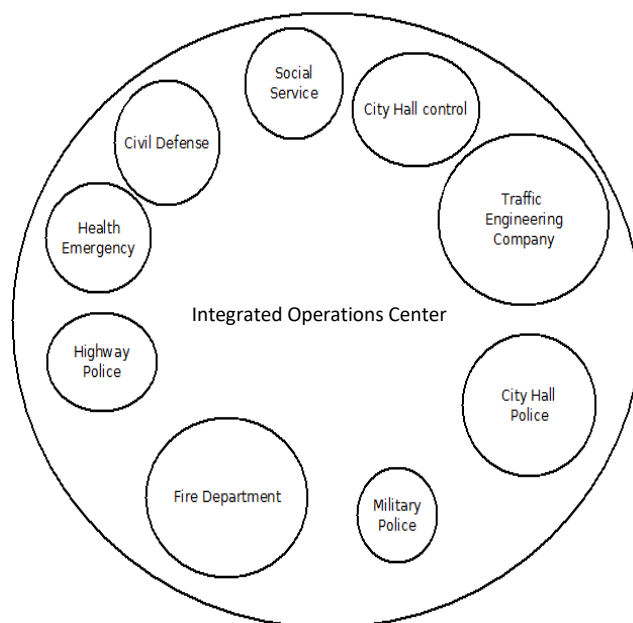
Fig.14: Nine departments of an Integrated Operations
Center (Room of War)

Massive alerts warn the population of a crisis situation in more than one way, in both sound and/ or visual form. It is important to emphasize that no system can cover 100% of the area by itself and provide a full availability. Therefore, the system must be redundant and integrated into other types of resources.
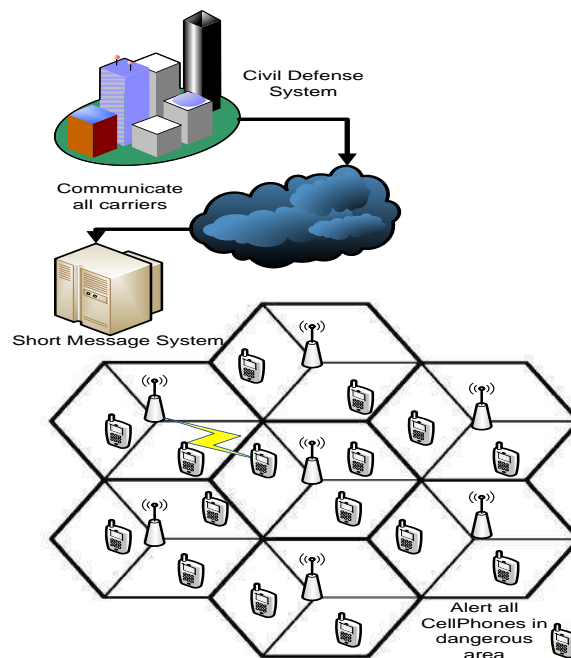
Fig.15: The coverage area of an alert system using a short
messaging system provided by a mobile carrier

Once a crisis situation is detected and if it is necessary to alert citizens, the Civil Defense Department is called upon to notify the population with text messaging systems, web pages, mass media such as radio and TV, as well as with sirens and speakers.

The proposed system considers the constant evolution and new technologies will be available to the population to provide evolutionary maintenance, educate people, and adapt the system to the new facilities.

Figure 15 illustrates a coverage area of an alert system using the short message system provided by a mobile carrier.

IV.   PROPOSED ALARMS CONFIGURATION

The speed limit exceeded is the biggest cause of a truck accident, so before exceeding the speed, the driver will have remembered the Integrated Operations Center receives alerts and can punish him.

According to Fernandes et al. [35], the accident injury scale is an acceleration function, the Integrated Operations Center receives alerts to a high-risk condition of an accident or to detect it, where major alarms mean attention, and critical alarms need actions. Considering a planned route and real-time tracking, the route analysis compares the location considering the traffic behavior, and if the difference is relevant, an alert is triggered as a possible accident.

A smartphone drop in free fall means 9,8 m/s^2 acceleration, so to avoid false alarms, and be feasible to major part of commercial smartphones, a sudden break considers accelerometer values above 3 * 9,8 m/s^2.

Truck's stability consider 28^0 as the maximum side slope, so angular speeds bigger than π/6 rad/s is considered a rollover. A closed vehicle under the Sun reaches 70ºC, so ambient temperatures above 80 ºC indicates fire. An explosion produces high noise, so the microphone sensor indicates a critical alarm to noise above 140 dB. According to Bhatti et al. [36], a car crash produces high pressure, so Pressure above 350,000 hPa indicates a critical alarm.

To avoid false alarms, and unnecessary field teams' displacement, the proposal considers bidirectional interaction between driver and Integrated Operational Center. Table 2 presents a proposal for the main alerts that the smartphone sends to the Integrated Operations Center. The column Sensor identifies which sensor is used, the column Function details the alarm configuration, and the column Criticality classifies the human actions, major means high risk, and critical a possible accident. Human actions can be automated according to table 1.

Table 2 Proposal of main alerts that the smartphone sends to the Integrated Operations Center

Sensor	Function	Criticality
GNSS/ Network_ provider	Speed > 110 km/h	Major
GNSS/ Network_ provider	Urban area Speed > 70 km/h	Major
GNSS/ Network_ provider	Difference between planned route and tracked route > 200m	Critical
Accelerometer	$\|a\| = \sqrt{a_x^2 + a_y^2 + a_z^2} > 3*9,8$ m/s^2	Critical
Gyroscope	$\|\omega\| = \sqrt{\omega_x^2 + \omega_y^2 + \omega_z^2} > \pi/6$ rad/s	Critical
Barometer	Pressure > 350,000 hPa	Critical
Ambient Temperature	Ambient Temperature > 80 ºC	Critical
Microphone	Noise > 140 dB	Critical

V.   CONCLUSIONS

Considering the implementation of smartphone sensors as a management control system will bring four main benefits:

a) Reduction of traffic jams, accident avoidance, and faster traffic release.

b) Reduction of the lost time: The average origin-destination time in big capitals is also directly related to the duration of traffic jams. Thus the reduction of the roads obstruction times will have a significant impact on the quality of the lives of passers-by and will consequently bring productivity gains in the professional sector as well.

c) Economic gains: Reduction of fuels and workforce time.

d) Environmental gains: Reduction of carbon dioxide emissions, the main greenhouse effect gas, as well as the reduction in emission of other pollutants such as carbon monoxide, nitrogen oxides, and hydrocarbons.

In the case of the leak of hazardous materials, in addition to mitigating the detection time, there is a reduction in combat time, with prior knowledge of the field teams which saves the lives of the field team members and the affected population. The leak of hazardous materials can contaminate soil, rivers, groundwater, and air.

VI.   FUTURE WORKS

As the continuation of this research work, it is suggested to:

a) Develop a mobile application, focusing on the security of access to traffic data.

b) Estimate and analyze the possible theft reductions of dangerous cargo vehicles and extend the study to other cargoes.

c) Estimate and analyze the possible saving of human lives by avoiding accidents, the cost of social assistance to injured people, and any victims of indirect effects such as exposure to gases and toxic materials spills.

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Indigenous Lands and The (I) Legitimate Exploitation

Maíra Cavalcanti Coelho[1], Sandra Valéria Silva Lins[2], Stefane Amorim Melo[3], Maísa Cavalcanti Coelho[4], Leonardo Diego Lins[5]

[1,2,5] Department of Technology and Social Sciences, UNEB, Juazeiro, Brazil.

[3] Student of Medical Course at Estácio de Sá University, Juazeiro, Brazil.

[4] Department of Chemistry, UFPB, João Pessoa, Brazil.

Abstract— In a historical context it is observed that since old times indigenous people were remarkable in the settlements and cultural fixation of the country, so much that the areas occupied by them are Union's goods. From this point of view, it is important to identify the constitutional and legal basis of indigenous lands, observing such configuration in a context of exploratory activities reinforced by rural leases and agribusiness practices.

Keywords— Exploratory activities, Historical Aspects, Indigenous Land, Legislation.

I.   INTRODUCTION

Indigenous lands are for typical agrarian activities in addition to others, what makes relevant the research from an environmental and legal perspective, based on an assumption of the rural leases and its deployments, legal or not.

The legislation that deals with indigenous people is gaining space into Brazilian law. Law number 601/1850 (Land Acts) is pioneering in concern with indigenous people, reserving wastelands to settlement by these people, being beyond preliminary and even succeeded constitutions. The constitutional history was thus outlined:

Federal Constitution 1934:

Art. 129 – It will be respected land ownership by forest dwellers since they are permanently located there, however it is forbidden to alienate it (BRASIL, 1934).

Federal Constitution 1937:

Art. 154 – It will be respected to forest dwellers the land ownership where they are permanently located, however, it is forbidden to alienate it (BRASIL, 1937).

Federal Constitution 1946:

Art. 216 – It will be respected to forest dwellers the land ownership where they are permanently located on the condition that they do not transfer It (BRASIL, 1946).

Federal Constitution 1967:

Art. 186 – It is ensured to forest dwellers the permanent ownership of the lands they permanently live and it is recognized their exclusive right of use of natural resources and all values found there (BRASIL, 1967).

Constitutional Amendment 1 in 1969:

Art. 198 – The lands inhabited by forest dwellers are inalienable, in terms of the federal law, and its permanent possessing are reserved to them, and it is recognized their right to exclusive enjoyment of riches and all utilities existing there (BRASIL, 1969).

The concept of indigenous land to own Indigenous persons exceeds the survival issue. It means to them all the basis of their knowledge and beliefs, in addition to represents the place of their social interactions.

According to Magna Letter (1988)[1] in its Section 232, §1º,

> The lands traditionally occupied by indigenous people are that permanently inhabited by them, that used to their productive activities, that essential for preservation of environmental resources necessary to their well-being and that necessary to their physical and cultural reproduction, according to their uses, customs and traditions.

For Indigenous Statute (Law Number 6.001/1973),

> Section 17. Indigenous lands are:
>
> I – the lands occupied or inhabited by forest dwellers referred to in Sections 4, IV and 198 of Constitution;
>
> II – the reserved areas dealt with in Chapter III of this Title;
>
> III – the lands of indigenous communities or forest dwellers domain.

Indigenous Statute (Law Number 6.001/1973) expressly prohibits the tenancy of indigenous lands, activities practiced by persons unfamiliar to the community and even any act or legal business that is able to restrict the direct ownership by indigenous people:

> Section 18. Indigenous lands shall not be leased or be under any legal act or business that restricts the full exercise of direct ownership by indigenous community or by forest dwellers.
>
> § 1º In these areas it is prohibited the practice of hunting, fishing or fruit gathering, as well agricultural or extractive activities to any person unfamiliar to tribal groups or indigenous communities.
>
> § 2º (Vetoed).

It is exactly on this point that is questionable the affront to the legal hindrance, considering the common contemporary practice of leasing and agricultural and extractive partnership on indigenous lands of the Country.

Although the prohibition, it is verified in practice some constitutional aspects that are imposing in the context of Environmental Law and Agrarian Law, as explained by Melo (2017) [2], correlating indigenous lands and environment:

> There is a perfect compatibility between environment and indigenous lands, even these involve environmental "conservation" and "preservation" areas. This compatibility is what authorizes the Double Allocation, under competent body of environmental protection administration.

That is what happened in 2013 in an action brought by Fundação Nacional do Índio – FUNAI, pleading for nullity of a legal business signed by indigenous persons and renters of the Indigenous Land of Ivaí-OR, as well the restraint of crops illegally implanted, harvest and storage of crops with collective reversals, which sentence was valid

and ratified by the Tribunal Regional Federal da 4ª Região – TRF-4 (MPF, 2019) [3], *in verbis*:

> ADMINISTRATIVE AND CONSTITUTIONAL. FUNAI. RURAL LEASE OF INDIGENOUS LAND. ILEGALITY. COMPENSATION. GOOD-FAITH. INEXISTENCE.
>
> 1. The indigenous lands, pertaining to the Union, are inalienable and unavailable, not susceptible to exploitation by third party except the Indians themselves, keeping the rules established by FUNAI.
>
> 2. The Federal Constitution ensures to indigenous people the exclusive enjoyment of the riches of their lands soil, reputing null and without legal effects the acts that have as purpose the exploitation of soil's natural riches.
>
> 3. It is not possible to recognize the validity of lease contracts with indigenous lands as subject, neither the tenants' good-faith, because it is not plausible that they did not know the illegality of the farming operation there, mainly due to the processing of Police Investigation, intended to investigate such facts.
>
> (TRF4. Civil Apellate No. 5000913-22.2013.4.04.7006/PR. Apellate Judge-Rapporteur Vivian Josete Pantaleão Caminha. 4th Class. DJe 29.5.2017)

However,

> The protection to forest dwellers is so eloquent in the Constitution that, after classifying the lands traditionally occupied by Indians as inalienable and unavailable and establishing the imprescriptibility of rights to them, it renders void the acts of occupation, domain and land tenure that involve them (p. 117). [4]

Although they are protected constitutionally, indigenous lands are still used with different purpose to that allowed by Law. In other words, the protection offered constitutionally does not inhibit the problem of economic exploitation.

Oliveira Filho's doctrine[5] links the indigenous lands nature to sociocultural processes, bound to the sense of belonging and identity:

Constitution 1988 adopts an only criterion to definition of an indigenous land: that there the indigenous persons exercise a traditional occupation in a sustainable and regular way, in other words, that they use such territory according to their "practices and customs". This is, therefore, replace a merely "negative" identification (of presence of white) by a "positive identification", that can be made through field work and explanation of sociocultural process by which indigenous people take ownership of that territory (p. 111). [5]

Cavalcante (2016)[6], when discussing the legal concept of indigenous land from History and Anthropology, reinforces the construction and reconstruction of this idea and its enforceability importance to administrative and political order.

The construction process of the concept "indigenous land" was long and legally complex. However, a lot of ignorance still hangs above it, including in spaces where it should not happen, such as public administration. There is, in addiction and primarily, a big mobilization of society's conservative sectors that intends to suspend or even revoke the indigenous' land rights, or even assign new meanings to the concept, either by direct politic influence in the performance of federal Executive Power or by initiatives in the context of the National Congress. A relevant example of this second alternative is the Proposed Amendment to the Constitution no. 215/2000 that intends to transfer to the National Congress the final word about the demarcations, what in practice would mean the total standstill of these proceedings. It is feasible that it is ongoing the political deconstruction of a legal concept (p. 17-18). [6]

To Caldart et. al (2012)[7],

[...] in relation to earth, what is observed in Brazil is a complex reality that involves, on the one hand, multiple forms of collective and wide access, and struggle for its democratic control, in terms of indigenous, quilombolas lands, traditionally occupied or occupied by social movements fighting for Agrarian Reform; and on the other hand, the reaffirmation of monopolistic forms of land

ownership control in Brazil, favored by several State actions of diverse levels, either when denies the titling of indigenous lands, rejects the quilombolas lands' recognition and do not legitimize traditionally occupied lands, or when do not expropriate to Agrarian Reform the lands that do not fulfill the social function, favors the land grab, ensures the maintenance of untouched unproductive latifundia and preserves the land right of those who use slave labor (p. 444). [7]

Thus, it is up to Public Power to delimit and recognize which are indigenous areas and, with the demarcation lack of all them, the indigenous lands are in various legal situations all over Brazil, what causes concern to indigenous people, indigenists, non-Indians, mainly due to the lack of definitive and definitely accepted judgements with regards to legality and reasonable demarcation with respect to existing laws [4].

II. THE INDIGENOUS AREAS

Our 1988 Constitution ensured to indigenous people the respect for their social organization, customs, languages, beliefs and traditions and equally recognized the primary law of the lands traditionally occupied by them, being the last an important achievement.

In this standard, it should be highlighted that the indigenous right on the current Constitution are provided at eight isolated provisions in a Chapter with title "Social Order" and in an article of the Transitory Constitutional Disposition Act. Two important points should be emphasized, namely: the first is the abandonment of an assimilationist perspective that understood indigenous people as a transitory social category fated to oblivion. The second is that indigenous rights over their lands are established as primary law, in other words, it is prior to which law or act that declared such rights. This factor occurs in virtue of historical recognition that the indigenous people were the first Country settlers. Therefore, the novel Constitution establishes innovative milestones to relationships between State, Brazilian society and indigenous people.

In short, the legislation recognizes to indigenous the right of being different and stay unending this way, according to what can be surmised from Section 231 of Constitution 1988.

It is possible to surmise from the §1º of FC/88 same Section that the recognition made by Constitution 1988 is

in order to assert that if there are enough elements to define some lands as indigenous, the occupant indigenous group's right is legitimate, irrespectively of any constitutive act.

It is not negligible to add that the Supreme Law recognized the importance and the rights of indigenous people definitely, considering them to be the first owners de facto and de jure of Brazilian lands, adding their justice ideals. However, unfortunately there is much to do. Experience demonstrates that theory and practices are different since the respect for these rights, in the face of various economic interests, are not followed as a rule and with the proper importance the subject deserves. It is necessary the aid of support agencies and Public Power as well the indigenous peoples themselves to the full realization of what is established in the Constitution.

The §2º of the alluded Section 231 puts forward that "The lands traditionally occupied by indigenous people are fated to their permanent possession, ensuring to them exclusive use of the existing soil, rivers and lake riches".

The Magna Letter [1] did not recognize to indigenous people the property right, on the other hand It assigned to them the right of permanent possession of the lands traditionally occupied by them. Thereby, a few legal writings in the legal field brings a consensus of understanding in the sense that when the Constitution 1988 intends to indigenous the permanent possession of the lands occupied by them, it means that that right is pre-existent, in other words, it is, thus, a primary law.

In the case of indigenous possession, it is not the course of time nor the origin that determine or legitimize it, but the fashion of traditional occupation, in the terms of provisions of Section 231 of Federal Constitution.

Furthermore, it is necessary to emphasize that it is not possible to submit a territory classification as indigenous land to the benevolence and altruistic will of personnel of the State. This is an issue of objective character and it is based on undeniable facts, namely the traditional occupation of indigenous people.

III. ENJOYMENT AND ITS IMPACTS

The Federal Constitution 1988 clarifies that "lands traditionally occupied by indigenous persons are designated to indigenous' permanent possession, ensuring to them exclusive use of the existing soil, rivers and lake riches.

According to Santos *apud* LARANJEIRA (1999, p. 561)[8],

The possession is exclusive to the Indian, it cannot be communicated even to partners, shareholders, financiers, tutors and etc. Stay means continuity, the quality of what does not stop or disrupt at any time. And exclusivity is quality of what excludes or marginalizes, removing any competition possibility with the same title, place or activity. Exclusive and permanent enjoyment implies privative usage and fruition at all times. [8] (emphasis added)

The institute was initially integrated to Brazilian normative with Constitution 1967, which recognized the indigenous' right to exclusive enjoyment of natural resources and all utilities existing on indigenous lands. The legislator regulated this institute with Section 24 of Law No. 6.001/73 (Indigenous Statute).

Usufruct is about real right of use and fruition of certain property transferred from the owner to usufructuary, implying in the possibility of the fully use by indigenous of the natural riches existing on the ground, rivers, lakes of the lands, including by economically exploring them.

This issue does not offer bigger complications when it is considered the usufruct to reality of indigenous communities that use natural existing riches to their subsistence, due to little interaction with Brazilian society. This can be considered the economic model traditionally known and practiced by indigenous communities when, even because the little degree of contact, they reveal themselves as self-sufficient in their needs.

The concern appears due to the exposure of indigenous communities to technologic advances and the relationship with economic reality of other societies, thus causing inevitable dependency on industrial goods. This situation impacts on these communities' estate, as far as their needs pressure them to use their riches to satisfy that new consumer requirements.

In addition to this reality, another variant should be considered because it means the worsening and harmful speed-up of this dependency on consumer goods: the reduction of support and assistance by Public Power to indigenous communities. This has led these communities, or part of them, to sell their riches of which they have exclusive enjoyment. It follows some bleak problems like wood sale to economic activities consistent with timber harvesting; mining exploration by prospectors; and the disposal of natural and valuable riches at a vile price to supply basic needs as health care and food needs.

The use and exploitation of soil, rivers and lakes natural riches existent on the lands traditionally occupied by

indigenous people should be guided by the so desirable sustainable development, in other words, it must not endanger the existence and future use of these riches.

The use and enjoyment with economic purpose of the natural riches existent on their lands must not imply in lose or constraint on the permanent possession, under penalty that the activity licensing legal act shall be null and void due to violation of provisions of § 6º of Section 231, d, from Federal Constitution.

The lands traditionally occupied by indigenous people are inalienable: they must not be alienated, sold, donated, transferred to use of any person; unavailable: they must not be used to other purpose than the enjoyment by indigenous people, except the exceptions defined in law in FC; and inviolable the rights on them: the indigenous people will never lose the right to reclaim their rights on the lands they traditionally occupy.

The section 231, §6º, FC, clearly expresses that the acts that have as a subject the occupation, domain and ownership of such areas, or exploitation of soil, rivers and lakes natural riches existing there, shall be considered null and extinct. However, if there is a relevant interest to the Union, these areas can be occupied and exploited. Nullity and termination, meanwhile, have two legal consequences, if, in good faith, it was made betterments derived from occupation: right to compensation and actions against the Union.

The current Letter Policy provides four restrictions to indigenous land rights, in other words, exceptions to the general principle, which determines it shall be declared invalid or revoked the acts whose subject is the occupation, domain and ownership of indigenous lands, not having legal effects.

The first two restrictions shall occur when there is a need of research and mineral resources mining and enjoyment of water resources and its energy potential. The third restriction is when it is necessary the displacement of indigenous groups from their lands due to disaster, epidemic or interest of Country's sovereignty. The fourth and last exception remains configured when there are acts of relevant interest to the Union.

The question is in that fourth exception, as long as at paragraph 6 of article 231 of the Federal Constitution the legislator provided it would be created a complementary law to describe what is relevant, important to Union public interest to the point that restricts the indigenous right of use their lands.

IV. CONCLUSION

The presented study advances the sustainability field and the environmental preservation and conservation principles, linked, therefore, to capitalist and consumerism interests of today's society.

Unfortunately, the indigenous people are being led to a factual "need" of renting the Union's properties, trampling the legal restriction, in such way that the indigenous community may be damaged in relation to ruralists favored by back-channel negotiations.

There remains, of course, that the land ownership is an indigenous' right in our Country, in spite of this right has been "forgotten" by Public Power and barred by economic interests for a long time.

Thereby, assuring the indigenous involvement in the whole process of public policy improvements about their lands' demarcation and disposal is a necessary and coherent arrangement, ensuring a process of awareness concerning their rights, as well as using preventive elements, creating conditions to avoid new undue invasions and exploitations on indigenous lands.

It is concluded that as soon as demarcated and secured the indigenous lands, always seeking to preserve the already guaranteed rights to indigenous people, it shall be ensured to all existing indigenous communities a unique process of development, proper and satisfactory to the reality and yearning of this community, promoting and facilitating the achieve of these objectives.

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Analysis Regarding the Approach of the aspects of Resilience in the Implementation of Industry 4.0, for Employees who have had technological Unemployment

Jadir Perpétuo dos Santos[1], Alexandre Acácio de Andrade[1], Júlio Francisco Blumetti Facó[1], Fernando Gasi[1], Alex Paubel Junger[2]

[1]Innovation Engineering and Management. Universidade Federal do ABC, Brazil
[2]Faculdade de Tecnologia Termomecânica, Brazil

Abstract— The research aims to evaluate whether aspects of resilience are addressed in the implementation of industry 4.0, for employees who will have technological unemployment. A case study with a multinational company with more than 10,0000 employees in the automotive sector, which already has experience in the implementation of Industry 4.0 in its processes. The results show the approach used for dismissal is directed to achieving the increase in operating results. In conclusion, the theme of resilience compared to Industry 4.0 and productivity is more researched in the world, although the research has not evidenced its use by the researched company, so there is a huge opportunity for schools (Learning Industries) and aquaculture companies to direct efforts to explore the characteristics of resilience and mitigate the impacts caused by technological unemployment on people and society.

Keywords— Industry 4.0, Resilience, Technological Unemployment, Schools, Learning Industries.

I. INTRODUCTION

In a global production system the competitiveness and innovations end up having great prominence, it is sought to adopt intelligent technologies in the production system to increase productivity, thus reducing risks, protecting the environment, and as a result, the development of projects with better, quality, and cost-benefit, and businesses tend to thrive in this extremely competitive market.

Because of the competitiveness, several techniques and tools have been used as vectors of achievement of strategic objectives, to find a balance between the strengths and weaknesses of organizations. Among these tools, computational resources stood out due to their relationship with increased productivity through their exponential growth, helped to provide improvements in products and services, and can stand out from their competitors, which still has operational activity based on manual or mechanical processes.

Currently, the highly talked about industrial practice in the business and academic world is industry 4.0, also known as the 4th industrial revolution that is becoming a new reality,

made possible by the growth of computational resources, additive manufacturing social networks digital platforms among others, can thus raise companies to productivity levels scales difficult to scale, among these expectations I filled the increase in economic growth and the generation of technological jobs where new technologies replace the operating workforce in many industries of occupations (Kergroach, 2017).

The innovations caused by industry 4.0 can enhance manufacturing through time gain in production systems, improvements, and minimization of losses in processes and service operations but have consequences for the generation of jobs in the present and future of new business models (Coelho, 2016; Ślusarczyk, 2018). These consequences are the motivation of this work, and the question to be answered is:Are companies in the pursuit of competitiveness at global levels doing some analysis ofthe resilience behavior of individuals who will be affected by technology?

Initially, the research has a focus on how organizations define their processes to be replaced by robots in place of people and whether these people were somehow prepared

during their time of professional activity for this replacement, or we will be increasing social problems with more unemployment under technology.

This subject is of interest to the whole society, industrial and academic community (Facó, 2016) since the replacement of these people in the labor market can be directly linked with the knowledge that can be acquired in universities, resulting directly the ability that professionals have to deal with complexity, innovation, flexibility and adding to this a

psychosocial balance. Also, when comparing it, it is perceived that the line of interest is quite similar to productivity and resilience, while industry 4.0 has a very high interesting in the last 12 months in the world, according to the Google Trends (2020) evidenced in Figure 1 below, reinforces the importance on the subject, although the researches carried out in this study indicate that in Industry 4.0 they have not been highlighted by the small number of relevant publications on the subject evidenced in the literature review.
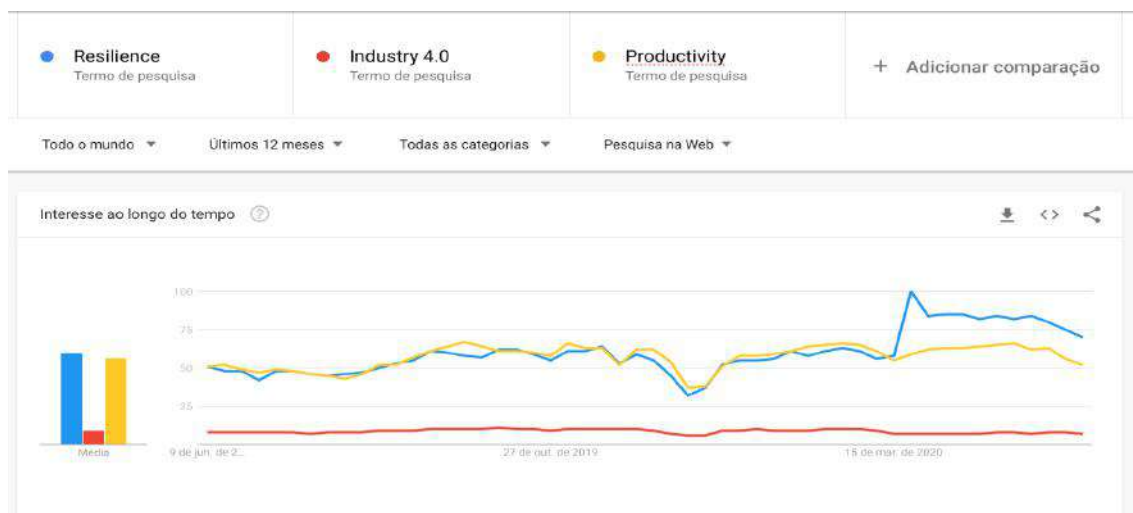
Fig.1: Comparison in 12 months of the interesting expressions: Industry 4.0, productivity, and resilience in the World.

Source: Google Trends, 2020.

When this research is conducted in Brazil, the distance between the 3 variables is not noticeable, they are walking together, as shown in Figure 2.
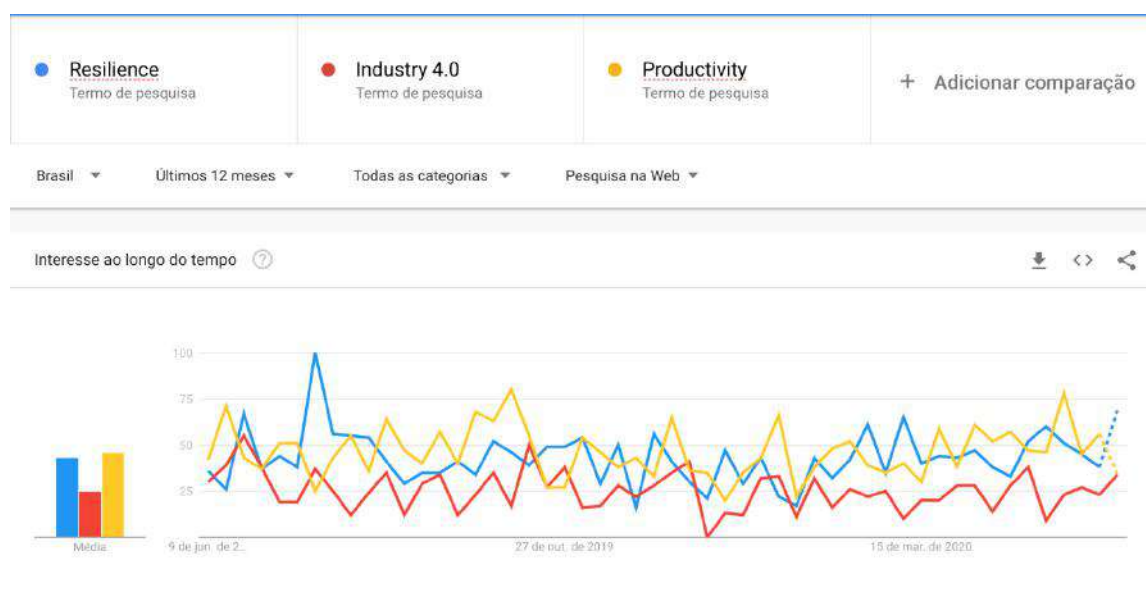
Fig.2: Comparison in 12 months of interest of expressions: Industry 4.0, productivity, and resilience in Brazil.

Source: Google Trends, 2020.

When researched in the language Portuguese the themes are already distant and resilience has greater prominence than industry 4.0 and productivity, shown in Figure 3
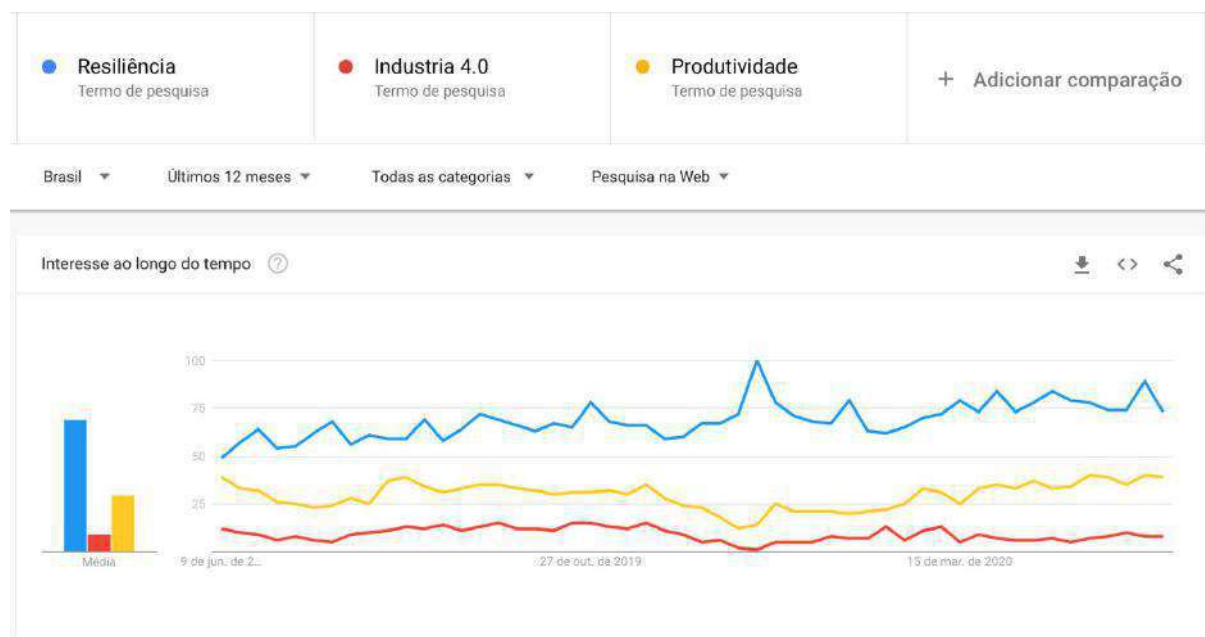
Fig.3: Comparison in 12 months of interest of expressions: Industry 4.0, productivity, and resilience in Brazil in Portuguese.
Source: Google Trends, 2020.

II. LITERATURE REVIEW

This item represents a review of the literature considering topics that helped to understand how research is

2.1 Industry 4.0

The concept of industry 4.0 as far as research is coming from Germany since 2011, to strengthen the competitiveness of German industry, can in its implementation according to Abele, Metternich, Tisch., Chryssolouris, Sih, ElMaraghy, Hummel, & Ranz (2015), Qin, Liu & Grosvenor (2016), Ślusarczyk (2018), Dalenogare (2018), Sung (2018), Moktadir, Mithun, Kusi-Sarpong, Shaikh & Aftab (2018) cost reduction, improved performance improvement, products and services improved due to self-optimization of cyber-physical systems that communicate with workersand real-time data exchange, decentralized and adapted decision making, possible by technological advances (Faria, 2020), enabling vertical integration along the entire value chain and intelligent production system.

The 4th Revolution Industry (4IR) in the work of Ślusarczyk (2018) and Dalenogare (2018),reports the growing interest in improving the industry hrough new technologies 4.0emerging in countries such as Germany (Industrie 4.0), France (The Nouvelle France Industrielle), Sweden (Produktion2030), Italia (Fabbrica Intelligente), Belgium/Holanda (Made Different), Spain (Industry sicamente4.0), United States, (Advanced Manufacturing

Partnership), China, a (Made in China 2025), Áustria (Produktion der Zukunft), in Brazil, it was called "Towards Industry 4.0 through the Brazilian Industrial Development Agency (ABDI - Brazilian Agency for Industrial Development), understood as the new phase of the industrial era that will integrate production systems, communication through cyber-physical systems to achieve better operational performance, through reduction of setups, labor costs, materials and processing time.

Industry 4.0 concepts are proposed to enable companies to have a higher level of productivity and operational efficiency (Facó, 2020), with flexible processes and manufacturing to analyze large amounts of data in real-time, improving strategic and operational decision making linking manufacturing aspects and the virtual world, will bring computerization and interconnect to the traditional industry, combining multiple technologies, encouraging managers to think of a new business model. (Kagermann, 2015.; Dalenogare, 2018; Alcácer, Cruz-Machado, 2019).

The goal of Industrials 4.0 according to Ślusarczyk (2018), Stock & Seliger (2016), Pereira and Romero (2017) "is to achieve a higher level of operational efficiency and productivity and also a higher level of automation", creating smart factories (environment), products and other smart devices and smart services creating a new business model

where it substantially influences the manufacturing industry.

Paprocki (2016) cited by Ślusarczyk (2018), Baur & Wee (2015) cited by Sung (2018), associate 4IR with five phenomena:

1. Digitization of processes to enable constant communication in increasing data between people, people, and devices and between the devices themselves;

2. More and more frequently implemented disruptive innovations, which allow a gradual increase in the efficiency and effectiveness of the functioning of the socio-economic system;

3. The realization of such machine development in such a way that they gain the ability to autonomous behavior through the use of artificial intelligence;

4. The emergence of analysis and *business* intelligence capability;

5. New forms of human-machine interaction, such as digital instruction transfers to the physical world, such as advanced robotics and 3-D printing.

The basic feature of Industry 4.0 is to connect shop floor activities and their systems to smart grids, having their decisions controlled autonomously, being able to identify and correct failures automatically, storing knowledge and gaining predictability, reducing inactivity in their value chain, according to Sung (2018), enabling them to provide products and processes with lower cost and increasing their performance and image with society, other enabling technologies for industry 4.0 is often applied in academic works they are: Industrial Internet of Things (IIoT), Physical Cyber Systems; Digital simulations; Cybersecurity; Additive manufacturing; Collaborative robots; Big Data; Augmented reality; Horizontal and Vertical Integration of Systems; Cloud Computing and Smart Sensors (Lucizano, 2019).

These enabling technologies are aligned with the paradigm described by stock & Seliger (2016), Mrugalska (2017), where he describes them in 3 dimensions:

1. Horizontal integration throughout the network represents value creation during smart articulations in creating end-to-end value in various factors such as equipment, human capital, organization processes, and products throughout the product lifecycle and their adjacent cycles in a cyber-physical system, offering a new and innovative environment for intelligent business models.

2. End-to-end engineering throughout the product life cycle: Reports the connection of interdisciplinary and transdisciplinary of stakeholders with the use of Cyber-physical technology at all stages of the product life cycle, from the acquisition of the material, until the end of its useful life, considering its reuse, re-manufacturing, and recycling.

3. Vertical integration and the manufacturing system in the network: describe cross-linking and technology, within the different levels of value aggregation and hierarchy, during production processes and integrating associated processes such as marketing, sales, and technology development.

The application of these dimensions results in a system of mechatronic components, with sensors for data collection, continuously exchanging data in virtual networks in real-time in IoT and services, integrating man-machine and digital interfaces can be evidenced in Figure X in a macro perspective evolving to intelligent factories, evolving according to Qin, Liu & Grosvenor (2016), through automatic information exchanges, to a conscious and intelligent company smart enough to predict and keep the machines in a position to control and manage the production processes.

This long-range view will lead to the increased complexity of manufacturing processes at the micro and macro levels. Especially small and medium-sized manufacturing companies are uncertain about the financial effort required to acquire such new technologies and the overall impact on their business model. (Schumacher, 2016).

Smart factories must harmonize sustainable technology (Santos, Andrade, Facó, Santos &Thimóteo,2020) with reduction of negative impacts generated by technological unemployment, these psychological factors were studied under the perception of workers replaced by Robots, they do not see robots as a threat, but their replacement by people yes. (Granulo, Fuchs & Puntoni, 2019; Santos, Andrade, Facó, Santos & Thimóteo,2020).

New jobs for new human capital will require new digital skills and skills and lifelong learning from an early age, including educational profiles, brown assist in solving difficult activities for automation such as problem-solving intuitions, creativity persuasion, work in, team communication skills, possibly will be important future academic approaches (Kergroach, 2017).

Table 1. the following presents a synthesis of articles that have been studied and addresses the topic of resilience in Industry 4.0 or not. There are several theoretical pieces of research on the theme Industry 4.0 but few technological

and financial results of the implementation of the technology are still disseminated, and among the most researched topics are the use of technologies and the development of the learning industry.

Table 1- Synthesis of the articles studied.

Year	Authors	Theme	Country	Research	Deployment	Technological solutions	Difficulties encountered in relocating people	Conclusion
2012	Wagner, et al	The State-of-the-Art and Prospects of Learning Factories.	Germany	Secondary data	No	No	Not described	This study and associated research revealed that the terminology surrounding learning factories is still in development. The minimum set of capabilities that must be present to call the installation of a learning factory must be specified, as well as the attributes of an ideal factory learning.
2015	Abele, et al	Learning Factories for research, education, and training	Germany	Primary data	No	In	Not described	It shows that learning factories have simulations that help students understand the complexities of an organization.
2015	Sokolov et al	Integrated scheduling of material flows and information services in industry 4.0 supply networks.	Russia, Russia	Secondary data	No	No	No	In this work, nondeterministic questions were considered in Programming Dynamics where programming is interconnected to the control function.

2016	Stock, T. and Selinger, G.	Opportunities for Sustainable Manufacturing in Industry 4.0	Germany	Case study	Yes	Yes. Transformation of analog signals into digital signals for data processing.	Not described	A use case for adapting a machine tool as a specific opportunity for sustainable manufacturing in Industry 4.0 has been delineated.
2016	Qin, Liu, andGrosvenor	The Categorical Framework of Manufacturing for Industry 4.0 and Beyond.	Not identified	Secondary data	Yes	Describes the Smart Factory KL soap factory and its advantages in industry 4.0. Describes the characteristics of intelligent vehicles with a cyber-physical system reaching 80% prediction accuracy.	Yes. The production system is influenced by many different factors, which are the types of operations of '', 'Number of workstations', 'automation level', and 'system flexibility'.	With industry 4.0 the soap factory can produce the soap in any color requested by the customer. For smart vehicles that are loaded into a database, this data is sent to drivers.
2016	Erol et al	Tangible Industry 4.0: a scenario-based approach to learning for the future of production	Austria	Secondary data	No	It describes that for the learning plant there is a need for technological solutions, ICT, augmented reality systems.	Not described	The basic assumption of our approach is that human actors in a future production scenario will have specific skills to address new challenges in technological and organizational developments and business models.
2016	Schumacher, Erol, andSihn	A maturity model for assessing Industry 4.0 readiness and maturity of manufacturing enterprises.	Austria	Secondary data	No	No	Not described	From a scientific point of view, a conceptual model of maturity of Industry 4.0 was developed. This

								conceptual model allows us to collect data on the development of manufacturing companies from different sectors and identify additional success factors for effective industry 4.0 strategies.
2017	Mrugalska, Beata and Wyrwicka	Towards Lean Production in Industry 4.0	Poland	Secondary data	No	No	Not described	Lean production has successfully challenged mass production practices for production systems focused on good quality products aimed at customer satisfaction, where anything that does not add value is concerned with being waste. To achieve this, it is advisable to introduce IT integration of the production level with level planning, customers, and suppliers by the CPS known as "Industry 4.0".
2017	Baena, et al	Learning Factory: The Path to Industry 4.0.	Colombia	Secondary data	No	No	No	Describes that the success of learning should be geared towards the skills

2017	Tjahjono et al	What does Industry 4.0 mean to Supply Chain?	Spain	Primary Data	No	No	No	Through the analysis, the results showed that the areas that will be most affected by the introduction of Industry 4.0 are those of order fulfillment and transport logistics. Regarding order fulfillment, 53.84% of the impact of technology will be opportunities, while reminders can be opportunities or threats, depending on the context of the implementation.
2017	Bortolini et al	Assembly system design in the Industry 4.0 era: a general framework.	Italia	Secondary data	No	No	No	The application of these enabling technologies to the assembly domain results of a new generation of assembly systems, the assembly system defined here 4.0
2018	Ślusarczyk B.	Industry 4.0 - Are we ready?	Poland	Secondary data	No	In	Lack of culture and digital training, which is indicated by half of the interviewees. Lack of clear vision or support from managers, unclear economic	Most respondents recognize the concept of industry 4.0 as a great opportunity for the development and improvement of competitiveness, in particular

							benefits from investments in digital technologies, and high financial investment, is the shortage of qualified staff.	since its implementation is probably inevitable.
2018	Sung, T.K. (2009).	Industry 4.0: A Korea perspective.	Korea, South Korea	Primary data	No	In		IT security risk; Major investments in new technologies, Increased unemployment rate for repetitive jobs; reluctance to change by stakeholders.	Security risk in the information, which depending on the leak, impacts the reputation of the company; the education system should be changed, but it does not solve the problem of older workers;
2018	Dalenogare et al	The expected contribution of Industry 4.0 technologies for industrial performance	Brazil	Secondary data	No	The research describes technologies that have had significant results in their implementation in industry 4.0, highlighting: engineering systems, CAD-CAM, Sensing, Big Data, additive manufacturing, Clouds.	Some technologies have been recently deployed, and there are no records of resulting benefits.	It divided its results into 2 groups: Product development technology and production technologies, showing that companies have different expectations regarding these technologies, showing that Brazilian companies have not yet taken advantage of some promising technologies developed in developed countries.

2018	Moktadirnet al	Assessing challenges for implementing Industry 4.0: Implications for process safety and environmental protection.	Bangladesh	Secondary data	Yes	No	Lack of technological infrastructure, lack of data protection, large initial investment, reduction of job opportunities because of the replacement of people, lack of qualified staff, complexity of integration of information and operational technologies	Lack of technological infrastructure initiates a change in its layout for technological change. Invest in process safety and environmental protection. Motivate managers to adopt intelligent technologies in their processes
2018	Vaidya, Ambad, andBhosle	Industry 4.0 - TheGlimpse.	India	Secondary data	No	No	No	The paper focused mainly on the concept of the fourth industrial revolution, called Industry 4.0 that allows intelligent, efficient, effective, individualized, and customized products at a reasonable cost.
2019	Granulo, Fuchs, andPuntoni	Psychological reactions to human versus robotic job replacement	Netherlands	Quantitative research	No	No	The research on workers had no obstacle described.	Workers believe that a replacement by robots is has a smaller impact on their economic future compared to replacing them with people.
2019	Alcácer, Cruz-Machado	Scanning Industry 4.0: A Literature Review on	Portugal	Secondary data	No	No		The fundamentals of IR 4.0 are the advanced

		Technologies for Manufacturing Systems.						automation and ICT technologies present in this review. I4.0's key challenge is to make production systems more flexible and collaborative.
2019	Castelo-Branco, Cruz-Jesus and Oliveira	Assessing Industry 4.0 readiness in manufacturing: Evidence for the European Union.	Portugal	Primary data	Yes	No	No	The reasons for the differences between countries in the capacity to adapt to Industry 4.0 require more research: the structure of the industrial sector, its role within each country's economy, and differences in business models or management styles, even within the same sectors.

2.2 Resilience

Resilience, in the etymological sense, is a concept used since 1620, derived from the Latin resilient, derived from the verb resilio (re + salio) with the meanings of "jumping back", recovering, returning to "normal"(Sabbag, Bernadi Jr, Goldszmidt & Zambaldi, 2010).

The concept of resilience and multidisciplinary worked by several authors and correlate with the following elements: (i) readiness and preparation, (ii) response and adaptation, and (iii) Recovery or adjustment (Bhamra, Dani & Burnard, 2011).

For Hartmann Junior and Medeiros (2017*)*citing the authors Pinheiro (2004), Yunes (2003), describe that resilience is: "the possibility of developing properly, even facing many difficulties, is the basic idea that relates the aspects that define resilience, because some individuals who suffer

stressful situations, overcome it by remaining healthy biologically and emotionally." The exercise of resilience may be responsible for the good cognitive functioning and mental health, reinforced by Chen, McCabe& Hyatt (2017) to quote Luthans 2002; Youssef and Luthans (2007) as "kind of positive psychological ability to improves performance" related ability to cope with major organizational changes.

The SOBRARE - Brazilian Society of Resilience (2020), conceptualizes resilience as follows: "Ability to be flexible when assigning meanings with the balance in times of difficulties and challenges of life."

Several scales are presented in the literature such as Connor-Davidson Resilience Scale (Cd-Risc); Adolescent Resilience Scale; Deployment Risk and Resilience Inventory (DRRI); Military Social Index; A Child Psychosocial Distress Screener(CPDS); Strong Soul,an

example has been reportedby Kamanchek (2012), intable 2to follow the steps to evaluate the level of resilience of

professionals including areas presented by SOBRARE (2020).

Table 2- Resilience scale

Factors	What is it?	How to purchase
Self-efficacy	Belief in the very ability to organize and perform actions required to produce desired results. Associated with self-confidence, it becomes a "fuel" for proactivity and problem-solving.	Specific training is needed to better understand situations, to become aware of what concept you make of yourself, and what your usual pattern of attitudes is. Psychotherapy can help a lot in this case, as well as the realization of projects in a systematic and planned way.
Self-control	Ability to manage emotionally in the face of unexpected situations and manage their behaviors appropriately for the different life challenges.	Seek to mature emotional behavior, since it will be this behavior that will be read by other people.
Social Competence	Ability to go in search of external support in times of stress. It encompasses both openness to receiving support and proactive search for help.	All training offered to develop leadership, ethical behavior and relationship improvement are valid. One can also practice "empathic listening", which invites the other to speak and offer greater details, postponing critical judgments; and "active listening", a process of guided inquiry. Getting involved in social projects helps develop moral awareness.
Empathy	Ability to promote both social competence and problem-solving. it means putting yourself in the place of the other, understanding the person from the frame of reference of the other.	Within resilience, being empathetic is not just putting yourself in the other's shoes and having compassion, it's knowing how to behave and put yourself in a way that considers the needs of other people involved in the situation. It is the ability to see "through the eyes" of the other person, to generate confidence and reciprocity when overcoming a given crisis.
Conquering people (Support Network)	It is the area of resilience that acts on beliefs that determine the ability to engage with others for the same cause.	Stay connected to other people. Thus, it makes it possible to aggregate and cultivate relationships, making them a consolidated and lasting support network. The purpose is to form strong support and protection networks.
Body reading	Being aware of the reactions that happen in our body refers to the understanding of the changes that occur in adverse situations and high stress.	Carefully analyze the different reactions that happen in our bodies.
Flexibility	It is related to greater tolerance of ambiguity and greater creativity. Pessimism causes low-resilience individuals to stubbornly insist on ineffective attitudes. The resilient, in contrast, is flexible. Think about options, act, and if the action is not effective, choose another option and persist.	Think straight away about yoga classes or ballroom dancing, for example. "the flexibility of the body is associated with that of the mind." In the long run, go after creativity development training, which unlocks and lets you "think outside the box."

Table 2- Resiliencescale (continued)

Factors	What is it?	How to purchase
Tenacity	It is about persistence and the ability to withstand uncomfortable or adverse situations.	Individuals with low tenacity give up easily. Sports practice helps because it improves discipline and exposes the limits of the body. It's the guy who regularly does an hour of the treadmill because he knows it's important, not because he likes it.
Troubleshooting	Characteristic of change agents, individuals prepared to diagnose problems, plan solutions, and act, without losing control of emotions. The attitude that mobilizes for action.	Good advice, for starters, is to entertain yourself with strategy games, those that make you think of solutions such as chess. but to fully develop this factor, the best solution is even the dedication to put projects on their feet — personal or professional.
Productivity	It is associated with challenges, living with uncertainties and ambiguities. It refers to the propensity to act and the search for new solutions. Reactions tend to wait for the impacts of adversity; proactive initiatives.	One solution is to look for a coaching service. The guidance of more experienced professionals can teach you how to be agile and give the right answers.
Temperance	It is associated with the control of impulsivity and anger. It means a greater ability to regulate emotions while maintaining serenity in difficult situations.	Palliative measures, such as listening to a song, moving away from a little and throwing water on the face, are valid. In the long run, meditation, physical conditioning, and psychotherapy to solve self-esteem problems.
Optimism or self-confidence	On the scale of resilience, optimism is a competence resulting from the union of three others: social competence, proactivity, and self-efficacy.	All recommended activities for social competence, proactivity, and self-efficacy are useful in this case. Moreover, it is having a positive attitude towards life.
Environmental analysis	It is understood as the area of resilience that acts in the beliefs that determine the ability to read carefully the environment. Capturing all clues that demonstrate a situation of risk or vulnerability.	Resilience in this area promotes flexibility for proper adaptation to a given context, to position itself in times of change, to focus on solutions, and to manage with balance the information obtained in the environment.
Sense of life	Ability to understand the vital purpose of life.	It promotes enrichment of the value of life, strengthening and empowering the person to preserve his life to the fullest.

Source: Kamanchek Adapt (2012) and SOBRARE (2020).

It is perceived that the term resilience is used quite broadly although all of them are related to the individual's ability to return to a stable state after a rupture, also being applied in organizations when there is some interruption in processes, through acceptance of reality and the ability to improvise (Bhamra, Dani & Burnard,2011).

III. METHODOLOGY

This research began with the definition of a relevant theme for an article in the area of higher education. The authors understand that evaluating, helping the resilience of workers who may lose their jobs because of Industry 4.0 is important, by proposing this idea provokes a fundamental change in the perception of companies about the impacts caused by this change and how to make conspicuous the implementation with reduction of social impacts. In addition, Martins (2010) methodology was increased to measure the importance of the theme using the following formula: $M =^3\sqrt{7}(V) \times 10 (I) \times 10 (O) = 8.87$(where: V = Viability; I = Importance; O = Originality). For this formula, a viable theme was considered above 6.

The structure of the work methodology presented in the funnel diagram in Figure 4.
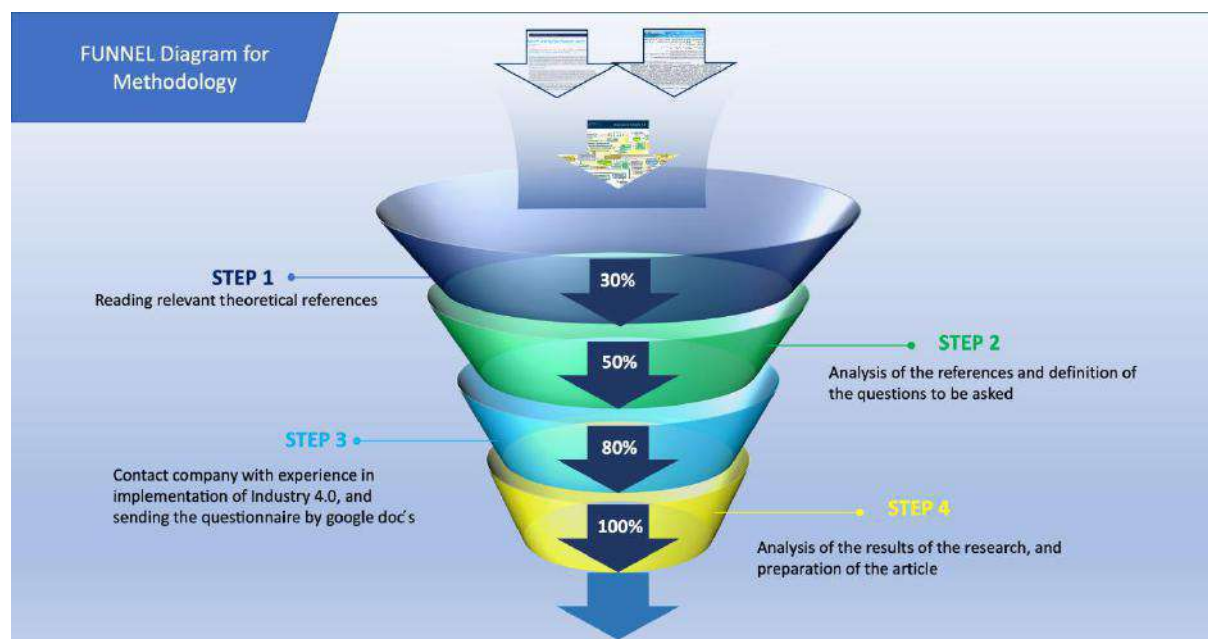
Fig.4: Funnel diagram for research methodology

Source: The authors.

The steps represented in the funnel diagram where the percentages represent the time of each phase before the article is ready to describe the methodology are: Step 1 - a literature review in relevant sources to provide a theoretical basis for the research, which according to Gil (2017) and Ruiz (2006) will allow informing the current situation of the theme; Step 2 - The literature review had the role of assisting in the elaboration of the key issues to be addressed in step 3 (Vergara, 2017); Step 3 – sending the questionnaire through the Google doc's (Cooper and Schindler, 2003), Linkedin contacts and professional relationship was used to enhance the research time that was impaired by COVID-19, or by the lack of interest and the industrial sector in completing research, which resulted in the case study method in a multinational company; Step 4 analyze of the questionnaire and choice of the journal to verify the writing pattern of the article.

The qualitative method was determined because it is the case study that according to Gil (2017) is classified according to its general purpose and objectives, which is basic and exploratory and descriptive. After all, it familiarizes the researcher with the theme and fills gaps in knowledge through business practice. Its approach is direct by interrogating and requesting information from a given group of people, characterizing qualitative analysis concerning the approach. As for nature, it is classified as applied, as it is focused on the acquisition of knowledge for a specific purpose.

IV. RESULTS AND DISCUSSIONS

The company surveyed is multinational in the automotive sector in the region of ABC / São Paulo / Brazil with has close to 10,000 employees, the company believes to be prepared to enter Industry 4.0 and does not realize any threat to its competitiveness

The person was responsible for the research Industry4.0 as A way to intelligently join technology, working between various areas, generating information and product data, process, and supply chain the most efficient, enabling more insights and communication of the data in real-time.

The concepts of Industry 4.0 were implanted in machines and process, the reason was to make them more competitive, this implementation presented as benefits: productivity gains, reduction of variability in the process and increase in financial performance.

The barriers encountered during the deployment were: lack of adequate manpower, general reluctance to change by stakeholders, loss of many jobs to automated and controlled processes, large investments in technologies and complexity of integration of information and operational technology.

The criteria used for the implementation of Industry 4.0areprocess bottlenecks, level of rejection or deviations of tolerance, customer complaints, constant maintenance, risks to worker´s health, low cost of replacing workers with machines/technologies, and quality assurance.

Among the resilience factors described by Kamanchek (2012) and SOBRARE (2020), none of them is used as an evaluative factor for the replacement of employee´s by technology, but during the employee´s stay in the company, the same seeks to develop Tenacity, Temperance, Productivity/Proactivity, Self-efficiency a problem-solving skills.

There is no type of aid for employees resulting from technological unemployment, for a replacement in the market, so the result of the use of technology in Industry 4.0, within the company, for employees is the dismissal.

4.1 Final considerations

The study evaluated how companies use the characteristics that reinforce resilience, to define technological unemployment, which was found in the case study, industry strategies 4.0 take into account the increase in performance, it is the human being, who had an investment in their skills over time, this can cause difficulties in proposing the consequences of some types of innovations, without attenuating the results caused socially and psychologically.

It is noticed that the theme resilience is highly sought after, as shown in Figure 1, but evidence in the literature and the case, the study does not corroborate its use at the time of dismissals due to technologies.

4.2 Theoretical implications

The research's contribution is to assess whether when defining a cut for technological reasons resilience is taken into account, since technically employees should perform similarly, making employee resilience and after no longer being employee's objectives of studies, in the implementation of Industry 4.0.

4.3 Practical implications

The work has practical implications when presenting the possibility of developing a characteristic of strengthening resilience in schools and companies even in a laconic way that can mitigate problems of employee relocation whether within the company or outside.

4.4 Limitations and suggestions for future research

The work also in acquiescence with transversal and interdisciplinary activities, shares the difficulty of responses of the target population, although the theme is of business interest and thus corroboration should be easier. Therefore, the proposal is to replicate the case study for multiple case studies, or with greater sampling, to go from a qualitative to quantitative research.

A survey of employees who were the result of technological unemployment could provide schools (learning industries) and enterprise with information on which path to be developed in the resilience of active workers mitigating the social consequences resulting from technology.

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Profile and Experiences of Nursing Students related to Tuberculosis: An Evaluation of Health Education

Ana Caroline Guedes Souza Martins[1], Lidiane Assunção de Vasconcelos[2], Raphael Garcia Campestrini[3], Gisele de Brito Brasil[4], Jackline Leite de Oliveira[5], Maria do Perpetuo Socorro Dionizio Carvalho da Silva[6], Willame Oliveira Ribeiro Junior[7], Luis Fernando Silva Santos[7], Luan Cardoso e Cardoso[7], Leilane Almeida de Morais[7], Geovana Brito Nascimento[7], Ariane Salim do Nascimento[7], Chrisla Brena Malheiro Lima[7], Monike Karina Macedo Soares[7], Jessica Rayane de Miranda Costa[7], Izabela Moreira Pinto[7], Juliane Moreira de Almeida[7], Ana Luisa Lemos Bezerra[7], Wesley Brandão Dias[7], Widson Davi Vaz de Matos[8], Andrey Oeiras Pedroso[9], Nadja da Fonseca Veloso[10], Alda Lima Lemos[10], Andrea Oliveira da Silva de Almeida[10], Thamyres da Silva Martins[10], Mário Roberto Tavares Cardoso de Albuquerque[11], Márcia Bitar Portella[12], Jofre Jacob da Silva Freitas[13], Antônia Margareth Moita Sá[14].

[1]Nurse, Master in Health Education in the Amazon at the State University of Pará (UEPA). Professor at the UEPA, Belém, Pará, Brazil.E-mail: carolguedes.devs@hotmail.com

[2]Nurse. Master in Health, Environment and Society in the Amazon at the Federal University of Pará (UFPA). Professor at the UEPA, Belém, Pará, Brazil.

[3]Nurse at the State University of Pará (UEPA). Nurse at the Municipal Health Department of Benevides, Pará, Brazil.

[4]Nurse. Master in Nurse at the State University of Pará. Professor at the Uninassau, Belém, Pará, Brazil.

[5]Nurse. Master in Risk and natural disaster management at the Federal University of Pará. Professor at the Estácio College, Belém, Pará, Brazil.

[6]Nurse. Master in Nurse at the Federal University of Pará. Professor at the State University of Pará, Belém, Pará, Brazil.

[7]Nursing Student at the State University of Pará, Belém, Pará, Brazil.

[8]Nurse at State University of Pará (UEPA). Program member Multiprofessional Residency in Oncology Nursing at Federal University of Pará (UFPA). Specialization in Adult Intensive Care Unit and Neonatal, Integrated Faculty of the Amazon. Belém, Pará, Brazil.

[9]Nurse at the State University of Pará (UEPA), Belém, Pará, Brazil.

[10]Master in Health Education in the Amazon at the State University of Pará, Belém, Pará, Brazil.

[11]Doctor. Master in Health Education in the Amazon at UEPA. Specialist in Family and Community Medicine, Professor of Community Health at University Center of Pará (CESUPA). Belém, Pará, Brazil.

[12]Doctor. PhD in Pediatrics and Sciences Applied to Pediatrics, Federal University of São Paulo. Permanent member of the faculty in the StrictoSensu Graduate Program, Master and Professional Doctorate in Education and Health in the Amazon at UEPA. Belém, Pará, Brazil.

[13]Biomedic. PhD in Cellular and Tissue Biology from the University of São Paulo. Permanent member of the faculty in the StrictoSensu Graduate Program, Master and Professional Doctorate in Education and Health in the Amazonia at UEPA, Belém, Pará, Brazil.

[14]Nurse, PhD in Nursing at Federal University of Rio de Janeiro. Permanent member of the faculty in the StrictoSensu Graduate Program, Master and Professional Doctorate in Education and Health in the Amazon at UEPA, Belém, Pará, Brazil.

Abstract—Objective: This study aimed to evaluate the sociodemographic profile of nursing students and their experiences with tuberculosis (TB) during undergraduate nursing at a public university. Method: Quantitative-descriptive research, carried out in the Undergraduate Nursing Course of a public university, in 2019, with the participation of 30 5th year students, who answered a self-administered questionnaire. It was used percentage and Pearson's Chi-square for statistical analysis. Results: The results show that the majority of academics never participated in courses or scientific events, as well as few had experiences with extracurricular activities. It was found that 76.6% underwent nursing consultation for TB patients; 70% did Directly Observed Treatment administration / supervision; 53.3% requested sputum tests; 50% scheduled and monitored patients' attendance; 33.3% had BCG vaccination; 23.3% advised on sputum collection; 20% applied and read tuberculin tests; 20% made a search for TB cases in the general clientele and no academic made a home visit to a patient with TB, the latter being a worrying fact. Thus, they consider to be partially prepared for the care of clients with tuberculosis. Conclusion: It is concluded that the academic experiences regarding tuberculosis need to be intensified and more valued by universities, just as there is a need to innovate teaching-learning methods and implement new methods for evaluating curricular axes in order to detect possible flaws in their structure.

Keywords—Tuberculosis. Teaching. Evaluation. Nursing.

I. INTRODUCTION

Tuberculosis (TB) is still a serious and challenging global public health problem. Worldwide, in 2018, around ten million people fell ill and 1.5 million people died as a result of it, being the main cause of death by a single infectious agent (Brazil, 2020).

Furthermore, late diagnosis is an important factor for the worsening of the clinical condition of patients with tuberculosis, a fact that hinders proper management and makes a good prognosis impossible (Salzani et al., 2017).

Therefore, it is observed that poor academic training of health professionals represents a factor for the delay in the diagnosis of tuberculosis, since teaching about this disease is considered a difficult task in institutions of higher education, mainly due to the lack of new ones. Attractive teaching methodologies capable of innovating the way of teaching and improving the skills of undergraduate and graduate students in the health field, especially among nursing students (Grecco et al., 2014).

Among others, the fragility of teaching will have a negative impact on both the management of the program and the assistance to people with the disease. Thus, in order to improve the teaching of academics in the health area, it is essential to develop innovations and investments in the evaluation of clinical competences and to ensure the quality training process. Investment in teaching needs to be provided from the academy, through meaningful learning, which emphasizes the use of active methodologies, capable of integrating different teaching strategies and developing critical and reflective thinking (Silva and Moraes, 2015).

The education of nurses has shown frequent changes. However, whatever the teaching-learning methodology applied, assessment is the fundamental axis to guarantee the effectiveness of learning. For this to be successful in its formation, it is necessary that the teaching methodology is consistent with the form of applied assessment (Gomes et al., 2009).

The selection of the evaluation method must be guided by its purpose. Assessments aimed at detecting deficiencies in pedagogical projects, failures in the curricular structure and teaching methods must have great validity, reliability and reproducibility (Vieira et al., 2016).

A comprehensive assessment must then include cognitive aspects, skills and attitudes necessary for the exercise of the profession. It must also involve the different areas of nursing and cover as much knowledge as possible. Ideally, it should be done with objective methods, in standardized, diversified conditions and in viable circumstances (Gomes et al., 2009).

Thus, this study aimed to assess the sociodemographic profile of nursing students and their experiences with tuberculosis during their undergraduate nursing program at a public university.

II. METHOD

Exploratory research with a quantitative-descriptive approach, developed on the premises of the Undergraduate Nursing Course of a public university, in June 2019, with the participation of 30 academics enrolled in the 5th year and who were attending or have attended the Supervised Internship Curricular Component in Collective Health. Participants with a locked registration or who were away for any reason were excluded.

An instrument for data collection was used, this being a questionnaire with open and closed questions, self-administered, containing data of identification and characterization of the participants and information about participation in updates and previous experiences in tuberculosis.

Pearson's chi-square statistical tests for nominal variables were used for statistical analysis of the data, in order to indicate whether the observed frequencies showed a significant trend. To perform the test, a significance level of p-value <0.05 was adopted, that is, if p-value <0.05 is accepted H1 = The observed frequencies differ significantly for the different groups.

Thus, the data collected were tabulated, interpreted, processed and analyzed using descriptive and inferential statistics. For data analysis, computing resources were used, through processing in Microsoft Excel and Statistic Package for Social Sciences (SPSS) version 24.0, all in Windows 7 environment.

This study was approved by the Ethics Committee on Research with Human Beings, obeying Resolution No. 466/12 of the National Health Council by the number: CAAE: 12062919.6.0000.5170.

III.   RESULTS AND DISCUSSION

Regarding the sociodemographic profile of nursing students, 90% are single, 60% are aged between 22 and 26 years old, 70% only study and 100% do not have another degree. As for academic activities, 53.3% underwent extracurricular internships, 43.3% participated in extension projects, 23.3% for monitoring and Institutional Program for Scientific Initiation Scholarshipsand 13.3% participated in other activities, in which participation in the academic league was mentioned and 3.3% did not participate in any of these activities, these being significant trends (p <0.05) in this investigated population, as shown in Table 1 below.

Table 1: Sociodemographic profile of nursing students at a public university. Belém - Pará (2019).

Sociodemographic profile	N	%	P-Value[1]
Marital status			
Not married	27	90,0%	0.000*
Married	2	6,7%	
stable union	0	0,0%	
Others	1	3,3%	
Age Range	**N**	**%**	
18 to 22 years	9	30,0%	0.002*
23 to 26 years	18	60,0%	
27 to 30 years	2	6,7%	
30 to 36 years	0	0,0%	
Above 36 years	1	3,3%	
Occupation	**N**	**%**	
Just study	21	70,0%	0.001*
Studies and works in the health area	6	20,0%	
Studies and works in another area	3	10,0%	
Has another graduation	**N**	**%**	
Yes	0	0,0%	0.000*
Not	30	100,0%	
Activities during graduation	**N**	**%**	
Extracurricular internship	16	53,3%	0.021*

Extension	13	43,3%
Monitoring	7	23,3%
Institutional Program for Scientific Initiation Scholarships	7	23,3%
Others	4	13,3%
None	1	3,3%

Note: Results are basedon non-emptyrowsandcolumns in eachinnermostsubtable.

N- Numberofacademics.

(1) Pearson's chi-squaretest (Wilks' G²) for independence (p-value<0.05).

* SignificantValues; NS - Non-SignificantValues.

Interpretationofthetest:

H0: The frequenciesobservedoccur in thesameproportion for thedifferentgroups.

H1: The observedfrequenciesdiffersignificantly for thedifferentgroups.

Decision: Sincethecomputed p-valueislessthanthesignificancelevelof alpha = 0.05, thenullhypothesis H0 shouldberejectedandthealternativehypothesis H1 accepted.

Source: Research protocol, 2019.

As for the students' previous experiences about tuberculosis, which can be seen in table 2, it was found that 76.6% never participated in a course and 86.6% never participated in scientific events on the theme. When asked about other types of contact with the theme, they were cited: curricular internship (36.6%); theoretical classes (26.6%); integrating seminar (16.6%); construction of educational technology (10.0%); reading scientific articles (3.3%); performing PPD (3.3%) and experiencing the disease (3.3%).

As for the practical activities related to tuberculosis that participated during the undergraduate course in nursing carried out in health centers, outpatient clinics or hospitals, 76.6% stated that they had undergone a nursing consultation (or interview) with TB patients; 70% did Directly Observed Treatment administration / supervision; 53.3% requested sputum tests; 50% scheduled and monitored patients' attendance; 33.3% had an intradermal BCG vaccination; 23.3% advised on sputum collection; 20% applied and read tuberculin tests; 20% made a search for TB cases in the general clientele and no academic made a home visit to a patient with TB.

When asked if the student feels prepared to develop nursing activities in the Tuberculosis Control Program, 70% responded partially, as shown in Table 2 below.

Table 2: Distribution of nursing students at a public university according to previous experiences with tuberculosis. Belém - Pará (2019).

Previous experiences with tuberculosis	N	%	P-Value[1]
Attended a course on TB			
Yes	7	23,3%	0.001*
Not	23	76,7%	
Participated in some scientific event on TB			
Yes	4	13,3%	0.001*
Not	26	86,7%	
Had another contact with the theme			
Theoretical classes	8	26,7%	0.004*
Curricular stage	11	36,7%	

Integrating Seminar	5	16,7%	
Construction of educational technology	3	10,0%	
Reading scientific articles	1	3,3%	
Realization Tuberculin Skin Test	1	3,3%	
He experienced the disease	1	3,3%	
What practical activities related to TB were performed during the nursing course			
BCG intradermal vaccination	10	33,3%	0.001*
Application and reading of tuberculin skin tests	6	20,0%	
Search for tuberculosis cases in the general clientele	6	20,0%	
Guided on sputum collection	7	23,3%	
Nursing consultation	23	76,7%	
Ordering sputum tests	16	53,3%	
Administration / supervision of Directly Observed Treatment	21	70,0%	
Scheduling and control of patient attendance	15	50,0%	
Home visits to patients with TB	0	0,0%	
Others	0	0,0%	
Feels prepared to develop nursing activities at the Tuberculosis Control Program			
Yes	1	3,3%	0.001*
Partially	21	70,0%	
Not	8	26,7%	

Note: Results are basedon non-emptyrowsandcolumns in eachinnermostsubtable.

N- Numberofacademics.

(1) Pearson's chi-squaretest (Wilks' G²) for independence (p-value<0.05).

* SignificantValues; NS - Non-SignificantValues.

Interpretationofthetest:

H0: The frequenciesobservedoccur in thesameproportion for thedifferentgroups.

H1: The observedfrequenciesdiffersignificantly for thedifferentgroups.

Decision: Sincethecomputed p-valueislessthanthesignificancelevelof alpha = 0.05, thenullhypothesis H0 shouldberejectedandthealternativehypothesis H1 accepted.

Source: Research protocol, 2019.

When analyzing the results, it was observed that, related to the age group, in a survey conducted in 2012, by the National School of Public Health (ENSP/Brazil), in partnership with the National Federation of Nurses (FNE/Brazil), the Brazilian Nursing Association (ABEn) and the Federal Council of Nursing (COFEN), characterized that nursing professionals are concentrated in the age group of 26 to 55 years, and that the vast majority are in the range of 26 to 35 years, which represents 35.98 % of total nursing professionals in Brazil (Silva, Nogueira and Sá, 2016).

A result similar to the present study was found in a survey conducted at four Brazilian universities, three public and one private, one in the south and three in the southeastern region of the Brazil, where a young profile of students was identified, aged between 20 and 24 years (50%), with an average age of 24.21 years (Bublitz et al. 2015).

The presence of young academics in nursing courses may be related to the incentive of the brazilian government to enter higher education. However, because it is a young

population, the choice of profession seems to be immature, which can lead to higher dropout rates during the course (Freitas et al. 2012; Bublitz et al. 2015).

It was observed in this research that a considerable percentage of academics study and work (30%) and this may be related to the fact that they are more engaged and give more value to the knowledge they acquire in the academy and are more concerned with their professional future, since they work to earn their own living.

Most academics have never participated in courses (76.7%) or events (86.7%) on TB, and this is a worrying fact, since the greater the knowledge and experiences acquired during graduation, the better the performances will be in future professional practice.

Therefore, it is important that academics are encouraged to participate in these extracurricular activities, since the nurse is a professional who needs to be constantly updated, as, at all times, new knowledge and technologies are created and for TB control to be efficient, with search for new cases, early and adequate diagnosis, treatment and cure in order to interrupt the chain of transmissibility. It is up to this professional to provide full assistance to the user with suspicion or confirmation of tuberculosis.

In this sense, it is the nurse's responsibility in Primary Health Care to initiate the treatment of new cases of pulmonary TB with positive sputum smear microscopy; perform the nursing consultation covering all aspects relevant to the user's treatment, according to the municipal protocols; order complementary exams and prescribe medications, according to the legal provisions of the profession and according to municipal protocols and other regulations established by the Ministry of Health (Seto and Costa, 2018).

The nurse has the function of analyzing the user in a comprehensive way, being responsible for investigating new cases of TB, because the anamnesis performed in the first visit, aims to implement nursing care clearly and precisely.

In this sense, it is noticeable the need to strengthen the nurse's performance regarding assistance to TB patients, since this assistance is sometimes hampered by the difficulty that the worker has in providing comprehensive care and, in return, dealing with limitations of the service, such as the high demand of users and the little time set aside for nursing consultation (Seto and Costa, 2018).

It was found that the Curricular Internship was the form of contact with the theme most mentioned in this study, which is considered important so that they can exercise the knowledge acquired in the theoretical classes, however the

extra-curricular activities come to add to the curricular, thus expanding their knowledge and clinical experience.

Among the activities on TB that must be carried out during the Supervised Internship offered in the 5th year of the undergraduate nursing course at the university in this study, it is highlighted that the majority of academics held nursing consultations and the administration / supervision of medication taking through Directly Observed Treatment. However, it is noteworthy that important items such as home visits to patients with TB were not mentioned by any of the participants.

Thus, universities should train and encourage teachers to encourage academics to participate in home visits to TB patients, since this is one of the nurse's duties and because it is a disease closely linked to the environment in which the individual lives. Thus, the greater the possibility of effective nursing interventions in preventing injury and breaking the transmission chain.

Clementino and Miranda (2015) corroborate with the statement that it is necessary to open spaces for dialogue with the community, generating reflection, problematization and a co-responsibility relationship, favoring humanization in the health work process, in the relationship between users and professionals.

Therefore, considering that most TB patients present themselves in situations of physical, emotional and social vulnerability, it is necessary to know the environment in which this individual is inserted, so that the health team performs a different approach for each case, thus minimizing barriers to TB care (Clementino and Miranda, 2015).

In this context, the Family Health Strategy (FHS) provides for the use of home visits as a way to equip professionals for their insertion and knowledge of the population's life reality, as well as the establishment of bonds (Clementino and Miranda, 2015).

The results show that there is a need to reorganize the teaching-learning process of nurses, with emphasis on the use of active methodologies, which are defined as important contributions to meaningful learning, as the training of professional nurses requires a solid mastery of clinical skills fundamental, such as communication with patients, physical examination, clinical reasoning and the proposition of diagnostic and therapeutic measures (Troncon, 2007).

His training has been the object of reflection and study over the years, while the new National Curriculum Guidelines (DCNs) for Nursing Graduation have directed changes in the training of this professional and require

more critical, reflective, flexible and versatile training. In this sense, several assessment tools have been used in undergraduate nursing courses (Medeiros et al., 2014).

The DCNs of health courses encourage the use of different teaching-learning scenarios and the integration between the contents, in addition to the fact that several strategies have been tested and compared as methods for teaching various pathologies, such as traditional classes, based on case readings. clinics, workshops, among others, but the demands of the world of work require new teaching methods. Therefore, the teaching-learning process is implemented through different tools and new successful methodologies have been described (Oliveira Neto, 2015).

Competency-based teaching involves constantly evaluating the acquisition of knowledge, skills and attitudes provided for in the DCNs, since its certification expresses the student's ability to work in the nursing career. It is through evaluation that information about learning is obtained. The central issue of the training of nurses must be the guarantee of the acquisition of these skills to meet the population's health demands with quality (Vieira et al., 2016).

The selection of the evaluation method must be guided by its purpose. Assessments aimed at detecting deficiencies in pedagogical projects, failures in the curricular structure and teaching methods must have great validity, reliability and reproducibility (Vieira et al., 2016).

Therefore, the evaluation of clinical competences in higher education has been presented as a need to ensure that the training process is of quality in the field of health, by highlighting the importance of mastering clinical skills, which allow them to solve a real health problem presented. or guide how to proceed to the solution of this (Silva and Moraes, 2015).

In nursing, clinical competence is configured as a fundamental aspect in professional training, as it encompasses dimensions of a cognitive, technical and relational character that are essential for the realization of humanized, integral, solidary care, incorporation of attitudes and ethical awareness, which must be developed during the course and the student's performance assessed regularly, by ensuring that the institution is training ethical, human and competent professionals, to provide adequate responses to the population's health needs (Silva and Moraes, 2015).

IV. CONCLUSION

From this study it was possible to verify that the academic experiences in relation to tuberculosis need to be

intensified and more valued by universities. There is a need to implement evaluations of curricular axes in order to detect possible flaws in its structure.

Corroborating these findings, the DCNs recommend that the training of nurses should be based on competences and skills to be developed during the training process and should privilege the technical-scientific, ethical-political, socio-educational conducts, in order to allow the future professionals recognize health as a right, in order to guarantee the quality of care at all levels of health care, planning, organizing, managing and evaluating the nursing work process, in partnership with other professionals in the workplace.

Therefore, the nurse must have training with a generalist, humanistic, critical and reflective profile, capable of knowing and intervening in the most prevalent health-disease situations in the national epidemiological profile, with emphasis on their region of activity, identifying the bio- psychosocial effects of its determinants.

Universities invest little in teaching evaluation and are stuck with archaic models of summative evaluation, in which many teachers are more concerned with grades than with the quality of teaching. This may be linked to the precariousness of training offered to teachers regarding the new assessment tools. Therefore, investing in new teaching and assessment methods is imperative in the current reality of higher education, as well as offering qualifications to teachers.

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ATTACHMENT

INSTRUMENT FOR DATA COLLECTION
I-PART- ACADEMIC PROFILE

Identification Code: D_____

01-Marital status: ( ) single ( ) married ( ) stable ( ) others

02-Age group ( ) 18 to 22 years ( ) 23 to 26 years ( ) 27 to 30 years ( ) 31 to 36 years ( ) over 37 years.

03- Occupation:
Only studies ( )
Studies and works in the health field ( )
Studies and works in another area ( )

04- Do you have another degree in health? ( ) Yes ( ) No. If so, which one?

05 - Did you carry out curricular or extracurricular activities during graduation? Which are?
( ) Monitoring ( ) Extension ( ) Extracurricular internship ( ) Institutional Program for Scientific Initiation Scholarships ( ) Others_____
( ) None

II- PART- PREVIOUS EXPERIENCES ON TUBERCULOSIS

01- Did you participate in any TB course (distance or face-to-face)? ( ) Yes ( ) No

02- Participated in some scientific event on TB (congresses, symposia, etc.) ( ) Yes ( ) No

03- Did you have any other type of contact with the theme? If so, which ones?

04- What practical activities related to tuberculosis did you participate during the undergraduate nursing course (in health centers, outpatient clinics or hospitals)?
( ) intradermal BCG vaccination
( ) application and reading of tuberculin skin tests
( ) looking for tuberculosis cases in the general clientele
( ) sputum collection (teaching the patient to spit)
( ) nursing consultation (or interview) to a TB patient
( ) request for sputum tests
( ) administration/supervision of Directly Observed Treatment
( ) scheduling and control of patient attendance
( ) home visitation to the TB patient
() others, which ones?
_____

05- Do you feel prepared to develop nursing activities in the Tuberculosis Control Program?
 ( ) Yes ( ) Partially ( ) No.

Bitumen Concrete Mix Design Using Cement and Phosphogypsum as Filler Materials

Shantanu Mehta, Siddharth Pastariya, Ashish Bhargava, Gajendra Verma, Anant Bharadwaj

Department of Civil Engineering, Sri Aurobindo Institute of Technology Indore M.P, India

Abstract— *Fillers play an important role in engineering properties of bituminous paving mixes. Conventionally stone dust, cement and lime are used as fillers. An attempt has been made in this investigation to assess the influence of non-conventional and cheap fillers such as phosphogypsum (which is a waste product generated for phosphoric acid industries in large quantities discussed later) in combination with cement in asphalt paving mixes. It has been observed as a result of this study that asphalt mixes with these non-conventional fillers result in satisfactory Marshall Properties though requiring a bit higher bitumen content, thus substantiating the need for its use. The fillers used in this investigation are likely to solve the problem of solid waste disposal of the environment to a very large extent. In this study we have worked out the optimum percentage of cement and phosphogypsum to be mixed in bitumen which gives best results in Marshall Stability Test. The combination of both optimum values are then taken to prepare the Asphalt mix for paving flexible pavements. The various results obtained live upto the expectations and are tabulated later on.*

Keywords— *Phosphogypsum, Filler, Cement, Bitumen, Concrete.*

I. INTRODUCTION

Construction of highway involves huge outlay of investment. A precise engineering design may save considerable investment; as well as reliable performance of the in-service highway can be achieved. Two things are of major considerations in this regard – pavement design and the mix design. The study emphasizes on the mix design considerations. A good design of bituminous mix is expected to result in a mix which is adequately strong, durable and resistive to fatigue and permanent deformation and at the same time environment friendly and economical. A mix designer tries to achieve these requirements through a number of tests on the mix with varied proportions of material combinations and finalizes the best one. This often involves a balance between mutually conflicting parameters. Bitumen mix design is a delicate balancing act among the proportions of various aggregate sizes and bitumen content. For a given aggregate gradation, the optimum filler content (Phosphogypsum and cement) content is estimated by satisfying a number of mix design parameters.

II. NEED OF STUDY

The need of study lies in the fact that millions of tones of Phosphogypsum is generated every year as a waste in phosphoric acid industries, the disposal of which is a major problem. Blending phosphogypsum with bitumen to be used in asphalt brings the solution to this problem of waste disposal.

III. METHOD AND MATERIALS

The materials used in this study work along with their desired characteristics are stated under.

Table 1: Materials and their properties

Material	Desired Properties
Coarse Aggregate	The coarse aggregate should have good crashing strength, abrasion value, impact value. Its function is to bear stresses coming from wheels. It has a resist wear due to abrasive action of traffic.
Fine	It shall be fraction passing 600 microns and

aggregate	retained on 75 microns sieve consisting of crushed stone or natural sand. Its function is to fill up the voids of the coarse aggregate
Fillers	It shall be fraction passing 600 microns and retained on 75 microns sieve consisting of crushed stone or natural sand. Its function is to fill up the voids of the coarse aggregate.
Aggregate Characteristic	The mineral aggregates most widely used in bitumen mixes or crushed stone, slag, crushed or uncrushed gravel, sands and mineral fillers. Since mineral aggregates constitutes of approximately 88% to 96% by weight and approximately 80% by volume of the total mix. Their influence upon the final characteristics of bituminous mixes is very great. Desirable aggregate characteristic gradation and size appropriate to type of constructions, strength and toughness, cubical shape, low porosity, Proper surface texture, Hydrophobic characteristics.

The gradation aggregates used in this project are as per IRC grading 2 as given in the following:

table (MORTH: Specifications for Road and Bridge works 2003):

Table 2: IRC Grading 2 for bituminous concrete mixes

Grading	2
Nominal Aggregate size	19mm
Layer thickness	30-45mm.
I.S. sieve	Cumulative Percentage by weight of total aggregate passing

19	100
13.2	79-100
9.5	70-88
4.75	53-71
2.36	42-58
1.18	34-48
0.6	26-38
0.3	18-28
0.15	12-20
0.075	4-10
Bitumen content by mass of total mix Bitumen Grade (penetration)	5.0-7.0 VG 30
Bitumen	60/70 grade of bitumen has been used

IV. EXPERIMENTAL INVESTIGATIONS & RESULTS

1. Penetration Test:

The consistency of bitumen cement is measured by the penetration test.A weighted needle (100 g) is allowed to bear on the surface of a dish of bitumen of standard test temperature (770 F) for a given length of time (5 sec). The depth of penetration of needle into the bitumen is termed as the penetration of the bitumen and is measured in units of 0.1mm.The needle penetrates farther into soft bitumen than into the harder grades, and thus the lower the penetration, the harder the bitumen. The test performed to check the penetration value of bitumen is tabulated as under:

Table 3: Penetration Test details of bitumen sample

	Sample 1				Sample 2			
Readings	Test 1	Test 2	Test 3	Mean value	Test 1	Test 2	Test 3	Mean value
Penetrometer dial readings								
Initial	0	0	0	0	0	0	0	0
Final	6.6	5.7	6.9	6.4	4.8	6.4	6.8	6.0
Penetration Value	66	57	69	64	48	64	67	60

Mean Penetration value = 6.2

Grade of Bitumen =60/70

2.Specific Gravity

Specific gravity is used to calculate voids in the compacted bituminous mix and to adjust quantities in mixture. Specific gravity of bitumen is found to be 1.05 by balance method.

Specific gravity of Filler

Two fillers are being used in this study namely cement (Gr.-43) and Phosphogypsum. The specific gravity of cement is found to be 3.15 and that of phosphogypsum is found to be 2.4 by pycnometer method.

Specific Gravity of Aggregate

The specific gravity of aggregates was found to be 2.67.

The results of various tests performed on the materials are tabulated as under:

Table 4: Tests performed on materials

Parameter	Observed Value
Mean Penetration value of bitumen	6.2
Grade of bitumen	60/70
Specific gravity of bitumen	1.05
Ductility Test (mm)	49.33
Specific gravity of Filler (OPC Gr. 43)	3.15
Specific gravity of Filler (Phosphogypsum)	2.4
The specific gravity of aggregates	2.67
Crushing Value of aggregate (%)	13
Los Angeles abrasion test (%)	22.08
Water absorption of aggregates (%)	3.15

3. Marshall Stability Test:

The objective of bituminous paving mix design is to develop an economical blend of aggregates and bitumen. In the developing of this blend the designer needs to consider both the first cost and the life cycle cost of the project. Considering only the first cost may result in a higher life cycle cost. Marshall Method of mix design has been adopted in this study. Accordingly aggregates with the grading 2 of IRC and bitumen 60/70 having properties as described in the preceding paragraphs have been used.

In this method, the resistance to plastic deformation of a compacted cylindrical specimen of a bituminous mixture is measured when the specimen is loaded diametrically at a deformation rate of 50mm/minute. The two major features of Marshall Method are Density Void Analysis and Stability Flow Test.

The marshall stability of mix is defined as the maximum load carried by the specimen at a standard test temperature of 60ºC. The flow value is the deformation that the test specimen undergoes during loading upto maximum load. Flow is measured in 0.25 mm units. In this test, an attempt is made to obtain optimum binder content for the type of aggregate mix used.

Marshall Test Data Compilation:

Type of Grading aggregate = B

Mixing Temperature = 60ºC

Number of blows = 75

Grade of Bitumen VG 30

Compaction temperature 27ºC

Table 4: Marshall Test Data Sheet

Filler	Cement (Gr.-43)			Phosphogypsum			Optimum Combination
BITUMEN STABILITY PROPORTION	1%	1.5%	1.5%	6%	8%	10%	1.5% OPC + 8% Phosphogypsum (by Wt.)
Stability (kg.)	810	1076	964	1806	2286	2139	2590
Flow Value (mm)	1.6	2.3	3.1	1.8	2.21	2.53	3.45
Unit Wt. (g/cc)	2.18	2.24	2.22	2.41	2.4	2.36	2.38
% air void	8.01	4.68	4.31	2.03	0.83	1.26	1.65
VMA (%)	18.39	17.48	19.11	13.5	14.54	16.99	15.2

Bituminous mixes containing marble dust as filler displayed maximum stability at 6% content of bitumen, having an increasing trend upto 6% and then gradually decreasing. The unit weight/bulk density also displayed a similar trend with flow value being satisfactory at 6% content of bitumen.

Results of Marshall Stability Test:

Parameters	Cement (Gr. 43)	Phosphogyp sum	Optimum Combination
Optimum content in bitumen (%)	1.5	8	1.5% Cement and 8% Phosphogypsum
Stability (kg.)	1076	2286	2590
Flow Value (mm)	2.3	2.21	3.45
Unit Weight (g/cc)	2.24	2.4	2.38
% Air Voids	4.68	0.83	1.65
VMA	17.48	14.54	15.25

V.   CONCLUSIONS

1. Bituminous mixes containing combination of cement and phosphogypsum as filler is found to have Marshall properties much better as compared to those of conventional fillers.

2. Bituminous mixes containing OPC as filler displayed maximum stability at 1.5% content of bitumen having an increasing trend upto 1.5% and then gradually 3. Bituminous mixes containing phosphogypsum as filler showed maximum stability at 8% bitumen content displaying an ascending trend up till 8% and then decreasing, the flow value showed an increasing trend and similar was the trend shown by unit weight or bulk density, the percentage of air voids obtained were seen to be decreasing with increase in bitumen content thus from here we can say that 8% bitumen content, satisfactory results are obtained.

4. The combination of these above two results is considered and results are summarized in Table 5. These results are clearly better.

5. From the above discussion it is evident that phosphogypsum generated as waste material can be utilized effectively in making of bitumen concrete mixes for paving purposes.

6. Further modification in design mixes can result in utilization of phosphogypsum as filler in bituminous pavement thus solving the waste material disposal substantially resulting in utilization of industrial space being consumed in disposal of industrial wastes.

7. Though stone dust being conventional filler however marble dust can be utilized in its place effectively thus solving the waste material disposal substantially resulting in utilizing of industrial space being consumed in disposal of industrial wastes.

8. The cost effectiveness of these non conventional filler specimens can be realized after performing a cost analysis of these non-conventional materials against the conventional specimens resulting in reduction of the construction cost considerably.

9. It is evident that with further tests phosphogypsum generated as waste material can be utilized effectively in making of bitumen concrete mixes for paving purpose.

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Analytical Approach in Stability Enhancement Techniques by Altering Beam Members at Different Levels

Bhagwat Mahajan[1], Sagar Jamle[2]

[1]M Tech Scholar, Department of Civil Engineering, Oriental University, Indore, India
[2]Assistant Professor, Department of Civil Engineering, Oriental University, Indore, India

Abstract— Many cities need a space for its further development with a criterion to capture everything that would run it with ease without any difficulties. The future demand of each city will ultimately in the favor to attract the population and living demand. This demand leads to the progress of the multistoried building. To counteract the lateral forces and stand in its position, the tall structures need stability with or without any improvement in the same. The current work is going to show the stability criteria of changing the grades of beams without altering the size at various floor levels. Total 6 cases of the current theme created and analyzed with the help of software approach after then result is compared. Result shows that the increase of stability has seen in Case BS3 and Bs4 and would be recommended whenever this type of stability activity performed.

Keywords— Dual supported system, Lateral load capacity, Optimum case, Shear wall, Stability enhancement.

I. INTRODUCTION

Multistorey buildings are common now a day in metro cities. They are increasing rapidly because of their construction methods, modern equipment's, skilled labour, modern machineries used in construction and day night construction. The equipment's and new methods of construction made it easy therefore it is necessary to apply methods for increasing stability in each and every multistory building. Stability analysis is one of the best methods of increasing stability of multistory building, can be analyzed with software or by manual approach.

Factor Affecting Stability of Building

The stability plays an important role in any type of structure and in high-rise and tall structure buildings its importance increases. Its importance increases with increase in height of the building. There are some major factors which affect the stability of the building. They are as follows-

1. Earthquake generates Seismic waves.
2. Dead load (self-weight of the building)
3. Live load or imposed load
4. Height of the building
5. Shape of the building
6. Wind load at top of the building.'

II. OBJECTIVES OF THE CURRENT STUDY

Following heads shows the point of comparison of result parameters between various models during earthquake forces for building and its various cases. They are as follows:-

1) To determine Base shear response when seismic forces are applied in X and Z direction to the structure when conducting grade change of beams at different floor levels.

2) To find member Shear Forces values in Beam with efficient case between grade change and without grade change cases.

3) To examine Bending Moment values in Beam with efficient case between grade change and without grade change cases.

4) To determine and compare member Torsion values in Beam members.

5) To examine column Axial Forces for total 6 cases with efficient case to determine minimum axial force between grade change and without grade change cases in Beam members at different floor levels.

6) To find member Shear Forces values in Beam with efficient case between grade change and without grade

change cases in Beam members at different floor levels.

7) To examine Bending Moment values in Beam with efficient case between grade change and without grade change cases in Beam members at different floor levels.

8) To determine and compare member Torsion values in Beam with efficient case between grade change and without grade change cases in Beam members at different floor levels.

9) To analyze the maximum nodal displacement case in X direction with most efficient case that provides more stability among others.

10) To obtain the maximum nodal displacement values in Z direction with most efficient case between grade change and without grade change cases in Beam members at different floor levels.

To demonstrate and recommend the efficiency of the reduction of Base Shear by changing the size of beam member at top floors that increase stability of the structure.3.

III. PROCEDURE AND 3D MODELING OF STRUCTURE

As per criteria for earthquake resistance design of structures, a Residential Building (G+16) with plinth area 576 sq. m. has taken for analysis. Total six different cases have been chosen for parametric analysis, its description shown below. Various dimensions of structure are shown in Table 1, seismic parameters taken have shown in Table 2 respectively.

Dead loads, Live loads, Response spectrum loads are applied on the structure with various load combinations. M25 grade and M 40 grade of concrete used with Fe 415 grade of steel is used. After then six building cases described and each of them abbreviated as discussed below. Figure 1 shows typical floor plan as per selected grid system. After then, comparative results of various parameters shown with the help of graphs that has provided to compare each parameter figuratively.

Table 1: Dimensions of different components of building

Parameters	Values
Building configuration	G + 16
Building type	Residential building
Total plinth area	576m^2
Building Length	4m @ 6 bays

Building Width	6m @ 4 bays
Height of building from Ground level	55 m
Height of each floor and GF height	3 m and 4 m
Depth of footing	3 m
Beam dimensions 1	550 mm x 300 mm with M25 grade
Beam dimensions 2	550 mm x 300 mm with M40 grade
Column dimensions	500 mm x 550 mm with M25 grade
Slab thickness	130 mm
Staircase waist slab	150 mm
Shear wall thickness	180 mm
Material properties	Concrete (M25), (M40) Steel (Fe 415)

Table 2: Seismic parameters on the structure

Parameters	Values
Importance factor I	1.2
Fundamental natural period of vibration (T_a)	$0.09*h/(d)^{0.5}$ $Ta_x = Ta_z$
Fundamental natural period (Ta_x) for X direction	1.0655 seconds
Fundamental natural period (Ta_z) for Z direction	1.0655 seconds
Response reduction factor R	4
Damping ratio	5%
Zone factor	0.16
Soil type	Medium soil

Different building model cases selected for analysis using software approach

1. **CASE BS1** = Beam Stability Case - Beams of same sizes (All M25 grade beams)

2. **CASE BS2** = Beam Stability Case - Beams of different sizes (All M40 grade beams at plinth level)

3. **CASE BS3** = Beam Stability Case - Beams of different sizes (All M40 grade beams at fourth floor level)

4. **CASE BS4** = Beam Stability Case - Beams of different sizes (All M40 grade beams at eight floor level)

5. **CASE BS5** = Beam Stability Case - Beams of different sizes (All M40 grade beams at twelfth floor level)

6. **CASE BS6** = Beam Stability Case - Beam Stability Case - Beams of different sizes (All M40 grade beams at sixteen floor level)
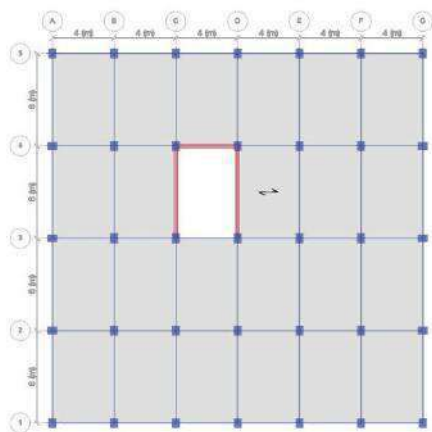
Fig. 1: Typical floor plan
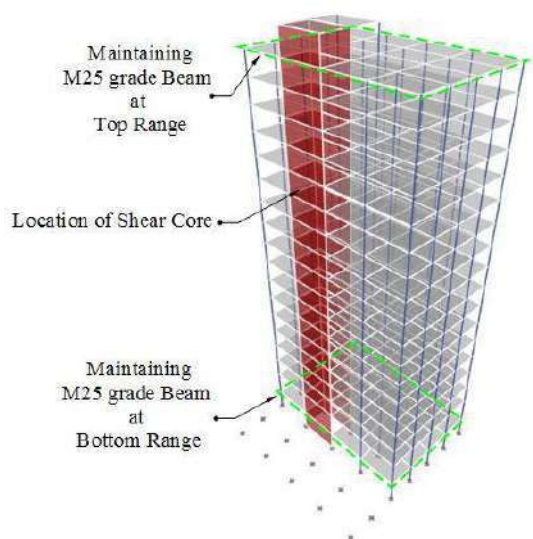
Fig. 2: Beam Stability Case - Beams of same sizes (All M25 grade beams): Case BS1
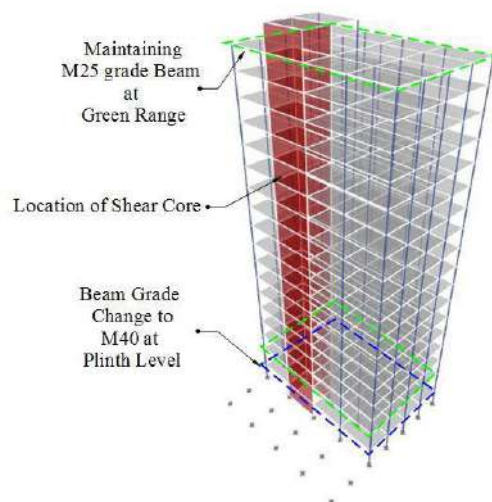
Fig. 3: Beam Stability Case - Beams of different sizes (All M40 grade beams at plinth level): Case BS2
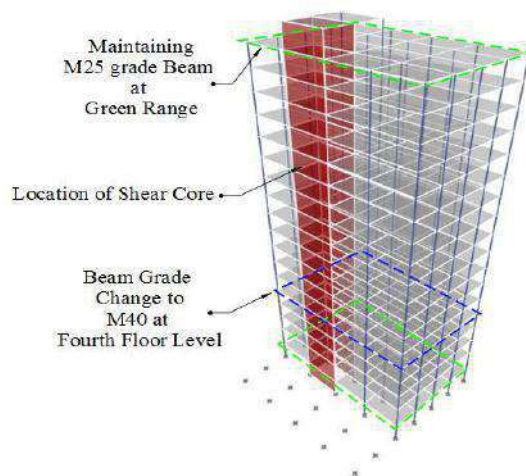
Fig. 4: Beam Stability Case - Beams of different sizes (All M40 grade beams at fourth floor level): Case BS3
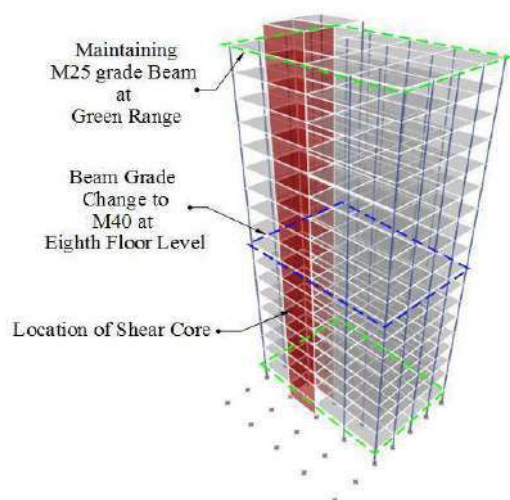
Fig. 5: Beam Stability Case - Beams of different sizes (All M40 grade beams at eight floor level): Case BS4
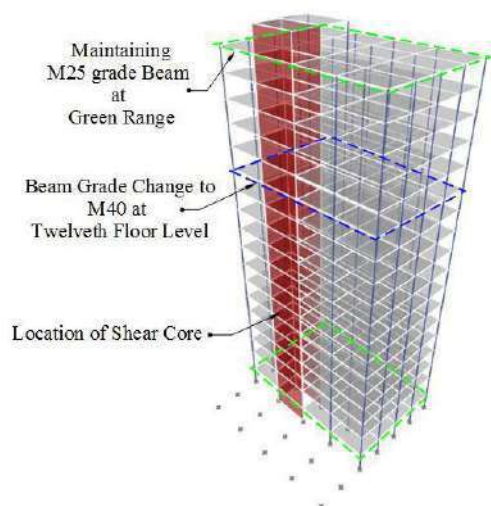
Fig. 6: Beam Stability Case - Beams of different sizes (All M40 grade beams at twelfth floor level): Case BS5
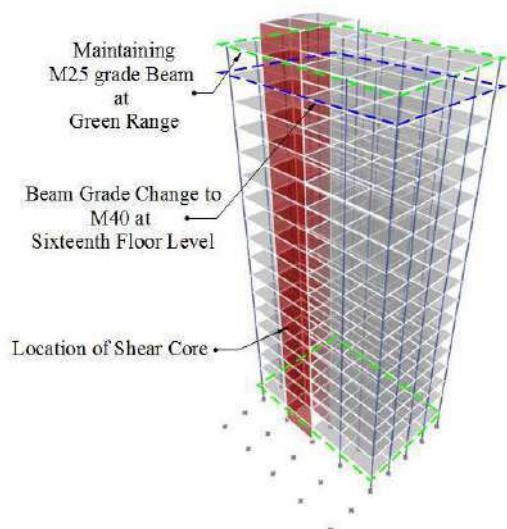
Fig. 7: Beam Stability Case - Beams of different sizes (All M40 grade beams at sixteen floor level): Case BS6

IV. RESULT ANALYSIS

As per the objectives, the Response Spectrum Analysis has been performed on different models consist of beam Stability Case BS1 made up of G+16 storey residential apartment with all beams of same sizes (All M25 grade beams). Beam Stability Case BS2 made up of G+16 residential apartment with all beams of different sizes (All M40 grade beams at plinth level). Beam Stability Case BS3 made up of G+16 storey residential apartment with all beams of different sizes (All M40 grade beams at fourth floor level). Beam Stability Case BS4 made up of G+16 storey residential apartment with all beams of different sizes (All M40 grade beams at eight floor level). Beam Stability Case BS5 made up of G+16 storey residential

apartment with all beams of different sizes (All M40 grade beams at twelfth floor level). Beam Stability Case BS6 made up of G+16 storey residential apartment with all beams of different sizes (All M40 grade beams at sixteen floor level). All the cases are situated in Earthquake Zone III.

Since for the analysis of seismic effects, all the cases of the structures have been analyzed for seismic shake for longitudinal along with transverse direction. Various loads along with load combinations applied on all the cases and reflective result parameters have been analyzed with each other to determine the efficient case. Graphical Representation of each parameter has discussed with its graphical form below:-
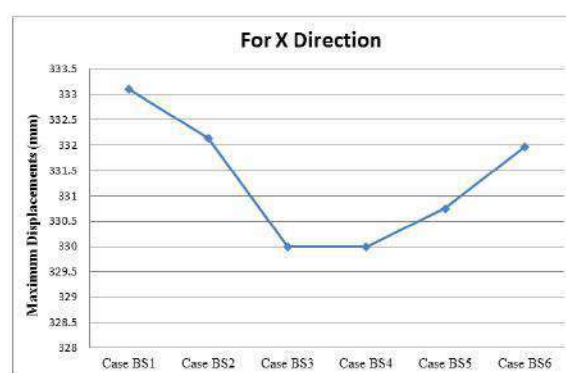
Graph 1: Graphical Representation of Maximum Displacement in X direction for all Beam Stability Cases
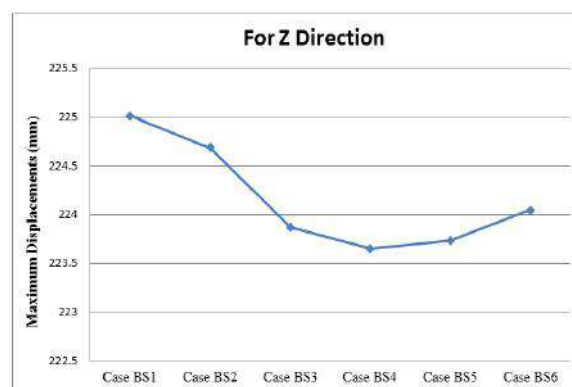
Graph 2: Graphical Representation of Maximum Displacement in Z direction for all Beam Stability Cases
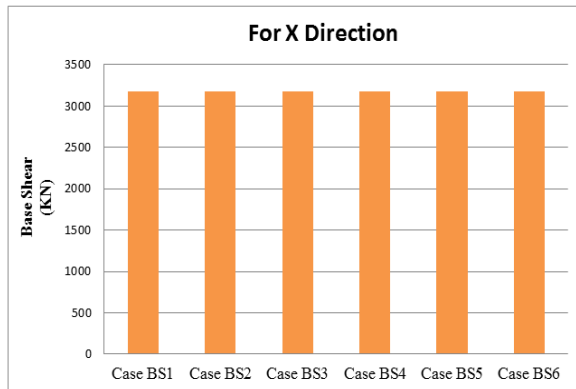
Graph 3: Graphical Representation of Base Shear in X direction for all Beam Stability Cases

Graph 4: Graphical Representation of Base Shear in Z direction for all Beam Stability Cases

Graph 5: Graphical Representation of Maximum Axial Forces in Column for all Beam Stability Cases

Graph 6: Graphical Representation of Maximum Shear Force in Column for all Beam Stability Cases

Graph 7: Graphical Representation of Maximum Bending Moment in Column for all Beam Stability Cases
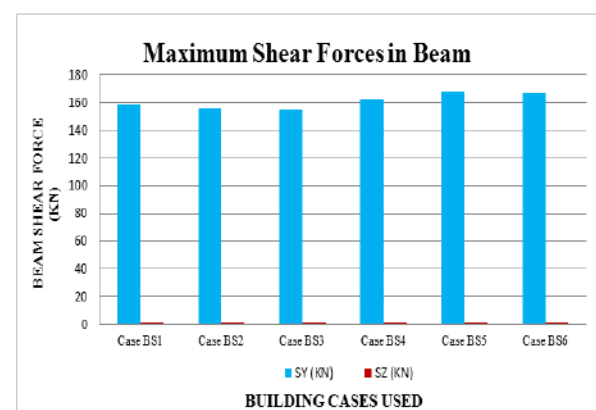
Graph 8: Graphical Representation of Maximum Shear Force in Beam for all Beam Stability Cases
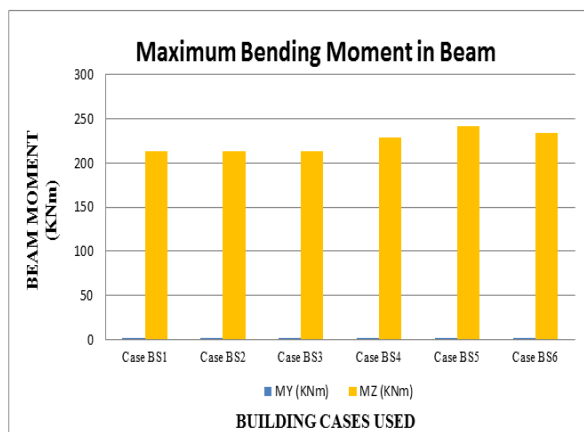
Graph 9: Graphical Representation of Maximum Bending Moment in Beam for all Beam Stability Cases
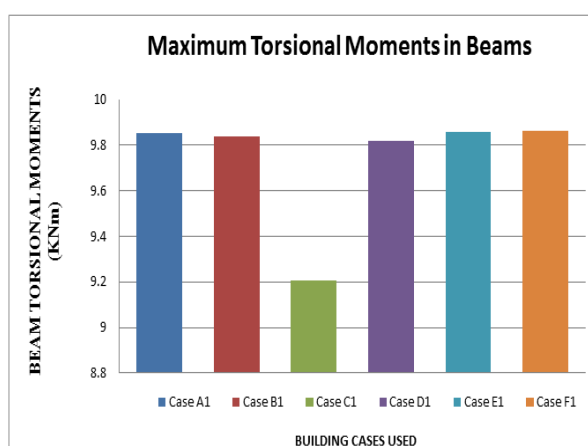
Graph 10: Graphical Representation of Maximum Torsional Moments in Beam for all Beam Stability Cases
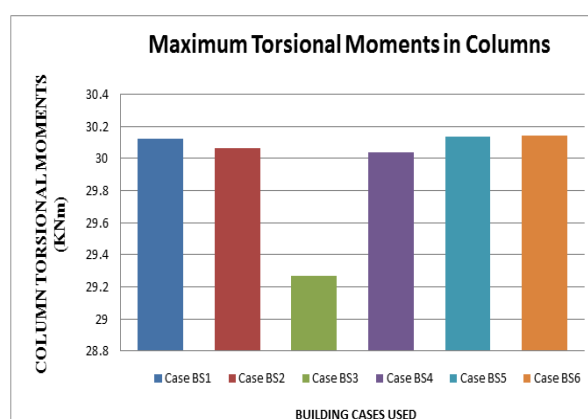
Graph 11: Graphical Representation of Maximum Torsional Moments in Columns for all Beam Stability Cases

V. CONCLUSION

The conclusion can be pointed out are as follows:-

1. Maximum displacement in X direction has a minimum value of around 329 mm for Beam Stability Case BS3 and BS4 since the values keep on decreasing to Beam Stability Case BS3 when beam grade level changes. No special displacement reducing components are implemented in these buildings.

2. Again, the maximum displacement in Z direction behaves same as the X direction when no special displacement reducing components are implemented in these buildings. Case BS3 and BS4 shows good results.

3. Base Shear in X direction for all Beam Stability Cases shows equal values, since no additional mechanisms were added.

4. Again, no additional mechanisms were added, the Base Shear in Z direction behaves same as the trend obtained in X direction. Here, also, no value change has been observed in any Beam Stability Case.

5. The maximum Axial forces in Column keep on decreases to BS6. Observing the least parameter, Beam Stability Case BS6 obtained as an efficient case with a parametric value of 7597.9567 KN.

6. The sectional Shear Forces along both Y-Y axis and Z-Z axis in column members shows least values in Beam Stability Case nearly same in all.

7. The Bending Moment along both Y-Y axis and Z-Z axis in column decreases gradually to Beam Stability Case BS3 and proves to be an efficient case with values of 158.5923 KNm and 175.9371 KNm respectively.

8. For beams in the structures, the minimum value of Shear Forces along both Y-Y axis and Z-Z decreases gradually to Beam Stability Case BS3 and BS4 and proves to be an efficient case with values of 155.0516 KN and 0.1268 KN respectively.

9. Bending Moments in beams Shows least value in Beam Stability Case BS3 along both in Y-Y axis and in Z-Z axis.

10. The main criterion has seen in torsion effects in beams. The values keep on decreasing when grade change done on fourth floor beams. For this parameter, Beam Stability Case BS3 seems to be efficient among all.

11. Similarly, the same trend has seen in Torsional Moments in columns. The values gradually decrease to

a minimum value of 29.2705 KNm for Beam Stability Case BS3 and hence prove to be an economical case.

Observing all the parameters, the main theme of this work has achieved with increasing stability by changing grades of concrete in beam member in both X and Z direction in Residential Apartment, (G+16) multistoried building under seismic loading. Beam Stability Case BS3 and BS4 observed and obtained as efficient case and should be recommended when this type of approach will be adopted in earthquake zone III.

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Some Variants of Water Wave Dispersion Equation, Formulated with Small Amplitude Wave Assumption

Syawaluddin Hutahaean

Ocean Engineering Program, Faculty of Civil and Environmental Engineering,-Bandung Institute of Technology (ITB), Bandung 40132, Indonesia

Abstract— *This research formulates some dispersion equations with formulating procedure similar to the one in formulating dispersion equation of the small amplitude and long wave theory, i.e. by applying velocity potential equation on the Bernoulli surface equation and Kinematic Free Surface Boundary Condition equation.*

Furthermore, this research uses non-linear term of the Bernoulli equation, whereas the Kinematic Free Surface Boundary Condition equation is applied with two scenarios, i.e. neglected non-linear term and not-neglected non-linear term

Wave length from various dispersion equations that are obtained are then compared with breaker length of the breaker index equation.

This research aims only to show that using similar governing equations can be obtained some dispersions equations to produce different wave length.

Keywords— *Dispersion Equation, Wave Length.*

I. INTRODUCTION

Wave length is an important parameter of a water wave. Various phenomena in a water wave that are determined by wave length are among others shoaling and breaking, refraction and diffraction, wave force on a structure, and sediment transportation by a wave. Therefore, a dispersion equation that produces an appropriate wave length is needed.

Dean (1991) formulated dispersion equation an equation to calculate wave length, using two basic equations, i.e. Bernoulli equation at the surface and Kinematic Free Surface Boundary Condition (KFSBC) equation. In both equations, the non-linear term is neglected, by applying an assumption of small amplitude and long wave.

In this research, dispersion equation is formulated using similar governing equation, i.e. Bernoulli surface equation and KFSBC equation by keep applying the small amplitude wave assumption but without applying the long wave assumption. The non-linear term at the Bernoulli equation is still used, whereas the KFSBC is applied in two scenarios, i.e. the neglected non-linear term and the not neglected non-linear term. In the scenario where KFSBC equation is not neglected, the formulation is applied with two different approaches.

The wave length from the resulting dispersion equation is compared with breaker length calculated by breaker index equations from Komar and Gaughan (1972), Mc. Cowan (1894) and Miche (1944). Breaker height is calculated using equation from Komar and Gaughan (1972), using input breaker height breaker depth is calculated withMc.Cowan (1894) equation, using input breaker height and breaker depth, breaker length is calculated using Miche (1944) equation.

II. VELOCITY POTENTIAL EQUATION

By completing Laplace equation with variable separation method, Dean (1991) obtained the following velocity potential equation,

$$\Phi(x,z,t) = A\cos kx \, (Ce^{kz} + De^{-kz})\sin(\sigma t)$$
$$+B\sin kx(Ce^{kz} + De^{-kz})\sin(\sigma t) \quad ....(1)$$

This equation has two components, i.e. $\cos kx$ component and $\sin kx$ component. Hutahaean (2019) shows that both components have similar wave constant, where (1) can be written as,

$$\Phi(x,z,t) = A(\cos kx + \sin kx)(Ce^{kz} + De^{-kz})$$
$$\sin(\sigma t) \quad .....(2)$$

The $coskx$ and $sinkx$ functions have an intersection point where the two functions have similar values, so at that point the velocity potential equation can be written as,

$$\Phi(x,z,t) = 2Acoskx \, (Ce^{kz} + De^{-kz})sin(\sigma t)$$

A new constant is defined, i.e. $A = 2A$

$$\Phi(x,z,t) = Acoskx \, (Ce^{kz} + De^{-kz})sin(\sigma t)$$

....(3)

This velocity potential (3) is an equation at the characteristic point i.e. kx point where $coskx = sinkx$. The formulation of A, C, D constants using (3) will produce a constant value at the characteristic point, where the constant value applies at all points at the wave curve.

At the formulation A, C, D constants with (3), flat bottom is used (Dean (1991), i.e. by applying the bottom water kinematic boundary condition, where at the flat bottom $\frac{dh}{dx} = 0$ applies where $h(x)$ is water depth. Hence, the bottom water kinematic boundary condition in the form of $w = -u\frac{dh}{dx}$ becomes $w = 0$, or $\frac{d\Phi}{dz} = 0$ at $z = -h$. The following is obtained

$$\Phi(x,z,t) = Gcoskx \, cosh(h+z)sin\sigma t \quad ......(4)$$

Where wave constant $G = 2ADe^{kh}$ is defined. The detail of the formulation can be seen in Dean (1991).

III. DISPERSION EQUATION OF THE LINEAR WAVE THEORY

3.1. Water Surface Equation of the Linear Wave Theory

In this section dispersion equation of linear wave theory or small amplitude and long wave theory is formulated with a procedure corresponds to the one in Dean (1991).

3.1. Applying Bernoulli Equation at the Surface,

The Bernoulli equation at the surface is,

$$-\frac{d\Phi_\eta}{dt} + \frac{1}{2}\left(u_\eta^2 + w_\eta^2\right) + g\eta + \frac{p_\eta}{\rho} = C(t) \quad ......(5)$$

By applying an assumption that the wave amplitude is very small then η, where η is the water surface elevation vis-à-vis still water level, will also be very small, so that the surface pressure can be considered as equal on the entire surface and if the reference is the atmospheric pressure then $p_\eta = 0$.

By applying an assumption that the wave amplitude is very small, then the velocity of particles u and w are also very small number so that in Bernoulli equation the second term is much smaller than the third term and therefore can be neglected.

$$-\frac{d\Phi_\eta}{dt} + g\eta = C(t)$$

Substitute the potential flow equation, water surface equation is obtained, i.e.,

$$\eta(x,t) = \frac{G\sigma}{g}coskx \, cosk(h+\eta)cos\sigma t + \frac{C(t)}{g}$$

or

$$\eta(x,t) = \frac{G\sigma}{g}coskx \, coskh\left(1 + \frac{\eta}{h}\right)cos\sigma t + \frac{C(t)}{g}$$

For a very small wave amplitude A, then $\frac{\eta}{h} \ll 1$, therefore the last equation becomes,

$$\eta(x,t) = \frac{G\sigma}{g}coskx \, coskhcos\sigma t + \frac{C(t)}{g}$$

$\eta(x,t)$ has an average value against time that is equal to zero, then $C(t) = 0$, the water surface equation becomes,

$$\eta(x,t) = \frac{G\sigma coskh}{g}coskx \, cos\sigma t$$

or

$$\eta(x,t) = Acoskx \, cos\sigma t \quad ......(6)$$

It is defined that

$$A = \frac{G\sigma coskh}{g} \quad .....(7)$$

where A is the wave amplitude. (6) can be written to be an equation for G, i.e.

$$G = \frac{Ag}{\sigma coshkh} \quad .....(8)$$

$$\Phi(x,z,t) = Gcoskx \, coshk(h+z)sin\sigma t \quad ....(9)$$

(9) is velocity potential equation of the linear wave theory. The velocity particle equation in the horizontal direction at the surface for small amplitude and long wave is

$$u_\eta = -\frac{d\Phi}{dx}\bigg|_{z=\eta} = Gksinkx \, coshkhsin\sigma t$$

........(10)

Whereas the particle velocity in the vertical direction at the surface is

$$w_\eta = -\frac{d\Phi}{dz}\bigg|_{z=\eta} = -Gkcoskx \, sinhkhsin\sigma t$$

........(11)

To ease the writing, constant G is still used with the value as in (8).

3.2. Applying the Surface Kinematic Boundary Condition

The next constant to be formulated its equation is wave number k, which will be formulated using surface kinematic boundary condition equation, i.e.,

$w_\eta = \frac{d\eta}{dt} + u_\eta \frac{d\eta}{dx}$ ....(12)

For small amplitude andlong wave, $\frac{d\eta}{dx}$ is a very small number and can be neglected, hence (9) becomes

$w_\eta = \frac{d\eta}{dt}$ ...(13)

Substitute (11) and (6),

$-Gk coskx\ sinhkh sin\sigma t = -\frac{G\sigma^2 coshkh}{g} coskx\ sin\sigma t$

A relation is obtained, i.e.

$\sigma^2 = gk\ tanhkh$ ....(14)

This equation is a dispersion equation of linear wave theory to calculate wave number k, whereas wave length can be calculated with a relation $L = \frac{2\pi}{k}$.

In deep water, the relation $tankh = 1$ applies, hence, dispersion equation becomes,

$\sigma^2 = gk$

From this equation, wave number in the deep water is obtained, i.e.

$k_0 = \frac{\sigma^2}{g}$ ....(15)

IV.   DISPERSION EQUATION OF SHORT WAVE

In this section, the formulation of dispersion equation will be done using Bernoulli equation at the surface and KFSBC equation as in the formulation of dispersion equation of linear wave theory. However, the long wave assumption is not applied and a complete Bernoulli equation is used instead.

4.1.   Water Surface Equation of a Complete Bernoulli Equation

In this section, water surface equation will be formulated using a complete Bernoulli equation i.e. (5). Substitute (9), (10) and (11) to (5), using $C(t) = 0$,

$\eta(x,t) = \frac{G\sigma}{g} coskx\ coshkh cos\sigma t$
$\qquad - \frac{G^2}{2g} k^2 sin^2 kx\ cosh^2 kh sin^2 \sigma t$
$- \frac{G^2}{2g} k^2 cos^2 kx\ sinh^2 kh sin^2 \sigma t$ ...(16)

(16) is non-linear water surface equation for small amplitude wave. Time differential from (16) is,

$\frac{d\eta}{dt} = -\frac{G\sigma^2}{g} coskx\ coshkh sin\sigma t$

$\qquad - \frac{G^2}{g} k^2 \sigma sin^2 kx\ cosh^2 kh sin\sigma t cos\sigma t$
$\qquad - \frac{G^2}{g} k^2 \sigma cos^2 kx\ sinh^2 kh sin\sigma t cos\sigma t$

........(17)

4.2.   Applying KFSBC Equation

As with the formulation of dispersion equation in the previous section, dispersion equation is formulated using KFSBC equation, i.e. (12). Substitute (9) and (10) to (12),

$\frac{d\eta}{dt} = -Gk coskx\ sinhkh - Gk sinkx\ coshkh \frac{d\eta}{dx}$ ....(18)

By equalizing (17) with (18) and applying it at the characteristic point, where $coskx = sinkx$ and the characteristic point is also applied at domain time t, i.e. $cos\sigma t = sin\sigma t$, the following is obtained

$-\frac{\sigma^2}{g} coshkh - \frac{G}{2g} k^2 \sigma\ (cosh^2 kh + sinh^2 kh) =$
$\qquad\qquad -k\ sinhkh - k\ coshkh \frac{d\eta}{dx}$

.....(19)

4.2.1.   KFSBC linearand G linear

In this section, the long wave assumption is applied where the second term in the right side (19) is very small compared to the first term, and relation G i.e. (8) is used to obtain dispersion equation in other form, i.e. ,

$\sigma^2 = gk\ tanhkh - \frac{gA}{2} k^2 (1 + tanh^2 kh)$ ...(20)

Equation (20) shows that wave number or wave length is also determined by wave amplitude.

4.2.2.   KFSBC nonlinear, G linear, $\frac{d\eta}{dx}$ linear

In (19), G of (8) is substituted to (19) whereas $\frac{d\eta}{dx}$ is substituted with (6) and was applied at the characteristic point to obtain

$\sigma^2 = gk\ tanhkh - \frac{gA}{2} k^2 (2 + tanh^2 kh)$ ...(21)

(21) is another form of dispersion equation, where the wave amplitude is the parameter, so that the resulting wave length is also determined by wave amplitude.

4.2.3.   KFSBC nonlinear, G and $\frac{d\eta}{dx}$ nonlinear.

Substitute $\frac{d\eta}{dx}$ to (19)   with differential (16) against horizontal x axisand apply to the characteristic point , the following equation is obtained

$$Gk^2\sigma\,(cosh^2kh + \, sinh^2kh) =$$
$$-2\sigma^2 coshkh + 2gk\,sinhkh$$
$$-\left(G\sigma k\,^2 cosh^2kh + \frac{G^2}{2}k^4 coskh\right).......(22)$$

The water surface elevation η of (6) at the characteristic point is,

$$\eta = \frac{A}{2} \quad ...... \quad (23)$$

Then (16) is applied to the characteristic point and is equalized with (23), and the following equation is obtained,

$$gA = G\sigma\,coshkh - \frac{G^2}{4}k^2(cosh^2kh + sinh^2kh)$$
......(24)

(22) and (24) are two simultaneous equations with unknown wave constant G and wave number k. With input wave amplitude A, water depth h and wave period T where $\sigma = \frac{2\pi}{T}$, wave contant G and wave number k can be calculated with (22) and (24).

The result of wave length calculation with (14), (20), (21) and with the system of equation (22) and (24) is presented in table (1). On that table, L_{14} is the wave length calculated with (14), L_{20} is the wave length calculated with (20), and so forth

Table 1. Wave Length from four dispersion equations

Wave length L (m)

h	L_{14}	L_{20}	L_{21}	L_{22+24}
(m)				
20	88,79	83,66	80,43	80,42
19	87,63	82,57	79,36	79,39
18	86,35	81,38	78,19	78,26
17	84,96	80,07	76,88	77,01
16	83,45	78,63	75,45	75,63
15	81,79	77,04	73,87	74,11
14	79,98	75,31	72,12	72,42
13	78,01	73,4	70,19	70,56
12	75,85	71,3	68,07	68,49
11	73,49	68,98	65,71	66,21
10	70,9	66,43	63,1	63,66

Table (1), presents the result of wave length calculation with (14), (20), (21) and ((22)+(24)) using a wave with wave period $T = 8$ seconds and wave amplitude $A = 1.0$ m. The result of the calculation shows that L_{14} is the longest, whereas, L_{21} and L_{22+24} is more or less equal although L_{21} is relatively shorter. In addition, there is a constraint at ((22)+(24)), i.e. it cannot be used in a shallow water. Henceforth, ((22)+(24)) can no longer be used.

Wave length calculation is then done with wave period $T = 8$ seconds and wave amplitude $A = 1.0$ m in a shallow water, with the result of the calculation as presented in table (2), where $\delta = \frac{L_{\cdot 14} - L_{21}}{L_{\cdot 14}} x100\%$.

Table 2. Comparison of wave length in a shallow water.

h	Wave length L (m)			δ
(m)	L_{14}	L_{20}	L_{21}	(%)
20	88,79	83,66	80,43	9,42
18	86,35	81,38	78,19	9,46
16	83,45	78,63	75,45	9,58
14	79,98	75,31	72,12	9,83
12	75,85	71,3	68,07	10,26
10	70,9	66,43	63,1	11
8	64,9	60,47	56,94	12,27
6	57,5	52,98	49,08	14,65
4	48,01	43,14	38,38	20,04
2	34,69	28,5	19,34	44,24

In the deep water, the difference between L_{14} and L_{21} could reach 9.5 %, whereas in shallow water the difference could reach 44 %.

Furthermore, the effect of wave amplitude A on (21) will be studied using a wave with wave period of $T = 8$ sec., with various wave amplitudes, i.e. 0.20 m, 0.60 m and 1.0 m, with the result of the calculation as presented in table(3). It shows that the larger the wave amplitude the shorter the wave length. It can be concluded that wave amplitude is to shorten the wave length.

Table.3: Wave Length from (21) at various wave amplitude values

Wave Length L (m)

h	$A = 0.2$	$A = 0.6$	$A = 1.0$
(m)	(m)	(m)	(m)
20	87,28	84,04	80,43

18	84,88	81,72	78,19
16	82	78,91	75,45
14	78,56	75,52	72,12
12	74,45	71,44	68,07
10	69,5	66,49	63,1
8	63,48	60,42	56,94
6	56,02	52,8	49,08
4	46,37	42,75	38,38
2	32,6	27,66	19,34

To see the effect of the difference in wave length, particle velocity in the direction of horizontal x is used with the result of the calculation as presented in table (4), using a wave with wave period $T = 8$ sec., wave amplitude $A = 1.0$ m, and velocity calculated at $z = -0.25$ h. The calculation of the wave number is done using (14), (20) and (21). In table (4) t $u14$ is the particle velocity calculated using wave number from (14), and so forth, whereas $\delta = \frac{u21 - u14}{u14} x 100$ %.

Table.4. Particle velocity in the direction of horizontal x, u

h	$u14$	$u20$	$u21$	δ
(m)	(m/sec)	(m/sec)	(m/sec)	(%)
20	0,66	0,68	0,69	5,66
18	0,7	0,72	0,74	6,02
16	0,74	0,77	0,79	6,47
14	0,8	0,83	0,86	7,05
12	0,87	0,91	0,94	7,84
10	0,96	1,01	1,04	8,97
8	1,08	1,14	1,19	10,76
6	1,25	1,34	1,43	13,98
4	1,55	1,7	1,88	21,55
2	2,2	2,64	3,73	69,64

The difference between $u14$ and $u21$ is quite large where the shallower the water the greater the difference.

V. COMPARISON WITH BREAKERINDEXES.

As a comparator of wave length produced by dispersion equation, breaker length of breaker Indexes are used. The procedure of calculating the breaker length using breaker indexes is as follows

Breaker height that is calculated with the Komar and Gaughan equation (1972) is

$$\frac{H_b}{H_0} = 0.56 \left(\frac{H_0}{L_0}\right)^{-1/5} \text{.......(24)}$$

H_b is breaker height, H_0 is deep water wave height and L_0 is deep water wave length calculated with (15).

Breaker depth that is calculated with McCowan (1894) equation is

$$\frac{H_b}{h_b} = 0.78 \quad \text{......(25)}$$

h_b is breaker depth, whereas breaker height H_b is obtained from (24).

Breaker length that is calculated using Miche (1944) equation is

$$\frac{H_b}{L_b} = 0.142 tanh \left(\frac{2\pi h_b}{L_b}\right) \text{....(26)}$$

L_b is breaker length. Breaker height H_b was obtained from (24) whereas breaker depth h_b was obtained from (25).

The calculation of breaker height with (24) requires an input of deep water wave height H_0 and wave period T for the calculation of deep water wave length L_0. Those two parameters were obtained by applying Wiegel equation (1949,1964).

By establishing a wave period T, deep water wave height H_0 is calculated using Wiegel equation (1949,1964), i.e.

$$T = 15.6 \sqrt{\frac{H_0}{g}} \quad \text{.....(27)}$$

or

$$H_0 = \frac{gT^2}{15.6^2} \quad \text{......(28)}$$

Where g is gravitational velocity $\left(9.81 \frac{m}{sec^2}\right)$, deepwater wave height H_0 is in meter unit. The result of the calculation of the breaker length with this procedure is presented in table (5).

Table.5: Breaker length L_b in various wave periods.

T	H_0	H_b	h_b	L_b
(sec.)	(m)	(m)	(m)	(m)
6	1,45	1,69	2,16	20,41
7	1,98	2,3	2,95	27,78
8	2,58	3	3,85	36,28
9	3,27	3,8	4,87	45,92
10	4,03	4,69	6,01	56,69

| 11 | 4,88 | 5,68 | 7,28 | 68,6 |
| 12 | 5,8 | 6,75 | 8,66 | 81,63 |

Furthermore, with breaker depth h_b and with an assumption of sinusoidal wave where $A = \frac{H_b}{2}$, wave length is calculated with (14), (20) and (21), with the result as presented in table (6), where on the table, L_{14} is wave length of (14), L_{20} is wave length of (20) and L_{21} is wave length of (21).

Table.6: The comparison of wavelength of dispersion equation with breaker length L_b

T	L_b	L_{14}	L_{20}	L_{21}
(sec.)	(m)	(m)	(m)	(m)
6	20,41	26,53	22,05	15,67
7	27,78	36,11	30,02	21,33
8	36,28	47,17	39,21	27,86
9	45,92	59,7	49,62	35,26
10	56,69	73,7	61,26	43,54
11	68,6	89,18	74,13	52,68
12	81,63	106,13	88,22	62,7

Table (6) shows that L_{20} is the closest to L_b. However, if it is viewed based on wavesteepness criteria of Michell (1893) where $\frac{H}{L} = 0.142$, then the one that makes wave steepness to be closer to critical wave steepness is L_{21}, as presented in table (7).

Table.7: Comparison of wave steepness

T (sec.)	$\dfrac{H_b}{L_b}$	$\dfrac{H_b}{L_{14}}$	$\dfrac{H_b}{L_{20}}$	$\dfrac{H_b}{L_{21}}$
6	0,083	0,064	0,077	0,108
7	0,083	0,064	0,077	0,108
8	0,083	0,064	0,077	0,108
9	0,083	0,064	0,077	0,108
10	0,083	0,064	0,077	0,108
11	0,083	0,064	0,077	0,108
12	0,083	0,064	0,077	0,108

VI. CONCLUSION

As a conclusion, from a governing equation can be obtained e some dispersion equations that produce various wave lengths. The higher the level of the precision, the shorter the wave length. Even using an assumption of small amplitude wave, dispersion equation with wave amplitude

as its parameter can be resulted. The influence of wave amplitude is to shorten the wave length.

Variety of dispersion equations producing variety of wave lengths require a criteria on the appropriate wave length. One of the criteria that can be used is critical wave steepness,

Further research needed is formulating dispersion without applying an assumption of small amplitude wave and by taking into account the criteria of critical wave steepness.

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Use and Diversity of Medicinal Plants in Aquaculture Practices

Elias Fernandes de Medeiros Júnior[1,*], Eugênio Bispo da Silva Júnior[1],
Xenusa Pereira Nunes[1], Rosimeire Morais Cardeal Simão[1], CleoniVirginio da
Silveira[2], Luciana Souza de Oliveira[2], Lucia Marisy Souza Ribeiro de
Oliveira[3], Denes Dantas Vieira[3], XirleyPereira Nunes[3]

[1]PhD students from the doctoral graduate program in Agroecology and Territorial Development, Federal University of the São Francisco River Valley (UNIVASF)-Brazil
[2] PhD Professor, of the IFAM-*Campus* São Gabriel da Cachoeira-AM
[2]PhD Professor, Federal Institute of Education, Science and Technology of Sertão Pernambucano, *Campus* Petrolina Zona Rural, Brazil
[3]PhD Professor, doctoral graduate program in Agroecology and Territorial Development, Federal University of the São Francisco River Valley (UNIVASF)-Brazil
*Corresponding Author

Abstract—Medicinal plants are widely used in Brazilian folk medicine because of their various properties. Their chemical components have attracted the attention of researchers from the field of animal production, particularly aquaculture. This study aimed to analyze the use of medicinal plants in aquaculture practices. The main results showed that medicinal plants have been used in the management of anesthesia, in antibacterial, antifungal, and antiparasitic treatments, and as growth-promoting additives. When the potential of Brazilian flora is considered, little knowledge has been gained about the use of medicinal plants in aquaculture practices, especially when considering the native species, which may represent an important research front in the development of phytopharmaceuticals for the treatment of diseases of cultured aquatic organisms.

Keywords—Fish farming, Plant extract, Tambaqui, Tilapia.

I. INTRODUCTION

In 2016, the world aquaculture production, including aquatic plants, was 110.2 million tons (FAO, 2018). In this context of growing aquaculture activities, Brazilian fish farming reported an 8% growth in 2017, with a total production of 691,700 tons of farmed fish (Peixe & Peixe, 2018). Success in fish farming depends on a number of management practices, including water quality control, quarantine of newly acquired batches, and providing quality and balanced food. This ensures fish health and, consequently, disease prevention (Santos et al., 2013).

According to Tavechio et al. (2009),many of the diseases affecting fish farming are caused by infectious agents that can make the activity costly and unprofitable due to high mortality during outbreaks of infection/infestation. Natural products have been the objects of growing attention, representing a potential alternative as antibacterial agents in the culture of aquatic organisms, mainly because of their easy availability, relatively low cost, and proven efficiency against a number of pathogens (Galina, Yin, Ardó, & Jeney, 2009; Nazzaro, Fratianni, De Martino, Coppola, & De Feo, 2013).

Herbal medicines and compounds from plants (phytopharmaceuticals) can be applied as prophylactic or therapeutic measures against bacterial diseases in aquatic organisms, mainly using two methods: through bathing or by incorporating in the feed(Saccol et al., 2013; Sutili et al., 2014). The substances found in essential oils and plant extracts can act directly on bacteria, causing cell lysis, inhibiting the antibacterial activity of other substances, or inhibiting bacterial resistance mechanisms and virulence factors (Stavri, Piddock, & Gibbons, 2007).

Thus, considering the nutritional, immunological, bactericidal, antifungal, anthelmintic, and antiparasitic properties of medicinal plants, among other benefits, this

study aimed to analyze the use of medicinal plants in aquaculture practices.

II.   MATERIALS AND METHODS

This study was conducted from August to September 2019; it is a qualitative and quantitative review of the literature about the use of medicinal plants in aquaculture practices. Data were searched in three databases: Google Scholar, SciELO, and the journal database of the Brazilian Coordination for the Improvement of Higher-Education Personnel (CAPES),using "AND" as the Boolean operator. The keywords or indexing terms were"medicinal plants AND aquaculture,""medicinal plants AND fish farming,""medicinal plants AND tambaqui (*Colossoma macropomum*),"and "medicinal plants AND tilapia (*Oreochromis niloticus*)."The latter two searches included the scientific name of the species most commonly produced in aquaculture freshwater in Brazil.

The inclusion criteria were scientific articles published in scientific journals in the last 10 years only (2009–2019). Duplicate articles or articles not related to the study theme, as well as abstracts in annals of scientificjournals, dissertations, theses, technical newsletters,and other documents were excluded. The data collected from the articles were inserted into Microsoft Office Excel® 2010 spreadsheets for content analysis and data tabulation.

III.   RESULTS AND DISCUSSION

The search in the SCIELO database found only one article based on the descriptor "medicinal plants AND aquaculture," one article for "medicinal plants AND fish farming," no results for "medicinal plants AND tambaqui (*Colossoma macropomum*)."and two results for "medicinal plants AND tilapia (*Oreochromis niloticus*)."In CAPES journals, six articles were found for "medicinal plants AND aquaculture,"but only one met the inclusion criteria;ten results were found for "medicinal plants AND fish farming,"but only two were related to the study theme;and two articles each were found for both "medicinal plants AND tambaqui" and "medicinal plants AND tilapia."

In the Google Scholar database, 2,300 articles were found for "medicinal plants AND aquaculture," 2,850 for "medicinal plants AND fish farming," 549 for "medicinal plants AND tambaqui (*Colossoma macropomum*)," and 1,360 for "medicinal plants AND tilapia (*Oreochromis niloticus*)." After a careful analysis of all Google Scholar search results, only 28 items were related to the study theme, and they were selected for content analysis.

The medicinal plants most commonly used in aquaculture practices were pitanga (*Eugenia uniflora* L.), *Hyptidendron canum* (Pohl ex Benth.) Harley, clove basil (*Ocimum gratissimum*L.), mint (*Mentha arvensis* L.),clove (*Eugenia caryophyllus*L.), passion flower (*Passiflora incarnata*L.), aloe vera (*Aloe vera*(L.) Burm. f.), lemon balm(*Lippia*spp.L.)(Verbenaceae), cockspur coral tree (*Erythrina crista-galli*L.), velame (*Croton heliotropiifolius*Kunth), country almond(*Terminalia catappa*L.), yellow cinnamon (*Nectandra grandiflora* Ness), and plants from thePiperaceae family.Table 1 shows the use of these medicinal plants in aquaculture practices.

Table 1. List of medicinal plants used in aquaculture and their applications

Medicinal plants	Effect/use in aquaculture	Fish species	Reference
Pitanga (*Eugenia uniflora* L.)	Clinical study	*Oreochromis niloticus*	Fiuza et al. (2011)
Hyptidendron canum (Pohl ex Benth.) Harley	Clinical study	*Oreochromis niloticus*	Fiuza et al. (2015)
Clove basil (*Ocimum gratissimum* L.)	Anesthesia	*Brycon amazonicus*	Ribeiro et al. (2016)
Mint(*Mentha arvensis* L.)	Anesthesia	*Colossoma macropomum*	Façanha & Gomes (2005)
	Anesthesia	*Xiphophorus maculatus*	Hoshiba et al. (2015)
	Anesthesia	*Centropomus parallelus*	Souza et al. (2012)
	Anesthesia	*Piaractus mesopotamicus*	Gonçalves et al. (2008)
Clove (*Eugenia caryophyllus* L.)	Anesthesia	*Piaractus mesopotamicus*	Gonçalves et al. (2008)
	Anesthesia	*Centropomus parallelus*	Souza et al. (2012)

Passion flower (*Passiflora incarnata* L.)	Nutrition	*Oreochromis niloticus*	Oliveira, Pereira-Da-Silva, & Bueno (2010)
Aloe vera (*Aloe vera* (L.) Burm. f.)	Semen cryopreservation	*Colossoma macropomum*	Melo-Maciel et al. (2015)
Lemon balm (*Lippia* spp.L.)	Nutrition	*Oreochromis niloticus*	Rodrigues-Soares et al. (2018)
	Antibacterial	*Colossoma macropomum*	Oliveira et al. (2018)
Cockspur coral tree (*Erythrina crista-galli* L.)	Anesthesia	*Carassius auratus*	Siqueira, Sousa, Tirloni, & Gebara(2019)
Velame (*Croton heliotropiifolius* Kunth)	Nutrition	*Oreochromis niloticus*	Souza et al. (2018)
Country almond (*Terminalia catappa* L.)	Nutrition	*Oreochromis niloticus*	Santos et al. (2015)
	Antiparasitic	*Colossoma macropomum*	Claudiano et al. (2009)
	Behavior/Performance	*Betta splendens*	Santos et al. (2013)
Yellow cinnamon (*Nectandra grandiflora* Ness)	Antiparasitic	—	Rodrigues et al. (2017)
Piperaceae (spp.)	Anthelmintic	*Colossoma macropomum*	Santos et al. (2018)

Source: The authors themselves (2019).

3.1 Pitanga (*Eugenia uniflora* L.)

The *pitanga* tree (*E. uniflora* L.) has edible fruits that are well known and appreciated in Brazil; the infusion of its leaves has applications in folk medicine mainly as a hypotensive, anti-gout, stomachic, and hypoglycemic agent (Auricchio & Bacchi, 2003). In vitro and in vivo tests have shown that extracts from the leaves of *E. uniflora* L. have several pharmacological properties, such as antidiarrheal, diuretic, anti-inflammatory, and antifungal actions(Almeida, Faria, & Silva, 2012). Fiuza et al. (2011) found that tilapia (*Oreochromis niloticus*) exposed to different *E. uniflora* L. extracts and leaf fractions had a vasodilation effect on gills, and toxic effects, such as detachment and desquamation of the respiratory epithelium and hyperplasia of the interlamellar epithelium cells.These effects were more pronounced in those individuals who received the highest concentrations. This study contributed to establish *Nile tilapia* as a model system for testing active ingredients of plants, such as the vasodilation effect, the effect on cell morphology and on the tissues of the gills, the main respiratory organ of fishes.

3.2 *Hyptidendron canum*(Pohl ex Benth) Harley

Hyptidendron belongs to theLamiaceae family, which consists of herbs, shrubs, and trees, with usually quadrangular branches (Fiuza et al., 2010). *Hyptidendron canum* is native to the Brazilian savannah (*cerrado*) regionsand is frequently used in alternative medicine for

the treatment of malaria, with anti-inflammatory, anti-ulcerative, and anti-hepatotoxic actions (Brandão, 1991; Ferri &Ferreira, 1992). Desquamation of the respiratory epithelium, changes in curvature, cell hyperplasia, and vasodilation in the lamellae and in the central vessel of the filaments were the main results that Fiuza et al. (2015) found in the gills of *O. niloticus*submitted to ethanol extract and to hexane, chloroform, and ethyl acetate fractions of *H. canum*. The authors pointed out that *H. canum*caused inflammatory processes and injuries that varied according to the dose administered.

3.3 Clove basil (*Ocimum gratissimum*L.)

Ocimum gratissimum, popularly known as clove basil, belongs to the family Lamiaceae, one of the largest families of angiosperms (Cruz & Bezerra, 2017).In traditional medicine, *O. gratissimum* has several indications, such asan anti-flu bath, and diuretic, febrifugal, anti-bleeding, antifungal, antioxidant, antibacterial, antidiarrheal, hypoglycemic, and anti-inflammatory indications (Lemos et al.2005; Stanley, Ifeanyi, Chinedum, & Chinenye,2014). The use of *O.gratissimum*in aquaculture activities is associated with the presence of eugenol, the main active component present in the plant, which has been studied as a natural anesthetic used in fish farming. Ribeiro et al. (2016) used the essential oil of clove basil as a natural anesthetic in young *matrinxã* (*Brycon amazonicus*), a neotropical fish found in the Amazon

region, without side effects on the fish; as no death was reported for 30 days, the authors suggested that the essential oil of *O. gratissimum* did not pose any risk for handlers at a concentration of 20–60 mg.L⁻¹ fora 10-min exposure, , thus allowing its use in *matrinxã* anesthesia.

3.4 Mint (*Mentha arvensis* L.)

The*Mentha*genus comprises approximately 25 different species of mints and related plants that belong to the Lamiaceae family (Watanabe, Nosse, Garcia, & Pinheiro Povh, 2006). Mint (*Mentha arvensis* L.) is an aromatic plant, with menthol as the substance found in the largest amounts in the composition of its essential oil (Paulus et al. 2007; Arrigoni-Blank, 2011). Menthol is a natural anesthetic, which has been used for different species grown in Brazil, proving to be efficient and safe in fish anesthesia procedures, mainly in the following species:tambaqui (*Colossoma macropomum*) (Façanha & Gomes, 2005); platys (*Xiphophorus maculatus*) (Hoshiba et al. 2015); *robalo-peva* (*Centropomus parallelus*), and*pacu* (*Piaractus mesopotamicus*) (Gonçalves, Santos, Fernandes, & Takahaski,2008).

3.5 Clove (*Eugenia caryophyllus* L.)

The clove plant belongs to the Myrtaceae family, which has approximately 3,000 species of tropical and subtropical trees and shrubs. Its scientific name varies with its classification; it was recently classified as *Syzygium aromaticum*(L.) Merr.et Perry, despite several previous citations, as follows: *Eugenia caryophyllus* (Sprengel) Bullock et Harrison, *Caryophyllus aromaticus* L, *E. caryophyllata* Tumb, and *E. aromatica* (L) Baill (Maeda, Bovi, Bovi, & Lago, 1990). Eugenol, the main component of the plant, has anti-inflammatory, healing, and analgesic effects, and it is effective in reducing bacteria present in the mouth (Silvestri et al., 2010). The use of cloves in aquaculture is related to the need to anesthetize cultivated organisms for performing management practices, such as biometrics, reproduction, and transport.The use of cloves has been recommended for *robalo-peva* (Souza et al., 2012) and *pacu* (Gonçalves et al., 2008) juveniles, proving to be safe and efficient for the animals handled.

3.6 Passion flower(*Passiflora incarnata* L.)

Passion flower, of the *Passiflora incarnata*species, has the potential to reduce stress.Its activity is related to the presence of pyronic derivatives, harman alkaloids, and flavonoids, to which sedative and anxiolytic effects are attributed (Dhawan, Kumar, & Sharma,2003). In a study conducted by Oliveira et al. (2010), the authors suggested that passion flower extract could be included in the diet of young tilapia, without prejudice to food consumption and growth. They also reported that the extract changed the

morphometry of hepatocytes, suggesting the activity of flavonoids on carbohydrate metabolism, which contributed to increased glycogen levels in liver, particularly in the group that received 100 mg.kg⁻¹ of the extract.

3.7 Aloe vera (*Aloe vera*(L.)Burm. f.)

*Aloe vera*belongs to the Aloaceae family,which includes approximately 15 genera and 800 species. It is a herbaceous plant that grows on any type of soil, but it is better adapted to light and sandy soils and does not require much water (Freitas, Rodrigues, & Gaspi,2014). It is very common in Brazil, where it is popularly used in wound healing, in the treatment of burns, conjunctivitis, rheumatic pain, and other uses (Guerra, Araújo, & Oliveira,2008; Araújo, Lemos, Menezes, Fernandes, & Kenrtopf,2015). The use of *Aloe vera* in fish farming was studied by Melo-Maciel et al. (2015) in tambaqui semen cryopreservation, and the authors concluded that *A. vera*as a crude extract did not improve sperm production during the cryopreservation process.

3.8 Lemon balm(*Lippia*spp.Linn.)

The*Lippia*genus (Verbenaceae) includes approximately 200 species of herbs, shrubs, and small trees mainly found in Central America and in the tropical regions of Africa, North America, South America, and Australia (Reis et al. 2014; Gomes, Nogueira, & Moraes,2011). The species of this genus are widely used in folk medicine because they have anti-inflammatory, antifungal, antiseptic, antihypertensive, anxiolytic, anti-*Leishmania*, antiviral, and digestive properties, among other applications (Soares & Tavares-Dias, 2013; Costa, Souza, Brito, & Fontenelle,2017). Rodrigues-Soares et al. (2018) added *Lippia alba*essential oil to the feed of tilapia (*O. niloticus*) in order to analyze the hemato-immunological parameters. The authors concluded that the essential oil did not contribute to anti-inflammatory activities; however, an increase in the number of neutrophils was observed. In a study by Oliveira et al. (2018), the authors used*L. origanoides*essential oil to control infections by *Aeromonas hydrophila* in tambaqui (*C. macropomum*) juvenilesand found a survival rate of 79.2% after a therapeutic bath with 10 mg.L⁻¹ of essential oil; the changes in hematological and biochemical parameters were not significant.

3.9 Cockspur coral tree (*Erythrina crista-galli* L.)

The *Erythrina*genus (Fabaceae) contains more than 100 species distributed in the tropical and subtropical areas of the Americas, Africa and Australia (Kone, Solange, & Dosso,2011). This tree is found in very humid areas, in secondary open formations, from Maranhão to Rio Grande do Sul (Gratieri-Sossella & Nienow, 2008).

Pharmacological investigations have demonstrated that *E.crista-galli* seed extracts have sedative, hypertensive, laxative, and diuretic properties (Maier, Rödi, Deus-Neumann, & Zenk,1999). Additionally, its bark is used to treat many diseases associated with rheumatism and hepatitis (Hashimoto, 1996). Siqueira et al. (2019) conducted a study to evaluate the anxiolytic effect of *E. crista-galli* extract in goldfish (*Carassius auratus*)juveniles, and the authors observed that the extract did not present fish toxicity or mortality.However, it did cause undesirable changes in blood physiological parameters when used in doses above100 mg.L⁻¹.Thus, the authors reported that the anxiolytic action was not beneficial to the fish species analyzed.

3.10 *Velame*(*Croton heliotropiifolius* Kunth)

Croton is the second largest genus of Euphorbiaceae, with approximately 1,200 species predominantly distributed across the American continent (Berry, Hipp, Wurdack, Van, & Riina,2005). Brazil has the largest number of species, approximately 350, distributed across the most diverse ecosystems, especially the savannah (*cerrado*), the semiarid plateau (*caatinga*), and rupestrian fields (Berry et al. 2005). This genus' species have demonstrated anti-inflammatory (Ramos et al., 2013), gastroprotective (Coelho-De-Souza et al., 2013), and woundhealing (Cavalcanti et al., 2012) properties. Souza et al. (2018) evaluated the nutritional effect of adding extracts of *Croton heliotropiifolius* to the diet of young tilapia. The authors found that the inclusion of *velame* extract reduced the average weight gain and the total blood sugar and protein concentrations, whereas the specific growth and survival rates had a small improvement with the addition of 2.0% of crude *velame* extract to the diet.

3.11 Country almond (*Terminalia catappa* L.)

The country almond (*Terminalia catappa*) belongs to the Combretaceae family.It is an ornamental plant found in several tropical countries, widely used in urban forestry, and present in coastal areas to provide shade (Francis, 1989). Its origin is the coastal areas of eastern India, Indochina, Malaysia, northern Australia, Oceania, Philippines, and Taiwan (Francis, 1989). Studies have demonstrated its bactericidal and fungicidal effects (Costa, Bevilaqua, Morais, & Vieira,2008), and its anti-*Helicobacter pylori*and anti-ulcer (Pinheiro Silva et al., 2015), anti-diabetic (Nagappa, Thakurdesai, Venkat Rao, & Singh,2003), and anti-inflammatory (Fan et al., 2004) properties. *T. catappa* leaves were tested as a growth-promoting additive for *N. tilapia* (*Oreochromins niloticus*)juveniles, and the results did not showany positive effects on performance.However, when

administered at high levels, it reduced mortality (Santos et al., 2015). In a study conducted by Claudiano et al. (2009), an aqueous extract of dry leaves of *T. catappa* presented improved efficiency at the dose of 120 ml.L⁻¹ and effectively controlled monogenetic parasites and the protozoan *Piscinoodinium pillulare* in *tambaqui* (*C. macropomum*) juveniles; however, it had no effect against the protozoan *Ichthyophthirius multifiliis*. Santos et al. (2013) evaluated the performance and behavior of *Betta splendens* fish growing at different concentrations of *T. catappa* aqueous extract, and concluded that the extract had no effect on fish performance,whereasfish behavior was influenced by the concentration—that is, higher concentrations caused the fish to be calmer.

3.12 Yellow cinnamon(*Nectandra grandiflora* Ness)

The yellow cinnamon (*Nectandra grandiflora* Ness) (Lauraceae) is an endemic species of Brazil, predominantly found in the Atlantic rainforest and *cerrado* biomes (Lorenzi & Brasileira,2002). Regarding the properties of this medicinal plant, Ribeiro (2002) and Ribeiro et al. (2005) analyzed the antioxidant activity of an ethanol extract of *N. grandiflora* leaves the extract inhibited the oxidation of β-carotene, analgesic (da Silva-Filhoet al., 2004), antibacterial (Ferrazet al., 2018), and anxiolytic (Garlet et al., 2019) actions. Rodrigues et al. (2017) reported an in vitro analysis in which the essential oil of *N. grandiflora*exhibited an antiparasitic effect against *I. multifiliis*, a fish parasite that causes considerable losses in aquaculture. They also suggested that in vivo studies should be conducted to develop a product for the control of *I.multifillis.*

3.13 Species of the Piperaceae family

The *Piper*genus belongs to the Piperaceae family, which was described in the 18ᵗʰ century by Linnaeus. It hasapproximately 12 genera, of which *Piper* and *Peperomia* are the most important ones in the Brazilian flora (Medeiros & Guimarães, 2007). Thisfamily's pharmacological potential is related to its antitumor (Duh, Wu, & Wuang,1990), insecticide (Mamood, Hidayatulfathi, Budin, Ahmad Rohi, & Zulfakar,2017), anesthetic (López et al., 2016), anesthetic, and antimycobacterial (Cunico et al., 2015)properties. Santos et al. (2018) found that essential oils from four species of plants of the family Piperaceae—*Piper hispidinervum, P. hispidum, P. marginatum,* and*P. callosum*—showed anthelmintic efficacy against the acanthocephalon parasite *Neoechinorhynchusbuttnerae*in *tambaqui* (*C. macropomum*) juveniles, and that parasite mortality occurred at the highest concentrations andtimes of exposure to the essential oils. The authors concluded the

essential oils were an alternative source for direct use or for the development of anthelmintic herbal medicines, requiring advanced studies for in vivo treatment.

IV. CONCLUSION

This study on the use of medicinal plants in aquaculture practices demonstrated the diversity of plants used. However, when analyzing the biodiversity of the Brazilian flora across its most diverse biomes, the production of knowledge in this area still presents few results, particularly considering that the tests were conducted with *Nile tilapia*, the main exotic species grown in Brazilian aquaculture.

The potential of the Brazilian flora for the production of phytopharmaceuticals that can be used in aquaculture still needs further investigation, mainly regarding its use with cultivated native species. While fish farming activities have increased in Brazil, many cases of diseases related to the presence of parasites, endoparasites, bacteria, fungi, and viruses have been reported because of the intensive systems used in fish farming practices. Fish sanitary diagnoses are usually expensive, particularly for small fish farmers. Thus, the use of medicinal plants, especially those producing essential oils and mentioned in this study, has presented great potential for the treatment of aquaculture diseases. Further studies evaluating their use are required to reduce the costs involved in the treatment of these diseases.

ACKNOWLEDGMENTS

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Damage Identification of Vehicle Brake Disks by the use of Impedance-Based SHM and Unsupervised Machine Learning Method

Stanley Washington Ferreira de Rezende, Bruno Pereira Barella, Jose dos Reis Vieira de Moura Jr

Department of Mathematics and Technology, IMTec, Federal University of Goias, Catalao-GO, Brazil

Abstract— *Although SHM (Structural Health Monitoring) has been widely used for aeronautical purposes, in the last decades new application scenarios have become applicable, such as the civil and automotive industries. Automotive components are increasing the maximum operational efficiency, aiming to obtain greater performance and safety of its mechanical systems at low production and maintenance costs. In this context, it is necessary to make predictive studies related to the incipient damages or about the useful life of the structures. The brake system represents one of the most important mechanical systems in a passenger vehicle since it deals directly with the preservation of their lives. Thus, in this contribution a regular vehicle brake disc is studied in order to evaluate the sensitivity of the impedance-based SHM application to identify mechanical changes and propose a method to check their integrities. With the purpose to promote structural changes, a virtual damage was created by mass addition with small magnets attached on the surface of the disc in different positions. Further, some experiments were conducted to have several state conditions of the brake discs (pristine and several virtually damaged cases). Then, the unsupervised machine learning technique called K-Means Clustering Method was applied to the data set and a quadratic regression model was used as well based on RMSD damage metric of the cases. Obtained results show the applicability of the method in the identification of damages, as well as the potential of the use of unsupervised machine learning methods and mathematical models in the context of SHM.*

Keywords— *Electromechanical Impedance-based SHM, Unsupervised Machine Learning, K-Means Clustering Analysis, Structural Health Monitoring, Vehicle Brake Disk.*

I. INTRODUCTION

The main purpose of the SHM (Structural Health Monitoring) is to implement a predictive maintenance system to use the mechanical component along of its useful life, minimizing costs and reducing stoppages [13, 14, 19-21]. One of the most important mechanical systems in a regular passenger vehicle is the brake system composed by brake pads and brake disc. This system was designed to promote wear in brake pads which are exchanged periodically while the brake discs continues to has a longer useful life. Thus, this investigation was considered because the importance of the brake system in a vehicle and the preventive maintenance aspect of the component.

The impedance-based SHM is applied today and under investigation for a several applications in aeronautical studies [4, 7, 8]. However, with the advances of new manufacturing lines and low-cost electronic circuits, the technique becomes to be applicable for other maintenance purposes of lower order of costs [10, 17, 20].

It has been shown that the electrical impedance from the piezoelectric ceramic (sensor/actuator) surface bonded to a structure can be directly associated with the mechanical impedance of the structure to which it is bonded. By using the same piezoelectric element as a sensor/actuator, a simple testing device, containing a smaller number of components and cables has been developed [16].

[11] first proposed the impedance method as a technique for structural monitoring. The technique was later improved by [1-3, 5, 6, 9, 12, 13, 15, 18, 20, 21]. It has been shown that electromechanical impedance (EMI) techniques utilize the two modes of behavior of the piezoelectric material. When stressed mechanically, an electric charge is produced, which is called the Direct Piezoelectric Effect. Conversely, when an electric field is

applied in the poling direction, the piezoelectric patch undergoes mechanical deformation and this is known as the Inverse Piezoelectric Effect. Fig. 1 shows a one-dimensional electromechanical model of the impedance-based structural health monitoring system.
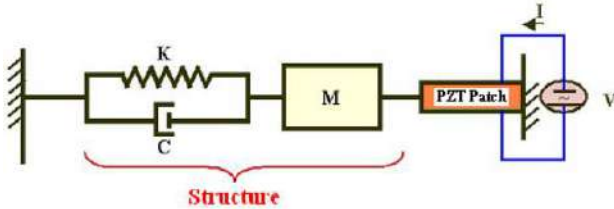
Fig. 1: One-dimensional electromechanical model.

The PZT patch (Lead Zirconate Titanate) is considered as a thin bar undergoing axial vibrations in response to the alternating voltage applied by the impedance analyzer. Equation (1) shows the expression for the electromechanical admittance [11].

$$Y(\omega) = \frac{I}{v} = i\omega a \left(\bar{\varepsilon}_{33}^{T}(1-i\delta) - \frac{z(\omega)}{z(\omega)+Z_{a}(\omega)} d_{3x}^{2} \hat{Y}_{xx}^{E} \right) \quad (1)$$

where V is the voltage applied to the PZT patch, I is the output current, a is the geometric constant of the PZT patch, d_{3x} is the piezoelectric coupling constant in the arbitrary x direction at zero stress, $\hat{Y}_{xx}^{E}$ is the Young's modulus and $\bar{\varepsilon}_{33}^{T}$ is the complex dielectric constant at zero stress, ω is the angular frequency, Z_a and Z are the PZT's and the structure's complex mechanical impedance, respectively, and δ is the dielectric loss tangent of the PZT patch. This equation states that the electrical impedance of the PZT patch bonded onto the structure is directly related to the mechanical impedance of the structure [5-8, 11, 12, 14, 21]. Consequently, since the mechanical impedance of the PZT patch is assumed to be constant, any change in the electrical admittance is expected to be equal to the change in the mechanical impedance of the structure.

The method uses frequencies usually higher than 30kHz that are applied to the PZT patch that is bonded to the surface of the structure to evaluate the signal modifications as captured by the sensor. The PZT patches use a low voltage (< 1V) and generate high frequency excitation at given points in the structure [16]. However, the voltage equal to 1V leads to satisfactory results with respect to the identification of structural changes.

Basically, the technique consists in obtaining the frequency response functions (FRFs) of the structure in order to further compare the modification in these signals as caused by damage. A modification in the FRFs would indicate the presence of damage.

The impedance-based SHM measures the real part of the impedance signature by the use of piezoelectric sensor/actuator bonded in the investigated structure. Then, both baseline (pristine condition) and damaged signatures are compared in order to calculate the severity of the problem as well as locate it [12-14, 21]. This quantitative comparison in this work uses the RMSD (Root Mean Squared Deviation) damage metric to do evaluations [12, 14]. This damage metric was proposed by [19], being expressed according to (2):

$$RMSD = \sum_{i=1}^{n} \sqrt{\frac{(R_i^B - R_i^D)^2}{(R_i^B)^2}} \quad (2)$$

where R_i^B and R_i^D is, respectively, the real part of the impedance signature from baseline and damaged conditions and n is the size of the sample set [12, 14, 21].

II. EXPERIMENTAL PROCEDURE

The proposed experimental procedure used one regular vehicle brake disc with dimensions of 100x260x260 mm. Then, two simulated damage conditions were proposed by addition of mass in places where real wearing occurs, i.e., the area of the wear use to occurs. For this damage tests were used magnets (10x10x10 mm) and Fig. 2 illustrates the test positions, which the damage #2 is closer to the PZT patch.

Damage #1

Damage #2

Fig. 2: Brake disc with the PZT patch and damages (added masses).
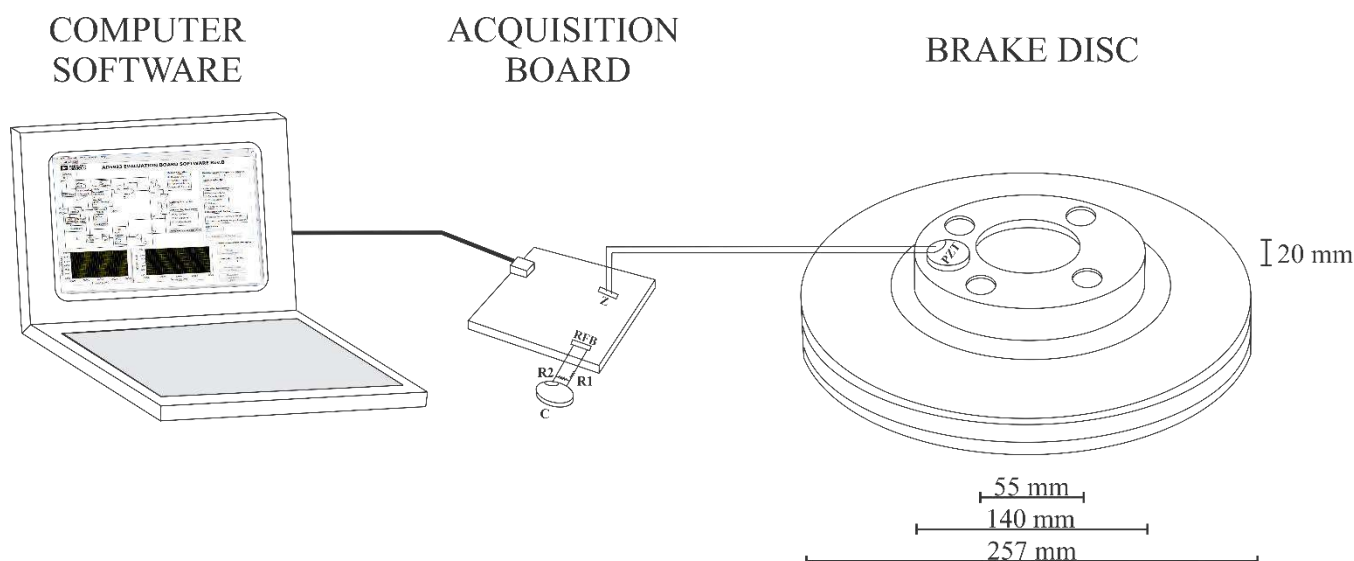
Fig. 3: Experimental setup for the data gathering.

The used experimental setup to gather the data samples is illustrated by the Fig. 3. The system is composed by on vehicle brake disc (structure to be investigated), one data acquisition card (analogic-digital converter) and a laptop with the software interface for data gathering.

The impedance-based SHM measures the signature in high frequencies because on these ranges it is possible to check small damages or cracks. In this proposed work the frequency range obtained by trial and error was 20.5-28.17 kHz.

The data acquisition system used in this contribution was an EVAL AD5933-EBZ card from Analog Devices and one circular PZT patch (diameter of 20 mm and thickness of 3 mm) was used as sensor/actuator. For each condition test was gathered 10 samples obtaining a total of 30 samples (10 baseline, 10 damage #1 and 10 damage #2). Fig. 4 illustrates the data acquisition system (EVAL AD5933-EBZ) used in the experiment.

Fig. 4: Evaluation board EVAL-AD5933EBZ.

The card communicates to the computer by USB port and uses the software called "AD5933 Evaluation Board Software Rev.B" supplied by the manufacturer Analog Devices for gathering purposes. Although the measured impedance is important to define the status of the structure, this information needs to be processed and classified before by filtering and metric calculations.

III. RESULTS AND DISCUSSION

The evaluated frequency range was 20.5-28.17 kHz in a step of 15 Hz, presenting a total of 511 points. According to the references, it was considered only the real part of the impedance signatures due to the mechanical properties are associated with them. All experiments were conducted and the impedance signatures were compared for each condition and it was possible to check amplitude as well as frequency peak deviations as illustrated by Fig. 5.

Fig. 5 illustrates the real part of the impedance signature and it is evident how hard can be the process of evaluation from the direct impedance curve. In addition, due to the presence of an insignificant deviation between the signatures an assertive quantitative analysis of the presence of damage is also not possible since only a qualitative analysis could be performed in the signatures.

Moreover, another factor of great impact in the decision process of the presence of damages is the extension of the data sets necessary to carry out such analyzes, since the computational cost to scan large volumes of data is often not accessible, thus necessitating a process of intermediate abstraction previously to the quantitative analysis of these.
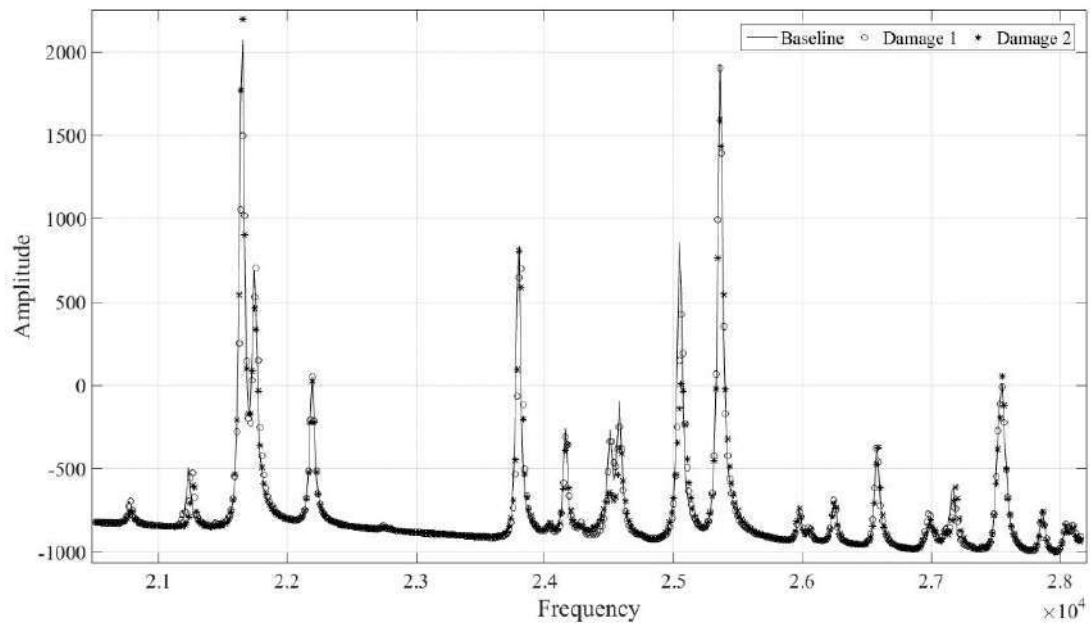
Fig. 5: Baseline and damage signatures – real part of the impedance.

Thus, in order to delimit a subset of signal abstractions, whose information contained are consistent and at the same time representative of the different groups of signals, the *k*-means clustering algorithm was applied to the set of samples that were later splitted into 5 subgroups, in which each observation of the signal was grouped according to its proximity to the average of each of the cluster of the group to which it belonged. Table 1 shows the different subsets obtained by the *k*-means method in relation to the respective clusters.

Table 1: Subsets of data obtained through the k-means algorithm for each sample of each level in relation to their respective clusters. The data represent the frequency clusters of each sample.

Cluster – 1			
Sample	Baseline	Damage #1	Damage #2
1	-126,3718	-169,2348	-138,8865
2	-126,3581	-169,2329	-138,9159
3	-126,3992	-169,2055	-138,8474
4	-126,4853	-169,1331	-138,8513
5	-126,3249	-169,1625	-138,7886
6	-126,1819	-169,1135	-138,7436
7	-126,2505	-169,0607	-138,7202
8	-126,1096	-169,0509	-138,7397
9	-125,9022	-169,0451	-138,7515
10	-126,1703	-169,0998	-138,7710

Cluster – 2			
Sample	Baseline	Damage #1	Damage #2
1	-150,8963	-175,9178	-126,3581
2	-150,9002	-175,9452	-126,3992
3	-150,7260	-175,9413	-126,4853
4	-150,8865	-175,9491	-126,3249
5	-150,8493	-175,8160	-126,1820
6	-150,8728	-175,8904	-126,2505
7	-150,8063	-175,8415	-126,1096
8	-150,7691	-175,7867	-125,9022
9	-150,7906	-175,7436	-126,1703
10	-150,7554	-175,7730	-126,7886

Cluster – 3			
Sample	Baseline	Damage #1	Damage #2
1	-169,2329	-138,9159	-150,9002
2	-169,2055	-138,8474	-150,7260
3	-169,1331	-138,8513	-150,8865
4	-169,1624	-138,7886	-150,8493
5	-169,1135	-138,7436	-150,8728
6	-169,0607	-138,7202	-150,8063
7	-169,0509	-138,7397	-150,7691
8	-169,0450	-138,7515	-150,7906
9	-169,0998	-138,7710	-150,7554
10	-168,7906	-142,1135	-148,7886

Cluster – 4			
Sample	Baseline	Damage #1	Damage #2
1	-175,9452	-126,3992	-169,2055
2	-175,9413	-126,4853	-169,1331
3	-175,9491	-126,3249	-169,1624
4	-175,8160	-126,1820	-169,1135
5	-175,8904	-126,2505	-169,0607
6	-175,8415	-126,1096	-169,0509
7	-175,7867	-125,9022	-169,0450
8	-175,7436	-126,1703	-169,0998
9	-175,7730	-126,7886	-168,7906
10	-175,2035	-126,7045	-168,7534

Cluster – 5			
Sample	Baseline	Damage #1	Damage #2
1	-138,8474	-150,7260	-175,9413
2	-138,8513	-150,8865	-175,9491

3	-138,7886	-150,8493	-175,8160
4	-138,7436	-150,8728	-175,8904
5	-138,7202	-150,8063	-175,8415
6	-138,7397	-150,7691	-175,7867
7	-138,7515	-150,7906	-175,7436
8	-138,7710	-150,7554	-175,7730
9	-142,1135	-148,7886	-175,2035
10	-141,8102	-149,0391	-175,2172

From Table 1 we can identify that the applicability of the *k*-means method allowed an optimization of the computational cost due to the reduction of the dimensionality of the data set. Abstracting each sample of signal, formed by 511 points, to a vector of 5 points of frequency amplitude, without lack of relevant information to the decision process.

Subsequently in order to transform this evaluation in a quantitative result, it was used the RMSD Damage Metric for the cluster set obtained from de *k*-means method which were splitted into groups by boxplot chart, obtaining the Fig. 6. Thus, the boxplot is responsible to check the independence of the damage groups and then propose a parameter to represent this variation.
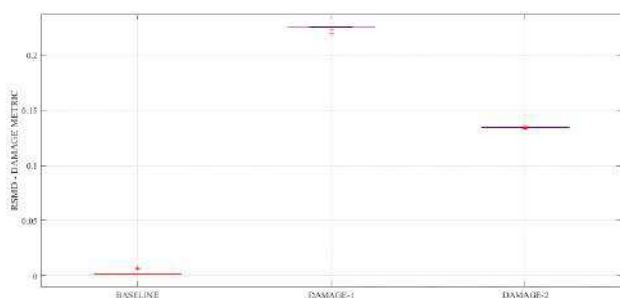
Fig. 6: Damage metric Boxplots for each cluster set of each condition test.

According to the Fig. 6, the proposed methodology was able to detect damage (statistically split) as well as locate it, showing its applicability of the impedance-based SHM for the proposed work. Also, it is possible to understand by the boxplot that the closer the damage is, the greater is the RMSD damage metric severity. Then, based on this observation it was proposed the modeling of the damage case by the use of such damage metrics by a regression model.

Considering 30 samples (10 for each group), it was selected randomly 8 samples from each case to build a regression model classifying the damage case based on the RMSD damage metric, obtained after clustering. Then, it was checked the model by the use of the missing data amount (2 for each group).

Table 2 illustrates all RMSD damage metrics of clusters obtained from the 30 samples.

Table 2: All RMSD damage metrics obtained for the 10 repetitions of the 3 damage groups.

Baseline	Damage #1	Damage #2
0,0016	0,2248	0,1345
0,0016	0,2248	0,1348
0,0018	0,2251	0,1342
0,0018	0,2255	0,1346
0,0018	0,2252	0,1347
0,0018	0,2256	0,1346
0,0017	0,2260	0,1347
0,0017	0,2253	0,1350
0,0070	0,2232	0,1338
0,0065	0,2193	0,1358

From Table 2 it was selected 2 columns of samples (gray rows) for each group to be removed and the Fig. 7 illustrates the correspondent type of damage regression model built.
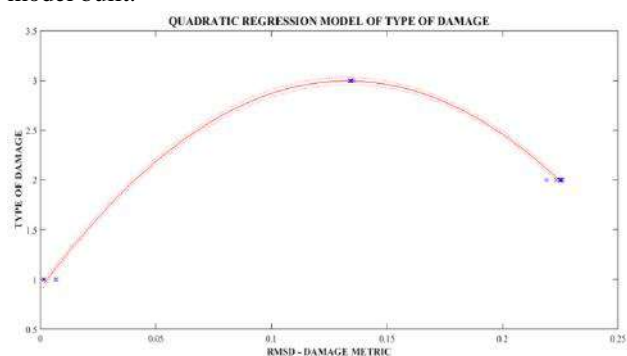
Fig. 7: Type of damage quadratic regression model.

Fig. 7 illustrates the same aspect of the boxplot. However, now it is possible to determine a type of damage with a degree of precision (about 99.7%), corresponding to the correlation of the data amount. This value is not very precise because the model includes only three conditions: baseline, damage #1 and damage #2 and these RMSD damage metrics are not quite linear (baseline, for example is completely different from damage #1). For a best quadratic regression model, it is necessary to build a model with a linear increase of the RMSD damage metrics for previously studied positions of damage, not made randomly like this preliminary study.

After the calculation of the regression model, it is necessary to validate the model in order to check the mathematical expression for new values not used to create the model as represented in Fig. 8.

For this purpose, to check the model, it was used the missed figures (gray rows) from Table 1. Then, it was predicted the type of damage from these 2 samples for each 3 groups by the use of the correspondent RMSD damage metrics and the quadratic regression model obtained.
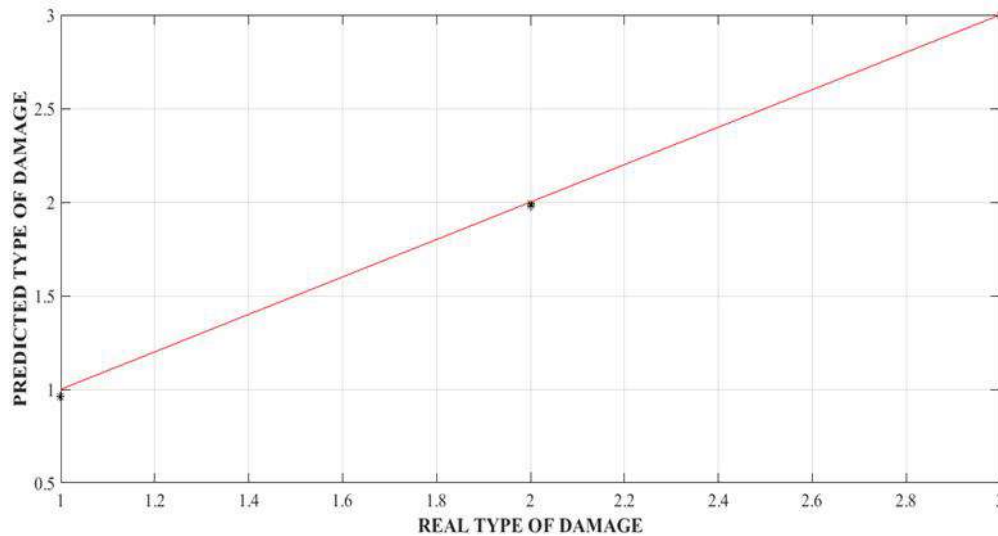
Fig. 8: Validation of the type of damage regression model.

Fig. 8 represents the checking procedure of the type of damage regression model. This chart plots in the x-axis the real type of damage of the missed figures from Table 2. In y-axis is plotted the figures of the same missed cases calculated by the use of the type of damage regression model (Fig. 7).

The correlation between both types of damages (real versus calculated by the regression model) shows also a correlation about 99.7%, indicating a validation of the type of damage regression model obtained previously.

IV. CONCLUSIONS

This contribution proposes a new approach to investigate mechanical changes in brake discs by the use of impedance-based SHM in a quantitative aspect. For this, the *k*-means algorithm, an unsupervised machine learning technique was applied in order to reduce the dimensionality of the data without loss of relevant information in the decision process.

During the quantitative analysis, the boxplot obtained from the experiments illustrates a very good separation between different damage conditions allowing the calculation of a regression model for an automated way to investigate the type of damage based on the RMSD damage metric. Although preliminary results obtained are not straightly applied, they show a potential of use of the technique for this kind of problems. Concluding, these nondestructive tests associated to the machine learning technique shows the ability to detect incipient damages in brake systems helping in the future to improve the safety of automotive components.

ACKNOWLEDGEMENTS

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Development and Financial Analysis for the Elaboration Jominy Test Device: Conception of an Engineering Project from the Point of View Undergraduate Students

Luís Gustavo Fortes Ferreira Giroto[1], Giulliano Assis Sodero Boaventura[1], Renann Pereira Gama[1], Regina Elaine Santos Cabette[1], Wilson de Freitas Muniz[1], Ramon Oliveira Borges dos Santos[1,2], Carlos Dolberth Jaeger[1], Pedro Henrique Colman Prado[1], Thiago Averaldo Bimestre[1], Joselito Moreira Chagas[1], Luiz Felipe Freire Honorato[1], Mariana Ferreira Benessiuti Motta[1], Livya Vitoriano Morando de Oliveira[1], Leonardo César da Silva[1], Beatriz Santos[1], Luiz Gustavo Lameu Marques[1], Cesar Augusto Botura[1]

[1]Department of Mechanical Engineering, Salesian University Center of São Paulo - UNISAL, Lorena – City, BRAZIL
[2]Student of ELS Brazil, ELS Brazil, BRAZIL

Abstract— *The proposal of the Jominy test is to analyze the hardness of certain specimens, leading to a better understanding of the heat treatments, more precisely, in the severity of the hardening heat treatment, thus contributing to the economy of finite material resources. The project is aligned with the objectives of performing this quantitative and qualitative analysis in the Jominy test project developed by undergraduate students in mechanical engineering, intended from the egress in particular as to skills and performance, in a multidisciplinary way, group work, context, design and diagnosis. The focus is to develop the knowledge about tempering, CCT curves, structure of steels and alloys, constituents such as martensite, austenite, among others, besides the application of the concepts involved in all disciplines of the semester, thus elaborating, step by step, the ideal device for Jominy tests. The main objective is to carry out a study on types of steels, heat treatments and their characteristics, constituents, tests, in order to aggregate knowledge and skills so that we can design the construction of a device for Jominy temperability tests.*

Keywords— *Tempering, Jominy Test, Martensite, Education, Steel Alloy, SAE 1040, SAE 4140 .*

I. INTRODUCTION

Steel is a metallic alloy formed essentially by iron and carbon, with its carbon content varying between 0.008 and 2.11%. It is distinguished from cast iron, which is also an alloy of iron and carbon, but with carbon content ranging between 2.11% and 6.67%. The fundamental difference between the two is that steel, due to its ductility, is easily deformed by forging, rolling and extrusion, while a piece of cast iron is manufactured by the casting process.

At the present stage of society's development, it is impossible to imagine the world without the use of steel.

Steel production is a strong indicator of a country's stage of economic development [1].

It is an extremely important component for the whole economic cycle due to the junction of several productive means. In February of 2020, Brazilian steel companies produced approximately 5.69 thousand tons of metal.

Steel can be fully reused as its properties are maintained during the recycling process. The use of scrap also reduces the iron ore expenses of the mills and reduces the use of natural resources such as coal [2].

The mechanical properties and in-service performance of a metal or alloys depend on their chemical composition, crystalline structure, processing history and the heat treatments performed. In a simplified way, heat treatments can be described as controlled heating and cooling cycles (in metallic material) that cause changes in their microstructure and mechanical properties [3].

While low and medium carbon steels are generally used after forging or rolling, high carbon and alloy steels need to undergo heat treatment before application. Annealing, normalizing, tempering, tempering and coalescing are the most common types of heat treatment. The hardening process will be the focus of this edition.

According [4] points out that The concept of hardenability is linked to the hardening capacity of the steel during rapid cooling, i.e. its capacity to form martensite, at a certain depth in a piece, the most commonly used methods to evaluate hardenability are the critical cooling rate, Grossman test and Jominy test. The critical cooling rate corresponds to the lowest rate that can be used for the whole structure to be martensitic, it is a simple method that can be used directly in the CCT (Continuous Cooling Transformation) curve of the steel. There is a difficulty in using this method because the survey of these curves requires sophisticated equipment in addition to specialized personnel in the area. In view of this, the development of simpler tests like Grossman and Jominy was chosen. Grossman's test (a method that consists in the hardening of several specimens of the same material, but with different diameters, submitting them to metallographic analysis and/or hardness tests in order to determine the critical diameter) has some limitations, such as a series of bars with different diameters to determine the critical diameter.

With the intention of achieving greater speed, Jominy showed a trial using a single bar of one inch diameter and four inches long, this bar is austenitized, i.e., it is taken to above its critical temperature (temperature at which the material becomes only the austenitic constituent in its structure), then cooled by a water jet at room temperature.

After being cooled, a ground track is made longitudinally in the sample and its hardness is measured from the cooled end. This work will be focused on the theoretical development of mounting a jominy device, in order to illustrate the ideal way and the precautions taken to carry out the practical mounting of the device. This work aims to carry out a study on types of steels, heat treatments and their characteristics, constituents, tests, and everything that is involved in order to design the theoretical construction of an equipment to carry out tests of temperability Jominy.

II. METHODOLOGY

2.1 Visual Representation

Subsequently, starting the work, it was necessary to create a sketch drawing of the device. For this task, a handwritten draft was made with its dimensions, as shown in Figure 1.
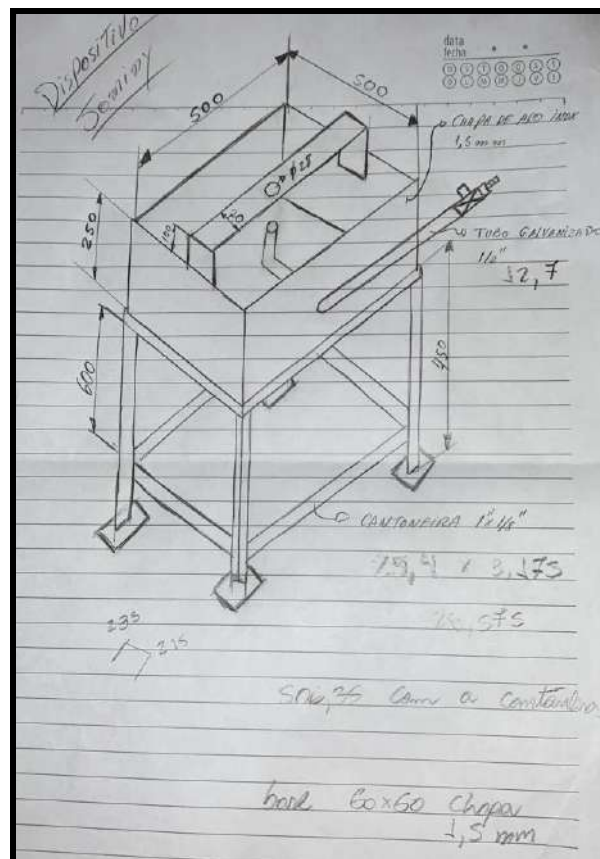
Fig. 1: Scope Device Jominy. Source: Authors (2020)

For the realization of the base we used steel angle bracket of 1" × 1/8 ", thus making a base and its support according to the sketch, being its total height of 750x600x600mm. And above the base where the cooling process will be carried out with stainless steel plate in its wrapping with a fixation device of the proof body with Ø28mm, and a galvanized tube of Ø 1/2" in the inferior part for extraction of the liquid that will be used to cool the proof body.

In order to provide a better visualization, a necessary development of the drawing was determined using the Auto CAD software, being illustrated in Figures 2 and 3.
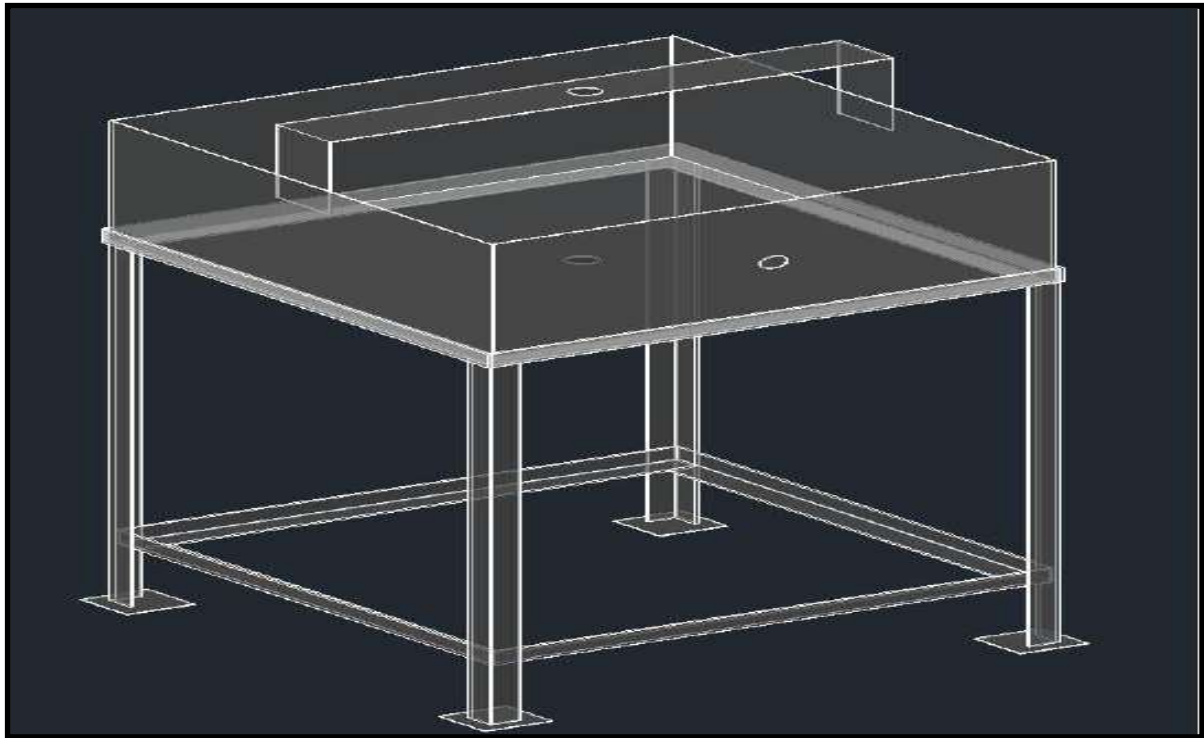
Fig. 2: 2D scope Jominy Device Developed in AutoCad. Source: Authors (2020)
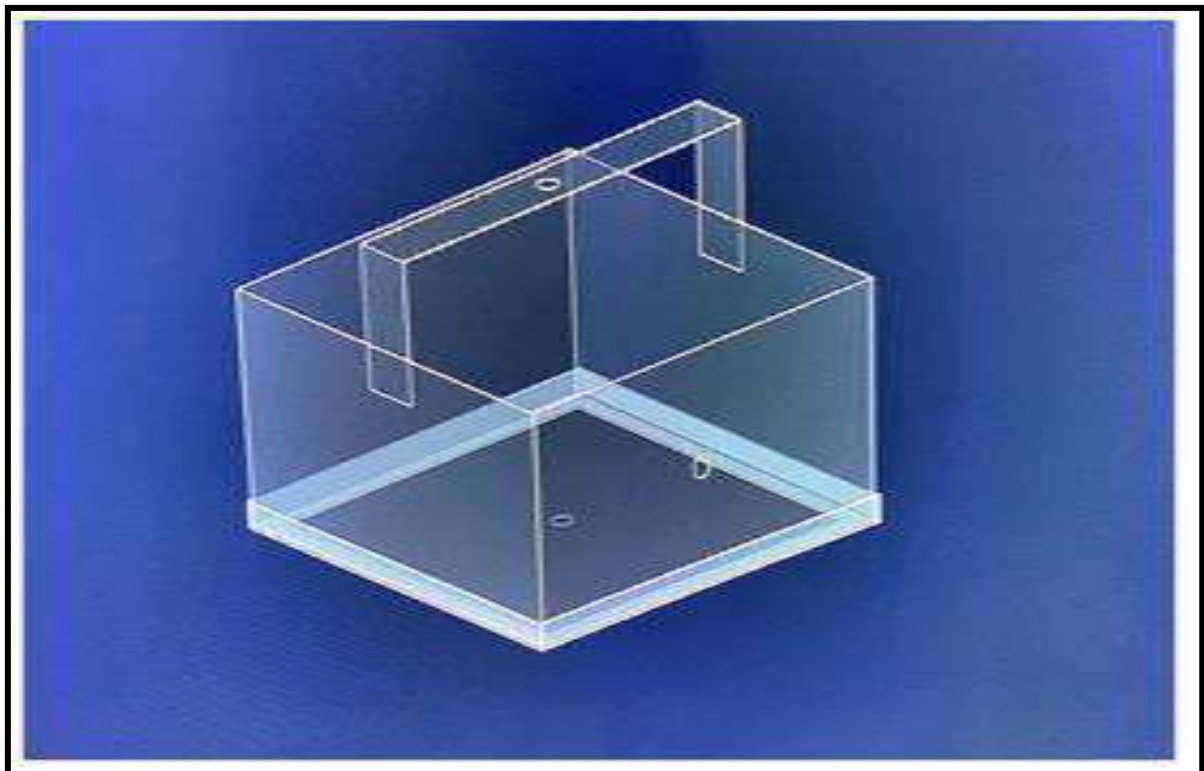
Fig. 3: 3D scope Jominy Device Developed in AutoCad Source: Authors (2020)

According to [5] the CAD (Computer Aided Design) software is framed as graphic tools supported by computer technology, whose objective is the development of drawings and projects applied to the most diverse areas of engineering, architecture, design, industrial design and visual communication, providing commands and environments for graphic representation with a high degree of accuracy static and dynamic, providing visual resources that enable the control of the development process. Because of this, the virtual modeling was of utmost relevance before trying to perform the practical action, reducing the probability of several types of errors, such as inadequate measures, poor grounds, among other possible errors that would cost losses both economically and in relation to time.

Table 1. Costs of the materials. Source: Authors (2020)

Jominy Device Materials List		
Description of the Material	**Quantity**	**Total value**
Stainless steel plate model 304 Measure:2000x250x1.5 mm.	1 Part	R$ 220,00
Stainless steel plate model 304 Measure:600x600x1.5 mm.	1 Part	R$ 100,00
Stainless steel plate model 304 Measure:1000x150x1.5 mm.	1 Parts	R$ 50,00
Carbon steel angle bracket Measurements: 1 "x1/8"	6 Meters	R$ 35,00
Plain carbon steel, thickness 1/4"- Measures 70x70mm.	4 Parts	R$ 40,00
1/2" full bore ball valve	2 Parts	R$ 72,00
1/2" BSP galvanized pipe	3 Meters	R$ 40,00
Galvanized glove 1/2" BSP	2 Parts	R$ 10,00
Brass Spike 1/2" x Male Thread 1/2" BSP	2 Parts	R$ 30,00
Elbow 90° Galvanized BSP 1/2"	2 Parts	R$ 10,00
Carbon steel billet 1040 measures 1.1/4 "x105mm(specimen).	1 Parts	R$ 20,00
Carbon steel billet 4140 measures 1.1/4 "x105mm(specimen).	1 Parts	R$ 40,00
Complete	**Total**	**R$ 667,00**

2.2 Cost Survey

A survey of the costs of the materials that will be used was carried out, something extremely relevant for the acquisition of the best possible cost benefit, considering that the available income is limited. After the discussion, the need for the following materials was determined in table 1:

2.3 Selected Materials For Project

Two different types of steels were selected in the hardening process, being SAE 1040 steel and SAE 4140 steel, this was decided to verify the different measures and results between the two, due to their certain TTT curves, TTT curves consists of a diagram that describes what happens with the steel, by means of cooling at different speeds, in several temperatures below 723°centigrade, observing the isothermal transformation of austenite into perlite.

- **SAE 1040 Steel Alloy (0.4% C Content)**
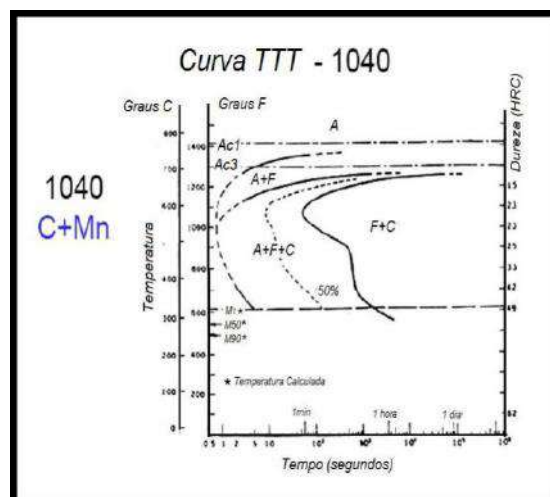
Fig. 4: Curve TTT of Steel Alloy SAE 1040. Source: [8]

This type of steel alloy is normally used in forged parts, distribution bar, connecting rod, shaft, shock absorber rod, brake lever, anchor bolt. It should be noted that SAE 1040 steel alloy has a low carbon percentage, which makes its TTT curve extremely narrow. Thus, there is a complicating factor in obtaining the martensitic constituent, that is, it complicates the treatment of tempering, making it necessary to have a sudden cooling down to less than 1 second to reach 100% martensite. It is important to note that if several tests are made for the same type of steel alloy as 1040, there will be a difference in results, this is due to the size of the grains, inclusions, etc. A 1040 steel

may have, as a rule, its carbon content ranging from 0.37% to 0.44%, which clearly interferes with the final result.

- **SAE 4140 Steel Alloy**
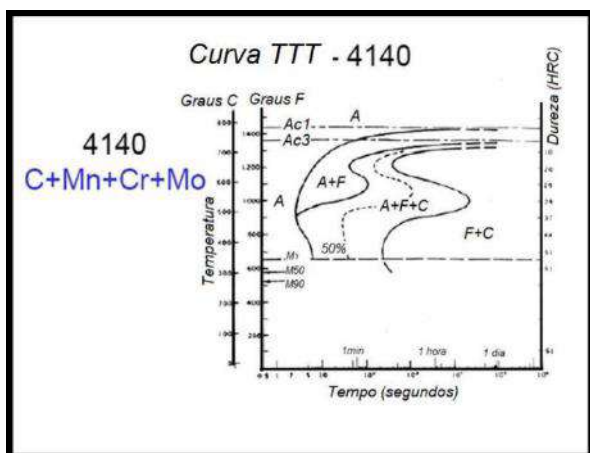
Fig. 5: Curve TTT of Steel Alloy SAE 4140. Source: [8]

SAE 4140 Steel Alloy | Chromium-Molybdenum carbon steel (Villares VL-40 or WNr / DIN 1.7225) is a stronger steel alloy than ordinary carbon steel. Chromium and Molybdenum improve the response of steel to heat treatment tempered and enable greater mechanical resistance [6].

It is a steel alloy for processing with medium temperability, used in the manufacture of different mechanical components, has a good combination of medium mechanical resistance and resistance to fracture and also has high resistance to fatigue.

This material facilitates the test because its curve is not as narrow as that of SAE 1040 steel alloy, this makes it possible to obtain the martensite constituent without the need for more robust or expensive equipment. In this way, we contribute not only to the success of the project, but also in the financial question, saving on equipment and energy.

2.4 Test Bodies

According to [7], in the construction of the Jominy apparatus, one of the most important details of adjustment, is related to the alignment of the specimen and the water jet that will make its cooling. Therefore, the construction and proper alignment of a specimen has total relevance, so they will be made according to NBR6339 standard brazilian, to determine the measures to be followed.
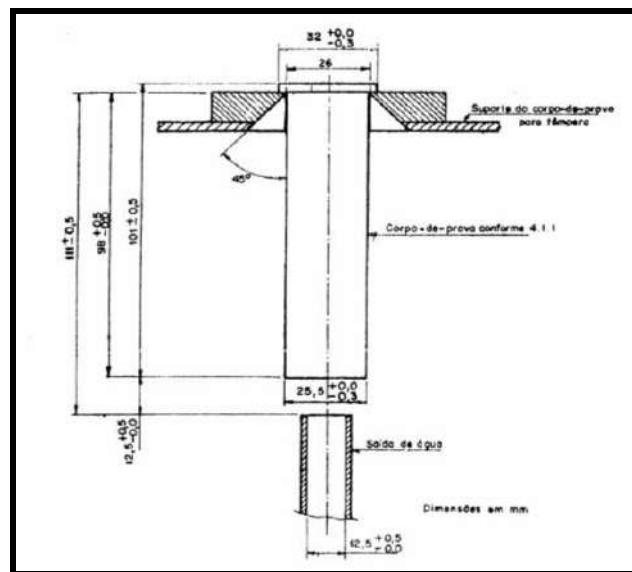
Fig. 6: Dimensions Test Bodies Second NBR6339 Standard. Source: [10]

The largest axis is Ø25.5 (+0.5)/(-0.0) x 98mm, and the "head" Ø32 (+0.0)/(-0.3) x 3mm.

III. RESULTS

After the construction and execution of a Jominy test on these materials, the respective curves illustrated in figures 7 and 8 should be obtained. It is important to note that a certain dispersion of test results under the same material is common, due to differences in steel structure in grain size inclusions and chemical compositions.
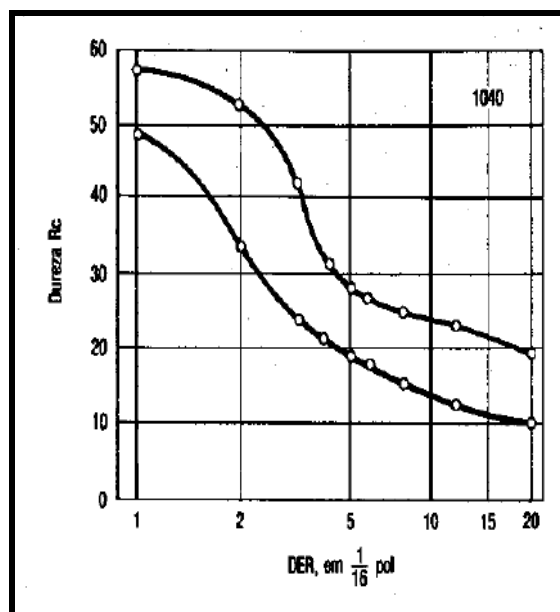
Fig. 7: Representation of Rockwell Hardness Test Points (HRC), Jominy Test of Steel Alloy SAE 1040. Source: [4]

Note that the red line corresponds to steel alloy 4140, while the black line corresponds to a derivative of it.

25, 2020. https://www.materiais.gelsonluz.com/2017/10/aco-sae 1040-propriedades-mecanicas.html;
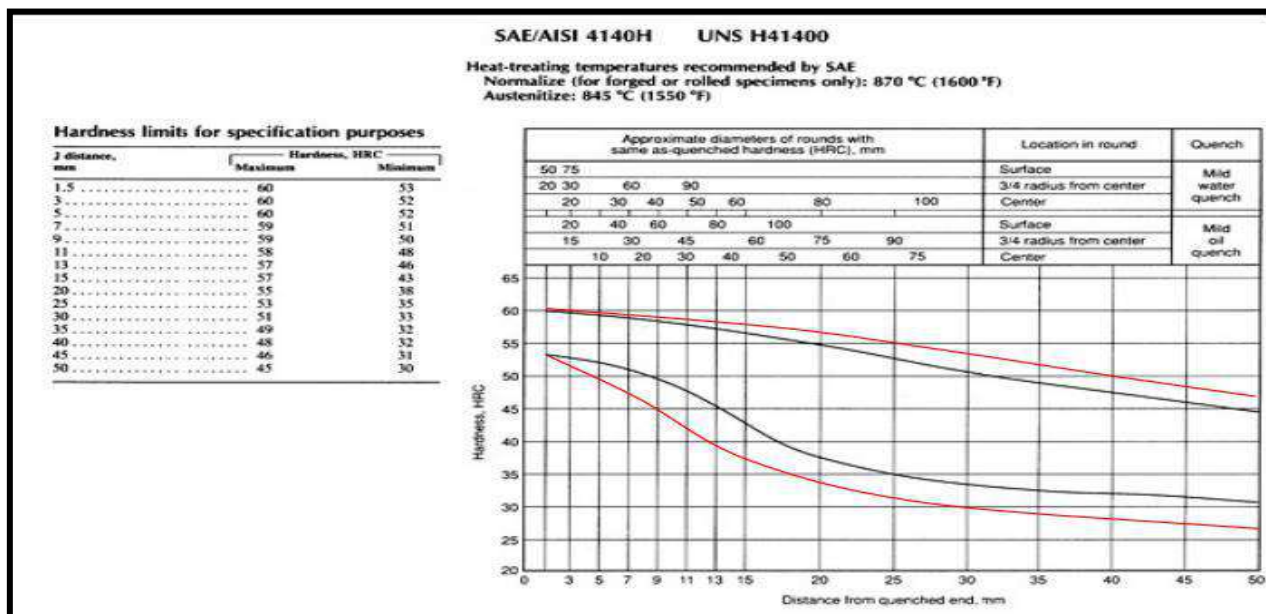
Fig. 8: Representation of Rockwell Hardness Test Points (HRC), Jominy Test of Steel Alloy SAE 4140. Source: [8]

IV. CONCLUSION

At the end of this project, it was possible to obtain knowledge of several types of steels alloy, because a whole research on steels alloy with suitable properties for Jominy trials was carried out. Besides acquiring several concepts and knowledge in various areas of mechanics, such as quenching processes, steel structures and their respective TTT and CTT curves, steel alloy constituents, for example austenite, martensite, ferrite and etc. Defining properties, as well as establishing the main requirements for assembly of a Jominy testing device.

ACKNOWLEDGEMENTS

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The Impact of Technology in the World of Work

Valdir Silva da Conceição[1], Angela Machado Rocha[2], Marcelo Santana Silva[3], Marina Cardoso da Conceição[4]

[1]Master's student of the Graduate Program in Intellectual Property and Technology Transfer for Innovation at the Federal University of Bahia, Institute of Chemistry, Salvador, Bahia, Brazil

[2]PhD in Energy and Environment from the Federal University of Bahia, Professor at the Institute of Health Sciences at the Federal University of Bahia (ICS-UFBA), from the Graduate Program in Intellectual Property and Technology Transfer for Innovation (ProfNIT) Focal Point from the Federal University of Bahia, Salvador, Bahia, Brazil

[3]Post-Doctor by the Graduate Program in Industrial Engineering - PEI (UFBA). Doctor in Energy and Environment (UFBA), Master in Regulation of the Energy Industry (UNIFACS) and Economist by the State University of Santa Cruz (UESC). Researcher and professor in technical and higher education at the Federal Institute of Bahia (IFBA). Permanent Professor of the Master in Intellectual Property and Technology Transfer for Innovation - PROFNIT (IFBA).

[4]Bachelor of Accounting (UFBA). Bachelor in Gender and Diversity Studies (UFBA)

Abstract— *Technology influences the individual's daily life and relationships, society and work. This article aims to understand how technological advances affect these relationships in the work environment, addressing the worker, the organization and the work itself. It also seeks to understand the causes and consequences of the use of technology by people in the various environments, the relationship between technological evolution, people and the organizational / labor environment and its influence in reducing employment. For the development of the article, a qualitative, descriptive bibliographic research was carried out through scientific articles in academic sites and journals. Initially, a history of technological evolution was presented from the beginning to the present day. Then, he discussed the technological advances and their effects for the worker, for the organization and for work. The conclusion indicates that technological progress has no deadline to end, as long as the human being has the capacity to innovate in all spheres of human thought and will also result in structural unemployment, with the extinction of some professions and the emergence of others necessary for its implementation and continuity.*

Keywords— *Technological advancement, Development, Organization, Human Resources, Worker.*

I. INTRODUCTION

The world and society are undergoing several and constant transformations caused mainly by the introduction of technology, which has been evolving continuously at every moment and which is part of and influences the daily lives of organizations and the population. Technological innovation developed in parallel with the Industrial Revolution, due to competition between capitals, which had as one of its characteristics the great discoveries and inventions in all fields of knowledge, having among its objectives to bring comfort and well-being to mankind, however, as a negative factor we can mention the degradation of the environment due to the unrestrained consumption of natural resources to obtain the raw material, the increase in the generation of garbage and waste and the precarious work with the use of technology [1, 2, 3].

Technology is about the knowledge used to improve human ability and allow them to do things that previously could not be done, or to improve the way they do it.. Digital technology is the main factor of changes in the 21st century, including changing the nature of work itself, mainly due to innovation and technological advances with the introduction of automation, made possible by technology such as robotics and Artificial Intelligence (AI) in manufacturing and management processes, with the objective of generating greater productivity, efficiency, profitability, safety, among others [1, 2, 4, 5].

Technological evolution is a human response to overcome the adversities that happen in your daily life.

Thus, technological advancement has corroborated so that human tasks became easier and easier, gradually reducing the need for human effort for some tasks and activities, this when it does not suppress the individual's need to perform certain activities. However, it brought some negative impacts that were brought to light after the First Industrial Revolution, such as structural unemployment and the degradation of the environment, also caused the polarization in the labor market with the conflict between high and low qualification jobs; unemployment versus underemployment [1, 3, 6, 7, 8].

The knowledge of technologies becomes a differential for the worker when seeking a placement in an organization in relation to the people who have little or no knowledge about them, because the knowledge of technology and the monitoring of its evolution makes people more qualified to exercise certain functions, it conditions it to become eligible for a job in the labor market, not making it obsolete in relation to technological advances, which is not new in the dominant capitalist regime in the world and this condition has occurred since the First Revolution Industrial, which was the period in which work specializations were created [1, 9, 10, 11, 12].

The objective of the present work is to verify the impact of technology on the worker and his work environment, checking if this condition influences people's employability and structural unemployment.

The introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper.

The objective of the work was to verify the impact of technology on the work environment, seeking to understand the causes and consequences of its use by organizations and whether this condition causes unemployment, in addition to the impact for individuals.

II. METHODOLOGY

The present work was carried out from a bibliographic review with themes related to work, technology and its impacts on the work environment.

The research was carried out in stages to achieve the proposed objective. The first stage included an exploratory research, followed by the collection of information and finally, the data analysis was carried out.

The research had an exploratory character, because it aims to provide a certain familiarity with the studied theme, collaborating for the improvement of ideas, so that

a greater understanding about the different aspects related to the theme occurs [13].

A bibliographic search was carried out to allow data collection, using as a tool the consultation of scientific articles, dissertations, conclusion papers, theses and specialized sites on the subject, with the help of materials published in scientific events, magazines, newspapers , books and other media [13].

III. HISTORICAL AND CONCEPTUAL ASPECTS

The word technology is defined etymologically by two words of Greek origin, the first being technical word is derived from the Greek tekhne which means "craft, technique, art" and logy which is derived from the Greek logus which means "study of something". It is a study of technical and scientific knowledge in the various research areas. In its primitive form, one can mention the discovery of fire, the wheel, writing, instruments and tools [14, 15].

In the beginning of civilization, humans needed to hunt or collect food for their survival. In order for these activities to be facilitated in their daily routine, there was a need to create the first tools and utensils. From sticks, to shovels and reaching tractors to facilitate handling with the land, later on producing food not only for their subsistence, but also for all humanity with the excess of production generated, which contributed to the emergence and development of modern agriculture, with the use of technology to reduce costs and increase productivity [16].

The workforce is being reduced over time due to technological developments, which replace some activities that were previously performed by humans and were gradually replaced by the mechanized system as can be seen in Fig. 1.
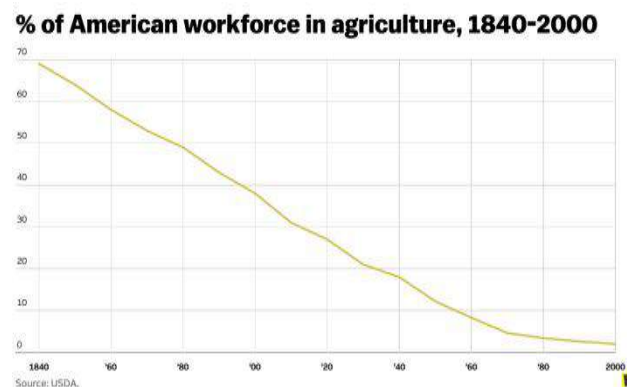
Fig.1: American agricultural workforce
Source: Grey (2014)

The graph in Figure 1 shows the gradual reduction of the workforce in the field from the technological inventions that have occurred since the advent of the Industrial Revolution, with a tendency to zero out the human need in activities, especially manual ones.

Currently, one of the reasons for organizations is to be profitable, aiming to perpetuate themselves in the market and generate dividends for their owners, and one of the ways to achieve this is through the use of technology, which will directly impact the worker, reducing their contingent and consequently generating unemployment, and sometimes the machine will replace it, and this condition will tend to reduce costs and labor charges arising from labor.

Technological development has directly impacted the modes of production of civilizations through the ages is illustrated in Figure 1. [17]
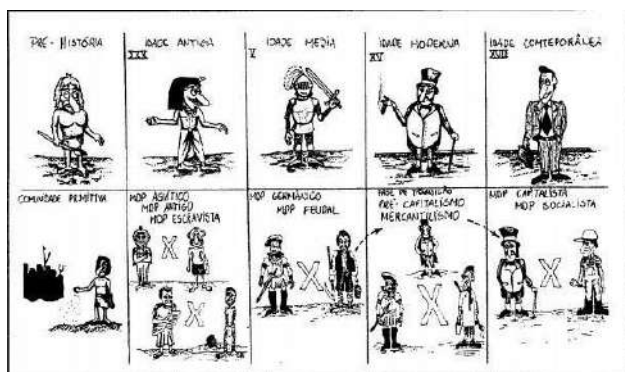
Fig.2: The evolution of the creation of forms of work

Source: Santos (1999)

Historically, the evolution of work, shown in Fig. 2, has the following steps:

In Prehistory, man transformed the existing raw material and within its reach into products and instruments essential only for his survival and the work performed was done and conducted collectively and in a community. It was known as the age of language and fire. One of the discoveries was the fire changed the way of acting and thinking, because it was a multifunctional technology because it provided light, transmitted security because the animals feared approaching, gave comfort in the cold period transmitting heat to those who were nearby, served to cook the foods. The language served for cooperation between people and became a skill of the human species, facilitating teamwork [5, 15, 16, 18].

In the Ancient Age, the means of production was made by enslaved people, whereas in Asia, the mode of production also used the labor of the peasants, and the final result of production was owned by the state. In the Middle Ages, the means of production was feudal and the labor used was through serfs (peasants). In the Modern Age, which was the era of pre-capitalism, part with the end of mercantilism predominated and the other part of production occurring at the beginning of the feudal system and the beginning of capitalist relations. In the Contemporary Age, the capitalist and socialist modes of production took place and part of the end of mercantilism still predominated. For capitalist production, wage labor was used and in socialist production, production was collective or public [15, 16, 18].

In the First Industrial Revolution (1760-1860), technical and scientific development took place, with the emergence of the steam engine, which was used in the extraction of minerals, in the textile industry and in the manufacture of other goods that before that time was carried out in a handmade and manual, mainly in homes, which contributed to replace in this way, the physical work performed by people [19, 20, 21, 22].

The Second Industrial Revolution (1860-1900) occurred with the acceleration of the industrialization process having, among other consequences, the substitution of coal for oil derivatives, the use of electricity to move machines, to light cities (which contributed to the production of electricity) large scale) and reduce the communication time of people with the telegraph and the replacement of people with machines [19, 21, 22].

The Third Industrial Revolution started after the Second World War, because the countries that were devastated, needed more machines, resources and labor to be able to structure themselves and leverage progress. It represents a productive restructuring or a new world order arising from the result of the war in which the world was divided into two parts, one being commanded by the United States of America (USA) which had capitalism as its premise and on the other side the Union of Republics Soviet Socialists (USSR) that had socialism as its political model, hence generating between both powers what was commonly called the Cold War. During this period the rapid integration of markets occurred and among the achievements are nuclear energy, information technology and microelectronics [19, 21, 22, 23].

The main consequences of the Industrial Revolution are as follows:

Table 1 - Consequences of the Industrial Revolution

STRENGTHS	NEGATIVE POINTS
Acceleration of the production pace	Unemployment
Price reduction	Exploitation of the proletariat and social inequality
Transporting more goods and people in a short time	Pollution
Rapid economic growth	Urban concentration, increasing cases of disease.
New production techniques	

Source: Gonçalves (1994)

Table 1 shows that one of the consequences of the Industrial Revolution is unemployment, which has a high rate worldwide, the extinction of some professions and increased demand for other activities incorporated in new technologies, which shows that the character technological advances presents this bias. Employment is the biggest income generator of people [1, 24].

The Table 2 presents some characteristics of the Industrial Revolution:

Table 2: Characteristics of the Industrial Revolution

1st INDUSTRIAL REVOLUTION	2st INDUSTRIAL REVOLUTION	3st INDUSTRIAL REVOLUTION
Increase in work income; Productivity increase; Scientific reason entry; Man is transformed into an appendix of machines; Urbanized societies; Changing animal dependency.	Economy closed to an increasing number of unskilled workers; Intellectual capabilities must be expanded; Replacement of human labor in production and services by machines; New forms of distribution and generation of energy and	Development of digital systems, communication; Scientific revolutions: microelectronics, microbiology (genetic engineering), energy revolution (nuclear energy); Service economy (lean and highly specialized;

	communication.	Globalized economy, instantaneous by the revolution of information links).

Source: Santos (1999); Davis (2016)

The Fourth Industrial Revolution does not mean a struggle between human beings and machines, but the incorporation of technology in society, being a reflection of humanity's desires and choices and which generates gains for the consumer and improves daily life, generating impacts on the market workplaces and their environments worldwide, regardless of political or economic regime [8, 21, 25, 22, 23, 26].

The definition given by Schwab (2015, p. 1) is as follows: "it is characterized by the fusion of technologies that is blurring the lines between the physical, digital and biological spheres [...] which is evolving at an exponential rate and not linear".

The interpreted the Fourth Industrial Revolution as follows: "It fosters artificial intelligence, robotics, 3D printing, drones, nanotechnology, biotechnology, storage of data and energy, autonomous vehicles, new materials, the Internet of things, etc. ". [13, p. 1]

The main jobs that are most susceptible to exposure to technological advances and will cause unemployment are: jobs that require low levels of education, occupations that do not involve complex social interaction and occupations related to routine manual tasks [4, 22, 28] .

The condition of unemployment, mainly in the functions closest to the manual or the use of physical force, reduces the negotiating force of the worker with the boss, showing the perverse face of capitalism, in which the bosses have enough strength to withdraw social advances and pay a wage with enough value only to support the worker, as organizations aim to increase the return on invested capital [1, 4, 8, 25, 29].

Just as technologies are innovating and better adhering to the demands of society and the market, workers also need to update themselves and employ new skills and competences, so that they are within the requirements of the labor market. For this reason, some competences were debated at the World Economic Forum in Davos, those of 2015 discussed with the proposals for the year 2020 [4, 8, 21, 26].

Table 3 - Conclusions of the World Economic Forum in Davos

2015	2020
Troubleshooting complex problems	Troubleshooting complex problems
Critical thinking	Critical thinking
Creativity	Creativity
People management	People management
Coordinate with others	Coordinate with others
Emotional intelligence	Quality control
Decision making and discernment	Decision making and discernment
Service orientation	Service orientation
Negotiation	Negotiation
Cognitive flexibility	Know hear

Source: Schwab (2015)

Comparing the competences that were designated by the 2015 World Economic Forum, and the future proposals for the year 2020, in general, they are very equivalent, but the replacement of "emotional intelligence" by "quality control" stands out, this that is, the ideal condition of the manufactured product or the like overrides the individual's ability to identify his emotions. Another altered item was "cognitive flexibility", which was replaced by "knowing how to listen", proposing that a greater importance to expand thinking is listening to what others have to add, instead of generating an alternative for solving something immediately. . The other to be heard may be the market, employees, competitors and customers. These skills demanded of workers generate changes in their profile, so that they can adapt to a qualification that is necessary and sufficient to enter the labor market, and that has the ability to follow the changes that have occurred in this context [21, 26].

IV. ADVANCES AND EFFECTS OF TECHNOLOGY

The introduction of technology produces several benefits for users, organizations, the labor market and society, such as: the use of new methods; efficiency with the use of machines in some services and activities; facilities in solving everyday problems such as communication among others. On the other hand, the advancement of technology can also bring losses both for the labor market, making labor short after the implementation of technology, and for the environment,

increasing the production of debris and reducing natural resources, such as Petroleum 9, 10, 22, 23, 26, 30].

Technological advancement has the power to eliminate some manual and intellectual jobs, starting to demand from workers a new profile based on new attitudes, specializations, skills, competences, dynamism, versatility, multifunctions and that has the capacity to accompany technological evolution, in addition to the emergence of new functions that use more intellectual capacity and a high degree of qualification, these conditions provided the elimination of some professions such as the telegraph operator. Technological advances affect not only the worker and the work environment, but also public policies due to the new needs generated due to the technological impact on inequality and wage polarization [1, 7, 9, 10, 11, 20, 30, 31]

Functional unemployment generated by technological developments may be related, among other reasons, to automation and technological illiteracy and its concentration is usually related to people with low schooling and / or little or no qualifications. Technological advancement also generates waste, new types of waste and directs people to seek power and capital, however, it does not eliminate accidents or known or new occupational diseases [1, 9, 10, 11, 20, 30, 31].

Unemployment due to technological advances is not new and is not just due to the replacement of men by the machine. The restructuring caused by technology in the production models directly affects the workforce, forcing formal workers to seek more specializations, in order to be able to perform various functions, that is, the worker must be multifunctional. When the worker does not prepare or does not properly qualify for a position or function, he runs the risk of being replaced by another more qualified worker or by a machine, or else the market does not generate this type of job anymore or closes the job of work intended for that unskilled or semi-skilled worker. In the capitalist world, the technological innovations that arise and are used in the market, lead to a desire to generate more wealth in less time and as a result, workers must qualify or they will be unemployed or underemployed in favor of machines and the need of the market [7, 9, 10, 11, 32, 33].

The exacerbated use of technology became more significant after the emergence of capitalism and with that came other factors tied, such as unrestrained consumption, the lack of concern with environmental issues and the lack of control of man before society. Man seeks to update, facilitate and advance, but does not recognize the limits, which brings harm not only to society but also to the environment in which he lives [9, 10, 34].

In the work environment, a structural change occurs as a result of the transformations arising from technological development, which can interfere positively or negatively in economic activities, as well as modify the type of labor required for its implementation and continuity [6].

The relationship of people with technology has two biases, because, at the same time that they change people's way of life, people are obliged to adapt to technological products and / or services, as currently happens with the cell phone and its functions which have become indispensable for people [7, 35, 36].

Technology impacts people in relation to their forms of communication, the demand for new skills, competences and attitudes, affects people's level of privacy, changes the ways of accessing information [10, 11, 30, 33, 34].

Technology can be a problem for people who need to deal with it, exerting a negative impact or technological stress on the individual and among these problems there is Technostress in which the individual has difficulty in dealing with or accepting new ones. technologies in a healthy way. This condition can impact a person's attitudes, thoughts and behavior [7, 12, 34]. These reactions are more noticeable in older people, in accommodated people, in the illiterate, in the semi-literate or with little education among other groups.

The difficulties highlighted by workers in automated services are: "explaining the activities they perform as a profession; painful working conditions; the lack of autonomy and instability in relation to working time ". [35, p. 14]

Technology impacts organizations and influences decision-making regarding its implementation / implementation, as it causes several problems for the universe of companies, generating fears and resistance in its employees, changing group relationships, requiring adaptation in the production and management system, will influence in productivity and logistics, it will require some changes from partners and consumers, it will affect the level of employment and remuneration, it can have consequences for the environment, it will affect the availability of products and / or services. Each affected part will affect the other part and the influence of one will also influence the other in whole or in part [9, 10, 11, 30, 36].

Technology is a fundamental item for the survival of organizations, because it reduces costs, increases productivity gains, increases competitiveness, improves process control and reduces the manpower in some essential activities or not, which demand the need for speed in solving problems. It also aims to improve the effectiveness and efficiency of the organization, serves to respond to the wishes of its customers and the market and becomes a differential in relation to its competitors, serving as a vital component for its survival in the market, due to the high existing competitiveness between organizations and transformations arising from the rapidity with which humanity progresses [7, 19, 36].

Technological advancement accelerated from the First Industrial Revolution and continues today, with society progressing and needing material goods with better quality and with the most advanced technology and organizations that do not follow this maxim, will tend to become obsolete . The Industrial Revolution had as its pillar the replacement of the worker by the machine, having a great impact on the collective process and on labor relations. There was also an evolution in production methods and techniques, in addition to changes in society, culture, management, labor relations and politics [7, 20, 36].

The machinery did not exterminate with the work that people performed in their homes, however, some activities employed people in factories to perform these functions, aiming to increase production on a scale.

V. CONCLUSION

The evolution of humanity has always been related to the pursuit of well-being and to achieve it, it sought elements that added conditions to develop techniques and products that would provide time for leisure and entertainment, minimize the forces for carrying out work and, above all, guarantee a improvement in quality of life.

Technological advancement presents substantial changes in the world economy, in organizations and in social and work environments. It also contributes to the advancement of administration, accounting, geography, physics, medicine, biology and other fields of knowledge

In terms of definition, technology is a study of knowledge together with the skills necessary to produce something that produces results in any area of knowledge.

Technological advancement is a factor that generates unemployment for some manual and manual activities, however, it generates other new professions where individuals must seek new learning, in addition to seeking to develop new skills, competences and attitude.

The technologies at the level at which they are presented cannot go backwards and their evolution is a real factor, being perceived that the future tends to increase structural unemployment even more with the use of new technological advances, which are presented at an exponential speed and the organizations with some technologies are aware that in the evolution their product

will soon become obsolete in a short period of time, with the real occurrence being that some products devalue before their completion and others at startup.

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The use of duplex stainless steel filler metals to avoid hot cracking in GTAW welding of austenitic stainless steel AISI 316L

André de Albuquerque Vicente[1,2], Peter Aloysius D'silva[2], Roberto Luiz de Souza[2], Italo Leonardo dos Santos[2], Renato Rodrigues de Aguiar[2], Amilton Barbosa Botelho Junior[1]

[1]Department of Chemical Engineering, Universidade de São Paulo, Rua do Lago,250, Cidade Universitária, São Paulo, SP, Brazil
[2]ESAB Middle East & Africa, Plot No. S20134, Jebel Ali Free Zone (South), PO Box 8964, Dubai, United Arab Emirates

Abstract— *Sulfur is an element that is intrinsically and sometimes even deliberately present in stainless steel. It is usually bonded in the form of manganese sulfides, which at low levels can have a significant influence on improving machinability. In this work, solidification cracking in austenitic stainless steels welds was investigated. The solidification mode of stainless steels is of fundamental importance and most austenitic stainless steels are designed to solidify to give primary ferrite and secondary austenite to minimize the occurrence of hot cracks. The primary austenitic solidification mode enables cracks to initiate and propagate more easily. This is further enhanced by sulfur segregation. The primary ferritic mode of solidification, however, inhibits crack initiation and propagation and promotes backfilling. The ability to backfill the cracks also affects the extent of cracking observed in welds. Different filler wires were tested to weld, through GTAW welding process, tubes of type 316L UNS S31603 to forged fittings of type ASTM A182 F316 that presented sulfur and phosphorous contents, respectively, 0.03% and 0.045% wt. Duplex stainless steel filler metals ER 2209 and ER 2594, represented a creative solution to avoid hot cracking observed on those samples welded using austenitic stainless steel filler metals ER 316L and ER 309L. Several complementary techniques of microstructural analysis were used, such as optical emission spectrometry, optical microscopy and scanning electron microscopy with coupled EDS*

Keywords— *Austenitic Stainless Steels; Solidification Mode; Hot Cracking.*

I. INTRODUCTION

The addition of sulfur to ease machinability of stainless steels is largely used by steel shops. Sulfur forms compounds in the stainless steels that will help to break stainless steel chip during machining and form a lubrication layer on the top of the cutting tool, reducing friction and extending tool life. The use of sulfur expanded throughout the stainless industry to give rise to free machining grades such as 303, 416 and 420F.

Certain alloying elements in stainless steels, such as sulfur, selenium, lead, copper, aluminum, calcium, or phosphorus can be added or adjusted during melting to alter the machining characteristics. These alloying elements serve to reduce the friction between the workpiece and the tool thereby minimizing the tendency of the chip to melt and stick to the tool. Also, sulfur forms inclusions that reduce the friction forces and transverse ductility of the chips, causing them to break off more readily. Figure 1 shows the improvement in machinability in the free-machining stainless steels namely types 303, 303 Se, 203, 430F, 416, and 420F. **[1,2]**
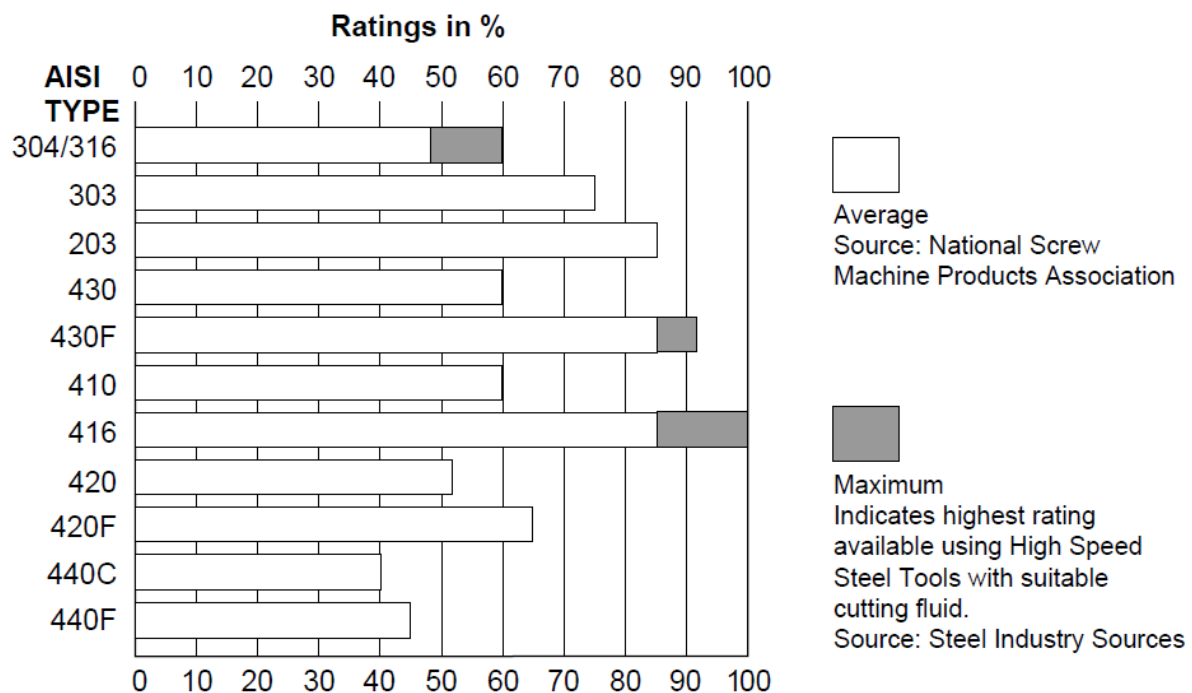
Fig.1: Comparative machinability of frequently used stainless steels and their free-machining counterparts. % based on 100% for AISI type 416 free-machining stainless steel [1]

However, there is a dark side to these high sulfur additions. Sulfur attacks the good attributes of stainless steels. Corrosion is compromised, interferes with welding and can become an initiation site for cracking to occur, especially when any deformation is performed on the part or when there are thin wall sections. The use of sulfur also found its way into other common stainless grades like 410, 304/304L and 316/316L. The adverse effects of sulfur in these grades are not as pronounced on properties as the free machining grades. Welding, corrosion resistance and ductility are generally not an issue. These small sulfur additions do have a substantial effect on the machinability of the stainless steels, as a 0.005% in weight increase can improve machinability by 30% or more. **[1,2]**

The possible solidification modes in the Fe-Cr-Ni system are:

I) ***Austenitic solidification (L $\rightarrow$ L+γ $\rightarrow$ γ):***
The only solid phase to form is austenite. In austenitic solidification, called solidification mode I, there is no other phase transformation at high temperature. **[3-5]**

II) ***Austenitic-ferritic solidification (L $\rightarrow$ L+γ $\rightarrow$ L+γ+δ $\rightarrow$ γ+δ):***
Austenite solidifies as a primary phase in a dendritic or cellular way. As the temperature decreases, ferrite δ is formed from the remaining liquid. Solidification

occurs through a peritectic reaction (L+$\delta$$\rightarrow$$\gamma$). This is called solidification mode II. **[3-5]**

III) ***Ferritic-austenitic solidification (L$\rightarrow$L+$\delta$$\rightarrow$L+$\delta$+$\gamma$$\rightarrow$$\delta$+$\gamma$):***
The duplex stainless steels solidify according to ferritic-austenitic solidification (L$\rightarrow$L+$\delta$$\rightarrow$L+$\delta$+$\gamma$$\rightarrow$$\delta$+$\gamma$). δ ferrite solidifies as the primary phase in dendritic or cellular fashion. As temperature decreases, austenite is formed by a peritectic (L+$\delta$$\rightarrow$$\gamma$) or eutectic (L$\rightarrow$$\delta$+$\gamma$) reaction. In the case of a peritectic reaction, the initially formed austenite completely surrounds the ferrite and subsequently grows into ferrite and liquid. Depending on the rate of diffusion through the austenite, the reaction may or may not be complete, and at the end of the solidification ferrite may be involved in austenite. Between the two reactions - peritectic and eutectic - the transition takes place where, during the initial formation of austenite by peritectic reaction, ferritizing elements secrete to the liquid, provoking their enrichment in these elements and consequently the simultaneous formation of ferrite and austenite by means of a eutectic reaction. This is called solidification mode III. **[3-13]**

IV) ***Ferritic solidification (L$\rightarrow$L+$\delta$$\rightarrow$$\delta$):***
The only solid phase to form is ferrite. In ferritic solidification, called solidification mode IV, ferrite is

the only phase to form during solidification and, depending on the chemical composition, austenite can precipitate only in the solid state in the ferritic grain boundaries. **[3-5]**

The solidifications of austenitic stainless steels can occur according to the first three solidification modes, being therefore possible to obtain a "completely austenitic" matrix according to the Fe-Cr-Ni equilibrium diagram shown in figure 2.

Fig.2: Fe-Cr-Ni ternary phase diagram highlighting the pseudo-binary Cr-Ni diagram for 70% Fe. [6]

Figure 3 presents the Fe-S equilibrium diagram and respective solubility limits of sulfur in the allotropic phases of iron, δ ferrite and γ austenite.

Fig.3: Fe-S equilibrium diagram showing solubility limits of sulfur in δ ferrite and γ austenite [14]

It is observed in figure 3 that the solubility limit of sulfur in δ ferrite is 0.14 % in weight and in γ austenite is 0.05 % in weight.

Figure 4 presents the Fe-P equilibrium diagram and respective solubility limits of phosphorus in the allotropic phases of iron, α ferrite and γ austenite.

Fig.4: Fe-P equilibrium diagram showing solubility limits of phosphorus in α ferrite and γ austenite [14]

It is observed in figure 4 that the solubility limit of phosphorus in α ferrite is 2.80 % in weight and in γ austenite is 0.31 % in weight.

The information taken from both Figures 3 and 4, helps to understand why solidification cracking is a significant problem during the welding of austenitic stainless steels, particularly in solidification modes I, austenitic solidification, and II, austenitic-ferritic solidification. Hot cracking in stainless steel welds is caused by low-melting eutectics containing impurities such as sulfur and phosphorus, and alloy elements such as titanium and niobium. **[15]**

Sulfur is known to be an undesirable impurity in welding of stainless steels due to the formation of low-melting sulfide films along the interdendritic and grain-boundary regions. Sulfur is strongly rejected into the liquid during solidification of austenite, rapidly lowering the melting point of the interdendritic liquid. Thus, the potential for forming low-melting eutectics remains strong even with very low contents of sulfur in austenite (< 0·005 wt.%). On the other hand, δ-ferrite shows higher solubility for elements like sulfur, phosphorus, silicon and niobium. **[15]**

Manganese additions are well-known to decrease cracking in steels that present high content of sulfur by forming higher-melting MnS-γ eutectic in preference to Fe-FeS. Further, the addition of lanthanum and other rare earth elements has been found highly effective in binding the P and S as stable compounds. **[15]**

Table 1 presents the most important eutectic reactions involving sulfur and phosphorus during the solidification of commercial stainless steels.

Table.1: Partition coefficients of elements promoting hot cracking in austenite and ferrite, constitution and melting points of possible low-melting phases. [15]

Constituent	Temperature (K)	Partition coefficient		Low-melting phases	
		δ	**γ**	**Structure**	**Melting point (K)**
Sulfur	1638	0.091	0.035	**Eutectic Fe–FeS**	1261
				Eutectic Ni–NiS	903
Phosphorus	1523	0.23	0.13	**Eutectic Fe–Fe₃P**	1321
				Eutectic Ni–Ni3P	1148

Most of the compositions of commercial stainless steels, are in the iron-rich side of the ternary Fe-Cr-Ni equilibrium

diagram, between 50 and 70% of iron in weight. The initial solidifying phase is determined by the position of the alloy

with respect to the liquidus surface, which under equilibrium conditions proceeds toward the eutectic/peritectic before solidification is complete. Figure 5 shows the pseudo-binary equilibrium diagram on the vertical section of Fe–Cr–Ni equilibrium diagram at a constant Fe content of 70% in weight. It is commonly used to identify the primary solidifying phases or solidification modes for various compositions of different stainless steels. **[3, 4, 15]**

Fig.5: Pseudo-binary section of the Fe–Cr–Ni ternary diagram at 70% Fe, showing solidification modes; A - fully austenitic, AF - austenitic–ferritic, FA - ferritic–austenitic and F - fully ferritic. [15]

When the Cr_{eq}/Ni_{eq} ratio < 1.5, the solidification may be austenitic (mode I) or austenitic-ferritic (mode II). When the ratio $1.5 < Cr_{eq}/Ni_{eq} < 2.0$ the solidification will be ferritic-austenitic (mode III). And finally, when Cr_{eq}/Ni_{eq} ratio > 2.0 the solidification will be ferritic (mode IV). **[3]**

Sulfur is known to be an undesirable impurity in welding of stainless steels due to the formation of low-melting sulfide films along the interdendritic and grain-boundary regions. Sulfur is strongly rejected into the liquid during solidification of austenite, rapidly lowering the melting point of the interdendritic liquid. Thus, the potential for forming low-melting eutectics remains strong even with very low contents of sulfur in austenite (< 0·005 wt.%). On the other hand, δ-ferrite shows higher solubility for elements like sulfur, phosphorus, silicon and niobium. **[15]**

Manganese additions are well-known to decrease cracking in high-S steels by forming higher-melting MnS-γ eutectics in preference to FeS. Further, the addition of lanthanum and other rare earths has been found highly effective in binding the P and S as stable compounds. **[15]**

According to studies by Suutala **[16-21]**, the Cr_{eq}/Ni_{eq} ratio is fundamental in determining the solidification mode of austenitic stainless steels.

Figure 6 presents the solidification cracking behavior in austenitic stainless steels welds as a function of Cr_{eq}/Ni_{eq} ratio and P+S levels.

Fig.6: Solidification cracking behavior in austenitic stainless steels welds as a function of Cr_{eq}/Ni_{eq} ratio and P+S levels.[18]

It is observed in figure 6 that austenitic stainless steels that present P+S wt% below 0.01%, are not susceptible to hot cracking. When the Cr_{eq}/Ni_{eq} ratio is below 1.5, if the total P+S wt % is higher than 0.01%, the austenitic stainless steels welds are very susceptible to hot cracking. If $1.5 < Cr_{eq}/Ni_{eq} < 1.75$, the austenitic stainless steels welds are slightly susceptible to hot cracking. Finally, when the Cr_{eq}/Ni_{eq} ratio is higher than 1.75, the austenitic stainless steels welds are not susceptible to hot cracking even for total P+S wt % higher than 0.20.

The Suutala Diagram [18], shown on figure 6, considers the Cr_{eq} and Ni_{eq} are according to the formulas proposed by Hammar and Svensson [23,24]:

$$Cr_{eq} = \%Cr+1.37*\%Mo+1,50*\%Si+2,00*\%Nb+3,00*\%Ti$$
(Equation 1) [3]

$$Ni_{eq} = \%Ni+0.31\%Mn+22.00*\%C+14.20*\%N+1.00*\%Cu$$
(Equation 2) [3]

One way of empirically quantifying pitting corrosion resistance is through the PREN (*Pitting Resistance Equivalent Number*), $PREN_N$ (equation 1) and $PREN_W$ (equation 2), when dealing with materials having Tungsten (W) in their composition. [3]

$$PREN_N = \%Cr + 3,3 \ x(\%Mo) + 16x(\%N)$$
(Equation 3) [3]
$$PREN_W = \%Cr + 3,3 \ x(\%Mo + 0,5 \ \%W) + 16x(\%N)$$
(Equation 4) [3]
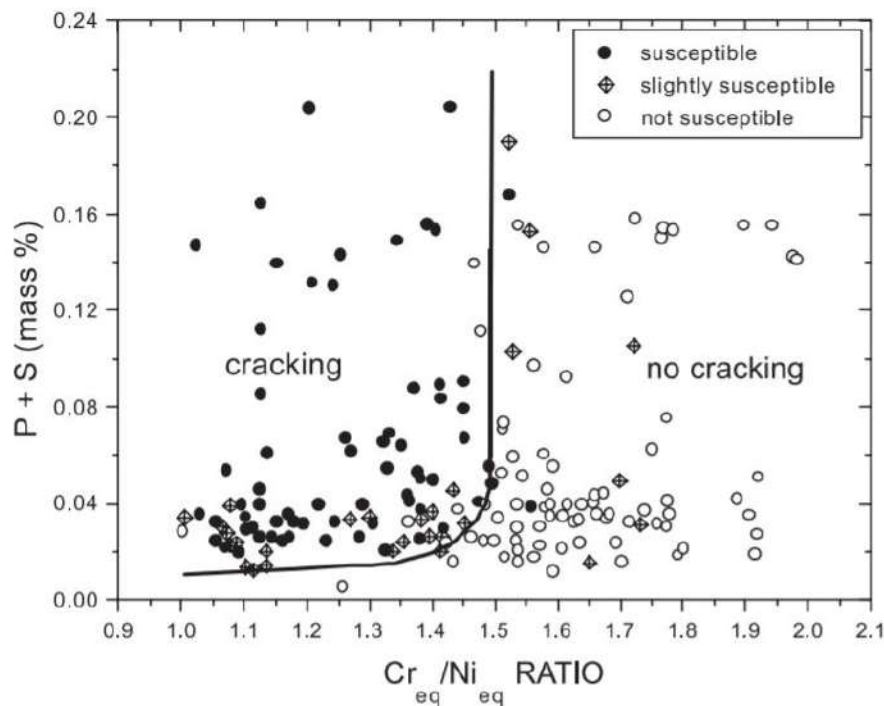
II.   EXPERIMENTAL

Four pairs of tubes of type 316L UNS S31603, and forged fittings of type ASTM A182 F316 (weldolets), from the same heats, were welded with different welding wires through GTAW process but keeping the welding parameters as equal as possible.

The tubes are 2 inches diameter and thickness 2,77 mm (SCH 10).

The welding wires used to produce samples 1, 2, 3 and 4 were, respectively, ER 316L, ER 309L, ER 2209 and ER 2594 2.4 mm.

The shielding gases used were 99.99% Ar to samples 1 & 2, 98% $Ar+2\%$ N_2 to samples 3 & 4, and the purge gas used was the same 99.99% Ar to all the samples.

The specimens were removed from the base metal and the joints of the tubes using a cut-off.

Chemical analyzes were carried out in all samples by means of an optical emission spectrometer, according to ASTM E 1086-08. [24]

Afterwards, the samples were embedded in hot-cure resin (bakelite). The conventional manual polishing was applied using water slicks (100, 240, 320, 400, 600 and 1000 mesh) in order to standardize the surface finish of the samples. Afterwards, a cloth polishing with 9, 3 and 1 μm diamond abrasive paste was carried out in this sequence. The samples were electrolytically attacked in 20% NaOH solution, 6V, for 90 seconds. This allowed the microstructural characterization of the samples through optical microscopy. The quantitative metallographic analyzes for the determination of volumetric fractions of δ ferrite and austenite were performed according to ASTM E 562 ed. 08, [25] using a 4 X 5 grid (20 points) with a magnification of 400 X in 30 different regions per test piece.

Finally, tensile tests were performed on welded joints to evaluate their mechanical properties. The preparation of the sub-size specimens to the tensile test was according to ASTM E8/E8M-16ae1 [26].

III.   RESULTS AND DISCUSSION

Table 2 presents the welding parameters used to weld the samples. It is important to emphasize that the welding wires used to produce samples 1, 2, 3 and 4 were, respectively, ER 316L, ER 309L, ER 2209 and ER 2594, all 2.4 mm diameter.

Table 2 – Welding parameters used to weld samples 1, 2, 3 and 4 using the filler metals, respectively, ER 316L, ER 309L, ER 2209 and ER 2594, all 2.4 mm diameter.

	Welding Parameters					
	Tension (V)	**Current (A)**	**Travel Speed (mm/s)**	**Thermal Efficiency (%)**	**Heat Input (kJ/mm)**	**Shielding Gas**
Sample 1	11.0	52	0.40	80	1.14	99.99% Ar
Sample 2	10.0	54	0.40	80	1.08	99.99% Ar
Sample 3	10.5	53	0.40	80	1.11	98% $Ar+2\%$ N_2
Sample 4	10.0	55	0.40	80	1.10	98% $Ar+2\%$ N_2

Table 3 presents the chemical compositions of the tube, fitting, filler metals and all weld metals of the four joints.

According to the chemical compositions obtained from table 3, table 4 presents the calculations of PREN, Cr_{eq}, Ni_{eq}, Cr_{eq}/Ni_{eq} ratio and total P+S wt %.

The calculation of Cr_{eq}, Ni_{eq} and PREN were done using Equations 1, 2 and 3, respectively.

Table 3 - Chemical compositions of the studied stainless steels (% by weight).

		%C	%Si	%Mn	%P	%S	%Cr	%Ni	%Mo	%Cu	%N
Base Metals	**UNS S31603**	0.030	0.45	1.93	0.019	0.003	16.46	11.96	2.07	0.44	0.06
	F316	0.080	0.72	1.93	0.045	0.03	18.66	13.5	2.5	0.10	0.09
Filler Metals	**ER 316L**	0.025	0.63	1.1	0.012	0.008	18.64	12.23	2.53	0.18	0.03
	ER 309L	0.024	0.61	1.72	0.015	0.013	23.57	13.52	0.11	0.16	0.11
	ER 2209	0.022	0.52	1.62	0.01	0.018	23.01	8.89	3.2	0.17	0.15
	ER 2594	0.010	0.48	0.63	0.021	0.015	26.14	9.57	3.92	0.39	0.24
All Weld Metals	**Sample 1**	0.026	0.59	1.27	0.013	0.007	18.2	12.18	2.44	0.23	0.04
	Sample 2	0.035	0.63	1.76	0.021	0.016	22.59	13.52	0.59	0.15	0.11
	Sample 3	0.023	0.54	1.52	0.01	0.016	22.14	9.56	3.07	0.17	0.13
	Sample 4	0.013	0.51	0.85	0.02	0.015	25.63	10.36	3.16	0.34	0.21

Table 4 - PREN, Cr_{eq}, Ni_{eq}, Cr_{eq}/Ni_{eq} ratio and total P+S (weight %).

		PREN	Cr_{eq}	Ni_{eq}	Cr_{eq}/Ni_{eq}	Total S+P (wt %)
Base Metals	**UNS S31603**	24.25	19.97	14.51	1.38	0.022
	F316	28.35	23.17	17.24	1.34	0.075
Filler Metals	**ER 316L**	27.47	23.05	13.73	1.68	0.020
	ER 309L	25.69	24.64	16.3	1.51	0.028
	ER 2209	35.97	28.17	12.18	2.31	0.028
	ER 2594	42.92	32.23	13.78	2.34	0.036
All Weld Metals	**Sample 1**	26.83	22.44	13.88	1.62	0.020
	Sample 2	26.22	24.34	16.49	1.48	0.037
	Sample 3	34.27	27.15	12.49	2.17	0.026
	Sample 4	39.47	30.71	14.29	2.15	0.034

The results shown on tables 3 and 4, confirm that the four filler metals chosen to run the tests, presented PRENs higher than that of the tube UNS S31603. That resulted in chemical compositions of the all weld metals of the samples 1, 2, 3 and 4 that have PRENs above that of the base metal with lower PREN, that in this study is the tube of Type 316L UNS S31603.

The calculation of the Cr_{eq}/Ni_{eq} ratio, and total P+S wt %, showed that both base metals presented Cr_{eq}/Ni_{eq} ratios below 1.5 and the total P+S wt % higher than 0.01%. The same was observed on the all weld metal of sample 2, welded using the filler metal ER 309L. This is an indication that these austenitic stainless steels are very susceptible to hot cracking.

Although the four all weld metals from samples 1, 2, 3 and 4, showed P+S wt % higher than 0.01%, it is interesting to verify that sample 1 presented Cr_{eq}/Ni_{eq} ratio equal to 1.62 indicating that this joint is slightly susceptible to hot cracking. In the case of samples 3 and 4, welding using duplex and super duplex filler metals, respectively, ER 2209 and 2594, the Cr_{eq}/Ni_{eq} ratios are higher than 1.75, resulting

that these dissimilar stainless steels welds, solidify in a ferritic-austenitic (mode III) or ferritic (mode IV) fashions. It is expected that these joints are not susceptible to hot cracking even for total P+S wt % higher than 0.20.

Table 5 presents the results of the mechanical properties of the samples 1, 2, 3 and 4.

Table 5 – Mechanical properties and volumetric fractions of δ ferrite.

		Yield Strength (Mpa)	Tensile Strength (Mpa)	Elongation (%)	% δ Ferrite
Base Metals	UNS S31603	225	528	42	4
	F316	240	560	32	2
All Weld Metals	Sample 1	200	273	10	7
	Sample 2	160	241	8	2
	Sample 3	240	575	40	44
	Sample 4	243	563	33	47

Both samples 3 and 4, welded using duplex and super duplex stainless steels filler metals, respectively, ER 2209 and ER2594, showed higher tensile test results than base metals, being in this way considered approved.

In the other hand, both samples 1 and 2 showed lower tensile test results than base metals. As discussed before, both all

weld metals of samples 1 and 2 are prone to solidification cracks.

Figure 7 presents the micrographs of the all weld metals of samples 1 and 2.
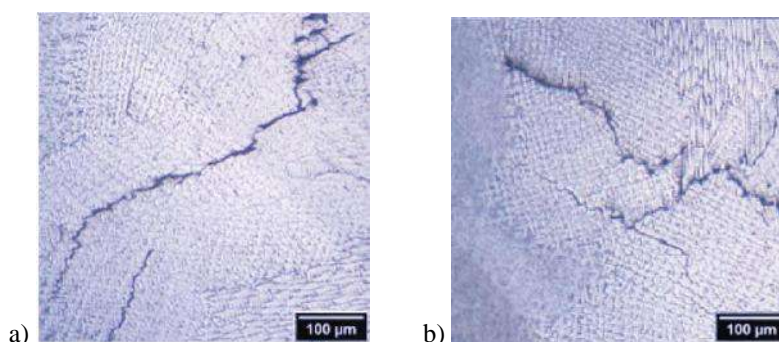
Fig.7 - Micrographs of the all weld metals of a) Sample 1 (ER 316 and b) Sample 2 (ER 309l)

Figures 8 and 9 presents the metallographic analyzes and the respective characterizations of sample 1, as well as the respective semi-quantitative chemical analyzes of regions near and far from the cracks through SEM with coupled EDS.
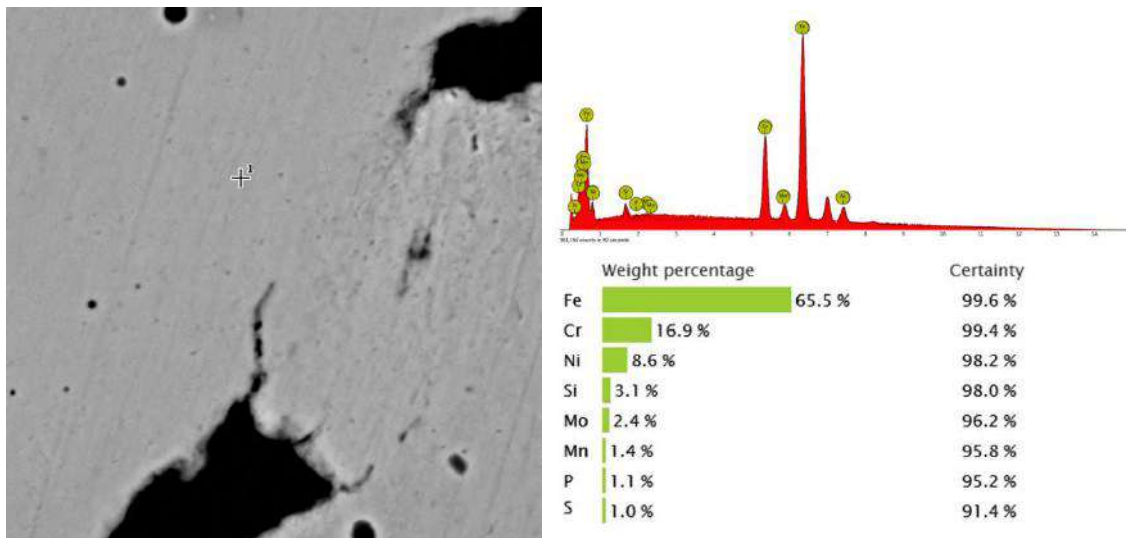
Fig.8 - Metallographic analyzes and respective characterization of Sample1 (All weld metal), as well as, the respective EDS of the region near the cracks.
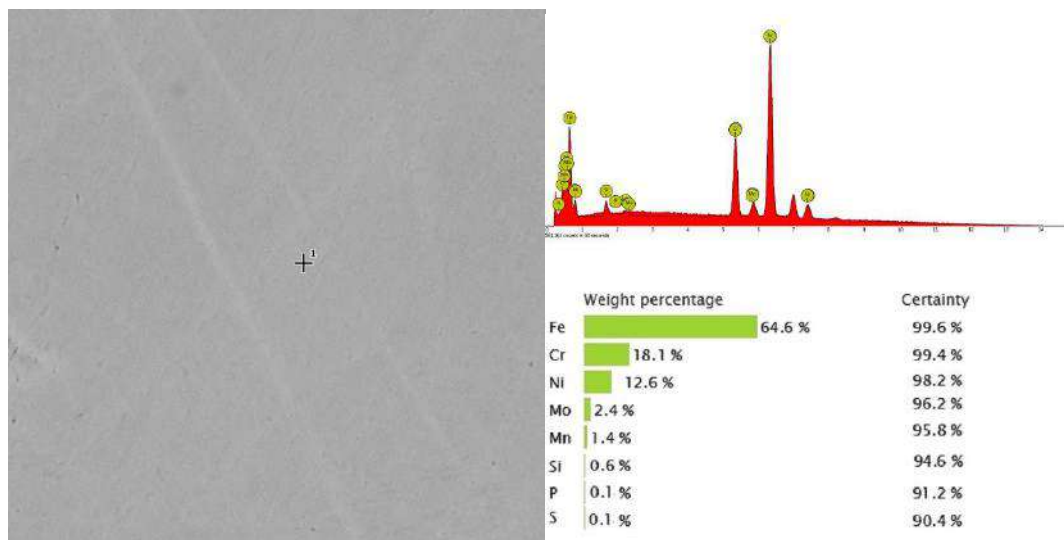
Fig.9 - Metallographic analyzes and respective characterization of Sample1 (All weld metal), as well as, the respective EDS of the region far from the cracks.

The analysis of figures 8 and 9, shows that the regions close to the cracks have higher sulfur and phosphorus contents than the regions away from the cracks.

This fact reinforces the theory that micro segregations of sulfur and phosphorus during the solidification of austenitic stainless steels that present Cr_{eq}/Ni_{eq} ratio below 1.75 can generate solidification cracks.

Austenitic stainless steels are, usually, indicated for high temperature applications [27]. However, it is important to emphasize that duplex stainless steels are not recommended for high temperature applications, due to the fact that these stainless steels are prone to the precipitation of deleterious phases, as shown at figure 10.
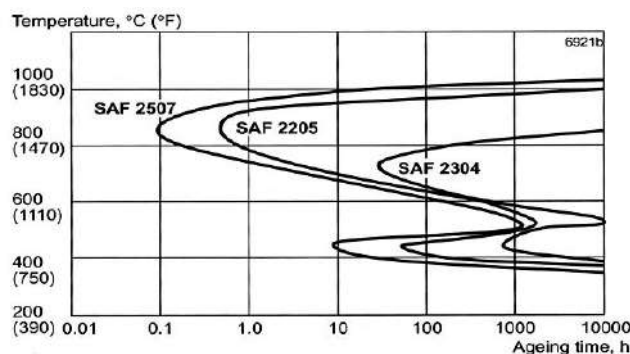
Fig.10 – Time Temperature Transformation (TTT) diagram of duplex stainless steel UNS S32750. [7, 13]

IV. CONCLUSIONS

When the Cr_{eq}/Ni_{eq} ratio is lower than 1.75, the solidification may be austenitic (mode I) or austenitic-ferritic (mode II). If the total content of phosphorous and sulfur is higher than 0.01%, the all weld metal is susceptible to hot cracking.

Sulfur and phosphorous are strongly rejected into the liquid during solidification of austenite, rapidly lowering the melting point of the interdendritic liquid. On the other hand, δ-ferrite shows higher solubility for elements like sulfur, phosphorus, silicon and niobium.

Due to the ferritic-austenitic solidification (mode III), duplex stainless steel filler metals, demonstrate to be efficient in the welding of austenitic stainless steels that present total content of phosphorous and sulfur higher than 0.048%.

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Knowledge rate of students of the nursing graduation course on Basic Life Support

Maicon de Araujo Nogueira*[1], Luciane Caroline Ferreira de Azevedo Emim[2], Mayco Tadeu Vaz Silva[2], Marcilene Souza da Silveira[2], Karolayne Teles Costa[2], Letícia dos Santos Cruz[2], Lívia Karolina Silva de Oliveira[3], Thamyris Abreu Marinho[4], Simone Aguiar da Silva Figueira[5], Cinthya Lorena Bezerra Sarmanho[6], Márcio Almeida Lins[7], Elieni Santana de Abreu[7], Joyce da Silva Pantoja[7], Simone Batista da Silva dos Santos[7], Nathália Conceição Gonçalves Dalmacio[7], Fábyla D' Tácia Brito Trindade[7], Eimar Neri de Oliveira Junior[7], Leliane do Nascimento do Espírito Santo[7], Adams Brunno Silva[8], Evelyn Amorim Coelho[9], Karla Christina Bernardes[9], Caroline Marinho Pereira[9], Bruna Camila Blans Moreira[9], Wanda Carla Conde Rodrigues[10], Glauber Marcelo Dantas Seixas[9], Viviane Ferraz Ferreira de Aguiar[11], Cinthya Lorena Bezerra Sarmanho[12], Eloísa Avelino de Sousa França[13], Elizabeth Valente Barbosa[13], Shirley Iara Martins Dourado[14], Tobias do Rosário Serrão[15], Manuella Matos de Azevedo[16], Tanymara Xavier de Morais[17], Dayhane Souza da Conceição[17], Izadora Larissa Cei Lima[17], Gabriel Itaparica de Oliveira[17], Manoel Vitor Martins Marinho[18], Deisiane da Silva Mesquita[19], Gabriela Oliveira da Silva[20], Brena do Socorro Correa de Oliveira[21], Widson Davi Vaz de Matos[22], Jasmin Stephany Savaris dos Santos[23], Otávio Noura Teixeira[24], Antonia Margareth Moita Sá[25]

[1]Nurse, Master in Health Education in the Amazon, PhD student, Stricto Sensu Postgraduate Program, Professional Doctor degree in Health Education in the Amazon, State University of Pará. Professor at the University of the Amazon, Belem, Para, Brazil. *E-mail: profmaiconnogueira@gmail.com

[2]Nursing student. University of Amazon (UNAMA), Belem, Para, Brazil.

[3]Nurse, Pan Amazonian College (FAPAN), Belem, Para, Brazil.

[4]Nurse, Post graduate. Stricto Sensu Graduate Program in Nursing, Federal University of Para (UFPA) Belem, Para, Brazil.

[5]Nurse, Master in Health Education in the Amazon, PhD student, Stricto Sensu Graduate Program, Professional Doctor degree in Health Education in the Amazon (ESA), State University of Para (UEPA). Professor at the State University of Para (UEPA), Campus Santarem, Para, Brazil.

[6]Nurse, Master in Health Education in the Amazon, Stricto Sensu Post Graduate Program, Professional Master degree in Health Education in the Amazon (ESA), State University of Para (UEPA). Professor at University Center of Amazon (UniFAMAZ), Belem, Para, Brazil.

[7]Nurse, University Center of Amazon (UniFAMAZ), Belem, Para, Brazil.

[8]Nurse, Ophir Loiola Hospital (HOL). Master degree student, Nursing Master Degree Program, State University of Para (UEPA), Belem, Para, Brazil.

[9]Nurse, University of the State of Pará (UEPA), Belem, Para, Brazil.

[10]Physitherapist. Master. Professor at University Center of Amazon (UniFAMAZ), Belem, Para, Brazil.

[11]Nurse. Master in Education, Formation and Management on Nursing, Federal University of Para (UFPA). Professor at University Center of Amazon (UniFAMAZ), Belem, Para, Brazil

[12]Nurse, Master in Health Education in the Amazon, Stricto Sensu Post Graduate Program. Professional Master degree in Health Education in the Amazon (ESA), State University of Para (UEPA). Professor at University Center of Amazon (UniFAMAZ), Belem, Para, Brazil

[13]Nurse, University of Amazon (UNAMA), Belem, Para, Brazil.

[14]Nurse, Doctor, Federal University of Rio de Janeiro (UFRJ), University Hospital João de Barros Barreto (HUJBB), Federal University of Para (UFPA), Belem, Para, Brazil.

[15]Nurse, Pan Amazonian College (FAPAN), Master on Engineering Processes, pela Federal University of Para (UFPA), Belem, Para, Brazil.

[16]Occupacional Therapist, Urgence and Emergency Metropolitan Hospital (HMUE), Ananindeua, Para, Brazil.

[17]Nursing Student, Estácio Castanhal Faculty, Castanhal, Para, Brazil.

[18]Nurse, State University of Para (UEPA). Intern at Holy House of Mercy of Para (FSCMPA), State University of Para (UEPA) on Woman's and Child's Health, Belem, Para, Brazil.

[19]Nurse, Estácio Castanhal Faculty. Master student, Stricto Senso Graduate Program, Master in Epidemiology and Health Surveillance from Instituto Evandro Chagas, Belem, Para, Brazil.

[20]Nurse. Resident in the Surgical Clinical Residency Program, Sírio Libanês, São Paulo, Brazil.

[21]Nurse, Estácio Castanhal Faculty, Castanhal, Para, Brazil.

[22]Resident Nurse, Oncology Nursing Residency Program, Federal University of Pará (UFPA), Belém, Pará, Brazil.

[23]Nurse, Faculdade Integrada Brasil Amazônia (FIBRA), Belem, Para, Brazil.

[24]Graduation in Computer Science and Technology in Data Processing. PhD in Electrical Engineering, Professor at Federal University of Pará (UFPA), Tucuruí, Para, Brazil.

[25]Nurse, Doctor in Nursing Federal University of Rio de Janeiro (UFRJ). Permanent member of professors' crew on Post graduation Program Stricto Sensu, Professional Master and Doctor degrees em Health Education in the Amazon (ESA), State University of Para (UEPA), Belem, Para, Brazil.

Abstract— *Objective: to analyze the knowledge of students of the Undergraduate Nursing Course of a Private Higher Education Institution in Belem, State of Pará, Brazil on Basic Life Support. Method: A cross-sectional, descriptive, exploratory study with a quantitative approach was carried out from September to October 2018. Result: In the evaluation of knowledge about Basic Life Support, on a scale of 0 to 100 points, it was verified that the lowest grade was 20.6 points and the highest was 90.4. The mean was 63.5 points, with a standard deviation of 15.5. The median was 64 points, with the interquartile deviation of 20 points (54 to 74 points). It was evidenced that 62% of the students had a grade lower than 70 points. And 19% scored less than 50 points. The population studied has reduced, and sometimes inadequate, knowledge about cardiorespiratory arrest and cardiopulmonary resuscitation, which may compromise the care provided, leading to damages to resuscitation and, consequently, to contribute to the appearance and / or aggravation of sequels, impacting on increased morbidity and mortality. Conclusion: it is understood that it is fundamental to establish training and evaluation of these, in a theoretical and practical, as a way to optimize and consolidate knowledge even during academic training.*

Keywords— *Cardiopulmonary resuscitation. Bachelor of Nursing. Education in Nursing.*

I. INTRODUCTION

Though great advances in the care of victims of cardiorespiratory arrest (CA) have been achieved, there's still variability on the probability of survival, that can not be attributed exclusively to the clinical characteristics of the patient. In order to CA victims have bigger chances of survival and receive the highest quality care, which follows scientific evidences, it is necessary that the training in Cardiopulmonary Resuscitation (CPR) use educational principles based on research that translate scientific knowledge in practice[1,2,3]. These recommendations are based on the guidelines of the International Liaison Committee on Resuscitation (ILCOR) and the on the consensus of the American Heart Association (AHA)[4].

Basic Life Support (BLS) is composed by steps and maneuvers put in sequence, which include evaluation and immediate intervention in each phase[5]. Otherwise, CA is a sudden stop on heart mechanical activity confirmed by unconsciousness (a person with no response), central circulation absence (pulse of carotid or femoral are absent), and apnea (no breathing) or agonic breathing (gasping)[3,6].

CPR is the set of maneuvers performed after a CA with the objective of artificially maintaining the arterial flow to the brain and other vital organs until the return of spontaneous circulatio2n (RCE) occurs[7]. Great part of CPR's success is due to nurses' ability to perform qualitative care in this context. Thus, they need to know how to act with efficiency front these occurrences[3,6].

Most cases of CRP occur in adults, and the highest survival rates occur when the viewer has the attitude of triggering a primary sequence of saving actions[3]. In the meantime, there are undeniable advances in CPR maneuvers like everything else; and great challenges still to be achieved, since success in the procedure depends on qualitative actions carried out in a timely manner, and a trained and harmonious team[8].

In this context, knowledge building and skill development in BLS is necessary because the earlier a PCR recognition occurs and high quality CPR maneuvers are instituted, lives can be saved with fewer sequelae rates[3].

Survival chain emphasizes the need for rapid response through surveillance and prevention, early recognition of CA and activation of emergency services, high-quality and immediate CPR, early defibrillation, advanced immediate life support, and post-CA care initiated immediately after the spontaneous circulation return[1].

Efforts to gather scientific knowledge about PCR, and to establish a standard and uniformity for its treatment, have been carried out since the beginning of the 60's when ILCOR's creation; that systematized the CA approach through a wide scientific review, leading to the first international scientific consensus in 2000, and has been conducting periodic reviews of this consensus, which ones occurred in 2005, 2010, 2015 and 2018[1,3,9,10].

International resuscitation committees directed efforts on improving and producing knowledge about CPR, review periodically guidelines and turning simpler the care process[1]. It is also necessary to carry on research on teaching methods that might increase the retention of knowledge and skills in CPR[11].

The teaching strategies focused on the training of large-scale CPR maneuvers depend on the existence of local organizations capable of disseminating training geared to these techniques[9]. The greatest challenge, especially in Brazil, is to increase access to of CPR teaching and establish processes for continuous improvement of its quality[12].

CA is a dramatic event, responsible for high morbidity and mortality, even in situations of ideal care. Time is an important variable; it is estimated that each minute of PCR

decreases by 10% the probability of survival[3,13]. Until few years ago, PCR was a synonym with death, because no more than 2% of the individuals survived this event. Nowadays, the survival rate reaches more than 70% if the assistance is early and effective and is substantially related to the time between the incident and the beginning of the resuscitation, and the technical effectiveness in performing the CPR maneuvers[8].

The assistance to CA must be performed quickly, firmly, safely and calmly, in order to avoid panic and mismatch among professionals. However, what is observed is that in the mean time, resuscitation efforts are tumultuous, with non-systematized actions that lead to overlapping of tasks, culminating in repetitive acts that lead to a crucial loss of time for patient survival[14].

Nursing professionals are usually the first to respond to a CA and initiate LBS maneuvers while awaiting the advanced support staff. The immediate, competent and safe application of CPR maneuvers by the first interventors are factors that contribute to the success of the care and, consequently, to the neurologically intact survival. Thus, it is necessary to mobilize the cognitive, psychomotor and affective abilities inherent to the Nurse's competence to act on these occurrences[14].

It is described that professionals and health graduates do not have satisfactory scientific knowledge both theoretical and practical in CA/CPR. This lack of knowledge is a consequence of the academic formation, in which the approaches on the subject are punctual and superficial, therefore, insufficient to provide the acquisition of solid knowledge necessary for the action against the CA[15,16,17].

Several Nursing Schools include content in their curricula with learning objectives focused on BLS. However, most of the nurses do not feel able effectively to act before the CA[3,4,17]. Despite the skills proficiency in BLS and Advanced Life Support (ALS) is one of the graduation objectives, there is still a great diversity on contents turned to the theme, between the different schools, so that the offered trainings do not comply the criteria described in the consensus of the science of resuscitation[18].

Thus, the present study aimed to analyze the knowledge of undergraduate Nursing students from a private Higher Education Institution (HEI) in Belem, State of Para, Brazil on BLS.

II. METHOD

A cross-sectional, descriptive, exploratory study with a quantitative approach was carried out at a private HEI in Belem, State of Para, Brazil, from September to October 2018. The sample consisted of all the students enrolled in the 8th, 9th and 10th semester of course. The HEI has 9 classes, totaling a sample of N = 285 students. We adopted as sample error a margin of 5%, with a confidence level of 95% - establishing an initial sample of n = 164 students. For the purposes of sample calculation, a systematic random sampling was used on categorical variables, using the following formula[19]:

$$n = \frac{N. Z2 . p. (1-p)}{Z2.p. (1-p) + e2. (N-1)}$$

In which:

n – calculated sample

N - population

Z – standard variable associated to the confidence level

p – true probability of the event

e – sample error

For this study we worked with a sample of 164 participants, representing 57.54% of the total sample.

A brief meeting was held with the students in the classroom, explaining the methodology and objectives of the research. After clarifying the doubts about the study, the Informed Consent Form (ICF) was given with the appropriate guidelines to be analyzed and signed by the possible participants of the research.

A structured questionnaire validated by Felix (2013)[20] was used, with 26 multiple choice questions, adapted to the new CPR guidelines, similar to that used by the American Heart Association (AHA) for training, with four possible answers and only one correct question , based on the AHA guidelines, 2015.

The data was stored in Windows® Office Access 2018 software and the results were tabulated and presented as tables and graphs. Statistical processing was done through the software Bioestat® 5.3 (21) and Statistical Package for the Social Sciences® (SPSS) 22.0.

To describe the sample profile according to the variables under study, it were built: frequency tables of the categorical variables (answers of the questions), with the absolute (n) and percentage (%) values; descriptive statistics of the continuous variables (age, gender, etc.), with mean values, standard deviation, minimum, maximum

and median values. The evaluation of BLS knowledge was performed based on a scale from 0 to 100 points, in which 0 (zero) represents the lowest hit rate and 100 (a hundred) the highest index.

In the comparison of the categorical variables, the Chi-square test of adhesion was used. The analysis of variance (ANOVA) and the "Student's T-test" were applied to compare the performance in the knowledge test according to the semester and shift (21). The significance level adopted for the statistical tests was 5%, that is, $p \leq 0.05$.

Emphasis is given to compliance with the requirements of the National Health Council (NHC) through Resolutions n. 466/2012 and 510/16 of the National Council of Research Ethics (NCRE) and, accordingly, the research was duly authorized by the Research Ethics Committee (RCE) of the University Center of Maranhão (UNICEUMA), Certificate of Presentation to Ethics Appreciation: 89952518.7.0000.5084, approval number: 2.686.164.

III. RESULTS

The sample consisted of n= 164 participants, from which 124 (75.6%) were female and 39 (23.8%) were male.

Regarding age, a minimum of 21 years and a maximum of 55 years, with a mean of 31 years and a standard deviation of 7 years, were observed. Students were 32.9% from the 8th semester; 33.5% from 9th; and 33.5% from the 10th (Table 1).

Table 1 - Sociodemographic characteristics of undergraduate Nursing students (n= 164) and Knowledge about BLS. Belem, State of Para, Brazil, 2018.

	Nursing students		Knowledge about BLS		
	n	**%**	**Mean**	**Standard Deviation**	**p-value**
Semester					**0.6608 (NS)**
8th semester	54	32,9	62,8	16,1	
9th semester	55	33,5	62,7	15,9	
10th semester	55	33,5	65,1	14,7	
Gender					**0.3425**

				(NS)
Female	124	75,6	63,0	14,9
Male	39	23,8	65,7	17,5
Other	1	0,6	50,0	---
Shift				0.1053 (NS)
Morning	38	23,2	59,8	20,1
Afternoon	73	44,5	66,0	13,1
Night	53	32,3	62,1	14,3

Source: Research data, 2018. NS - Not significant

Regarding the BLS knowledge rate analysis according to the semester, a p-value = 0.6608 was shown, which is not significant, demonstrating that there was no real difference between the semesters; 8th semester (mean 62.8 ± 16.1 points), 9th semester (mean 62.7 ± 15.9 points) and 10th semester (mean 65.1 ± 14.7 points) (Table 1).

With regard to the information source used by the students, it was identified that most use the internet as the main tool (67.7%) p-value <0.0001*. TV use was reported by 39% (64 students) and newspapers by 25.6% (42 students) as can be observed in table 2.

Regarding the professional activity distribution, it was verified that 60.4% work and 48.2% have other professional training, being Nursing Technician the most frequent formation (79.7%) (Table 2).

Table 2 – Information sources, training, work condition and professional performance of the students of the Undergraduate Nursing Course (n. 164). Belem, State of Para, Brazil, 2018.

	N	%	p-value
How do you get informed?			<0.0001*
TV	64	39,0	
Newspapers	42	25,6	
Internet	111	67,7	
Other	32	19,5	
Do you work?			0.0101*
Yes	99	60,4	
No	65	39,6	
Do you have another educational training?			0.6962
Yes	79	48,2	
No	85	51,8	
What's the other educational training? (n=79)			<0.0001*
Nursing technician	63	79,7	
Radiology technician	4	5,1	
Clinical pathology technician	1	1,3	
Hospital management	3	3,8	
Community Health Agent	1	1,3	
Oral health technician	1	1,3	
Drugstore assistant	1	1,3	
P.E. teacher	1	1,3	
Projects technician	1	1,3	

Source: Research data, 2018. * Chi-square grip.

The data revealed that 81.7% of the students performed an update on BLS (p-value <0.0001 *, highly significant), and this update was mostly performed through a college class (70.9%). Of the 134 (81.7%) who underwent update, they did it 6 months ago (median), ranging from 3 months to 1 year (Table 3).

Table 3- Update on BLS and teaching method used to update Nursing undergraduate students (n= 164). Belem, State of Para, Brazil, 2018.

	N	%	p-value
Update on BLS			<0.0001*
Yes	134	81,7	
No	30	18,3	
Did it through (n=134)			<0.0001*
College classes	95	70,9	
Books	29	21,6	
Scientific papers	10	7,5	
Lectures	39	29,1	
Presential courses	44	32,8	
Online courses	9	6,7	
Other (s)	9	6,7	

Source: Research data, 2018. * Chi-square grip.

In the evaluation of BLS knowledge, on a scale of 0 to 100 points, it was verified that the lowest score was 20.6

points and the highest score was 90.4. The mean was 63.5 points, with a standard deviation of 15.5. The median was 64 points, with the interquartile deviation of 20 points (54 to 74 points) (Chart 1).

Chart 1 shows that 62% of students scored lower than 70 points, and 19% scored less than 50 points.

Chart 1 - Evaluation of the SBV knowledge of undergraduate nursing students (n. 164). Belém, State of Pará, Brazil, 2018.
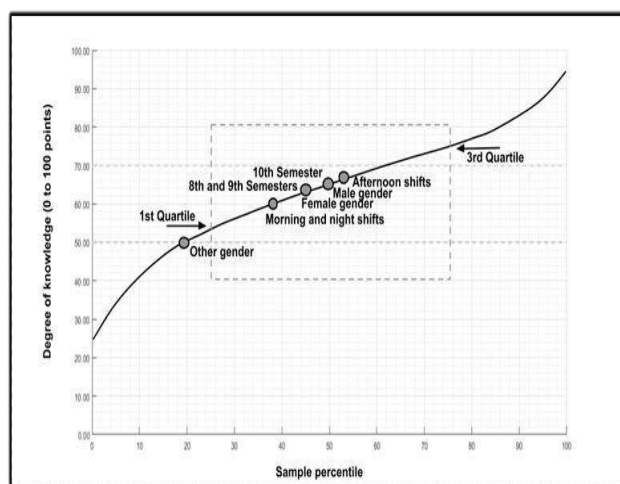
Source: Research data, 2018.

Also on the BLS knowledge, the items with a high level of significance, the items with higher level of knowledge and correctness were: Question 1, about cardiorespiratory arrest definition; Question 2, about the responsiveness of an unconscious person; Question 6, related to the proportion between chest compressions and ventilations according to the current CPR protocol; Question 14, on the importance of establishing BLS maneuvers early for both professionals and lay people; and Question 17, which was about care that should be taken when using an Automated External Defibrillator (AED) (Chart 2).

On the other hand, the items with a low index of knowledge and answers were the questions: Question 3, which was about the sequence of the BLS on adults; Question 10, about the time for the alternation between the appliers of chest compressions; Question 11, about the links that make up the survival chain of the extra-hospital CA; Question 18 on the contraindication for the use of AED; and Question 20, that focused on the steps after the shock application by the AED, as can be observed in chart 2.

Graph 2 - Evaluation of the SBV knowledge of undergraduate Nursing students (n= 164). Belém, State of Pará, Brazil, 2018.
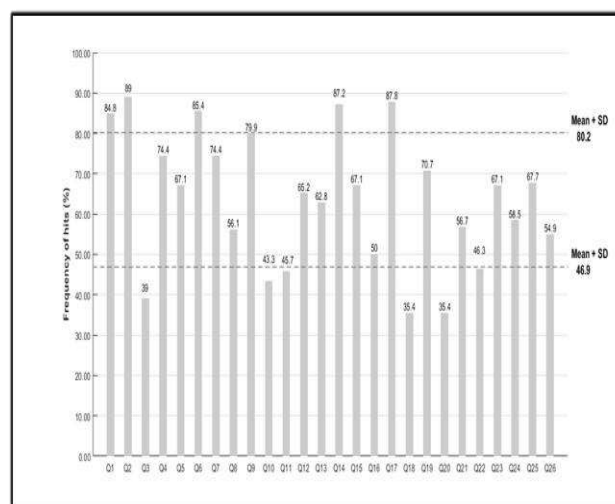
Source: Research data, 2018.

The correlation analysis between the students' age and the obtained score showed a non significant result with p-value= 0.5246, performed by Pearson's Linear Correlation and the low Correlation Coefficient (r = 0.0532) (Chart 3).

Chart 3 - Evaluation of the knowledge about SBV of students of the Undergraduate Nursing Course (n. 164). Belem, State of Para, Brazil, 2018.
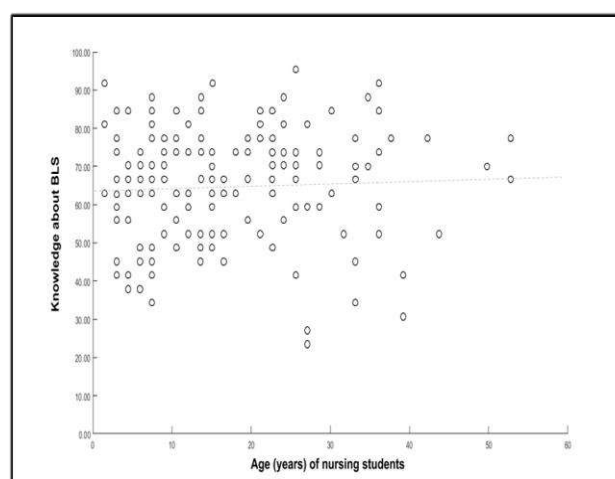
Source: Research data, 2018.

IV.   DISCUSSION

The results showed that the mean participants' age was 31 years, with a minimum of 21 and a maximum of 55. In the meantime, this research is in line with other studies[3,22] – including a survey carried out in 2012 by the National School of Public Health (NSPH), together with the National Federation of Nurses (FNE), the Brazilian

Nursing Association (BNA) and the Federal Nursing Council (FNC), which showed that Brazilian Nursing professionals have age range from 26 to 55 years, with a higher frequency in the range of 26 to 35 years – representing 35.98% of all professionals working with Nursing in Brazil.

The female gender was predominant. This result corroborates the results of other studies, in which the percentage of women was also predominant[3,22,23]. Thus, although there have been significant changes on the profession's profile, Nursing is still predominantly performed by women[22,23], since care as the essence of life maintenance has been attributed to the female gender throughout history, from the pre-patriarchal eras to the present day[3].

Regarding the ways of updating, the internet had greater emphasis as a source of information, representing 67.7%. It leads to infer that these students' knowledge has a tendency of developing in the theoretical scope, from online / virtual sources (which are easy to access) and not in face-to-face participation in theoretical-practical courses – which bring greater benefits towards technical and scientific foundation for the development of skills and competencies, that are fundamental in the care of CPR. It's said because these courses relate theory and practice, giving the student greater possibilities for understanding and understanding, as well as being more meaningful[14].

Although the participants reported that they performed updates on BLS (81.7% p-value <0.0001*, highly significant) – mostly performed through a college class (70.9%), with a period ranging from 3 months to 1 year (81.7%) – there is a low level of knowledge. Considering so, it is inferred that the contents taught in the college did not meet their learning objectives and the criteria described in the consensus of the science of resuscitation.

In this scope, a study carried out at a private University of Porto (Portugal) with 149 students, from the 1st, 2nd, 3rd and 4th years of Nursing graduation, showed that they had sufficient theoretical knowledge about BLS in adults, since most obtained correct answers higher than 70% in all series. However, it is important to point out that this is another country's reality[4]. Successful experiments in before-and-after studies, however, demonstrate that the knowledge and skills of nurses and Nursing students seem to improve following CPR training. However, in six weeks, knowledge and skills begin to decline, although they remain significantly larger than the initial one. Training programs improve CPR competence, but individuals are unable to maintain the same competence, even for a short period[24].

A similar study with 83 third-year undergraduate nursing students, from which 90.4% of participants had not received any training in CPR before the study, concluded that theoretical information and CPR practiced had a positive impact on the level of knowledge and nurses' practical skills in the following month[25]. However, there was a significant decrease in the level of information and correct preservation of the practical application six months after the training. Corroborating with these data, it is described that the knowledge and skills of BLS deteriorate in less than three to six months. The use of frequent evaluations will identify the individuals who need refresher courses[2,3,26].

In this understanding, it is considered relevant to expose the students early to this procedure, that is, to promote these skills early in the course, to be reinforced in the following years[27]. Trainings should include students in realistic contexts, which provide the acquisition of solid knowledge and skills. Among the qualifications, the theoretical-practical ones present better results, since they offer better return in the construction of skills and competences[6,12,14].

CA victims need fast and effective assistance, thereby increasing their chances of survival. Thus, early recognition of CA followed by early institution of high quality CPR maneuvers are essential strategies to increase the chances of survival in this population[3]. In this context, it is understood that the preparation of future health professionals should be based on methodologies and practices that subsidize actions qualitatively, taking into account an epidemiological reality and needs that emerge from the reality they are inserted.

The importance of future professionals in the effective implementation of CPR maneuvers in situations bordering on life, such as CRP, is noticeable. This training should be carried out from the beginning of the graduation and improved in subsequent years. It also should be facilitated by qualified teaching staff, in a way that allows knowledge sharing and collective construction of skills and competences, based on current consensuses[2].

The purpose of CPR is to make the heart, lung and brain return to their normal range, and because it is understood as a set of maneuvers designed to guarantee oxygenation to all vital organs, especially the heart, lungs and brain, it has great relevance[2,28].

Worryingly, on a scale of 0 to 100 points, it was found that 62% of the students had a grade lower than 70 points; and 19% scored less than 50 points.

Corroborating the study, a survey of 664 undergraduate students in the Medical, Nursing, Physiotherapy,

Pharmacy, Nutrition, and Occupational Therapy courses at seven HEI's in São Paulo, Brazil, found that only one participant scored at or above 84% and the others fell short of this AHA indicator. The results imply that efforts should be made so that curricular BLS components are introduced in the curricula in a more consistent way, from the first year of graduation and during the subsequent years, so that knowledge and skills are improved and, in turn, implemented effectively[12].

The items with a high level of significance and a higher level of knowledge and correct answers were questions related to: definition of cardiorespiratory arrest; assessment of the responsiveness of a person who is fainted; proportion between chest compressions and ventilation, according to the current CPR protocol; the importance of establishing early BLS maneuvers for both professionals and lay people; and about the care to be taken when using an AED.

On the other hand, the items with a low index of knowledge and correct answers were questions about: the sequence of the BLS in adults; time for the alternation between the people who apply the chest compressions; links that make up the survival chain of extra hospital CRP; contraindication for the use of the AED and the steps after the application of the AED shock.

This result allows us to infer that the students' knowledge about essential points of the current CPR guideline is unsatisfactory and needs to be improved, given that in the case of incorrectly performed maneuvers, there may be important neurological sequelae related to the decrease or absence of brain oxygenation, morbidity and mortality[3,28].

It should be emphasized that it is not enough to know what CPR maneuvers are and their function, while the knowledge about the correct positioning for maneuvers; AED use; relation between thoracic compression and ventilation; frequency; depth; defibrillator loads; drugs used at a CA, among other maneuvers, are not validated and scientifically substantiated[3,28].

Regarding chest compression, ventilation and compression depth, a correct response rate of 67.1%; 85.4% and 74.4%, respectively, was observed. According to the new AHA 2015 guidelines, the number of compressions per minute for adult CA victims should be at least 100 not exceeding 120 compressions per minute, in a ratio of 30 compressions for two ventilations and a depth of at least 5 cm not exceeding 6 cm[1].

These results demonstrate that the students investigated have reduced and sometimes inadequate knowledge for the care of CA victims. However, training is relevant and deserves to be systematically instituted as a way to optimize knowledge, contributing to academic training.

The lack of knowledge about the topic, evidenced in this research, has the potential to negatively and directly affect the care of CA victims. Thus, in order to perform the maneuvers efficiently, the domain of basic knowledge in CPR is taken as paramount. In addition, it is fundamental that the theoretical discussions are associated with practice, in order to provide future professionals with quality assistance to.

In this context, it is considered important to motivate the academy to mobilize in the student attitudinal competences that allow the latter to assume his or her share of responsibility, just as the teacher commits himself to this process, encouraging them in the search for the construction of their knowledge.

V. CONCLUSION

The objective of analyzing the knowledge of the Nursing Undergraduate Program students from a private HEI in Belem, State of Para, Brazil, on Basic Life Support, was achieved according to the results presented.

It was verified that the studied population has reduced and sometimes inadequate knowledge about CA and BLS, which can compromise the care provided, causing damage to resuscitation and, consequently, contribute to the appearance and / or aggravation of permanent sequelae, impacting on increase morbidity and mortality increase.

In many responses, the presence of disparate knowledge might be observed related to the theoretical basis of the science of resuscitation, proposed by the consensuses of the AHA, 2015. Thus, it is conjectured that some of these students may be encouraged to perform care motivated by compliance with solidarity actions without, often, having a knowledge base on the subject.

The limitations of the study were to carry out only the theoretical knowledge approach and did not evaluate the practical skills. Besides, the sample of participants was small, which may hinder the generalization of these results in other realities.

It becomes reasonable to be fundamental the institutionalization of trainings and their evaluation, in theoretical and practical scopes, as a way to optimize and consolidate knowledge during academic training, which may be the subject of further studies.

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Analysis of flow dynamics around two rotating circular cylinders in tandem and side by side

Alice Rosa da Silva[1], Antônio Marcos Gonçalves de Lima[2]

[1]Faculty of Civil Engineering, Federal University of Uberlândia – UFU, 38400-902 Uberlândia – MG, Brazil

[2]Faculty of Mechanical Engineering, Federal University of Uberlândia – UFU, 38400-902 Uberlândia – MG, Brazil

Abstract— In this paper, the flow dynamics around two rotating circular cylinders arranged in two different configurations, in turbulent and laminar regimes are analyzed through the Immersed Boundary Methodology. The Large Eddy Simulation with dynamic Smagorinsky sub-grid scale is also used here. For the side by side and in tandem configurations, the simulations are performed, for Re 100, specific rotation 0.5 and spacing ratio varying between 1.5 and 5.0. For the first arrangement, simulations are also carried out, for Re and spacing ratio constant, and the specific rotation varying between 0 and 2. For in tandem configuration, the Re ranges from 200 to 10^5 and the others parameters are maintained constant. The results showed that the cylinder arrangements, in addition to the mentioned parameters, play an important role in the mechanism of the vortex shedding, as well as in the wake pattern and in the fluctuations of drag and lift coefficients. The rotation mechanism inhibits the vortex shedding process for different values of spacing ratio depending on the arrangement of the cylinders. Vorticity contours, time evolutions of fluid dynamics coefficients as well as pressure distribution along the cylinder are presented.

Keywords— Immersed Boundary Methodology, Reynolds number, rotating cylinder, spacing ratio, specific rotation.

I. INTRODUCTION

The fluid flow with or without heat transfer is practically involved in all energy production processes, in the environmental phenomena, in the thermal equipment, in the aeronautical and aerospace engineering, in the reactor engineering, in the bioengineering and so on. In projects for automobiles and their components, in projects for rotating machines, in the sizing of anti-fire systems in large spaces, in the project of refrigeration equipment, in the forecast of pollution caused by chimneys in the atmosphere and by the discharge of pollutants into rivers, lakes and soils, in solving numerous multiphase flow problems found in the petroleum industry, etc., numerical simulation is of great importance [1].

Thus, the Computational Fluid Dynamics (CFD) has been widely used to study flows around bluff bodies, in several analyzes, as mentioned below: Silva et al. [2] investigated the flow dynamics around a pair of cylinders in different geometric arrangements for Re = 72000; Silva et al. [3] analyzed the rotation oscillation effect on the flow characteristics at low Reynolds number; Lima et al. [4] investigated vortex induced vibration in a circular cylinder mounted viscoelastically transverse to flow at moderate Reynolds; Dienstmann et al. [5] formulated a simplified

model for consolidating poromechanical analyses, induced by a rigid cylinder in rotating motion immersed in a porous medium; Xia et al. [6], investigated numerically through the BGK lattice Boltzmann method, the Poiseuille flow of the fluid power law on a free rotating cylinder located eccentrically in a two-dimensional channel; Wang et al. [7], experimentally studied the flow around a circular cylinder turning retrograde near the boundary layer of a turbulent wall to Re = 10000, using the particle image velocimetry technique; Maurya et al. [8] used a rotating cylinder arranged in a rectangular T-shaped channel to investigate the heat transfer and momentum characteristics of a Bingham plastic fluid; Musmar et al. [9] investigated experimentally, the effect of rotation increment of a cylinder on the wear rate of a cylinder-piston system. The engine speed, load and the rotation angle of the cylinder were the main parameters; Zou et al. [10] investigated numerically the flow induced vibration of a rotating circular cylinder for reduced velocity in the intervals $3.0 \leq U^* \leq 14$, with the cylinder free to move in the flow direction and transverse. Bouchon et al. [11] presented a cut-cell method for the simulation of two-dimensional flows past obstacles. They showed the results of flows around an impulsively started circular cylinder for

Reynolds number 1000 and 3000 and also, results of flows around a moving rigid cylinder at Re = 800. The semi-staggered grid technique was employed by Shu et al. [12] to solve several classical testing cases as flow in a channel with 180° bend, natural convection in a square cavity and lid-driven flow.

It is worth mentioning here, the Immersed Boundary Methodology (IBM), which has increasingly gained prominence in the study of flow of simple, complex, mobile and even deformable geometries, without need for rewrapping. Initially proposed by Peskin [13], it has been used and improved for different applications, such as in hydrodynamic magnet flow (MHD) with complex and mobile boundary problems [14]; in simulation of an elastic vesicle close to a wall in shear flow using the modified FI method [15]; in the mass diffusion and convection modeling through porous membranes under large deformations [16]; in problems involving heat transfer [17]; in the study of linear elliptic value problems on arbitrary domains with a Dirichlet boundary condition was proposed an augmented Immersed Boundary Method [18]; in the investigation of the flow physics behind dynamical transitions that occur in the flow field around a plunging foil [19]; among others.

In the present work, numerical simulations are performed for the analysis of two-dimensional, incompressible and isothermal flow around a pair of cylinders arranged side by side and in tandem. The influence of the spacing ratio is investigated for the two cylinders configurations, and the influence of the Reynolds number is analyzed for the aligned cylinders. Also, the rotating movement effect for the side by side case is investigated. The vorticity fields, the time evolution of the fluid dynamics coefficients, as well as the distribution of the pressure coefficient, are presented. The Immersed Boundary Methodology, together with the Virtual Physical Model is used (VPM) [20].

II. THE MATHEMATICAL MODEL

The IBM [13] together with VPM [20] are used in the present work, to simulate two-dimensional flows around two rotating circular cylinders arranged side by side and in tandem configurations. It is based on the Navier-Stokes equations plus a force term that acts so that the fluid "perceives" the interface, thus making the exchange of information between fluid and solid. In this method, the Eulerian grid represents the calculation domain and the Lagrangian grid, the immersed interface. These grids are geometrically independent and coupled through the force term.

2.1 Mathematical formulation for the fluid

The filtered Navier-Stokes equations and the continuity equation for viscous, incompressible and Newtonian flow, can be presented respectively, in tensorial form, as follow:

$$\frac{\partial u_i}{\partial t} + \frac{\partial (u_i u_j)}{\partial x_j} = -\frac{1}{\rho}\frac{\partial p}{\partial x_i} + \left[\nu_{ef}\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} \right) \right] + f_i \qquad (1)$$

$$\frac{\partial u_i}{\partial x_i} = 0 \qquad (2)$$

Where $\rho\ \left[Kg/m^3 \right]$ and $\nu_{ef}\ \left[m^2/s \right]$ are respectively, the specific mass and the effective viscosity, properties that characterize the fluid. The interest variables are represented by: $u_i\ \left[m/s \right]$ is i-th component of the filtered velocity; $p\ \left[N/m^2 \right]$ is the filtered pressure and $f_i\ \left[N/m^3 \right]$ is the i-th component of the Eulerian force, that acts on the fluid. The source term of Eulerian force only exists in the Eulerian points coincident or close of the Lagrangian grid, being null for the other points of the domain. It is calculated by distribution of the components of the Lagrangian interfacial force vector $\vec{F}(\vec{x}_k)\ \left[N \right]$, using a distribution function, as proposed by Peskin and McQueen [21]. The equation for Lagrangian force can be expressed as:

$$\vec{F}(\vec{x}_k,t) = \underbrace{\rho\frac{\partial \vec{V}(\vec{x}_k,t)}{\partial t}}_{\vec{F}_a} + \underbrace{\rho\vec{\nabla}.\left(\vec{V}(\vec{x}_k,t)\vec{V}(\vec{x}_k,t) \right)}_{\vec{F}_i} -$$

$$\underbrace{\vec{\nabla}.\left[\mu\left(\vec{\nabla}\vec{V}(\vec{x}_k,t) + \vec{\nabla}^T\vec{V}(\vec{x}_k,t) \right) \right]}_{\vec{F}_v} + \underbrace{\vec{\nabla}p(\vec{x}_k,t)}_{\vec{F}_p} \qquad (3)$$

In (3) $\vec{F}_a\ \left[N \right]$ is the acceleration force, $\vec{F}_i\ \left[N \right]$ is the inertial force, $\vec{F}_v\ \left[N \right]$ is the viscous force and $\vec{F}_p\ \left[N \right]$ is the pressure force.

2.2 Indicator function

The indicator function, proposed by Unverdi and Trygvason [22] is also used in the present work. It is an interface tracking method, where the function is calculated in whole domain or in part of it, with the attribution of the unit value for internal points to the interface, zero for the external points and values between zero and unit for the transition points, that is, on the interface. This function is based on a function $\vec{G}(\vec{x},t)$ and can be expressed by:

$$\vec{\nabla}I(\vec{x},t) = \vec{G}(\vec{x},t) \qquad (4)$$

The term on the right side of (4) is given by:

$$\vec{G}(\vec{x},t) = \sum_k D_{ij}(\vec{x} - \vec{x}_k)\vec{n}(\vec{x}_k)\Delta S(\vec{x}_k) \qquad (5)$$

In (5) $\vec{n}(\vec{x}_k)$ is the normal vector of the interface.

Applying the divergent operator in (4), the Laplacian of the indicator function is obtained:

$$\vec{\nabla}^2 I(\vec{x},t) = \vec{\nabla}\vec{G}(\vec{x},t) \qquad (6)$$

In this way, after solving (6), the solution of the indicator function is obtained, $I(\vec{x},t)$, in all points of the domain. For the resolution of the linear system resulting from the discretization of (6), the SIP solver is used.

2.3 Turbulence model

Turbulence is one of the most challenging problems of the modern physical and it is among the most complex and fascinating phenomena found in the nature. Due to several practical implications in different sectors, the number of researches related to the understanding and control of turbulent flows has become increasingly greater. An alternative for the treatment of flows at high Reynolds number can be done by scales separation. This separation can be accomplished through the decomposition process of the Navier-Stokes equations into a mean and a floating part, as proposed by Reynolds [23], or through a filtering process proposed by Smagorinsky [24]. Here, the Large Eddy Simulation (LES) is used, for which the filtering process is necessary. For the turbulent viscosity calculation, used in LES, there are different sub-grid models. In the present work, the sub-grid model of Smagorinsky is used, which is based on the hypothesis that the production of the sub-grid turbulent tensions is equal to the dissipation. The turbulent viscosity is given as a function of the strain rate and the length scale. The Smagorinsky constant used here is 0.18 for isotropic and homogeneous turbulence.

III. NUMERICAL METHOD

For the velocity-pressure coupling, the Fractional Step Method is used, initially proposed by Chorin [25]. It is a non-iterative method, where from the fields of u, υ, p and f of the previous iteration, the velocity fields are estimated. With these estimated fields, the pressure correction is calculated, through the solution of the linear system, by the Modified Strongly Implicit Procedure (MSI) developed by Scheneider and Zedan [26]. The pressure behaves like a Lagrange multiplier in minimization problems. The importance of the Poisson equation for the pressure correction is that it makes the connection between the momentum equations and continuity. It provides values

of p that allow that the values of the velocity components u^{n+1} and υ^{n+1}, obtained from the respective Navier-Stokes equations, satisfy the mass conservation in the instant of time $n+1$. Thus, the estimates of the velocity components, $\tilde{u}^{n+1}$, obtained with information from the fields u, υ, p and f of the preceding time, are:

$$\frac{\tilde{u}_i^{n+1} - u_i^n}{\Delta t} + \left[\frac{\partial(u_i u_j)}{\partial x_j}\right]^n = -\frac{1}{\rho}\frac{\partial p^n}{\partial x_i} +$$
$$\frac{\partial}{\partial x_j}\left[\nu_{ef}\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right)\right]^n + f_i^n \qquad (7)$$

Making the appropriate arrangements, obtain:

$$\frac{\tilde{u}_i^{n+1} - u_i^{n+1}}{\Delta t} = \frac{1}{\rho}\frac{\partial(p^{n+1} - p^n)}{\partial x_i} \qquad (8)$$

After the application of the divergent operator $\dfrac{\partial}{\partial x_i}$ on both sides of (8), follows:

$$\frac{1}{\Delta t}\left[\frac{\partial \tilde{u}_i^{n+1}}{\partial x_i} - \frac{\partial u_i^{n+1}}{\partial x_i}\right] = \frac{1}{\rho}\frac{\partial}{\partial x_i}\left(\frac{\partial p'^{n+1}}{\partial x_i}\right) \qquad (9)$$

On what $p'^{n+1} = p^{n+1} - p^n$ is the correction pressure. The importance of the divergent is due to the fact that it is one of the terms in the equation that expresses the mass conservation. As it is necessary that the velocity field satisfy the continuity equation, the second term on the left side of (9), $\dfrac{\partial u_i^{n+1}}{\partial x_i}$, will be null. Therefore, the equation can be rewritten as:

$$\frac{1}{\Delta t}\frac{\partial \tilde{u}_i^{n+1}}{\partial x_i} = \frac{1}{\rho}\frac{\partial^2 p'^{n+1}}{\partial x_j \partial x_j} \qquad (10)$$

Rearranging (10), a Poisson equation for the pressure correction is obtained, whose source term is the divergent of the estimated velocity:

$$\frac{\partial^2 p'^{n+1}}{\partial x_j \partial x_j} = \frac{\rho}{\Delta t}\frac{\partial \tilde{u}_i^{n+1}}{\partial x_i} \text{ or } \nabla^2 p'^{n+1} = \frac{\rho}{\Delta t}\vec{\nabla}\vec{\tilde{u}}^{n+1} \qquad (11)$$

Thus, the estimated velocity fields are obtained through (7) and the pressure correction field, through the resolution of the linear system, generated by discretization of (11). From (8), the velocity field is updated by solving (12):

$$u_i^{n+1} = \tilde{u}_i^{n+1} - \frac{\Delta t}{\rho}\frac{\partial p'^{n+1}}{\partial x_i} \qquad (12)$$

For the time advance of the momentum equations, second order Adams-Bashforth is used and, for the first iteration,

the first order Euler method. Thus, the discretization of the components x and y of the estimated velocity is given respectively by:

$$\tilde{u}_{i,j}^{n+1} = u_{i,j}^{n} + \Delta t \left[1,5\left(-A_{xi,j}^{n} + D_{xi,j}^{n}\right) - 0,5\left(-A_{xi,j}^{n-1} + D_{xi,j}^{n-1}\right) \right] -$$
$$-\Delta t \left(\frac{1}{\rho} P_{xi,j}^{n} + f_{xi,j}^{n} \right) \tag{13}$$

$$\tilde{\upsilon}_{i,j}^{n+1} = \upsilon_{i,j}^{n} + \Delta t \left[1,5\left(-A_{yi,j}^{n} + D_{yi,j}^{n}\right) - 0,5\left(-A_{yi,j}^{n-1} + D_{yi,j}^{n-1}\right) \right] -$$
$$-\Delta t \left(\frac{1}{\rho} P_{yi,j}^{n} + f_{yi,j}^{n} \right) \tag{14}$$

For the Navier-Stokes equations, the second-order centered finite differences in space are used. A displaced arrangement is adopted for the velocity components because it provides more stability in the pressure-velocity coupling. For the discretization of the Lagrangian force, the calculation of the existing derivatives, is done through the Lagrange polynomials using auxiliary points in the x and y directions. Thus, to determine the variables in the auxiliary points and in the points of the Lagrangian mesh, interpolations are made from the Eulerian mesh variables.

IV.   PROBLEM DESCRIPTION

The simulations are carried out in a non-uniform mesh of 600x300 points, calculation domain 50Dx30D, being D the cylinder diameter. Downstream from the cylinder center until the end of the domain is higher than 26D. According to Prasanth et al. [27], the boundary downstream of the cylinder, at a distance equal to or greater than 25.5D, has no significant effect on the flow and in the cylinder response. On the other hand, Chen and Zha [28], after intensive numerical experiments, concluded that the solution is not influenced when the downstream boundary is located 20D from the cylinder center.

For the two circular cylinders arranged side by side, θ = 90°, the upper cylinder rotates in the clockwise direction and the lower cylinder in the counterclockwise direction, Fig. (1a). For in tandem cylinders case, θ = 180°, the upstream cylinder rotates in the clockwise direction whereas the downstream cylinder in the counterclockwise direction, Fig. (1b).
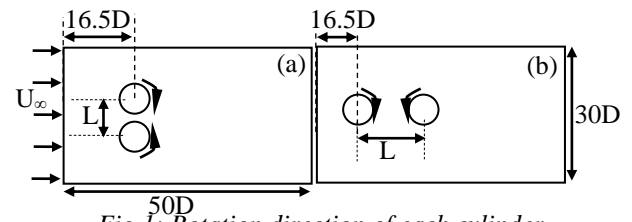
Fig.1: Rotation direction of each cylinder

The movement is imposed around its own axis through the imposition of the velocity components at each Lagrangian point. For this, the tangential velocity is decomposed.

V.   RESULTS AND DISCUSSION

The study of the flow around one or more stationary cylinders obtained by several authors, is of great importance to contribute to a better understanding of the flow dynamics when cylinders are in motion. In this section, are presented the results of the numerical simulations, carried out considering two rotating circular cylinders side by side and in tandem, in order to investigate the spacing ratio, the specific rotation and the Reynolds number effect on the flow characteristics.

5.1 Influence of the spacing ratio on the flow around a pair of cylinders side by side

Here, the vorticity fields are presented as well as the time evolution of the fluid dynamics coefficients and the respective mean values, for laminar flow regime.

   5.1.1   Vorticity fields

Figure 2 shows the vorticity fields for Re = 100, α = 0.5, spacing ratios 1.2, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0 and 5.0 and, the Fig. (2g) shows the vorticity contour, obtained by Yoon et al. [29].

For the spacing ratio 1.2, Fig. (2a), the two cylinders behave as one, due to the great proximity between them and the rotation movement in opposed directions. In this way, shear layers move from the upper and lower cylinders and merge to form a single wake downstream. With the increase of the spacing ratio, Fig. (2b), the flow behaves very different from the one observed in Fig. (2a). Downstream, positive and negative vorticity can be observed at the bottom and at the top sides, respectively from both cylinders; however, the vortices are not detached close to the cylinder, remaining as a single elongated vortex. It is even reasonable to say that for L/D = 1.5, the rotation movement of the two cylinders inhibited the vortex shedding process, even with a rotation equal to 0.5, which is confirmed in Fig. (3a). In the results presented by Xiao-hui et al. [30], for Re = 450 and T/D = 1.11, the

suppression of vortex shedding was obtained for rotation equal to 1.74. In Fig. (2c), the shear layers on both sides of each cylinder are visible, however, one cylinder influences the other so that the vortex shedding process until is not yet completely independent. For this spacing ratio, the flip-flopping pattern is observed. It is also verified by Yoon et al. [29], for stationary cylinders and g* = 0.7, Fig. (2g). For L/D = 2.5 the shear layers from both cylinders cause in phase synchronized vortex shedding in the first dimensionless times, approximately 50 and after the vortex shedding is out of phase, as shown in Fig. (3j). It is also noted that the opposite rotational movements contribute to the formation of a single wake more or less elliptical downstream of the cylinders. It is worth mentioning that, far from the two cylinders, the wake is narrower than close to them. This behavior is reported in Zdravkovich [31], for side by side stationary cylinders and 1.1-1.2 < T/D < 2-2.2. The same does not happen for L/D = 3.0, in which just downstream, alternating vortices, in phase, are detached from each cylinder, in the first dimensionless times, approximately ≤ 200. During this interval of time, the vortex shedding process is regular and the wake formed downstream of two cylinders is clearly independent. After, the vortex shedding process, goes through a transition so that two independent wakes no more exist giving way to a wake with shape more or less elliptical. The vortices are also released out of phase and, along of the wake, several vortices pairs of lesser intensity are noted. For L/D ≥ 3.5, a symmetrical pattern of anti-phase flow is observed. This characteristic is also seen for the case of two stationary cylinders side by side, for T/D = 4.0 [32]. However, as the cylinders have opposite rotation movement, although it is verified through the vorticity fields, the fluctuations produced by the vortex shedding process are in phase, as shown by the time evolution of the drag coefficients for L/D ≥ 3.5. Here, for these spacing ratios, two vortices wakes are also independent as described by many authors, for the stationary case. It is also pointed out, that the opposite movement of the two cylinders leads to symmetrical wakes in relation to the central line of the flow. It can be concluded from Fig. 2, that the spacing ratio as well as the rotation movement, have an important effect on the vortex shedding pattern, in the separation of the shear layers and consequently on the wake pattern.

(g)
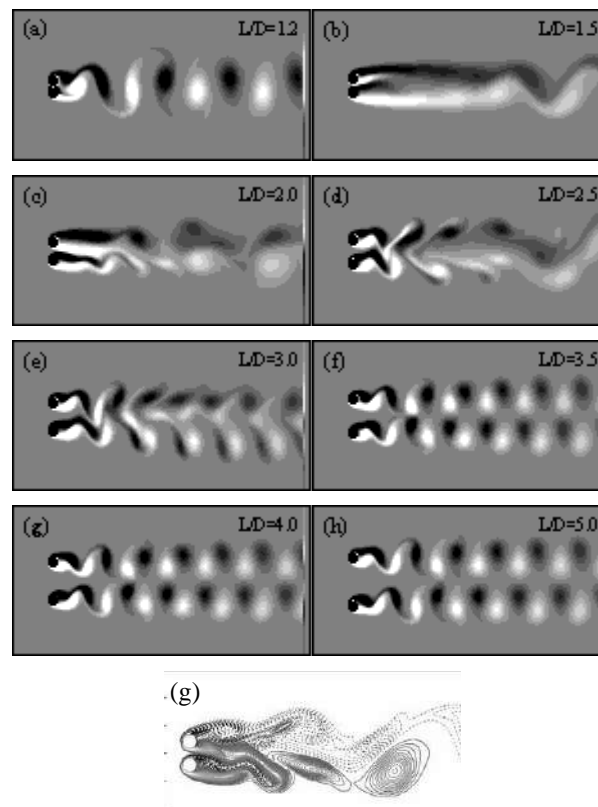
Fig.2: Vorticity fields for Re = 100, α = 0.5 and 1.2 ≤ L/D ≤ 5.0. (g) extracted from Yoon et al. [29], for α = 0.0 and g = 0.7*

5.1.2. Time evolution of the fluid dynamics coefficients

Figure 3 shows the time evolution of the drag coefficient, for the same data as in Fig. 2. The left column corresponds to the lower cylinder and the right column to the upper cylinder. It is observed that the fluctuations show similar behavior for the two cylinders, for all spacing ratios.

For L/D = 1.2, the fluctuations are periodic and no sinusoidal. It is worth mentioning that, although the amplitudes of these, for the both cylinders have the same tendency, the fluctuations are out of phase. For L/D = 1.5, the fluctuations amplitude decreased drastically, keeping it approximately uniform throughout the simulation. This confirms the great influence of the rotation in the vortex shedding process, for this spacing ratio, as shown in Fig. (2b). For L/D = 2.0, the fluctuations show an irregular behavior over the time, corresponding to the flip-flopping pattern. For the spacing ratio equal to 2.5, the fluctuations are synchronized in phase for the dimensionless time approximately up to 50, as already commented. After, "kinks" appear in the fluctuations, which are similar for both cylinders, just lagged in time, Fig. (3j). This behavior is due to the shape more or less elliptical of the wake, far

from the cylinders, Fig. (2d), and due to vortex fusion, that occurs during the vortex shedding process. For L/D = 3.0 the fluctuations for the drag coefficient are periodic, sinusoidal and of great amplitudes for the dimensionless time ≤ 200. After these times, the fluctuations remain regular, but with less amplitude. This behavior is due to the change in the wake pattern, throughout the simulation, as previously commented. For the spacing ratios ≥ 3.5, the drag fluctuations present similar behavior for both cylinders, with slight reduction in amplitude as the spacing is increased. It is interesting to point out that although the vorticity fields show an anti-phase flow pattern, Fig. 2, as classified for the case of two side by side stationary cylinders, here, as the cylinders are in opposite rotation movement, the drag fluctuations for the two cylinders are synchronized in phase, as already commented. For a better understanding of what is being exposed, a zoom has been done, considering L/D = 4.0 for the fluctuations of the both cylinders, Fig. (3i).
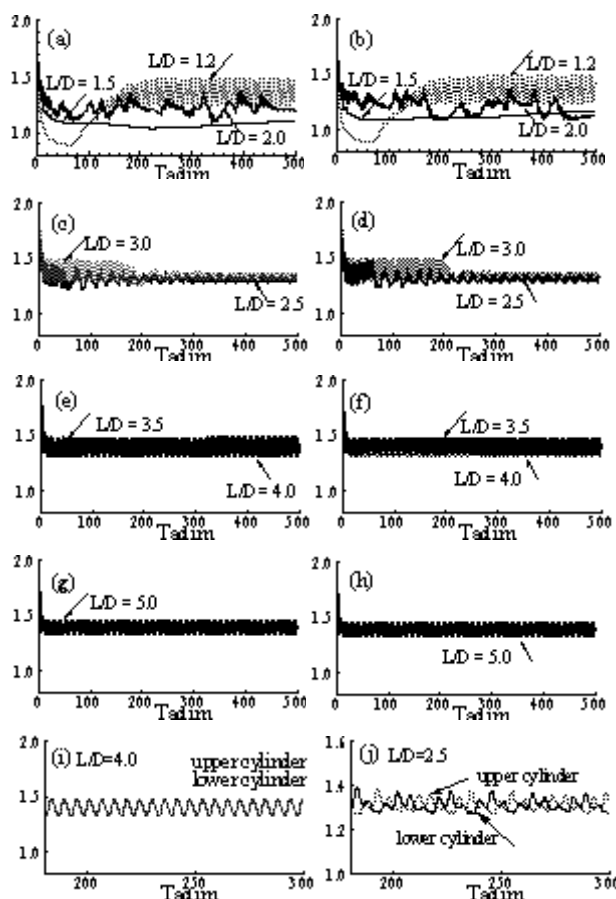
Fig. 3: Time evolution of the drag coefficients, for Re = 100, α = 0.5 and several spacing ratios.

Figure 4 shows the time evolution of the lift coefficient, for the same data of the Figs. 2 and 3. The left column corresponds to the lower cylinder and the right column to the upper cylinder. The behavior presented for all spacing

ratios is also similar for both cylinders. It is interesting to point out that the vortex shedding process and the wake pattern have different effects on drag and lift coefficients. For spacing ratio equal to 2.5, the lift fluctuations are in phase, as shown in Fig. (4i), contrary of drag fluctuations that are lagged in time, Fig. (3j). For L/D ≥ 3.5, again opposite to what is observed for the drag fluctuations, the lift fluctuations are anti-phase, as can be seen by zoom made for L/D = 4.0, Fig. (4j). It is worth mentioning that for all spacing ratios, the lift obtained for the lower cylinder (counterclockwise rotation) is negative and the obtained for the upper cylinder (clockwise rotation) is positive. This behavior is expected once a time that, the velocity at the top of the upper cylinder (same direction of the flow) is greater than the bottom (opposite direction of the freestream velocity).

As a result, the pressure at the bottom is greater, causing a positive lift force. On the other hand, for the lower cylinder, the velocity at the top is in the opposite direction of the flow, being, therefore, smaller than that the bottom (same direction of the freestream velocity). Consequently, the higher pressure at the top, causes a negative lift coefficient.
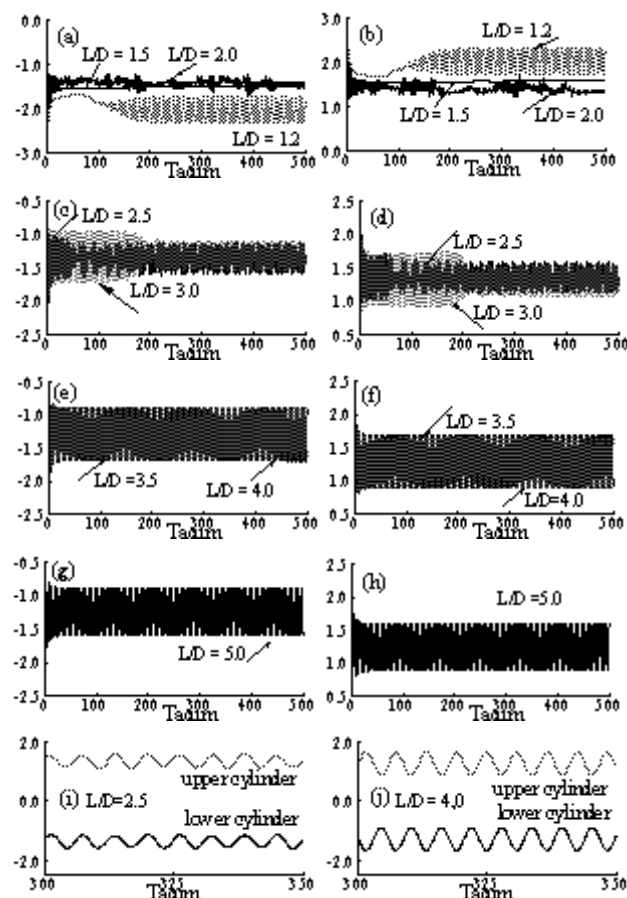
Fig. 4: Time evolution of the lift coefficients, for Re = 100, α = 0.5 and several spacing ratios.

Figure 5 shows for better understanding, the mean values of the fluid dynamics coefficients for the two cylinders, placed side by side. With the exception of what is observed for L/D = 1.5, the mean values of the drag coefficients for both cylinders, are practically the same. On the other hand, the mean values of the lift coefficients have opposite behaviors, due to the direction of the cylinder rotation. Here, the positive lift generated by the upper cylinder with clockwise rotation, and, the negative lift generated by the lower cylinder with counterclockwise rotation, are better visualized.
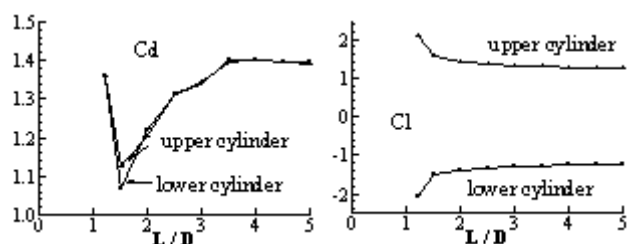
Fig. 5: Mean values of the drag and the lift coefficients as a function of the L/D for side by side cylinders.

5.2 Influence of the specific rotation on the flow around a pair of cylinders side by side

In this section the vorticity fields as well as the mean values of the drag and lift coefficients are presented, for Re = 100, L/D = 1.2 and $0 \leq \alpha \leq 2.0$.

5.2.1　Vorticity fields

The flow visualization by the vorticity contours is shown in Fig. 6, after the flow has reached the permanent regime. It can be noted the negative vorticity generated by the upper cylinder and the positive vorticity generated by the lower cylinder, as a single body. One probable reason for this behavior is that the cylinders are rotating in opposite direction from each other. The interaction between two shear layers originated from each cylinder occurs only at downstream of the cylinders, as expected. There is a '2S' mode of vortex shedding in the classical Von Kármán Street. Then, the wake formed behind them is symmetrical in relation to the center of the domain. As can be seen, the results show that the cylinder rotation has an important effect on the vortex shedding process. This mechanism is suppressed as the specific rotation increases. In this way, the flow reaches a steady state, without vortices, at the critical specific rotation equal to 1.3.
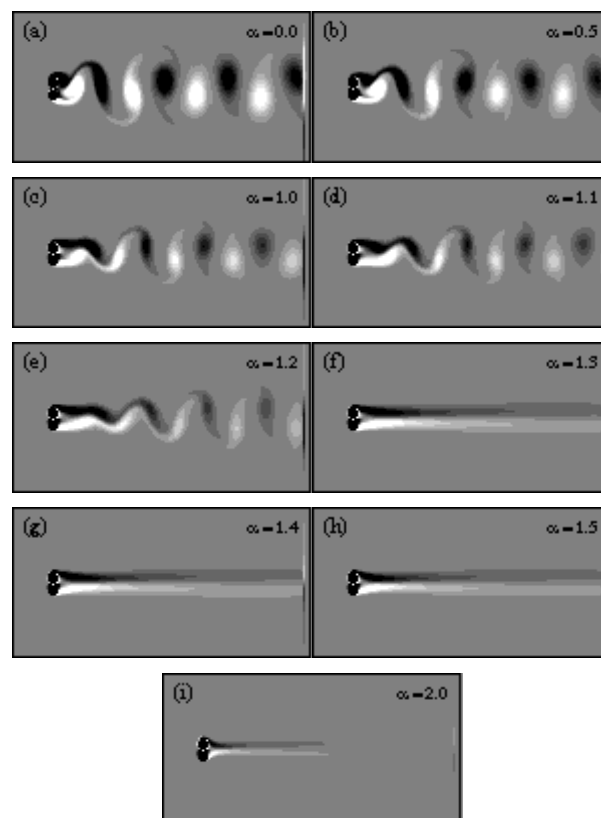
Fig. 6: Vorticity contours for Re = 100, L/D = 1.2 and $0 \leq \alpha \leq 2.0$.

The mean values of the fluid dynamics coefficients of the present study are compared with the numerical results of Yoon et al. [29]. Fig. (7a) shows the mean values of the lift coefficients for the upper and lower cylinders, and Fig. (7b) the mean values of the drag coefficients. The lift coefficients are equals for both cylinders, however with opposite values. The lower cylinder has negative mean values while the upper cylinder presents positive mean values, for all analyzed specific rotation.

It can be observed, Fig. (7a), that the mean values decrease with an increase of the specific rotation for the lower cylinder, presenting a little increase for α = 2.0. On the other hand, the values increase as the specific rotation is increased for the upper cylinder. In Fig. (7b) it is noted that the mean values of the drag coefficients decrease with an increase of the specific rotation. This is coherent once a time that, the vortex shedding mechanism is suppressed as the specific rotation increases, as shown in Fig. 6. The obtained results presented good agreement with the numerical results of Yoon et al. [29].
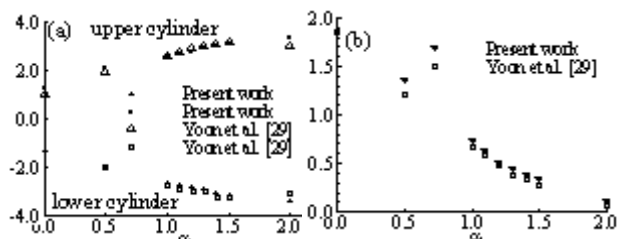
Fig. 7: Mean values: lift coefficients a) and drag coefficients b)

5.3 Influence of the spacing ratio on the flow around a pair of cylinders placed in tandem

Here, the vorticity fields are presented, as well as the time evolution of the fluid dynamics coefficients and the respective mean values, for laminar flow regime Re = 100, α = 0.5 and spacing ratios equals to 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 and 5.0.

5.3.1   Vorticity fields

The flow visualization by vorticity contours is shown in Fig. 8 after the flow has reached the permanent regime. Here, the upstream one has a clockwise rotation movement and the downstream one has a counterclockwise rotation. For spacing ratio from 1.5 to 3.5, Figs. (8a) to (8e), the both cylinders behave as a single bluff body and the vortex shedding process reduces as the spacing ratio increases. It is also noted that the vortices behind the cylinders are more elongated, which reduces the drag on the upstream cylinder as the spacing increases. On the other hand, as the downstream cylinder is surrounded by the shear layers of the upstream cylinder, consequently in a region of lower pressure, the drag on it is significantly less than that of the upstream cylinder. It interesting to point out that, for L/D equals to 3.0 and 3.5, the vortex shedding process occurs normally for the first times of simulation and decreases as time advances. For spacing ratios from 4.0 to 5.0, the vortex shedding process of the upstream cylinder becomes more independent, as well as that of the downstream cylinder. It is also verified that the generated vortices are closer to each other, are more robust and have a rounded shape, differently from what is observed for smaller spacing (vortices more elongated). As a result, the drag on two cylinders increased. From the presented results, it is clearly confirmed that the influence of the spacing ratio as well as the rotation movement in the suppression of the vortex shedding mechanism, depends on the cylinders arrangement.
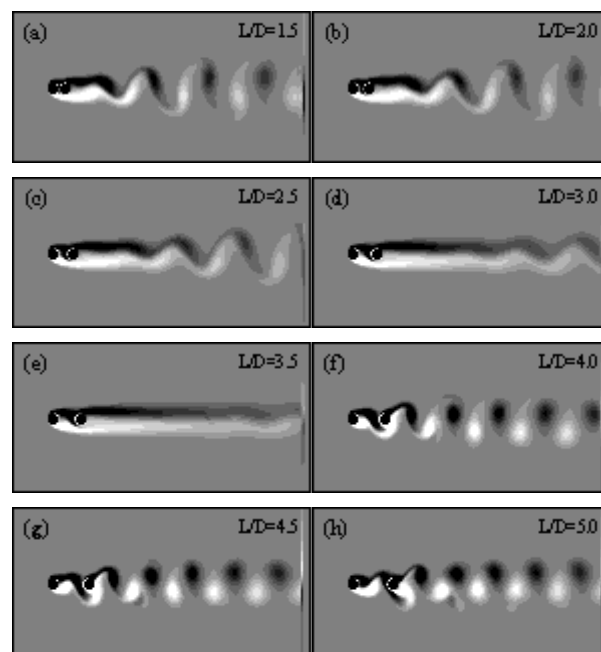
Fig. 8: Vorticity contours for Re = 100, α = 0.5 and 1.5 ≤ L/D ≤ 5.0.

5.3.2   Time evolution of the fluid dynamics coefficients

Figure 9 shows the time evolution of the drag coefficients, for cylinders in tandem, Re = 100, α = 0.5 and 1.5 ≤ L/D ≤ 5.0. As previously mentioned, the vortex shedding process is influenced by the spacing ratio and the rotation movement of the cylinders. Consequently, it also reflects in the amplitude of the fluctuations of the drag coefficients for both cylinders, which reduces as the spacing ratio increases up to 3.5, even keeping the constant rotation. Thus, for L/D = 3.0 and 3.5, the vortex shedding process occurs only in the first times of simulation. As time progresses, even for these spacing, due to the influence of the rotation movement, the vortex shedding process has been suppressed, consequently, the drag fluctuations as well. For L/D ≥ 4.0, the amplitude of the fluctuations increases significantly, compared to those observed for small spacing ratios. This is consistent, once a time that the generated vortices are stronger and more rounded, Figs. (8f) to (8h). It is also noted that the fluctuations amplitude remained practically the same with the increase of the spacing ratio, for both cylinders.
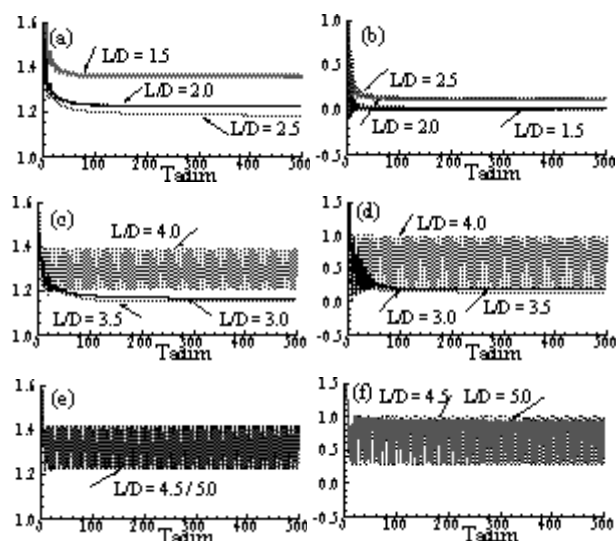
Fig. 9: Time evolution of the drag coefficients, for upstream cylinder (left column) and downstream cylinder (right column).

Figure 10 shows the time evolution of the lift coefficient for the same spacing ratios as in Fig. 9. For L/D = 3.0 and 3.5, fluctuations for the dimensionless time greater than 100 are no longer observed. On the other hand, for 3.5 < L/D < 3.0 the rotation movement had no effect in suppressing the vortex shedding process. It is noted that, for the upstream cylinder, the fluctuations amplitude decreases as the spacing ratio increases up to 3.5 and increases with further increase in L/D. This behavior is coherent once a time that, for L/D > 3.5, the vortex shedding mechanism occurs normally. The same behavior is verified for the downstream cylinder. However, the amplitude of the fluctuations is greater.
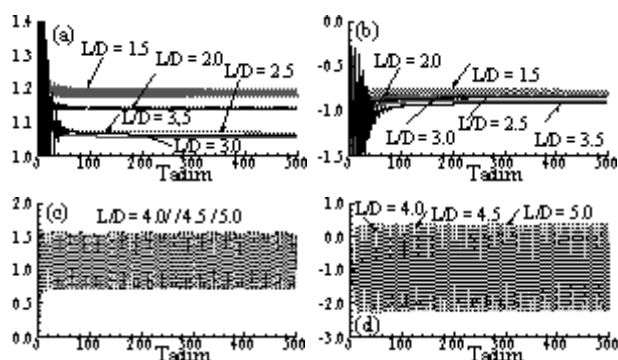
Fig. 10: Time evolution of the lift coefficients, for upstream cylinder (left column) and downstream cylinder (right column).

It is worth mentioning that, the upstream cylinder has a positive lift coefficient, once a time that, has a clockwise rotation movement, whereas the downstream cylinder has a negative lift coefficient, due to the counterclockwise direction movement.

Figure 11 shows the mean values of the drag and lift coefficients for the upstream and downstream cylinders, aiming at a better understanding of the previous Figs., (9) and (10). It can be seen that the drag exerted on both cylinders has opposite effects for L/D up to 3.5, this is, for the upstream cylinder, the drag reduces as the spacing increases and for the downstream cylinder, the drag increases. With further increase in the L/D, there is an increase in the mean value of the drag for both cylinders, being more significant in the downstream one. The explanation for this behavior is well visualized in Fig. 8, in which, for L/D = 3.5, the vortex shedding process is practically suppressed, due to the rotation movement, while for L/D > 3.5, the wake vortices is visualized. The mean values of the lift coefficient gradually reduce with increasing spacing ratio up to 4.0 for the downstream cylinder and then gradually increase as well. For the upstream cylinder, this increase is observed from a smaller spacing ratio (L/D = 3.0), after which the mean value grows and remains practically constant after L/D = 4.0.
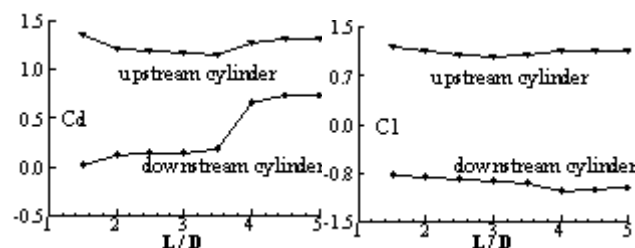
Fig. 11: Mean values of the drag and lift coefficients in function of L/D

It is interesting to note, that the rotation movement of the cylinders, produces more significant changes in the drag than in the lift, as shown in Fig. 11.

5.4 Influence of the Reynolds number for in tandem cylinders

Figure 12 shows the time histories of the drag coefficient for the upstream cylinder, considering the laminar and turbulent flow regime, L/D = 2.0, α = 0.5. It is clearly noted that the drag on the cylinder decreases continuously as the Re increases, Fig. (12a). For Re ≤ 500, the fluctuations are periodic, which corresponds to the alternating vortex shedding process, with the formation of the classical Von Kármán Street downstream of the two cylinders.

Fig. 12: Time evolution of the drag coefficients, for upstream cylinder, $200 \leq Re \leq 10^5$.

instabilities develop, turbulence levels begin to appear, which influences the vortex shedding process, even though the periodicity still remains robust [33]. Such instabilities, as well as the totally disorganized vortex street certainly reflect in the drag and changes the fluctuations pattern as shown in Fig. 12.

Figure 13 shows the time evolution of the drag coefficient for the downstream cylinder. The shear layers at the top of the upstream cylinder, in a clockwise rotation movement, collide with the downstream cylinder, while
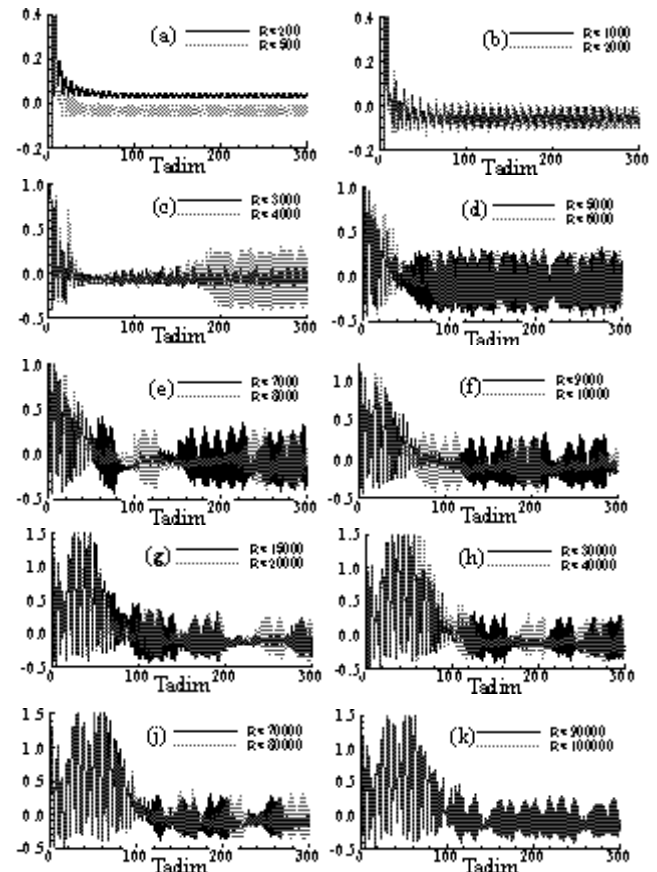
Fig. 13: Time evolution of the drag coefficients, for downstream cylinder, $200 \leq Re \leq 10^5$.

For Re 1000 and 2000, the fluctuations pattern is similar. It is noted the presence of "kinks" in the fluctuations along the time evolution, indicating the generation of more than one vortex per cycle. The wake seems disorganized, with vortices pairs scattered along it and, with different size and strength. The "kinks" pattern changes for Re = 3000, indicating a greater number of weak and strong vortices per cycle. It is interesting to note that for Re = 4000, there is a reduction in the mean value of the drag coefficient throughout the simulations. For the dimensionless time approximately between 40 and 173, the mean value is 0.9585, while for the rest of the time it is 0.9248. In addition, there is a reduction in the amplitude of the fluctuations for the mentioned time intervals. As increases the Re, the increase in the amplitude in the first dimensionless time became more considerable, being accompanied by a sharp reduction. In addition, the presence of envelopes, in a greater or lesser amount, for the cases with Re $\geq$ 5000, is observed.

It can be seen from obtained results, that although the numerical simulations are two dimensional, with the increase in the Re and the preponderance of the inertial forces over the viscous forces, three-dimensional

those originating from the bottom, surround the downstream cylinder, causing smaller drag and greater fluctuations amplitude.

For the two first simulated Re, the fluctuations pattern is similar to that observed for the upstream cylinder. In addition, it is clearly noted, that the mean drag is positive for Re = 200. With the increase of Re up to 3000, the fluctuations pattern is no longer sinusoidal and differs from that observed for the upstream cylinder. And, it is noted that the mean drag has a negative value. For Re = 4000, two different fluctuations pattern are verified, which implies that the vortex shedding pattern has changed over

the simulations. With further increase in the Reynolds number, there is a considerable increase in the amplitude of the fluctuations, for the first dimensionless time and after, a sharp reduction. This behavior is also observed for the upstream cylinder.

Figure 14 shows the time histories of the lift coefficient for the upstream cylinder. Note that the lift coefficient is positive for all analyzed Reynolds number. This is coherent, once a time that, as the upstream cylinder rotates in the clockwise direction, the velocity at the top of the cylinder is greater than at the bottom.
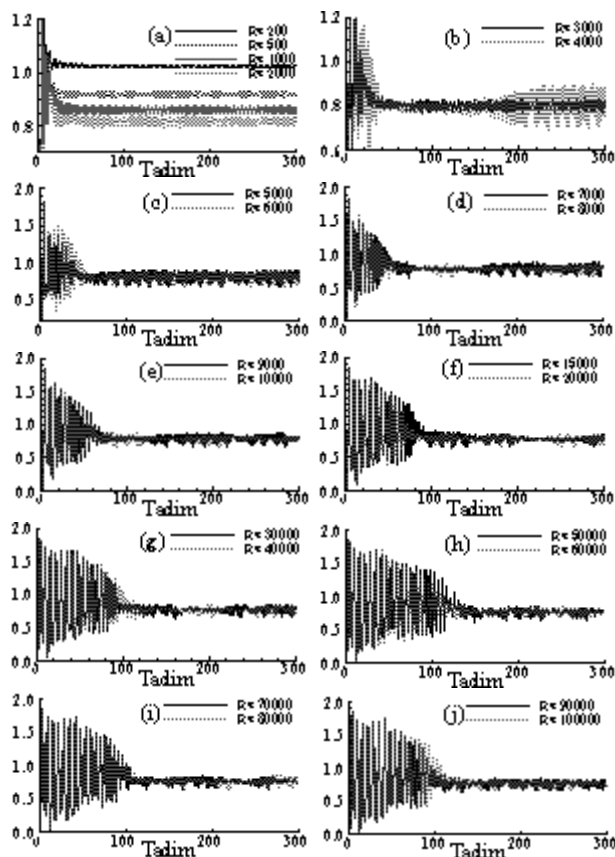
Fig.14: Time evolution of the lift coefficient for the upstream cylinder, $200 \leq Re \leq 10^5$.

As a result, the pressure at the bottom is greater, causing a positive lift force. It is also worth to note, that the coefficient reduces as the Re increases, with a slight increase from Re 6000 to 8000 and then remains approximately constant for the others Re, with small variations. It is clearly observed that the fluctuations pattern varies along of the simulations, which implies that the vortex shedding process has been changed.

The time evolution of the lift coefficient for the downstream cylinder is shown in Fig. 15. Contrary to what is observed for the upstream cylinder, Fig. 14, the

downstream cylinder has a negative lift coefficient for all analyzed Re. This is due to the fact that, with the counterclockwise rotation movement, the velocity at the top of the cylinder is smaller than that of the bottom and, consequently, the pressure at the top is greater, resulting in a negative lift coefficient. It is also observed that the fluctuations amplitude for the downstream cylinder are greater than for the upstream one, with a behavior approximately similar to that observed in Fig. 14.
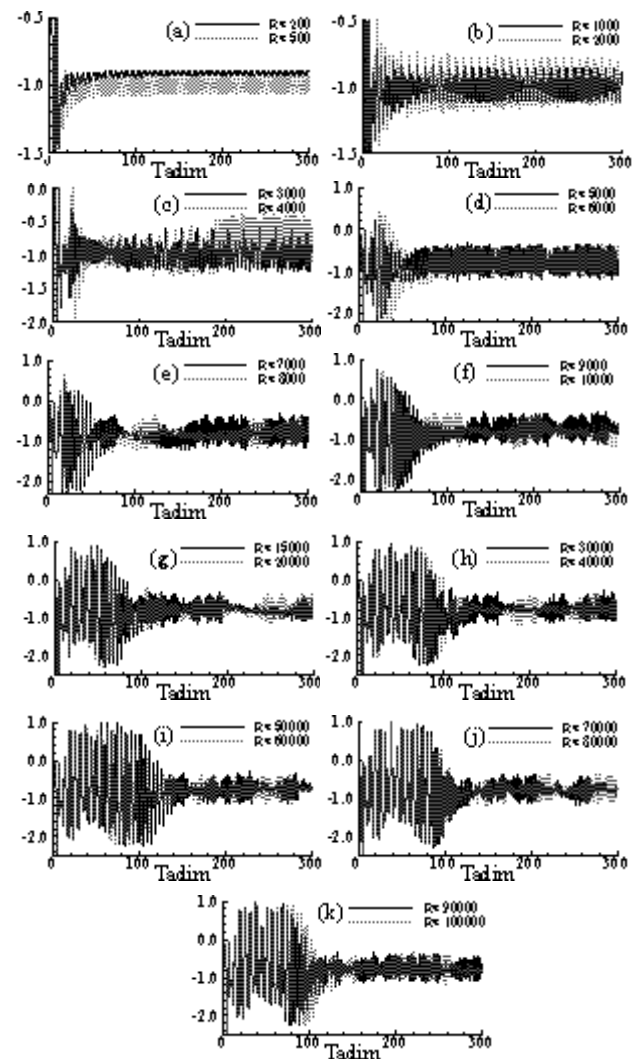
Fig. 15: Time evolution of the lift coefficient for the downstream cylinder, $200 \leq Re \leq 10^5$.

5.5 Influence of the Reynolds number in the pressure coefficient

The influence of the Reynolds number can also be analyzed through the mean values of the pressure coefficient around the surface of the rotating cylinder. The same Re values of the Fig. 15 are simulated. However, for better visualization, only the pressure distribution for five Re values is plotted. In Fig. (16a), are shown the pressure

distribution along of the upstream cylinder. It can be seen that, at the point of minimum velocity (stagnation point), θ = 0º, the local pressure is maximum and consequently the mean pressure coefficient also, Cp = 1. At the bottom of the cylinder (θ ≈ 90º), it appears that the values for the mean pressure coefficient are higher than those corresponding to the top side, θ ≈ 270º. This is coherent, once a time that, the flow is accelerated at the top and decelerated at the bottom. With the increase of Re up to 3000, a reduction in the pressure coefficient can be seen at the bottom side of the cylinder, and after this Re, an increase is verified, with the mean values being between those obtained for Re 200 and 3000. It is interesting to observe that for Re ≥ 1000 there is an inflection in the curve to the angle approximately equal to 90º. On the other hand, at the top of the cylinder, the coefficient shows variations with the increase in the Re, with the mean values between those obtained for Re 500 and 50000. In addition, it is noted that the curve moves slightly to the right.
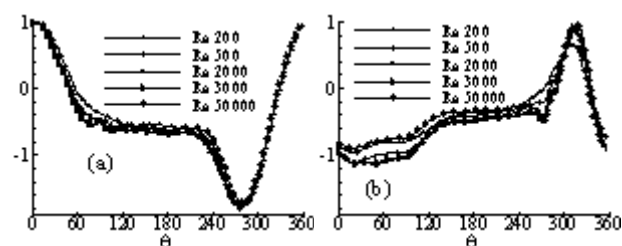
Fig. 16: Mean pressure coefficient in function of the angle

The mean values of the pressure coefficient for the downstream cylinder are shown in Fig. (16b). It can be seen that, at θ = 0º, the local pressure is minimum and consequently the mean pressure coefficient also, Cp ≈ -1.0. This is due to the fact that the shear layers coming from the upper side of the upstream cylinder collide with the front part of the downstream one, reducing the local pressure and consequently the pressure coefficient. Contrary to what is observed for the upstream cylinder, it is noted that the lower side of the cylinder, θ ≈ 90º, has smaller values than the upper side, θ ≈ 270º, for the pressure coefficient. This behavior is coherent, once a time that, the downstream cylinder has a counterclockwise rotation movement. Thus, the flow is accelerated on the lower side (smaller local pressure) and decelerated on the upper side (higher local pressure). It is important to note that the stagnation point, this is, point of minimum velocity and maximum pressure, has changed its position in relation to observed for the upstream one. It is verified a displacement of it towards the top of the cylinder, as shown in Fig. 17, by visualization of the pressure fields, for Reynolds number 2000 and 50000.

Here, for Re = 200, it is noted that the maximum mean value of the pressure coefficient, approximately 0.68, is obtained for the angle equal to 310°, less than the maximum value obtained for the upstream cylinder, Cp = 1.0. It is also noted that the Cp presents increasing values, for the angles of approximately 20° up to 310° and then it reduces in an accelerated way until 360°. Along the cylinder, it is verified that there are points at which growth is slower than at others. With the increase of Re to 500, the flow has a similar behavior, however for the angles 20° up to 310°, the mean values showed a reduction and in the range of 300° up to 340° an increase, remaining below 1.0, approximately 0.85. The maximum value of Cp (0.967) is verified for Re = 3000, with the curve moving to the right (from 310° up to 316°, approximately). For the others simulated Re, the mean values are between those obtained for Re = 200 and 3000.
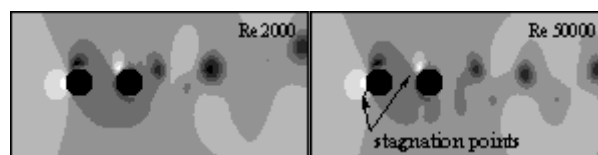
Fig. 17: Pressure fields for L/D = 2.0, α= 0.5.

VI. CONCLUDING REMARKS

Two-dimensional numerical simulations are carried out in order to investigate the flow dynamics around two rotating circular cylinders arranged side by side and in tandem. The results showed that, beside the influence of parameters such as Reynolds number, spacing ratio and specific rotation, on the flow behavior, the arrangement of the cylinders along the flow is also important. This is verified, through the analysis of the vortex shedding mechanism for both cases, considering α = 0.5 and Re = 100. For the side by side case, the suppression of the vortex shedding process is obtained for L/D = 1.5. On the other hand, for the in tandem case, the vortex shedding gradually decreased with the increase in the spacing, and the vortex suppression is obtained for L/D = 3.0 and 3.5 after a dimensionless time of approximately 100. Thus, it is showed the great importance of the cylinder arrangements combined with the spacing ratio on the vortex shedding process, separation of the shear layers and consequently on the wake pattern. It is also verified that, keeping the spacing ratio and Re constant, the flow dynamics is strongly influenced by the specific rotation. In the present work, the critical specific rotation, for which the vortex shedding mechanism is suppressed is 1.3.

It is also found, for the aligned cylinder case, that the Re number has a strong influence on the flow

characteristics, so that the wake seems disorganized, with three-dimensional instabilities and vortices with different sizes and forces. In addition, these characteristics reflect in the drag and lift force, as well as change the fluctuations pattern. Another great influence of cylinder arrangement is relating to the stagnation point of the downstream cylinder that displace towards the top of the cylinder, whereas in the upstream cylinder this point is located at front part, $\theta = 0°$.

Further studies will be performed in order to analyze the flow dynamics around two or more circular cylinders with staggered arrangements and also submitted to others types of movement such as rotational oscillation and one degree of freedom.

ACKNOWLEDGEMENTS

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Mathematical Knowledge in Contexts of Solidary Economic Enterprises

Carla Saturnina Ramos de Moura[1], Erilva Machado Costa[1], Rosimeire Morais Cardeal Simão[1], Jorge Luis Cavalcanti Ramos[2], Sandra Mari Yamamoto[2], Xirley Pereira Nunes[2]

[1]Doctoral Student of the Graduate Program in Agroecology and Territorial Development, Federal University of Vale do São Franscisco (UNIVASF), Juazeiro, BA.

[2]Professor of the Graduate Program in Agroecology and Territorial Development, Federal University of Vale do São Franscisco (UNIVASF), Juazeiro, BA.

Abstract—*This study aims to identify mathematical situations in practices of Solidary Economic Enterprises - EES, as well as to describe the performance of the ethnomatematic program in research with EES. The study consists of a bibliographic review with a qualitative approach, in which articles were selected in the CAPES Journal Portal. Thus, we conclude that there are situations in EES in which mathematical knowledge is used, such as: the understanding of spreadsheets; the organization of tables for production control; the calculation of materials needed for production and the understanding of mathematical operations used for budgeting the enterprise. It was identified that members did not understand these mathematical contents, and pedagogical interventions were carried out that were guided by the Ethnomathematics program, contemplating activities that valued the context of each enterprise and the previous knowledge of the members.*

Keywords—*Mathematics; Solidarity economy; Ethnomathematics.*

I. INTRODUCTION

The concept of education is so broad that it permeates the walls of a school. It is inserted in different contexts, providing a better quality of life for people. Thus, the teacher, as a knowledge facilitator, should act in other scenarios in addition to the school environment.

In this sense, the construction of knowledge, through an interconnection between knowledge, can provide the economic development of the region, based on important values, such as: respect for the environment, solidarity, collaboration and self-management, which leads us to the Solidarity Economy . Thus, when a group of people produce and market their products based on the principles of Solidarity Economy, they constitute Solidary Economic Enterprises (EES).

In strengthening the EES, in the state of Bahia, we highlight the performance of the Public Centers for Solidarity Economy (CESOLs), currently, the state has nine Centers that act not only in strengthening, but also in the generation and promotion of collective work. After visits to CESOL located in the city of Juazeiro and to the EES in which this center operates, a weakness was found in the execution of self-management, an important principle for its maintenance. It was also identified that there are mathematical situations embedded in many practices of these establishments, ranging from the elaboration of products for sale to the management of the enterprise, such as inventory control, cash closing, among others.

With that, we present the following question: What mathematical situations are present in the activities of Solidary Economic Enterprises? In order to support such questioning, a systematic review was carried out in order to identify mathematical situations in practices of Solidary Economic Enterprises - EES, as well as to describe the performance of the ethnomatematic program in research with EES. The research consists of a bibliographic review with a qualitative approach, in which articles were selected in the CAPES Journal Portal.

Thus, the theoretical focus that will be adopted in this study, is based on the principles of Ethnomathematics, characterized as Mathematics practiced by cultural groups, such as groups of workers, indigenous societies among

others D'Ambrósio (2013); the Solidarity Economy, which comprises "the set of economic activities - production, distribution, consumption, savings and credit - organized and carried out jointly by workers in a collective and self-managed manner" (BRASIL, 2006, p. 11).

To support this research, the main theoretical contributions are: the Solidarity Economy; Ethnomathematics, based on the studies of Singer, D'Ambrosio and Meneghetti.

SOLIDARITY ECONOMY

In the current context, there are discussions regarding the organization of society. In this organizational scenario, capitalism is found. According to Singer (2002), this mode of production, based on the right to property and individual freedom, has become dominant, this in such a way that we see it in a natural way. Thus, it highlights that one of the consequences of this mode of production is a competitive market economy, in which companies compete for sales. In this way, those that sell the most are also those that profit the most and grow the most. And those that sell less will suffer losses and tend to close. This fact has negative social effects: "the winners accumulate advantages and the losers accumulate disadvantages in future competitions. "(SINGER, 2002, p. 08).

According to Silva et al (2016), in the capitalist mode of production, labor for man is no longer used to supply his needs, but is seen as a means of accumulating wealth for the holders of the means of production. In this perspective, capitalism presents a contradiction: initially, it generated material goods necessary for society; therefore it brought a great wave of unemployment.

Contrary to this competitive and exclusive way of thinking, which has social inequality as one of its consequences, Singer (2002) proposes a society that is adept at Solidarity Economy, in which competition is replaced by cooperation between participants in economic activity. In this same perspective, Pitaguari, Santos, Camara (2012) highlight that the potential of the Solidarity Economy is centered on solidarity and equity, with no room for competition and individualism.

The transformations that have taken place in the world of work have made workers and poor communities organize themselves in the form of self-management, an important characteristic of the Solidary Economy (BRASIL, 2006). In a simple way, Santos (2012) clarifies that "self-management would be self-management. It starts with the intention that men can be responsible for organizing an activity, without the necessary intervention of a leader, or a superior "(SANTOS, 2012, p. 106).

In the company with an integral profile of the Solidarity Economy, management takes place in a democratic manner, which characterizes self-management. Thus, depending on the size of the company, decisions can occur through assemblies, in the case of small companies, or through the election of delegates, elected by section or departments, where they meet to deliberate on behalf of all (SINGER , 2002).

According to the author, all workers of the solidarity company understand what happens in the enterprise, appropriating the problems and looking for possible solutions. This fact contributes to a lack of appreciation of competition among members, since they will not be encouraged by competitions in the group, to know who is better than the other.

When a group of people produce and market their products based on the principles of Solidarity Economy, they constitute Solidary Economic Enterprises (EES). These enterprises can be: "cooperatives, associations, self-managed recovered companies, solidarity finance organizations, informal groups, etc. (MENEGHETI, 2016, p. 3).

Solidary Economic Enterprises, over time, receive support from entities. In the university context, we highlight the work carried out by NuMI-EcoSol-Integrated Multidisciplinary Center for Studies, Training and Intervention in Solidarity Economy, a teaching, research and extension unit directly linked to the Rectory of the Federal University of São Carlos (UFSCar). One of its objectives is to provide qualified and free assistance to groups of people who are in situations of social vulnerability from the perspective of the Solidarity Economy. One of the group's lines of action discusses issues of Gender and Mathematical Education, based on Ethnomathematics.

In this same perspective, we highlight the performance of the research group EduMatEcoSol, coordinated by Professor Renata C.G. Meneghett, being one of his lines of research on Education in Solidarity Economy. Meneghetti (2016) identifies the Ethnomathematics present in the EES and, from there, carries out interventions, contributing to the self-management of such enterprises.

ETHNOMATHEMATICS

Mathematical knowledge appears in the most varied social contexts, from the bricklayer when calculating the

area of a wall to make its covering; a farmer when calculating the amount of fertilizer he needs to use in his crops. In this sense, D'Ambrósio (2013) discusses contextualized mathematical know-how, which seeks explanations and ways of dealing with the environment. Thus, he points out Ethnomathematics as the mathematics practiced by cultural groups, such as groups of workers, indigenous societies, among others.

D'Ambrósio (2008) points out that the definition of Ethnomathematics is very difficult and, therefore, uses an explanation of an etymological character, in which ethno are the most varied environments, from the social, cultural and nature; matema, which means to explain, understand, teach, deal with; tica, which resembles the Greek word tecné, which refers to arts, techniques, manners. In summary, there is Ethnomathematics, which means "the set of arts, techniques of explaining and understanding, of dealing with the social, cultural and natural environment, developed by different cultural groups" (D'AMBROSIO, 2008, p. 8).

In the field of solidarity economics, we highlight the studies by Meneghetti who, in his postdoctoral research, concluded that "such an investigation pointed to the importance of the theory of Ethnomathematics, both with regard to the characterization of the Ethnomathematics of Enterprises in Solidary Economy, as regards the consideration of this Ethnomathematics in educational practices in the context of higher education "(MENEGHETTI, 2013, p. 537). Meneghetti, Giaquinto (2017) approached the process of teaching and learning mathematics in a contextualized way, meeting the specific demands of mathematical knowledge inherent to the activities of a Community Bank. The research by Meneghetti et al (2013) aimed to meet the specific demands of Mathematical Education with three Enterprises in Solidarity Economy (EES): a cleaning cooperative, a women's collective joinery and a group of homemade soap manufacturing.

The researcher conducts her research in EES as follows: Initially, she understands the Mathematics used in EES and how it is used within these environments. Then, from this survey, pedagogical activities are developed that are experienced through workshops, in order to facilitate an understanding of the mathematics used by the members of the EES, thus contributing to the self-management of such enterprises (MENEGHETTI, 2016).

II. METHODOLOGY

This study consists of a bibliographic review, with a qualitative approach (GIL, 2017), in which articles

published between the year 2000 and January from indexed Portal de Periódicos CAPES / MEC were selected. In the search, the following keywords were used "Ethnomathematics' '," Solidarity Economy "interconnected with the Boolean operator" AND ".

III. RESULTS

After searching for the words "Ethnomathematics " and" Solidarity Economy "in the Capes Journal Portal, 6 articles were identified, 3 of which were duplicates and one was not considered in the analysis, as it was intended to investigate, the point from a theoretical point of view, possible approximations between Mathematics Education and Solidarity Economy (MENEGHETTI, 2013), did not address mathematical situations present in EES practices. Thus, for the analysis of the results, 2 studies were considered, which are: Meneghetti; Barrofaldi (2015) and Meneghetti et al. (2013).

The study by Meneghetti and Barrofaldi (2015) aimed to develop mathematical activities in a contextualized way, aiming to meet the specific demand of a Community Bank (BC). Thus, initially there was an understanding of the daily life of this enterprise; seeking to identify the mathematical knowledge needed in its production chain and the difficulties presented by its members.

According to the initial survey, most of the activities carried out in the BC revolved around handling a spreadsheet for the analysis and control of productive credit, used for the analysis and granting of loans. Thus, it was identified a greater difficulty of the members in the use of this spreadsheet, more specifically, in relation to the mathematical concepts necessary for its completion and analysis, which involve basic operations with decimal numbers, calculation of averages, percentages, rule of three and conversions of measures. In view of this, in a second step, interventions were carried out in which these mathematical contents were worked on, valuing the prior knowledge that each member had. It was also found that the interventions provided the learning of mathematical content in which several difficulties initially pointed out were remedied, in addition, they indicate that these actions helped in the self-management of that enterprise.

The research by Meneghetti et al (2013) aimed to meet the specific demands of Mathematics Education with three Enterprises in Solidarity Economy (EES): a cleaning cooperative, a women's collective joinery and a group of homemade soap manufacturing. At first, the mathematical knowledge present in each of the groups found difficulties

members regarding mathematical knowledge. Thus, in the cooperative, participation in public notices that need to present contracts with values based on the type of service to be provided was identified, including calculations such as: number of members to perform the service; quantity of cleaning products required, displacement of products and people, etc. In these actions, operations with rational numbers in decimal form are used.

In the collective women's joinery, mathematical situations were identified, which involved everything from calculating the amount of wood used to make furniture to discussions about the use of a calculator, abacus and equations.

As for the group of homemade soap manufacturing, the researchers realized that the partners had difficulties in making the tables used to control the production and count of the product produced. In this sense, intervention activity was carried out in order to guide the construction of tables. Thus, after that moment, it was identified that as for filling the table, they understood how to fill and interpret a table, which consisted of an advance in search of self-management of this EES.

IV. CONCLUSION

When resuming the objectives of this work, of identifying mathematical situations present in practices of Solidary Economic Enterprises (EES), as well as describing the performance of the ethnomatematic program in research with EES, it is concluded that there are several situations in EES in which mathematical knowledge is used . According to the research analyzed, the following should be highlighted: the use and understanding of spreadsheets; the organization of tables for production control; the calculation of materials needed for production, as well as the understanding of mathematical operations used to prepare the project's budgets.

It was identified that the members of the EES involved in the research had difficulties in the manipulation of these mathematical contents, which resulted in a difficulty in carrying out the activities. Thus, in the three studies, pedagogical interventions were carried out, in which activities were considered that valued the context of each enterprise and the previous knowledge of the members, these actions provided a certain autonomy in the execution of activities, contributing to the strengthening of self-management.

We also highlight that, in all the studies carried out, the Ethnomathematics program was of fundamental importance because it was used as theoretical and

methodological support both in the initial survey, in which it was sought to know the daily life of the enterprises as well as to guide the pedagogical interventions carried out, which were also elaborated with theoretical contributions of Mathematical Education, like the Problem Solving. In relation to this fact, Meneghetti (2016) points out that his work may guide other research in strengthening self-management in Solidary Economic Enterprises, and pedagogical interventions may be developed using other teaching methodologies.

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Inclined Enamels and Accessories Support Made of Polyethylene Terephthalate (PET)

Fernanda Regina Tavares[1], Kaue Aparecido Peres Person[1], Rene Anderson de Souza[1], Victor Rustiguelli Mauro[1], Júlio Francisco Blumetti Facó[2], Alexandre Acácio de Andrade[2], Fernando Gasi[2]

[1]Center for Engineering, Modelling, and Applied Social Sciences, Universidade Federal do ABC, Brazil.
[2]Universidade Federal do ABC, Brazil.

Abstract— *This work aims to develop inclined support of enamels and accessories in Polyethylene terephthalate, also known as PET, which will have the option of inclination angles through the threading of the suction cups, to allow the brush to reach the enamel, regardless of the amount of product in the packaging. The support will apply to different fitting molds and will serve both rounded and/or square packaging, which will facilitate the work of professionals, such as manicurists/pedicurists and people who make personal use of the product. Another gain when using the support will be to maintain the organization of the material used, as it will support up to four enamels simultaneously, a container for acetone, located at its base, support for pieces of cotton and support for toothpicks.*

Keywords— *Project Development, Polyethylene Terephthalate, Solidworks.*

I. INTRODUCTION

Beauty has always been a subject of interest to human beings and the quest to meet beauty standards has been on the rise for many years. The population is increasingly interested in taking care of themselves, maintaining their appearance, and concerned about their health. In this way it is possible to compare the variety of beauty products that exist on the market today, with the one that a few years ago, and realize that it is expanding and evolving, focusing on products that offer a good cost-benefit ratio (STREHLAU & CLARO, 2015). According to the company Euromonitor International (2019), with its performance in 2018, Brazil remained in the fourth position in the world consumption ranking of the sector of Personal Hygiene, Perfumery and Cosmetics (HPPC), which is led by the United States and they have China and Japan in the second and third positions, respectively. In the domestic market, the beauty sector is among the top ten retail segments and it is said that this market can grow about 2.7% each year (BERTONI, 2018).

In the study "Panorama do Setor 2019", published by the Brazilian Association of the Perfumery and Cosmetics Personal Hygiene Industry (Abihpec), the ex-factory growth (net of sales tax) in 2018 was 1.7% when compared with the value calculated in 2017 (COSMETIC INNOVATION, 2019).

The industry pointed out that premium products, those

with higher value and generally from international brands, had an increase of 9.1% in sales, while popular products, 4.4% in 2016. Enamels, lipsticks, skin products, and sunscreens are the bestsellers of the premium line, in which the first two, being cheaper, allow customer satisfaction without compromising the budget (EUROMONITOR INTERNATIONAL, 2019). The large circulation of information about beauty products on the internet, and the growth of Digital Influencers, who work promoting product tips that are on the market, contributed to the increase in the volume of online sales of these products in Brazil (FREITAS, 2020). Another factor also taken into account is the increase in open companies in the beauty industry. According to Sebrae1 (Brazilian Support Service for Micro and Small Enterprises) (2015), the number of beauty salons and beauty clinics increased by 567% from 2010 to 2015, with approximately 482,455 people registered in the system, and for the cosmetics sector, growth of 10.2% per year is expected until 2019 (JARDIM, 2018).

Currently, customers want the companies from which they consume the products to practice sustainability, behave ethically, and be transparent. Because of this new scenario, two trends deserve special attention: sustainable technology, with a more conscious use of ingredients of natural origin, for the search for techniques that preserve the environment and earth-friendly processes for the production, transport,

and storage of products; and good products that do good (ABIHPEC & SEBRAE, 2020).

In the current market, some examples of competitors were found for the support developed in this present project (Figures 1, and 2).

Fig.1. Enamel support.
Source: Lima (2014).

Figure 2. Enamel support.
Source: Fine Print (2020).

From Figures 1, and 2 it is possible to verify that, although these products exist and meet the main objective (to facilitate the handling of the product when painting nails), they need some improvements. About Figures 1 and 2, there is no option to use the support at different angles and, therefore, it is not possible to solve the problem related to the quantity of product, since a very full package requires a different inclination than a product after several uses. Also, there are square and rounded enamel packaging and these supports serve only rounded packaging, thus reducing the diversity of use and reach of the public. In Figure 3, unlike Figures 1 and 2, it is articulated, so it has different angulation options, making it easier to reach the brush to the liquid regardless of the existing quantity. However, like the supports in Figures 1 and 2, it can only be used for rounded packages.

Today, the market is not aware of substitute products so comparisons can be made, because those who do not use one of the supports shown above, basically use a common table to support the enamel glass.

The purpose of the product of this project is, mainly, to be of low cost, because it is understood that it must be accessible both for manicures/pedicures and for other clients who do their nails on their own. Also, support should be light, as it can be carried on handbags, for example, by manicurists who offer home care services.

Between 2003 and 2017, the HPPC sector had an average annual growth rate (CAGR) of 4.28%. In terms of sales, there was an expansion from the US $ 256 billion in 2003 to US $ 464 billion in 2017, that is, an increase of 81% in the period (Figure 3).
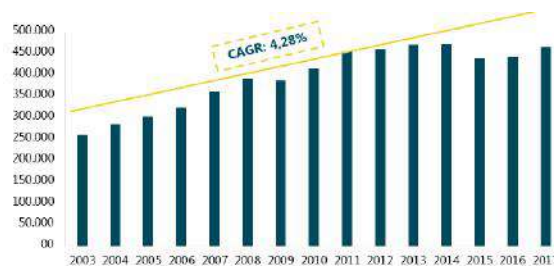
Fig.3. Evolution of the global revenue of the cosmetics industry (in millions of US$).
Source: Euromonitor (2018). Elaborated by Finance Club.

PROJECT DEVELOPMENT

The inclined support for enamels and accessories will have four slots on the top, which can be used by enamels of different diameters, for example, 2 cm in diameter that holds a pack of up to 8 ml, or 3 cm in diameter that tolerates a pack of up to 11 ml of enamel to meet all types of flasks, even personalized ones. A very common accident that happens to those who take care of nails is related to the use of acetone. With this information, the group developed space at the bottom for fitting bottles of up to 100 ml of product, another for storing cotton. Small spaces were also developed at the rear of the product for the storage of toothpicks. For better ergonomics, safety and the benefit of the products that will be placed on the support, "feet" were developed with adjustable height by threading (thus giving the possibility of varying the product's inclination) and with suction cups at the tips, providing greater safety and grip on various surfaces (Figure 4). When searching the base of Brazilian Patents - INPI (National Institute of Industrial Property), it was not possible to find any product that resembles the one described above
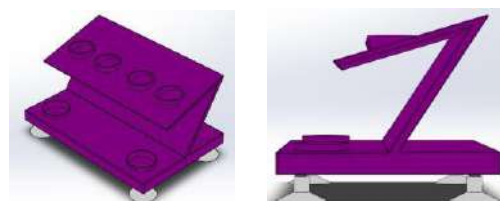
Fig.4. View of the prototype version

2.1 Dimensions of the Part.
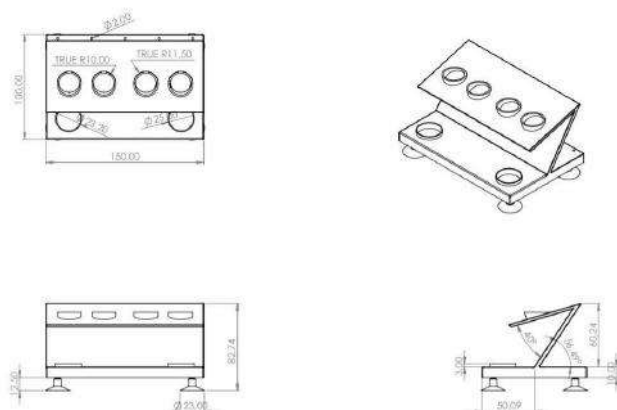
Fig.5. Views with the dimensions of the part.

II. METHODOLOGY

Solidworks CAD software was used to develop the product in 3D.

III. ENVIRONMENTAL IMPACT

. Vis Aiming to ensure and measure sustainability in the process of obtaining raw materials, manufacturing, consumption, transportation, and disposal, a study was carried out regarding the product, using the Sustainability module of the Solidworks tool. A module is a tool with good resources and analysis in a simple but complete way. Figure 6 shows the result of the Solidworks Sustainability module.
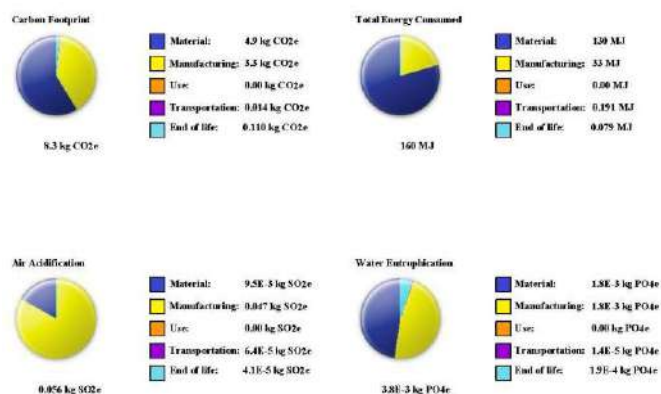
Fig.6. Environmental impact.

Air Acidification burning fuels creates sulfur dioxide, nitrous oxides, and other acidic air emissions. This causes an increase in the acidity of rainwater, which in turn acidifies lakes and soil. These acids can make the land and water toxic for plants and aquatic life. Acid rain can also slowly dissolve man-made building materials such as concrete. This impact is typically measured in units of kg sulfur dioxide equivalent (SO_2).

Carbon dioxide and other gasses resulting from burning fossil fuels accumulate in the atmosphere, which in turn increases the earth's average temperature. Also known as Global Warming Potential (GWP), the carbon footprint is measured in units of carbon dioxide equivalent (CO_2e). Scientists, politicians, and others blame global warming for problems like loss of glaciers, extinction of species, and more extreme weather, among others.

Total Energy Consumed measure of the non-renewable energy sources associated with the part's lifecycle in units of megajoules (MJ). This impact includes not only the electricity or fuels used during the product's lifecycle, but also the upstream energy required to obtain and process these fuels, and the embodied energy of materials that would be released if burned. Total energy consumed represents the net calorific value of primary energy demand from non-renewable resources (e.g. petroleum, natural gas, etc.). Efficiencies in energy conversion (e.g. power, heat, steam, etc.) are also factors.

Eutrophication occurs when an overabundance of nutrients is added to a water ecosystem. Nitrogen and phosphorous from wastewater and agricultural fertilizers cause an overabundance of algae to bloom, which then depletes the water of oxygen and results in the death of both plant and animal life. This impact is typically measured in either kg phosphate equivalent (PO_4) or kg nitrogen (N) equivalent.

IV. CONCLUSION

When searching the base of Brazilian Patents - INPI (National Institute of Industrial Property, 2020), it was not possible to find any product that resembles the one described above (The search for the keyword "inclined enamel support" in the TITLE and SUMMARY) - was carried out thus, the support for enamels and accessories proposed in this present project becomes a new product.

Support development proved to be viable as it is a new, innovative, and sustainable product.

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Surgical Intervention on an upper Side Incisive Affected by Transmigration and Dilaceration: Case Report

Eduardo Fernandes Marques, Jose Afonso Almeida, Wânia Dantas and Larissa Coelho Bitencourt

Abstract— The term "transmigration" is attributed to the fact that dental elements cross the midline of the bone base (maxilla or mandible), positioning themselves on the contralateral side. The incidence of this dental anomaly in permanent central incisors impacted on the maxilla is an unusual phenomenon and its etiology has not yet been elucidated. This pathology can be associated with root tearing. Given the context, this study describes a case report of a surgical intervention of an upper lateral incisor affected by transmigration and laceration. Patient P.M.R, 37, was seen at the surgery clinic. He used a removable prosthesis with only tooth 8 and complained that "a tooth was missing in the mouth". Tooth 7 was fractured in the crown and endodontic treatment was performed. The clinical examination showed an increase in volume close to the anterior nasal spine. A CT scan was requested which revealed that the right central incisor was included. In the coronal section, it was possible to observe only the inverted tooth crown. In the sagittal section, it was also possible to see the root, which had a large curvature in a V-shaped fold. After the diagnosis, he opted for the removal of the included element, since it was impossible to perform a traction due to its anomalous shape. Anesthesia of the anterior superior alveolar nerve and nasopalatine was performed using mepivacaine 2% 1: 100,000, syndesmotomy and a relaxing incision was made in the distal of tooth 9 going to the base of the nose. After exposing the crown, an odonto-section was performed with an HL 702 drill at the crown / root limit and the crown was removed. A small channel was made in the mesial of the crown to find a support point and to remove the root with the molt detacher nº 9. Afterwards, the place was washed with 0.9% saline solution to remove bone bruises and done the suture returning the flap to its original place. Made the prescription drug with amoxiline 500mg 8/8 hours for 5 days, ibuprofen 600mg 12/12 hours for 3 days.Patient returned with 8 days for suture removal and asymptomatic. It is possible to conclude with this study that surgical intervention in cases where the dental element is affected by transmigration and root laceration is effective.

Keywords— Transmigration, Tearing, Oral Surgery.

I. INTRODUCTION

Transmigration is a rare phenomenon, with a reported prevalence of 0.14% to 0.31%, occurring only in the permanent dentition, which normally affects the lower canines and its etiology is unknown (Bhullar et al., 2017). However, several etiological factors may be involved, such as ectopic tooth root growth, premature retention or loss of a deciduous tooth, insufficient eruption space and excessive crown length (Domenico et al., 2017). Genetic factors, endocrine diseases and trauma were also cited as possible etiological factors. However, abnormal bud displacement or tooth deviation during development is the most commonly accepted explanation (Pawel et al., 2018).

Transmigration is a dental anomaly that usually affects a dental element, that is, simple, however, multiple ones are even rarer. In most reports of transmigrated teeth, it is possible to observe that it is positioned horizontally, below the tips of erupted teeth (Muhammad et al., 2019).

Clinical and radiographic examination is usually necessary to diagnose transmigrants, as they usually remain impacted and asymptomatic. However, they can cause resorption of pressure from the roots or inclination of adjacent teeth, pain, discomfort and neuralgic symptoms to the patient (Plaza 2016).

Panoramic radiographs, lateral cephalograms, computed tomography (CT) and cone beam computed tomography (CBCT) can be used to accurately locate

transmigrated teeth and detect radicular resorption of adjacent teeth (Ralf et al., 2019). Early diagnosis with timely orthodontic or surgical intervention can help orthodontists to preserve dental elements, which can play an important role, both in aesthetics and in function, in human dentition (Giampietro et al., 2015). On the other hand, surgical removal may be an alternative, however, the decision of the procedure depends on the symptoms reported by the patient, the location of the tooth and the presence or absence of association with pathologies (Jain &Debbarma, 2019).

Due to the unfavorable position of the transmigrated tooth, orthodontic repositioning is difficult. Currently, successful corrections of transmigrated teeth using orthodontic treatment have rarely been documented in the literature (Plakwicz et al., 2019).

The tooth affected by transmigration may be associated with root laceration, which is a dental anomaly. It can affect the root or crown of the tooth and consists of the formation of a curvature in these regions. It is more common in the upper and lower central incisor teeth (Salek et al., 2019).Given the context, this study describes a case report of a surgical intervention of an upper lateral incisor affected by transmigration and laceration.

II.   CASE REPORT

Patient P.M.R., 37 years old, was seen at the surgery clinic of CEULP / ULBRA - Tocantins, Brazil for a routine examination. On physical examination, it was possible to observe a removable upper prosthesis with only artificial tooth 8 and complaining that "a tooth was missing in the mouth" .Tooth 7 had a fracture of the crown and endodontic treatment was performed.

The clinical examination showed an increase in volume close to the anterior nasal spine. A CT scan was requested which revealed that the right central incisor was included. In the coronal section (figure-01), it was possible to observe only the inverted tooth crown. In the sagittal section (figure - 02) it was also possible to see the root that had a large curvature in a V-shaped fold. A 3D reconstruction (figure - 03) was performed to better visualize the clinical case.
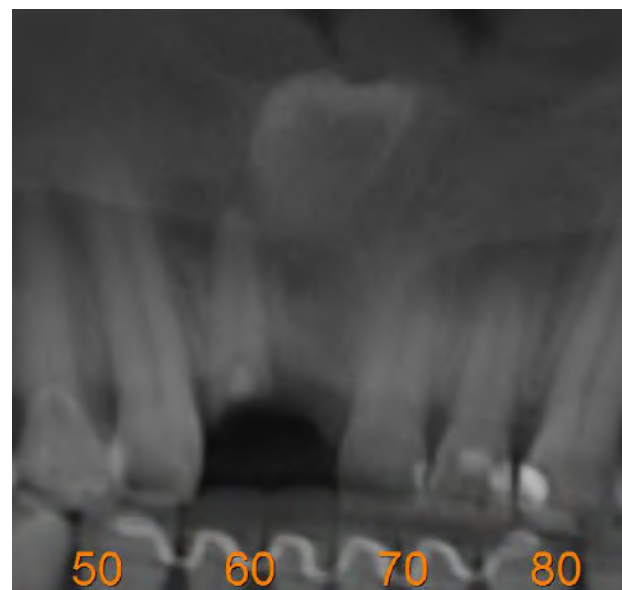

Fig.1: Coronal Section

Source: own authorship

Fig.2: Sagittal section

Source: Own authorship

Fig.3: 3D Reconstruction

Source: Own authorship

A clinical case of a right upper central incisor affected by transmigration and laceration was diagnosed. We opted for the removal of the included element, since it was impossible to make a traction due to its anomalous shape.

Anesthesia of the anterior superior alveolar nerve and nasopalatine was performed using mepivacaine 2% 1: 100,000, syndesmotomy and a relaxing incision was made in the distal of tooth 9 going to the base of the nose. After exposing the crown, an odonto-section was performed with an HL 702 drill at the crown / root limit and the crown was removed. A small channel was made in the mesial of the crown to find a point of support and to remove the root with the molt detacher nº 9.

Afterwards, the site was washed with 0.9% saline to remove bone bruises and the suture was made, returning the flap to its original place. Made the prescription drug with amoxiline 500mg 8/8 hours for 5 days, ibuprofen 600mg 12/12 hours for 3 days.

The patient returned with 8 days to remove the suture without signs and symptoms. Subsequently, oral rehabilitation was performed.

III. DISCUSSION

The incidence of trans migrant upper central incisors is rare, therefore, it is more difficult to find clinical guidelines derived from solid studies based on large samples of patients (Domenico et al., 2017).

Transmigration is a rare phenomenon in which unerupted teeth migrate through the maxillary or mandibular midline. It is more common in the female gender in the proportion of 1.6: 1, on the left side, generally affecting the mandibular canines with the reported prevalence varying between 0.14 and 0.31% 3 (Bahi et al., 2013) . The patient seen in this study was also female, however it was a right upper central incisor.

The etiology remains unclear and may occur as a result of the presence of a pathological process, such as a cystic lesion or an odontoma, or any other mechanical obstacle (Aktan et al., 2010). Heredity can also be associated (Pawel et al., 2018). Normally, transmigrated teeth remain included and asymptomatic and, in some cases, may erupt in the midline or in the contralateral canine region (Muhammad et al., 2019). The most frequently associated symptoms, when present, are pain and / or resorption of the roots of adjacent teeth. In this clinical case, it was not possible to identify interference from a pathological factor or heredity, however, the patient presented without symptoms.

The late and accidental diagnosis of transmigrated teeth is a reality in clinical practice (Bhullar et al., 2017). In the present case, surgical extraction was considered as the form of treatment capable of preventing the occurrence of complications. Indeed, the possibility of complications associated with inclusion, namely root resorption of adjacent teeth and the development of odontogenic cysts or tumors, makes surgical extraction the most appropriate treatment option. In this case, the surgery took place as planned, given the position and proximity to the roots of the adjacent teeth and maxillary sinus.

The treatment of dental transmigration depends almost exclusively on how the case presents itself, with the dental surgeon being able to choose extraction, auto transplantation, radiographic monitoring, or orthodontic alignment for their actual positions in the dental arch (Plakwicz et al., 2019). Despite the treatment risks, which require extreme control mechanics from the professional, transmigration can be successfully corrected, provided that the physiological limit of periodontal structures and root resorption is always taken into account, so that the planned treatment can be reversed. in a better aesthetic and functional gain to the patient (Giampietro et al., 2015). In this clinical case, tooth extraction was chosen, since its restoration to the dental arch is not viable, because it has anomalous root laceration. Dalessandri et al., (2017) also opted for the extraction of the dental element, as they perceived its replacement as unfeasible.

Conical beam computed tomography (CBCT) is superior to radiographic examinations, since it provides a three-dimensional image, demonstrating the exact location of transmigrated teeth in three planes in space. Thus, the orthodontic and / or surgical planning of the case becomes more accurate, enabling a better prognosis. In this study, the CFFC was used, which helped in the safe diagnosis and surgical planning. Thus, corroborating the studies by (Ralf et al., 2019 and Jain & Debbarma, 2019).

The surgical wound was subvisioned 8 days after the surgery, with healing due to the 1st intention of the tissues, in accordance with what would be expected, and with a highly favorable result. The follow-up revealed the existence of a favorable process of physiological bone neoformation in the surgery area. Surgical extraction of the transmigrated tooth is important to prevent complications, even in the absence of symptoms. Exodontics will allow for complete bone regeneration, which will occur within 6 months to 1 year.

IV. CONCLUSION

It is possible to conclude with this study that surgical intervention in cases where the dental element is affected by transmigration and root laceration is effective. This way preventing complications that can be generated by the transmigrated tooth.

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The use of light technology as a health education strategy about the main unintentional injuries in childhood: experience's report

Lidiane Assunção de Vasconcelos[1], Ana Júlia Góes Maués[2], Fernanda Tainá Oliveira da Cruz[3], Hanna Ariane Monteiro Carrera[4], Jessica Maria Lins da Silva[5], Luana Gomes de Lima Martins[6], Victória Lima Mendes Leite[7], Eliza Paixão da Silva[8], Osmar de Souza Reis Júnior[9], Andrea Fabiane Aguiar Chagas de Miranda[10], Tacilane do Socorro Rocha de Almeida[11], Andrea dos Santos Mendes[12], Hallessa de Fatima da Silva Pimentel [13], Ivonete Vieira Pereira Peixoto[13], Margarete Carrera Bittencourt[14], Laura Caroline Ferreira Cardoso[15]

[1] Nurse, Master in Health, Environment and Society in the Amazon by the Federal University of Pará (UFPA), Belém, Pará, Brazil.
[2,3,4,5,6,7,8] Academic of Nursing, State University of Pará (UEPA), Belém, Pará, Brazil.
[9] Nurse, Health Secretariat of Pará, Belém, Brasil
[10] Nurse of the Navy, Brazil.
[11] Nurse at Amapá State Health Secretariat, Brazil.
[12,13] Nurse, Master in Health, Environment and Society in the Amazon by the Federal University of Pará (UFPA), Belém, Pará, Brazil.
[14] PhD in Nursing from Anna Nery School, Federal University of Rio de Janeiro (UFRJ), Brazil.
[15] Graduate in Nursing, State University of Pará (UEPA).

Abstract— Objective: describe the experience of using light technolog as a health education strategy about the main unintentional injuries that occurred in childhood. Material and Methods: It is a descriptive study of the type of experience report describing the development of an exhibition activity and light technology. The activity was developed during the practices of the Curricular Components of Pediatric Nursing and Child Health, having as a stategy adopted the methodology of problematizing Berbel through the Arco of Maguerez, with five stages. Results and Discussion: Based on health education and the use of light technology, the team was able to obtain positive results regarding the activity, with a large public participation. Since listeners were given a moment to speak for reports of some cases that had occurred with a nearby child, a fact that provided a mutual environment of information and knowledge, with enriching reports for the team. Conclusion: Analyzing the activities developed and the results achieved during the health education action, it is concluded that the objective of the work was achieved, since during the action it was possible to guide users on the prevention of the main unintentional injuries that affect the children, counting on a significant participation of the users approached, be they parents, caregivers, uncles, grandparents, among others.

Keywords — Child, Child abuse, Health education, Violence, Primary health care.

I. INTRODUCTION

According to the World Health Organization, Injuries are a kind of traumatism usually caused by external factors. In Brazil, is about of 3,600 children aged 1-14 years die every year and another 111,000 are hospitalized by unintentional injuries[1]. This makes them a public health problem, as their greatest impacts are related to economic development and the country's production capacity. These impacts occur on

medical costs (hospitalizations, medication), non-medical costs (absence from work, replacement of the workforce), costs on missed opportunities (administrative costs in health) and other intangibles (changes in the productivity rate, job satisfaction, etc.), not to mention the emotional and psychological consequences of a family[2]

Here, the exchange of the term "accident" for "unintentional injuries" is punctuated, since the concept of accident is related to chance and unpredictability, and most of the situations thus defined can be prevented, through education, from changes in the environment environment and engineering, creation and compliance with specific laws and regulations. In this context, the current literature suggests that the term "accident" be replaced by "avoidable unintentional injuries" or "unintentional injuries" [3], the exchange of the term "accident" for "unintentional injuries" is punctuated, since the concept of accident is related to chance and unpredictability, and most of the situations thus defined can be prevented, through education, from changes in the environment environment and engineering, creation and compliance with specific laws and regulations. In this context, the current literature suggests that the term "accident" be replaced by "avoidable unintentional injuries" or "unintentional injuries"

The main unintentional injuries that occurred in the 0-14 age group in 2017 were traffic accidents with 1,190 occurrences, followed by drowning (954 cases), suffocation (777 cases), burns (217 cases), falls (181 cases)) and intoxication (79 cases) [1] (BRASIL, 2018).

These events happen mainly in a 0-14 year age group and come about in home environment since the child spends most of the time in it; and the frequency of occurrence is higher in younger children[2] This is because they have physical, sensory, psychomotor and cognitive limitations, that is, their perceptions and motor coordination are not fully matured, in addition to being more exposed to risk factors. [3]

Thereby, due to the high rates of morbidity and mortality resulting from unintentional injuries, in 2001 the Ministry of Health implemented the National Policy for the Reduction of Accidents and Violence, having one of the main objectives to reduce morbidity and mortality through articulated and systematized actions related to the promotion and preventing these events.[4]

In view of the presented scenario, it is clear that health education becomes a fundamental factor for the unintentional injury rates shown above, since the literature focuses on this being considered one of the most important resources in accident testing, and should be present in all the programs with this installation, including the

permanent forms in schools or other institutions, so that the educational process can be carried out.[5]

As previously mentioned, in the family context, children are more vulnerable to these accidents and families assume that they know the domestic environment very well, becoming less vigilant and, therefore, facilitate domestic accidents that have undesirable repercussions.[5] Therefore, it is necessary that the family, which is culturally considered as responsible for promoting the safety and protection of its members, become aware and can effectively carry out this preventive care, which, in turn, is only possible through the realization of a health education. quality health, where there is the transfer of information necessary for this awareness.

Considering that health education as a pedagogical political process requires the development of critical and reflective thinking, allowing the unveiling of reality and proposing transformative actions that lead the individual to his autonomy and emancipation.[6] Therefore, it becomes necessary that it be turned to assist the population in accordance with the reality in which they live, that is, pass on the appropriate guidelines to the parents and caregivers of these children in order that they perform this prevention based on the reality and financial situation in which they live.

For these guidelines to be effective and the target audience to absorb the knowledge passed on in a clear and coherent way, it is essential to use technology, which, according to Viana (2011) can be defined, in a very simple and generic way, as applied knowledge. In the case of health, it is applied knowledge that allows the prevention, diagnosis and treatment of diseases, and the rehabilitation of their consequences.[7]

Merhy (2002) classifies the technologies in three types: the light ones, which are those relational technologies, such as those of bond production, reception, autonomy. Which allows to generate information, for the health team and for the user, that allows the interpretation of the problems and the offer of new technological options of intervention, listening to the person and being understood by him, assuming the responsibilities of conducting and monitoring the cases where technological intervention is necessary.[8] The light-hard ones, that is, the technologies-knowledge, which are the structured knowledge that operate in the health work process and the hard which are the machine tools, such as equipment, devices, standards and organizational structures.[7]

In this context, an experience report using Berbel's problematization methodology in conjunction with the Maguerez arch was developed by nursing students from the State University of Pará, where you chose to address the

use of light technology and health education as basis to promote an action in a Basic Health Unit in the municipality of Belém.

II. METHODOLOGY

This article is a descriptive study of the experience's report type which seeks to describe the development of an exhibition activity, using light technology, about the main unintentional injuries that can occur during childhood. This fact refers to the Integrated Health Activity of the Nursing course at the *Universidade do Estado do Pará* (State University of Pará).

The activity was developed during the practices of the Curricular Components of Pediatric Nursing and Child Health, which took place in different institutions, the first being carried out in a large Hospital, in the Umarizal neighborhood, a reference in pediatrics and other specialties, and the second played in the reception hall of a Basic Health Unit, located in the Condor neighborhood, municipality of Belém, State of Pará, from October to November 2019.

The strategy adopted was the methodology of problematizing of Berbel through the Arco de Maguerez, which has five stages. The first one refers to the observation of reality, which occurred during the practices of Pediatric Nursing, where the students made visits to the beds of the pediatric ward of the hospital and from these, they obtained the opportunity to observe the main problems that were experienced by the patients and that led them to hospitalization, as well as allowing closer contact with the children and their guardians.

Thus, it was possible to proceed to the second stage, which consisted of identifying the key points and was carried out during a socialization of the notes between the authors (students and advisors), where the main points that were observed during the previous step were elected.

Based on this, it was possible to define the theme of the action, since the authors agreed that the most relevant point to be discussed and worked on was related to the lack of knowledge of parents in relation to the environment in which they live and the risks that children run, due to several situations that occur during their daily lives, which was observed through the report of one of the mothers during the visits.

According to the mother's report, when her son was about to be 2 months old, she left him accompanied by his brother-in-law, who has Down Syndrome and went to the bathroom to bathe. When he returned to the room, he saw that his brother-in-law had placed a domino piece on the child's throat, which began to show breathlessness and bruises. He was immediately taken to the city hospital,

however, none of the employees was qualified to carry out any procedure, so they went to the state capital, Belém, where the piece was removed and the child managed to survive, however, now he finds it difficult to swallow and is eating per probe.

Subsequently, the third stage was carried out, based on theorization, when articles and books on the subject in question were sought, as a way of increasing understanding on the subject and supporting the later stages. Thus, the fourth stage consisted of the elaboration of a viable alternative to solve the identified problem, where the students opted for the use of light technology, which would contain images illustrating the main unintentional injuries that can occur during childhood.

The last stage, which consisted of returning to reality, was carried out during Child Health practices in a Basic Health Unit in the city of Belém. Where the students presented the light technology to the parents and caregivers who were present for their consultations, explained with the help of the technology of the main unintentional injuries and gave the necessary guidance on how to prevent them.

Finally, the students made the public feel free to report their experiences on the topic, enabling the educational return of the activity performed.

III. RESULTS AND DISCUSSION

From the application of the Arch of Charles Maguerez, it was possible to make expository presentations on posters, a series of speeches with fathers, mothers, grandparents, grandparents, etc., as what were the main themes for the results of this research, these speeches had for objective to address as unintentional injuries in childhood, to change domestic accidents as one of the main causes of this theme, emphasizing the need for knowledge about preventive measures, an end to reduce occurrences.

In view of the above mentioned, it has to be confirmed, punctuating unintentional injuries in childhood as incidents that occur, especially in environments that present some risk or danger. In addition, children under the age of six are more vulnerable, since they undergo physical changes, enriching their interpersonal and socio-environmental relationships, in addition to being subject to developing new skills. However, as they are still completely dependent on their caregivers, they do not have the ability to detect the risks to which they are exposed. [9]

The role of the Health Professional is essential, as she becomes an educating agent, who explains her educational activities to the community, emphasizing the risks, teaching how to proceed in relation to the safety of children, how to create favorable environments, among

others. Thus, the professional can contribute by exposing specific prevention measures in order to reduce these injuries incidents. [9]

During the return to reality, which took place in a primary care environment, the activity began with a brief introduction about the importance of knowing unintentional injuries and the ways in which they present themselves during childhood, as well as the responsibility for its prevention, by those responsible/caregivers, as provided by law.

At first, the public was somewhat withdrawn about the subject, however, with the course of the activity and with the exposure of the information, they began to show interest in the matter.

During the educational action, some important types of aid were explained, which could be provided if any of the injuries mentioned in the exhibition occurred, they were taken from the Ministry of Health's First Aid Manual. With emphasis on some reported care, he explained that: in the event of an electric shock, the main recommendation is to turn off the power supply, before coming into contact with the child; in case of trauma, it is recommended not to move or lift the child, but to wait for the health team; for burns, depending on the degree, running water in place for a few minutes is oriented; as for falls, the child's condition should be ascertained and referred to medical attention to avoid complications resulting from the shock; among other points.

In a second step, as the action progressed, a space was opened for the listeners to speak, which made it possible to obtain reports of similar cases of accidents with children close to them, providing an aggregating environment through mutual exchanges of knowledge, following some of them:

Report 1: "I already had a similar experience of what they are talking about, for example, my nephew one of these days was running to the middle of the street and ended up having an accident that you say are injuries, hitting a bicycle that was passing by at the time and ended up with a leg between the spokes of the bicycle and having an open fracture, as I already had first aid training, in the place where I work, I was able to mobilize his leg until the arrival of SAMU".

Report 2: "My wife's nephew, seeing an extension cord with bare ends and plugged in, out of curiosity as a child, was immediately in the bare part and was shocked by being stuck to the wall, luckily the worst did not happen, because his mother turned off the breaker as soon as he saw the situation and took him to the hospital".

Report 3: "I can say that these are facts that really as parents we must be aware of. One day my inattentive sister on whatsapp forgot about my nephew (by the way, the first) for a few minutes, who seeing a pot handle exposed from the stove leaned on the stove and pulled the pan that was boiling water, result he had severe burns and ended up in the hospital with several days of hospitalization, including ending up in the ICU, and to this day he still has big scars all over his body."

However, with the statements above, it was possible to realize the relevance that thematic has in society, emphasizing that there is still a big gap regarding preventive measures. Because of this, socialization about the attitudes to be taken if they occur, focusing on the prediction of situations in which children are exposed to risk, avoiding the use of incorrect methods to solve accidents, encouraging the search for immediate help through emergency care. It has been the main purpose in reducing the risks of the aforementioned injuries.

Thus, it is important to note that health professionals, especially Nursing, have an active and mediating role in health education in the prevention of various agents, including injuries, considering that they have greater contact with the community, thus favoring the expansion of this education.

At the end of the activity, there was an immediate feedback from the listeners, in thanks for the action. Where it can be proved its relevance, as well as its help in the dissemination of knowledge. Finally, other invitations were received about the same activity, to be carried out at another time, aimed at the local community, with the aim of promoting greater educational reach in the community in action.

IV. CONCLUSION

Analyzing the activities developed and the results achieved during the health education action, it is concluded that the objective of the work was reached, since during the action it was possible to guide users with the use of light technology on the prevention of the main injuries not intentional attacks that affect children, counting on the significant participation of the users approached, be they parents, caregivers, uncles, grandparents, among others.

Therefore, we realize that health education contributes to disease prevention, health promotion and engagement of the population and it is emphasized that in this context, nurses have an essential role in preventing the main unintentional injuries that affect children, since they is able to guide the population during nursing consultations, home care and community actions, about the problem and how to avoid it, the use of light technology being an important tool in its work, since it is a communication facilitator.

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Gender differences in the Choice of Research Area Selection

Senayit Alazar Berhane[1], Joe Joe L. Bovas[2], Khatawkar D. S.[3], James P. S.[4]

[1]Postgraduate Scholar, Department of Environmental Sciences, Albert-Ludwigs-Universität, Freiberg, Germany

[2]PhD Scholar, The Gandhigram Rural Institute, Dindigul, Tamil Nadu, India

[3]Senior Research Fellow, Department of Farm Machinery and Power Engineering, Kerala Agricultural University, Kerala, India

[4]Professor, Agricultural Research Station, Mannuthy, Kerala, India

Abstract— The present study was focused to find out whether gender influences the choice of research topic, a researcher takes. To achieve this, published papers of research work from the 2014 to 2015 was collected. Based on the topic of study, the researches were classified into either of the following stereotype-classes, technology, natural sciences, vehicles, health &diet, fashion & shopping and Humanities and analyzed to find out whether gender had any role in the selection of the topic of research. It was found that there was fare presence of both the genders on research activity every year. Both the male and female researchers mainly selected research topics related to Humanities. There was no specific stereotype-class which was highly dominated by either of the genders. Thus, we concluded that, gender of the researcher did not have major significant influence on the topic of research that they select for the study.

Keywords— Gender, Natural sciences, Research, Stereotype-class, Technology.

I.   INTRODUCTION

Education of a person goes beyond the formal educational institutions, to social interactions with people (Tawil, 2013; Ghebru and Lloyd, 2020) and nature (Durmus and Yapicioglu, 2015; Horká, 2015; Otto and Pensini, 2017). The education should help in making people tolerant and equip them to face the challenges upcoming to face (Tawil, 2013). It should develop in them critical, independent and creative thinking (Durmus and Yapicioglu, 2015), which in turn decides the future environment of the world (Otto and Pensini, 2017; IPCC, 2014).Thus, higher level of education will help people conducting fundamental, applied and technology transfer researches to meet the needs of the society and there by promoting economic development (Senthilkumar and Arulraj, 2011; Banciu *et al.,* 2015; Padlee *et al.,* 2019). Studies have proved that there is a positive correlation between higher education and innovation (Laursen and Salter, 2004; Lederman and Maloney, 2003).

Universities of the world today are following a multisided, in addition to the traditional teaching method, they have added active research, entreprenuership (Etzkowitz *et al.,* 2000; Siegel *et al.,* 2003; Bercovitz and Feldman, 2006; Siegel *et al.,* 2007; Bishop *et al.,* 2011; Perkmann *et al.,* 2011a, 2013; Audretsch, 2012; Hvide and Jones, 2016; Belitski *et al.,* 2018), research collaboration,

patenting commercial products (Gulbrandsen and Smeby, 2005; Padlee *et al.,* 2019) and technology transfer to promote research commercialization (Lockett *et al.,* 2003; Lockett and Wright, 2005). Universities are the source for sprouting innovative research concepts (Etzkowitz *et al.,* 2000; Salter and Martin, 2001; Jacobsson, 2002; Laursen and Salter, 2004; Gulbrandsen and Smeby, 2005; Bishop *et al.,* 2011; Padlee *et al.,* 2019), fiber optics, computers and the internet and advancements in medical field relating to Hepatitis B, AIDS and stem cell research (Padlee *et al.,* 2019). Often the innovative ideas in universities are put forward by student researchers from both the genders.

It was clear that, there is a marked difference between the subject choices for higher education and carrier by both the genders (Lubinski and Benbow, 1992; Ceci *et al.,* 2009; Su *et al.,* 2009; Thelwall *et al.,* 2019; Finger *et al.,* 2020). This difference in choice is illustrated by the male gender domination in physical sciences, engineering (Su& Rounds, 2015; Britton,2017; Stockard *et al.,* 2018; Thelwall *et al.,* 2019), Technology, Mathematics (Su *et al.,* 2009; Ceci *et al.,* 2009; Su and Rounds, 2015; Thelwall *et al.,* 2019)Physics, computer science, dentistry and surgery, (Thelwall *et al.,* 2019), while the female gender dominate medicine (Su and Rounds, 2015; Britton,2017; Stockard *et al.,* 2018; Thelwall *et al.,* 2019) and life sciences (Ceci *et al.,* 2009; Su and Rounds, 2015; Thelwall *et al.,* 2019).The

selection of subject groups by gender is found to be as a result of differing abilities, satisfy personal goals and social impact (Yang & Barth, 2015; Pezzuti *et al.,* 2020). Many studies, such as, Charles & Bradley, (2009), Ceci, *et al.,* (2009), Jonsson, (1999), Lörz *et al.,* (2011) and Ochsenfeld, (2016), have concluded that male and female have different preference, while selecting the major subject to study in universities. Thus, it would also be interesting to know whether a similar trend is followed by the genders while selecting their topic of research topic. The papers thus try to find out whether there is any special likes and dislikes among the genders while selecting a research topic.

II. METHODOLOGY

The research samples selected for the study were grouped under 6 stereotype-classes. Stereotype-classes were technology (T), natural sciences (NS), vehicles (V), health &diet (HD), fashion & shopping (FS) and Humanities (H). The topics that cover under each stereotype-class were:

(a) **Technology:** The study for practical purposes, especially in industry, machinery and equipment developed and evaluation.

(b) **Vehicles:** The study related to machine, usually with wheels and an engine, used for transporting people or good on land, especially on roads.

(c) **Natural sciences:** The study on subjects such as biology, physics, and chemistry in which things that can be seen in nature are studied.

(d) **Health and diet:** The study related to the condition of the body and the degree to which it isfree from illness, or the state of being well and the food and drink usually eaten or drunk by a person or group.

(e) **Fashion and shopping:** The study related to a style that is popular at a particular time, especially in clothes, hair, make-up, etc. and the activity of buying things from shops.

(f) **Humanities and social sciences:** The study related to literature, language, history, philosophy, economics, sociology and the study of society and the way people live

The sample of the published papers collected were first sorted year wise, and then based on the gender of the first author. If the names were ambiguous, we used an internet database Namepedia to check if there is a gender commonly related to the name. If this still didn't give us a clear answer, we assigned 'NA' to the student and didn't use it in our statistical analysis. The data such as year of publication, gender of the first author, name of the first author, title of the study and the stereotype-class was observed and tabulated on the spread sheet. This tabulated data was called as the master data. The master data was then given to two examiners without gender in it. The stereotype-class was selected based on the highest proportion of votes by the examiners. If there were any unambiguous results, such as each examiner choosing the topic into different stereotype-class, then it was given three random people to evaluate the title in the same manner.

The data was analyzed using R (version 3.6.1, R Core Team 2019). In addition to the base R packages DHARM package (Hartig-2018) was used for model diagnostics. To test the correlation between a student's gender and their topic choice, Chi-squared test was performed and further used a linear regression model (Stereotype class by gender $\sim$ Student gender + Year) to test the interrelationship of a student's gender and their topic of choice.

It was also found that the researches usually published papers in groups. Thus, we also grouped them according to their collaboration and found out their dominant area of work among the selected stereotype-classes. We also checked the dominancy of gender in each group, to find out whether its male dominant or female dominant. If the gender distribution was found to be equal in a particular group, the group was classified as mixed and if we were not able to identify the genders of the group, it was classified under not available.

III. RESULTS AND DISCUSSION

a. *Distribution of collected researches*

A total of 317 studies starting from the year 2014 to 2018 were collected from the Cambridge dictionary for the present study. Taking into consideration the year wise distribution, we were able to collect 68 (21.45 %) studies form the year 2014, 74 (23.34 %), 53 (16.72 %), 66 (20.82) and 54 (17.03 %) respectively from the years 2015, 2016, 2017 and 2018. Though the number of studies by researchers during the years 2016 and 2018 were comparatively lesser when compared to 2014, 2015 and 2017, but the numbers were still was on the fairer side. Taking into consideration the groups, we could identify that there were 75 groups.

The gender wise distribution of the researches selected for the study is portrayed in figure 1 and 2. Taking into consideration the total pool (Figure 1), we had a total of 157 (49.5 %) male, 145 (45.7 %) female, and 15 (4.7 %) of unidentified researchers. Seeing the figure, we cannot say that one particular gender is more active in research. We should take into consideration the unidentified people. We can only conclude that both the genders are almost equally

active in research. Taking into consideration the year wise distribution, apart from the year 2016, the remaining years both the genders are almost equally active in research showing a very marginal majority towards the male gender. In the year 2016, the female gender was found to be involved more in research than males. The number of males higher than female were respectively 5 (17.14 %), 9 (12.16 %), 1 (1.52 %) and 8 (14.81 %) for the years 2014, 2015, 2017 and 2018. In the year 2016 females dominated males by 11 (20.75 per cent). It should also be taken into consideration the amount of unidentified gender, 3 4.23 per cent), 1 (1.35 per cent), 8 (15.09 per cent) and 3 (4.55 per cent) respectively for the years 2014, 2015, 2016 and 2017. Correctly identifying the gender of the unidentified group may change the status.

Figure 3 and 4 describes the gender dominance of groups. Taking into consideration the total groups taken for the study (Figure 3), we can conclude that the groups are mainly male dominated (31 Nos., 41.33per cent) ones. The strength of the female dominated ones (24 Nos., 32 per cent) are also not so weak. The presence of a fair amount of mixed group (14 Nos., 18.67 per cent) indicates the cooperation between the genders in research activities. We were not able to identify the gender dominance of 6 (8 %) groups.

Considering the gender dominance among the groups, year wise (Figure 4), there was an equal number (6 Nos., 32.29 %) of male and female dominated groups, while the remaining were mixed. In the year 2015, the male dominated groups (10 Nos., 58.82 %) were comparatively more when compared to the female dominated ones (4 Nos., 23.53 %). Considering the year 2016, It was found that 33.33 per cent (4 Nos.) of the groups were female dominated, while 25 per cent (3 Nos.) were male dominated. It should also be considered that 33.33 per cent (4 Nos.) of groups' gender dominance could not be identified. In the year 2017, 41.18 per cent (7 Nos.) were male dominated, 35.29per cent (6 Nos.) were female dominated, 11.76 per cent (2 Nos.) were mixed and 11.76 per cent (2 Nos.) groups gender dominance could not be identified. In the year 2018, 41.67 per cent (5Nos) were male dominated, 33.33 per cent (4 Nos.) were female dominated and the remaining 25 per cent (3 Nos.) were mixed ones. The maximum number of mixed groups was found in the year 2014; the remaining years had fewer numbers.
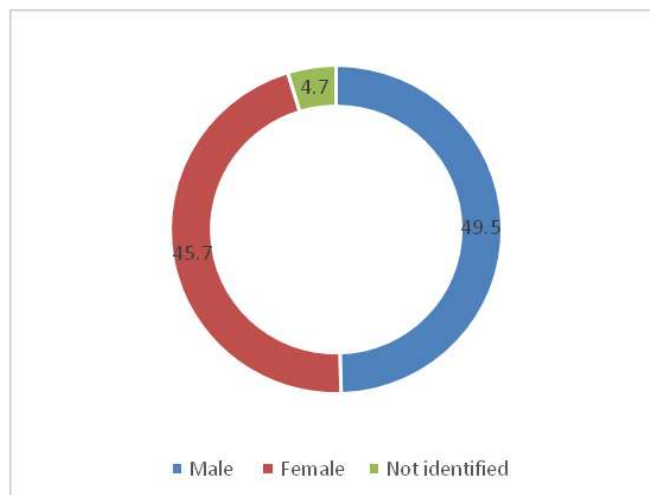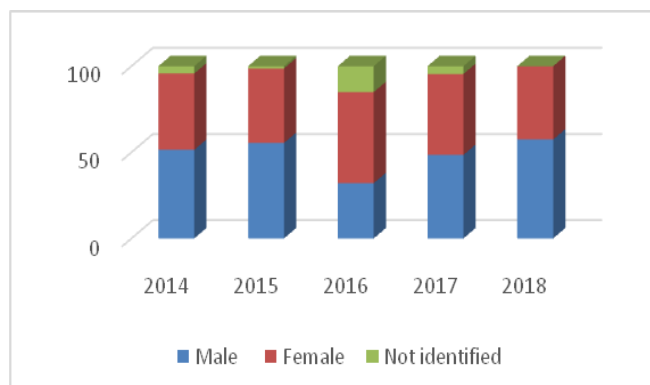

Fig.1: Total gender distribution
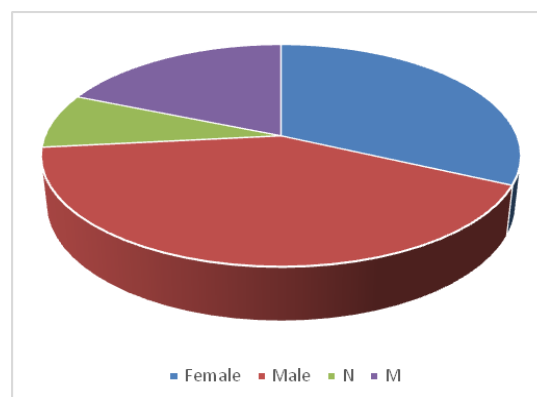

Fig.2: Gender distribution year wise

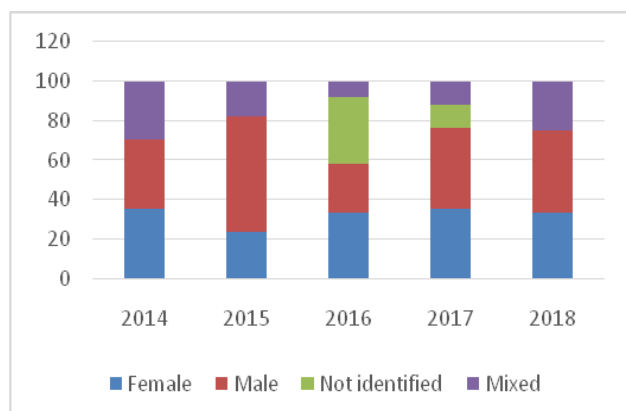

Fig.3: Gender dominance in groups

Fig.4: Year wise gender dominance in groups

b. Distribution of Stereotype-classes among individual and group researchers

Taking into consideration the total pool of data, the preference of the Stereotype-classes by initial and group researchers are detailed in table 1. The Stereotype-classes are depicted as FS, H, HD, T, V, NS and NA, respectively for Fashion & Shopping, Health & Nutrition, Humanities, Technology & Electronics, Vehicles, Natural sciences and Not Applicable. The stereotype-class NA is used for a group when they diversify their study and does not mainly concentrate on a particular field.

Considering individual male researchers, 9.5 per cent of them are interested in FS, 56.69 per cent in H, 10.19 per cent in HD, 0.63per cent in T, 4.46per cent in V and 18.47 in NS, while the preference was 8.97 per cent, 54.48 per cent, 16.55 per cent, 0 per cent, 4.83 per cent, and 15.17 per cent respectively for FS, H, HD, T, V and NS among the female researchers. Analysing the results, it was clear that both the male and female researchers prefer to do studies under the stereotype-class Humanities. Both the male and female researchers showed almost similar pattern of interest on all stereotype-class except the fact that none of the female researcher, selected for the study showed interest in the stereotype-class Technology & Electronics. It was also found that even males are also not much interested in Technology & Electronics, apart from a very few. Both Male and female researchers showed the highest interest on the stereotype-class Humanities and though low but similar interests on the stereotype-classes Fashion & Shopping, Health & Nutrition, Vehicles and Natural sciences. The group of researchers whose gender was not identified also showed a similar pattern of interest.

Considering the groups, none of the groups showed interest on the stereotype class, Technology & Electronics, the preference to the stereotype class Humanities stood first. The most interesting outcome from the study was that the female dominated groups did not show any interest of the stereotype class Fashion & Shopping, while the male

dominated groups showed at least a very small interest. The mixed and unidentified gender research groups showed no interest on the stereotype class Technology & Electronics and Vehicles. The stereotype class Humanities was also their most preferred research area. They showed a very small interest in Natural sciences. Considering the inconsistency in research work areas, 6.45 per cent of the male dominated groups, 20.83 per cent of female dominated groups, 14.29 per cent of the mixed group and 7.14 per cent of the unidentified gender dominated group, were not repeating the same area of study more than once. This might be due to the fact that they wanted to study different areas to increase their knowledge bank or, they are still in the process of deciding their field of interest.

Table 1 Selection of Stereotype-classes by individual and group researchers

	Gender	Stereotype-class						
		FS	H	HD	T	V	NS	NA
Individual	Male	15	89	16	1	7	29	-
	Female	13	79	24	0	7	22	-
	Unidentified	1	5	2	0	4	3	-
Groups	Male dominated	1	20	2	0	1	5	2
	Female dominated	0	13	2	0	2	2	5
	Mixed	1	9	1	0	0	1	2
	Unidentified gender dominated	1	9	1	0	0	1	2

c. Year wise distribution of Stereotype-classes by individual researchers

The selections of different stereotype-classes by different researchers are portrayed in figures 5 to 7. The figure 5 displays the year wise selection of different stereotype-classes by researchers without considering the gender, while figure 6 and 7 displays for male and female researchers respectively. It is clear from the figures, apart from the year 2017, all the researchers showed more interest towards the stereotype-classes Humanities. It was only in the year 2017, the researchers gave almost equal importance to the other stereotype-classes, but still the stereotype-class Technology & Electronics was totally avoided. The pattern was similar in both among male and female researchers. It was only in the year 2015, there was

a research contribution to the stereotype-class T. The interest to the stereotype-class T in the year 2015 was shown by male researchers, while the female researchers kept themselves away from it on all years.

In the year 2014, 8.57 per cent, 72.86 per cent, 4.29 per cent, 1.43 per cent and 12.86 per cent of the researchers showed interest on the stereotype-class FS, H, HD, V and NS respectively. Considering the interest of male researchers with respect to the overall average, the interest showed on FS was 3.01 per cent lesser, on H was 2.14 per cent higher, on HD was 1.51 per cent lesser, on V was 1.35 per cent higher and 1.03 per cent higher on NS. The female researchers showed 3.93 per cent and 1.96 per cent higher interest on FS and HD respectively and 0.98 per cent, 1.43per cent and 3.48 per cent lower interest on H, V and NS respectively, when compared to the overall average.

In the year 2015, neither male nor female researchers showed interest on the stereotype-class FS. Though the stereotype-class H was the highly selected, but was 13.4per cent lower than the year 2014. Similarly, the researchers showed 9.13 per cent and 9.92 per cent higher interest on HD and NS respectively, when compared to the year 2014. Comparing the interests of male researchers with the year's average, it was found that it was almost similar in the case of the stereotype-class H, 2.96 per cent and 1.67 per cent lower in the case of HD and V respectively and 3.54 per cent higher in case of NS. Comparing the interests of female researchers with the year's average, a similar trend as of the male researchers was seen in the case of the stereotype-class H. They showed 4.64 per cent lesser when compared with the years and 8.18 per cent lesser when compared with the male researcher's interest towards NS. It was found that the female researchers showed 3.87 per cent higher interest o V when compared with the male researchers. With the case of HD, the females showed 3.89 per cent and 6.85 per cent higher when compared with the year's average and male researchers' interest respectively.

The year 2016 was almost similar with the other years. Thought the interest was higher towards the stereotype-class H, but still there was a lighter fare amount of interests on FS, HD and NS respectively. Both male and female researchers completely neglected the stereotype-classes T and V. Comparing the interests between the female and male researchers, it was found that the males showed 9.24 per cent higher interest on FS and 9.67 per cent, 1.26 per cent lesser interest on HD and NS respectively when compared to females.

The year 2017 was unique when compared with the others years. The researchers showed a fare amount of interests on all stereotype-classes expect T. Though still

most of the people closed H, but was closely followed by NS. Comparing the choice of research among the male and female researchers, it was found that both showed similar trends with very minor variations.

Comparing the year 2018 with 2017, it was found that the researchers gave more interests in selecting the stereotype-classes H. It was found that there was an increase of 35.35 per cent in H, and decrease in 7.69 per cent, 1.86 per cent, 16.67 and 9.09 per cent respectively for stereotype-classes FS, HD, V and NS, when compared to the year 2017. Comparing the choices between the genders in the year 2018, it was found that 12.9 per cent of the male researchers were interested in FS, while none of the females chose FS and the females showed higher interest on H and HD, while the male researchers leaded the females in NS.
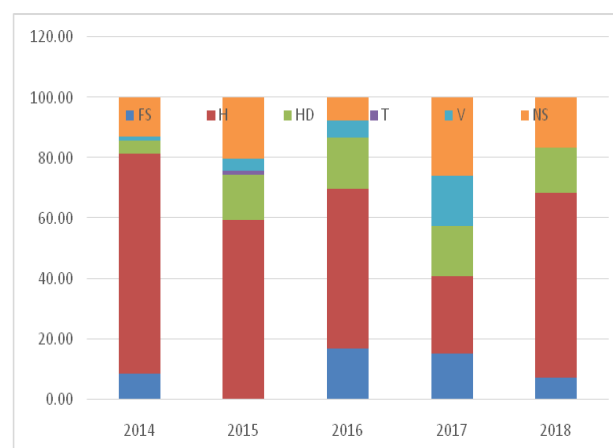

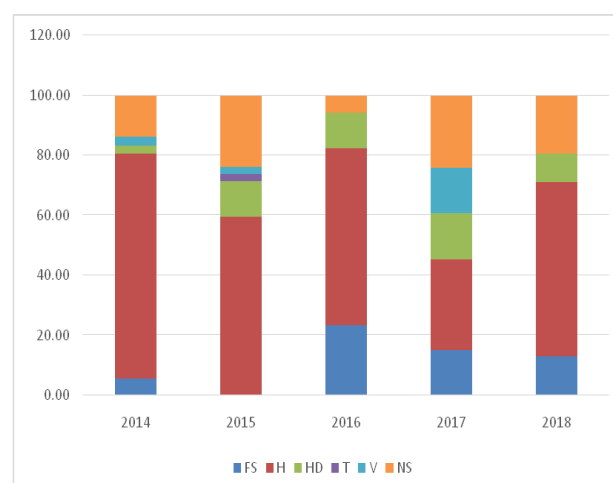*Fig.5: Year wise distribution of Stereotype-classes*

Fig.6: Year wise distribution of stereotype-classes Selected by male researchers
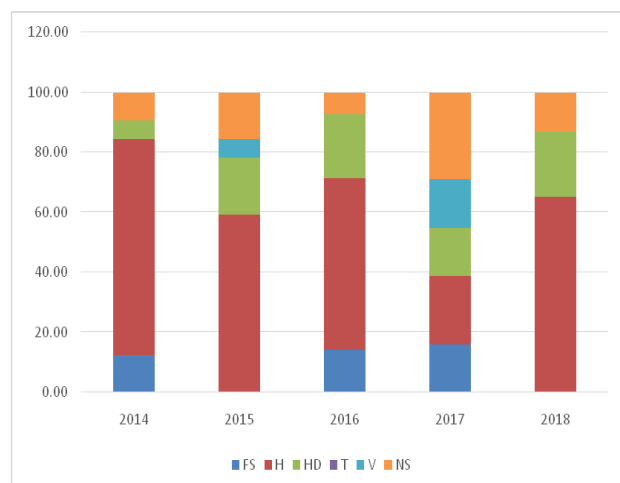
Fig.7: Year wise distribution of stereotype-classes Selected by Female researchers
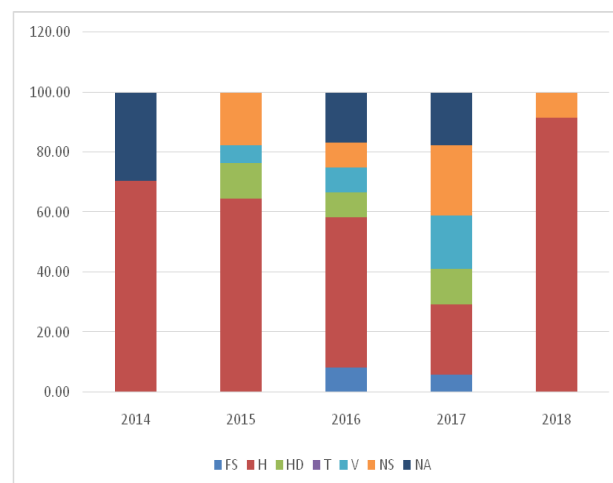
Fig.8: Year wise distribution of stereotype-classes Selected by groups

d. Year wise selection of Stereotype-classes by groups

The research topic selection behaviour of groups is described in figure 8 and 9. Figure 8 details the selection behaviour of groups year wise and figure 9 details the year wise selection behaviour of groups based on gender dominance. From the figure 8, it's clear that, it was only on the year 2015, 2016 and 2017 that the people selected all the stereotype-classes except T. Better distribution of the stereotype-classes was seen in the year 2017. I was also clear that no group showed a dominated interest on the stereotype-class T. In the year 2014, 70.59 per cent of the groups opted for H and the remaining 29.41 per cent did not stick on to a particular area. In the 2015, though there was representation on most of the stereotype-classes, the stereotype-class H (64.71 %) dominated, followed by 11.76 per cent, 5.88 per cent and 17.65 per cent respectively for HD, V and NS. The groups in the years 2018 showed dominated interest only in two stereotype-classes, H (91.67 %) and NS (8.33 %).

Comparing the topic selection of groups considering the gender dominance among the groups showed somewhat similar results. In the year 2014, the interest towards the stereotype-class H was more (83.33 %) for male dominated group, followed by female dominated (66.67 %) and mixed (60 %) groups.

In the year 2015, the groups preferred H, HD, V and NS stereotype-class. The male dominated groups preferred H (60 %), followed NS (30 %) and HD (10 %). The female dominated groups did not prefer NS but instead opted for V (25 %). The mixed group preferred to work only on the stereotype-class H.

In the year 2016, the mixed group preferred to work only on HD, while the male dominated groups chose FS and H. The female dominated group, 50 per cent of then prepared H, while the remaining 50 per cent did not stick on to a particular field of study. In the year 2017, the male and female dominated groups gave almost equal preference to all stereotype-classes apart from T. The mixed groups were either interested in V, or else did not stick on to a particular field of study. In the year 2018, the male dominated and the mixed groups were only interested in the stereotype-class H, while the female dominated ones showed 75 per cent on H and 25 per cent on NS.

Fig.9: Year wise distribution of stereotype-classes Selected by groups based on gender dominance

IV.   DISCUSSION

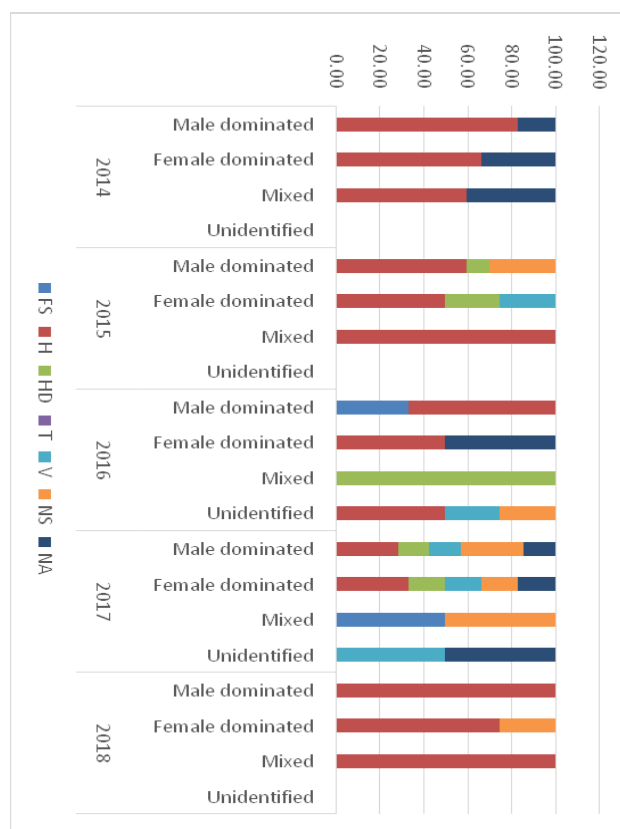Thelwall *et al.* (2019), was of the view that the titles of the published research work fully explain the content of the study that the researcher has done. Thus, we have also used the title of the published research works of the researchers from the year 2014 to 2018 to classify the area of interest of the researchers.

The demand for qualified scientific-technical personnel is growing and the representation of females in this area is less (Buccheri *et al.,* 2011). In the year 2012, females contribute 28 per cent of PhD graduates in engineering, manufacturing and construction and 21 per cent from computing in the EU. Men mostly choose engineering, manufacturing and construction, whereas women mostly like to pursue an education degree. Women as scientists and engineers are up to 2.8 per cent of the total labour force in 2013, whereas men are up to 4.1 per cent, but the growth of women in these areas are growing at a faster rate than men. (EU Directorate 2016). In USA females continue to be under represented in math-intensive fields of Science, Technology, Engineering, and Mathematics. Research from the last 30 years from the fields of psychology, sociology, economics, and

education, found that the possible factors are   (a) cognitive ability, (b) relative cognitive strengths, (c) occupational interests or preferences, (d) lifestyle values or work-family balance preferences, (e) field-specific ability beliefs, and (f) gender-related stereotypes and biases (Wang and Degol, 2016). The imbalances of genders in the field of science, technology, engineering and mathematics are partly due to greater male interests in these fields. Thus, there is a need to motivate females, thus providing high performers in science or mathematics and pursue scientific careers of special interest. The gender specificity and gender inequity in science education is and international problem (Buccheri *et al.,* 2011). According to our study, the results obtained by the above researchers are partially supporting our outcome. It was clear from our study that the male gender was more than the female gender, but the difference among them was not much. The lack of interest in science and technology by the female gender was also shown in our study, but the males were also found to be not much interested in these areas. The interest of males and females were found to be almost similar with marginal difference among the genders.

Females are especially interested in human biology and thus overrepresented in medicine, whereas males are being equally interested in chemistry and physics and significantly less interested in human biology. Thus, they are underrepresented in medicine and overrepresented in vocations such as engineering, architecture, physics, chemistry, technology, and computer sciences (Buccheri *et al.,* 2011). Females are interested in veterinary science and cell biology, while the males are interested in abstraction, patients, and power/control fields, such as politics and law, taking into consideration the career to provide status (Thelwall *et al.,* 2019). The above results by the researchers did not support our findings fully. We were not able to find much female researchers interested in the area of human biology and not much males interested in the area of science and technology. Vast majority of both the sexes were interested in research related to humanities.

Shopping is considered as major source of relaxation in females; they visit shopping centres more than men. In fact, they are the ones who often by cloths for men. Surveys indicate that females play a very significant role in shopping activities, particularly shopping for household groceries. Although in general females play a dominant role in household shopping, the male's role is not insignificant (Dholakia, 1999). One of the most common forms used in segmentation by the marketers is gender and women have higher levels of brand commitment than men. However, there is not enough data collected so far with regard to the study on gender differences and consumer

behaviour. All though it is an important topic to be researched, but has attracted only limited research attention (Tifferet and Herstein 2012). Our personal observations also support the finding of the above research outcomes. Though females are found to be interested in shopping of fashionables, health and diet products, we could find only a very few people interested in doing research on topics related to this area. In fact, we found more males doing research on topics related to this area. This made us to conclude that though females are interested in shopping fashionables, health and diet products, males are more interested in doing research in this area than females.

People at fight sight itself determine gender for specific scientific interests and vocational choices internationally. This is discouraging, considering the political and educational efforts to enforce gender equity (Buccheri *et al.,* 2011). Studies suggest that necessary steps are needed for eliminating explicit and implicit gender bias in academia and making fields more attractive to minority genders. (Thelwall *et al.,* 2019). We support the finding of Buccheri et al. (2011) as were also of the similar thought while setting our 6 stereotype-classes, though the outcome of our study was different. We also support the suggestion of Thelwall et al.(2019) as we also found some gender inequality, though not much large. Thus, steps are necessary to attract more females into the different branches of research as their suggestions can play a very vital role.

V. CONCLUSION

The conclusions of our study are listed below:

a) Out of the total samples selected for the study, though the male gender was greater than the female gender, the difference was very small. Thus, we conclude that, there is no male supremacy in research at large.

b) It was found that there was a healthy presence of both the genders throughout the period selected for the study. This brings us to a conclusion that, there is a fare contribution of both the genders in research activity every year.

c) Analysing the results, it was clear that both the male and female researchers prefer to do research under topics related to Humanities. Apart from one case, none of the researchers have selected to do research in the area of Technology & Electronics throughout the period selected for the study. It was also found that the females though interested in fashion and shopping more than males, but were not interested in doing research on topics related to Fashion & Shopping and Health & Nutrition, compared to males. The same

trend was shown by both the genders for every year selected for the study.

From the study, we conclude that, gender of the researcher has no major significant influence on the topic of research that they select for the study.

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Intrapreneurship: A conceptual model and its dimensions

Ana Caroline Lee, Danilo Martins do Nascimento, Júlio Francisco Blumetti Facó, Ricardo Gaspar

Centro de Engenharia, Modelagem e Ciências Sociais Aplicadas, Universidade Federal do ABC, Santo André, São Paulo, Brazil

Abstract— *The present paper objective is to develop a conceptual model of intrapreneurship, or as it is also known, corporate entrepreneurship (CE). The intrapreneurship, through the encouragement of innovation in big companies, can represent both a competitive advantage and also the survival of a company nowadays. For being a current theme, intrapreneurship had its aspects explored more by the authors in recent years, however there are no conceptual standards designed and disseminated that can help to have a general view of the subject.*

Based on the assumption that intrapreneurship can be grounded on pillars of various themes, the main and more important dimensions found in the literature were gathered. These dimensions, such as innovation capacity, risk taking, resources, among others, are considered essential for corporate entrepreneurship.

This paper proposes to discuss each one of the nine points raised and integrate them into one model. By the development of the subject, it was possible to obtain a well-grounded model with the key practice points of the intrapreneurship in large corporations. The nine dimensions were clustered in three core pillars (Structure, Management and Agents) in an intersection model, representing the interdependence between them.

Keywords— *Intrapreneurship; conceptual model; dimensions; innovation.*

I. INTRODUCTION

"Intrapreneurship" is a shortened term for "intra-corporate entrepreneurship" [1]. It is a "growing topic for both management and entrepreneurship research" [2]. The intrapreneurship brings competitive advantage to companies through innovation and development encouragement. This advantage is extremely important in ever-changing fierce markets where success can be determined by being more efficient and faster than the competitors, adapting and making changes to meet customers' desires. [3]

The intrapreneurship is important to encourage the growth, profitability, rejuvenation and renewal, as well as ensuring survival in competitive markets. [4][5] The financial performance of the company can improve through intrapreneurship, because among its several positive characteristics, there are the new and sustainable thinking related to value creation, the search for a more efficient use of the resources and the adoption of a better motivational environment for the employees. [6]

Kuratko and Hodgetts [7] relate the entrepreneur actions inside companies with the facilitation of ideation process and the barriers minimization usually imposed by rigid corporate structures. Mohanty [8] stated that companies that seek to break paradigms invest and nurture the intrapreneurship within their structure so they can actually execute their innovation process leading to innovation in products, services and process, and consequently to better results. In a more individual aspect, the intrapreneurship brings to the company innumerable opportunities, tracing new paths, initiating new ventures, challenging the status quo, and thus gaining new land. [9]

Knowing all the important intrapreneurship dimensions facilitate innovative activities implementation in big companies through the possibility of effectiveness evaluation of the reference points.

II. LITERATURE REVIEW

The literature can bring a lot of best practices references and general characteristics that a company should have in order to practice innovative actions

efficiently. From the reading and analysis of these authors, it was listed the main intrapreneurship dimensions with the aim of comprehend the innovation adoption in big corporates and their activities effectiveness.

2.1 Innovation and Renewal Ability

Innovation is an essential part of the theme. Innovation combined with strategic management is what elevates enterprises from small business. [10] For Drucker [11], innovation is the instrument by which an opportunity can become a new business or service, and in spite of the risks related to new ventures, if aligned with a good management and work methodology, these risks can be minimized. The search for new solutions to the customers' problems can demonstrate the company's innovation capacity. [12][13] It can bring different results, after all, intrapreneurship refers not only to business creation from inside projects, but also to the development of new products, services, technologies, process, strategies, marketing solutions and competitive posture. [14]

The ability to innovate is related to the tendency and frequency of engagement, the support and leadership of new ideas, and also with experimentation and creative process that can lead to new products, process or services.

[15][16] For this added value, both in intra and entrepreneurship, there is the need to capture ideas and resources. [17] The company can pursue new business and markets by redefying its products and services, what is essential to its survival. [14]

Encouraging new ideas is one of the primary characteristics of intrapreneur organizations. The opposite of what happens when the company only cares with quick return on investments and high-volume sales in the current period. They should be also worried about keeping the continuous generation of ideas. [18]

The renewal reflects the transformation of the organization by the flexibilization of key-ideas in which it is built. [14] It is necessary not only the creation of new products and the reach of new markets, but also the constantly renew of the business through adaptation and flexibility [19]. For that reason, some companies have been using the intrapreneurship as a strategic tool for growth and renewal. [20][21]

2.2 Risk-taking and management

Bosma, Stam and Wennekers [22], used the studies conducted in eleven countries with GEM (Global Entrepreneurship Monitor) data from various types of companies to confirm that less than 5% of the employees are considered intrapreneurs. Among the reasons, there is some apprehension of the risks that can cause status loss

(mentioned in high-income countries) and the job loss (mentioned in low-income countries). However, the risks must be considered as inherent feature to the innovation, new business formation, and aggressive or proactive actions inside the company. [14] This big companies' behavior focused in innovation is considered risky for their big investment and commitment with uncertain projects, which even with the failure possibility, can expect a great return with success. That scenario makes the risk-taking a distinctive dimension. [15]

Regarding the differences between intra and entrepreneurship risks, the main factor of divergence is that the entrepreneurs' own financial resources are very present in the second one. [23] Within the company, the employee can feel much safer to make risky decisions. By contrast, the financial rewards can be infinitely greater to entrepreneurs. [24]

2.3 Corporate venturing

When the company is involved in the creation of a smaller one in order to take advantage of a market demand, this small organization is called venture or corporate venturing. [20][25] Some authors classify the instigation of renewal and innovation inside a company as "venture" too. [26]

A venture can be intern or extern. It is intern when remains part of the mother-organization structure. The extern venture has its own independent structure, even when it is known as a result of a bigger company.

This dimension is specially associated to intrapreneurship since ventures are fruits of corporative projects of existing enterprises, by definition. [27] The creation of a venture enhances performance by being a phenomenon that can change the company's structural organization. [2][14] Bulgelman says that, in the case of internal corporate venturing, the strategic engine lies in each intrapreneur's initiatives in their operational acts. [28]

2.4 Organizational Culture and Environment

One of the more important elements of success in both intra and entrepreneurship is the suitable environment. [29] The typical model of an organizational culture has a system of privileging conservative decisions, and this restrictive environment can inhibit creativity, flexibility, independence and risk taking. [18] The market environment and the appropriate internal factors are both essentials for the innovation ability of the company. [30] Menzel, Aaltio and Ulijn mention the importance of a motivating physical environment that encourages creativity and the constant exchange of ideas with, for example, the

abolition of closed departments, the use of joint tables, clear environments, etc. [21]

Products and services are not born spontaneously, but are results of a series of trials and errors. "Experimentation should be encouraged" says Hisrich [18], it is necessary to establish an environment that accepts errors and failures especially in the early stages of a project. Besides being a key organizational change, it can also reduce costs, since it is common that errors in more advanced stages of a project can lead to serious consequences. It must be rooted in the company's culture that the learning in the failure is also important. The success cannot be measured only by financial performance, but also with the knowledge gained with the failure. [31] The failure can develop important skills in the intrapreneurs. With the errors, the team can engage, seek more meaningful information and internal opportunities as training, funding and mentoring. [24]

The recognition and the reward of the involved ones in the innovation projects should be remembered within the company. For new business, it is important to have in mind that the performance measures should be different from those taken on the daily basis. This is possible by adopting performance goals more generic and open, and rewarding the intrapreneurs by project stages than by final outcome. [18] Block and Ornati defend that the biggest motivation and reward that can be received is a high position or a percentage of the new established business. [32]

The reception of the changes that the organization goes through when practices the intrapreneurship is something that has to be managed. Rank, Pace and Frese suggest that psychologists can help to support the innovation and change climate by predicting and managing its effects. In fact, there are departments in the big companies that specifically take care of high impact projects that can cause major organization innovations. [33] Drejer defines these innovations as important changes that happen in the company's structure. To innovate, the company itself must be open to change. [34]

2.5 Proactivity

More than an essential skill of the intrapreneur, proactivity is an important characteristic for the company that wants to innovate. The tendency to lead instead of only follow the competitors, considered as pioneering, and actively compete against your rivals are some of aspects of intrapreneur companies. [16][35] Different than only react to the market, the innovative company always tries to anticipate itself by pursuing new opportunities in emergent markets and proactively bringing innovations. [15][13][36]

This posture is reflection of the actions taken by the top management and its strategic orientations for the company.

[14] As in entrepreneurship, pioneering brings great advantages for those who explore market opportunities. [37] There are authors that clarify that an organization can be proactive without necessarily be the first to take advantage of an opportunity [38], however, generally the authors connect proactivity to the causes of a company being innovative. [12][39]

Lumpkin and Dess affirm that proactivity refers to market opportunity. It is how the companies can take advantage creating an environment or suitable initiative to meet demand. [15]

2.6 Competitive aggressiveness

The willingness to overthrow and dominate competitors is seen as competitive aggressiveness. [40] Many people can confuse competitive aggressiveness with proactivity, since they both are dimensions that refer to corporate behavior. However, as previously mentioned, proactivity is related to the company's pioneering role in seizing market opportunities, while the competitive aggressiveness refers to the organization's challenging posture towards its competitors.

Differently from proactivity also, the company with competitive aggressiveness is concerned with responsiveness. While proactivity seeks to respond to opportunities, competitive aggressiveness seeks to respond to threats. [15]

This dimension is a characteristic very strong in entrepreneurship and in the ventures, since the risks are much greater for them than for established business, which makes aggressive attitudes critical to the survival and success of new entrants. [41]

2.7 Structure and Process for Autonomy

The organization worried about bringing an intrapreneur mindset should also be concerned with providing a structure that does not inhibit creativity and innovative actions in problem solving, from avoiding bureaucracies and hierarchies to pursuing an efficient innovation process. An organizational structure that supports intrapreneurship emerges slowly but it is extremely important for the company, although it is always considered a secondary activity. [18]

In order to promote intrapreneurship, many companies seek changes in organizational structure as the hierarchies' reduction and better work division by the delegation of responsibilities. [42] Entrepreneurship and intrapreneurship share many characteristics, but one of the main differences is their structures. Limitations by the hierarchy and a corporate context may require a lot of individual initiatives from the intrapreneurs. [22] Layers of bureaucracies and

traditions rarely contribute to innovation in big companies as well. [43] The ideal setting for intrapreneurship would be a flat structure that could reduce hierarchy and bureaucracy by giving employees autonomy for decision-making

An efficient communication channel is another one of the mentioned points by many authors such as van Everdingen & Waards [44]; Rejeb, Guimarães, Bolv & Assiélou; [45] Cooper; [46] Baruah & Ward; [24] Hisrich; [18] as essential in the culture and structure of the company concerned with innovation. From operational aspects as the information free transfer, to motivational strategic communication to employees and the update of the company's intrapreneurs' activities, these are topics that can make difference in how people can perceive the innovation in the company.

Creating a suitable structure to give autonomy to the intrapreneur is just one of the stages of the corporate entrepreneurship management. Its process of innovation, identification and opportunity-taking must remain constant and easy. Ireland, Hitt & Sirmon have identified that small enterprises can usually identify opportunities with more effectiveness although building competitive advantage is more difficult; while for large established companies it is easier to exploit chances for market advantage although they are less able to identify opportunities. [47]

In the most practical way, it is possible to implement procedures for the intrapreneur environment to work. Carvalho lists a framework of procedures that can facilitate the presence of innovation in the company. It is important to ensure that the intrapreneur finds a process that doesn't hamper innovation, since all projects have deadlines, costs, stakeholders that must be notified. Many of the aspects mentioned here dealt with important point to be achieved. A facilitating process is the bridge that will link the ideation to the final result because despite of defend an organization that don't introduce barriers, the company should have the minimum organization to reach the desired goals. [48]

At the end of each process stage, an evaluation system should be established to analyze the possibility of progress to the next phases or not. Always remembering that in order to maintain an intrapreneur organization in a healthy way, it is essential that there will be permission for the projects and ventures to fail as well as for the efficient ones to expand. [18]

2.8 Resources

Among many of the faced problems by companies interested in being intrapreneurs, there is the lack of money and the prioritization of other expenses. [29]

Intrapreneurship requires money. It is not uncommon for funds to be allocated for the resolution of recurring or immediate problems. [18] In addition, when there are resources available, they are difficult for the employee to achieve. The requirements list is so extensive that frustration overcomes the possible satisfaction of obtaining resources and discourages the intrapreneur. And depending on the purpose of the release of resources, it is necessary that the top management is aware that the investment returns only after a certain period of time.

In the entrepreneurship, to get resources becomes more difficult. In the majority of the cases, this resource presents itself as a personal investment of the entrepreneur. Unlike the intrapreneur, who usually don't participate in raising funds personally for corporate projects. [24]

However, after obtaining what is necessary for projects, the entrepreneur has more independency, while the intrapreneur often has no authority to decide the expenses alone. [12] When it is required to report regularly on its expenses and decisions, it can become a merely operational service and diverge from the kind of work an intrapreneur should seek. [49]

2.9 Multidisciplinary team and personal competences

The formation of a multidisciplinary team must be encouraged since new projects require inputs of several areas, so the people involved should be called in a planned way. [50] The presence of people with different roles and knowledge in a team relates to the idea of a flatter organization besides facilitating the exchange of information and abilities. [51] The intrapreneur activity is embedded in a network of contacts [52][53], as well as the intrapreneur, therefore it is important to unite creative and adaptive people. [54]

Other point that should receive attention was brought by Hisrich comparing entrepreneurship and intrapreneurship: accumulation of functions and stakeholders. In many companies, the intrapreneurs will come from other internal areas, performing the job with innovation as a parallel project to their daily activities of their area of origin. This becomes difficult to the development of a good team as the employees will accumulate functions and their performance will be impaired. Besides that, the rewards and promotion analysis become much more complicated if the work gets mixed up, and especially if the person's original tasks get more attention. Organizations genuinely interested in maintain strong intrapreneurship cannot overburden an intrapreneur and must recognize its contribution as innovative. [18]

Stakeholders are, by definition, all people interested in the results of innovation and intrapreneurship projects. This includes leaders, interns, advocates, sponsors and so on. Each one can bring a different vision and should be considered part of the project. Its advocates and sponsors, for example, not only support the activity but also have to be part of the planning and goals flexibility.

The formation of the team is extremely important for the intrapreneurship. However, it is essential to have in mind that a team is made up of people. Each one of them needs to be developed to be in their best version and bring positive results to the company. The characteristics desired for an intrapreneur should be clear to avoid future frustration, not only for the team but also personal.

In 1951, McClelland began his studies about behavior that were later improved and finalized in 1990 by Management Systems International (MSI). [55][56] A consistent and popular Entrepreneurial Behavioral Theory was developed. [57][58][59] His theory brought together ten of the main characteristics of the entrepreneurs (search of opportunities and initiative; persistence; commitment; quality and efficiency requirement; calculated risk taking; goals establishing; information search; systematic planning and monitoring; persuasion and networking; and independence and self-confidence). These characteristics refer to three main competencies related to entrepreneurs: achievement, planning and desire for power. In their study, Morris, Webb, Fu and Singhal also pointed out important characteristics of being encouraged and nourished in entrepreneurial profiles: Opportunities recognition; opportunity evaluation; risk management and mitigation; persuasion; perseverance; creativity; resources leverage; guerrilla ability; value creation; ability to maintain focus but adapt; resilience; self-efficacy; creation and usage of contact networks. [53] Although it is a very contemporary theme, the entrepreneur profile was already been specifically addressed in articles, different from the intrapreneur profile that has not yet been explored in detailed theories. Even without these more detailed theories on the subject, the studies about intrapreneurship often bring in their content important points of the intrapreneur profile.

Creative problem solving, or simply, the creativity, can be supported by the organization's practices and values. [21] The pursuit of corporate interests should be focused in innovation and creativity by the intrapreneurs. [24] The creativity not necessarily describes the ends only, but also the means. That is, it is not only about the final product or service, but also the process of ideation and development. [60] Rigid activities can negatively influence creative problem solving. [61]

Resilience allows those who work with innovation to cope with the risky environment and possible failures, as well as to adapt without losing their emotional stability. [62] Unlike entrepreneurs, intrapreneurs may have problems with conservative corporate structures, which also require resilience on the part of employees to overcome rigid controls and constraints. [24]

Perseverance or tenacity is described as "ability to sustain goal-directed action and energy when confronting difficulties and obstacles. [53]. The chances of failure in this universe are huge, therefore persevering despite the difficulties is an important feature. The intrapreneurs success depend on the creation of an environment where failures are allowed and tolerated. [8][24] What may not happen when large companies put the immediate profit as a priority and the low risk culture prevails. [63] For that reason, tenacity, constantly put to the test, is important for the intrapreneur.

Willingness to face risks is not only a feature of the corporate culture. The company must be open to risky actions, but the intrapreneur is also responsible for making this culture effective. They should feel free and comfortable to adopt such behavior, knowing that their innovative ideas will be supported even if risky. [64] Comparing the entrepreneur scenario, in large companies, the employee rarely realizes and feels the impact of the total risk and responsibility because the company itself absorbs a large part of them. It happens because the organization holds the concept and intellectual rights, as well as the financial results. [24]

Likewise, the ability to raise and manage resources is much more present in the entrepreneurs as they are constantly limited by resources. [65] Intrapreneurs can be sustained by access to the most present resources of a company. [61] There are several ways in which the intrapreneurs can guarantee greater access to resources and create synergy for the organization, such as creating research and development partnerships, teaching and learning partnerships (as universities), and joint ventures. [66]

Adaptation and flexibility while maintain focus is facilitated when there is a structure and culture that supports intrapreneurship. [67] The flexibility and the ability to be visionary in problem solving form are the main competences of an entrepreneur, in Williamson, Lounsbury & Han's opinion. [62] A rigid structure will require more reactionary and adaptive behavior of the intrapreneur. [24]

And finally, the ability to build and use people networks is one of the characteristics present in both

entrepreneurs and intrapreneurs. [21] The fact that any innovation project is multidisciplinary requires those involved to relate to the most diverse possible departments. The intrapreneurs' advantage is that they have already existing networks for many of the cases. Heterogeneity facilitates the exchange of information. [51]

2.10 Top management support

George & MacMillan point out that probably the most important topic of all is to have all activities fully supported and embraced by top management. [68] In fact, the first step of all intrapreneur process is to ensure the board's commitment to support all changes that will be made. Leadership support can be done with physical presence simply as well as with easy access to financial and human resources. [18]

The reason that this is such an important dimension is because intrapreneurship is a top-down process. It is a strategic activity for the company. [22] Therefore, senior leadership must encourage initiatives and efforts to innovate and develop new business.

III. LITERATURE REVIEW CONSIDERATIONS

After the literary review, the listing of intrapreneurship dimensions was done and organized in table 1. The dimensions were divided into three main pillars: Management, Structure and Agents.

Table.1: Intrapreneurship dimensions and their pillars

Pillars	Dimensions
Management	Innovation and Renewal Ability
	Risk-taking and management
	Organizational culture and environment
	Proactivity
	Competitive aggressiveness
Structure	Structure and process for autonomy
	Resources
Agents	Multidisciplinary team and personal competences
	Top management support

Source: Author

The management pillar refers to all dimensions linked to organizational culture and company behavior, which are not tangible or formalized in processes, such as innovation ability, proactivity, among others. These dimensions are extremely important for intrapreneurship and are

represented by activities and actions that the company takes. However, if the organization wishes to improve in these aspects, a simple methodology will not solve fully the problem because it requires long term changes that demands behavioral efforts by the company.

The Structure is the pillar that categorizes all dimensions and actions that a company can provide procedurally to intrapreneurs, for example, a formalized innovation process, the reduction of bureaucracies and hierarchies, and the facilitation of the granting of resources. Structural characteristics of the company can greatly facilitate or hamper the results of intrapreneur projects. Mainly because intrapreneurship refers to innovation within the company, the barriers imposed by the organization are capable of sabotaging its own interests.

No innovation can be purely produced by a machine, for the power of creative transformation is linked with the thinking capacity of the human being. Therefore, agents are an important part of intrapreneurship. From top management support, to investing in each person's competencies, and wisely building an innovation team are dimensions related with the care needed with the people directly responsible for making intrapreneurship work or not within a company.

IV. RESEARCH METHODOLOGY

In order to create a consistent intrapreneurship model, a broad review of the literature was made. At first, from a quick search with keywords, national and international articles were collected. After the first reading of these authors, it was possible to create an overview of the scenario. The bibliographic references of the articles that were closest to the desires approach were also researched. The dimensions that were more recurrent and significant were highlighted and, at the end, were analyzed. A model was then designed to represent the dimensions and the relation among them.

V. DATA DESCRIPTION AND ANALYSIS

Innovation is not only based on the three main areas studied (Management, Structure and Agents), but it cannot exist with only two of them. Intrapreneurship, then, can be seen as an intersection of these pillars.

The final model (figure 1) represents the need for the three pillars raised, without the exclusion or classification of importance of any of them. The innovation in a company with a good management and structure but without capable agents is non-existent, since all intrapreneur actions are linked to specific skills and

abilities. The whole core of an innovative project lies in the creative capacity and integration of a team and the individuals that make it up. Likewise, without the presence of a structure conductive to innovation, despite competent agents and incentive management, projects will be limited by the lack of methodology in their processes, resources and by excessive bureaucracies. If the company is concerned with establishing a good procedural structure with capable people, but in its day-to-day it does not strengthen the innovation culture in its small acts and way of behaving in the market, intrapreneurship does not find spaces to develop.
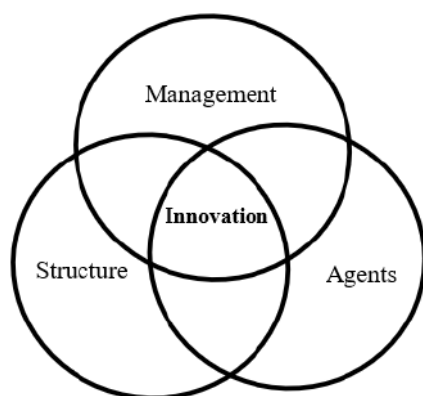

Fig. 1: Intrapreneurship intersection model

VI.   CONCLUSION

From the literature review, this article proposed to define, analyze and cluster the intrapreneurship dimensions in larger pillars (Management, Structure and Agents). Nine dimensions were studied: Innovation and renewal ability; risk-taking and management; Organizational culture and environment; proactivity; competitive aggressiveness; structure and processes for autonomy; resources; multidisciplinary team and personal competences; and top management support. With this, it was possible to draw a conceptual intersection model to make it clear that besides dependents, no pillar is more important. Innovation cannot exist outside the intersection of them. The agents will carry the intrapreneur actions with their creative abilities and integration, while the structure propitiates innovation with its processes, and the management creates a culture and environment that finds spaces for the development of intrapreneurship.

Bierwerth *et al.* [2] carried out a study with a meta-analysis approach, classifying and punctuating more than 40 articles that discuss companies' performance according to the presence of intrapreneurial aspects and taking into account also environmental and cultural factors. They could verify that innovation, corporate venturing and

strategic renewal have significantly impact to corporate overall performance but with limitations related subjectivity, number and heterogeneity of case studies. Most of the literature for corporate entrepreneurship is based in empirical findings. The main limitations are related to measure the impact of corporate entrepreneurship for having many subjective and not palpable outcomes in the short and medium term. Same difficulty reported in this article when we talk about analyzing intrapreneurship performance inside the companies. There are many articles with case studies involving companies but rarely with enough number to enable a solid and data-proved model. Therefore, next steps are related to the joint work of researchers and companies for cooperation with practical foundation.

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Three-phase DC-AC converter with LCL filter for distributed microgeneration with null error in steady state

Viviane Barrozo da Silva[1], Antonio Carlos Duarte Ricciotti[2], Hebert Sancho Garcez Militão[3], Júlio Sancho Teixeira Militão[4], Álvaro Daniel Hartmann Siliprandi[5], Wilson Domingos e Silva[6], Adailton Braga Júnior[7], Lillian Kathleen Dias Luz[8], Sandra da Cruz Garcia do Espírito Santo Aguiar[9], Diego Lima Veiga[10].

[1,2,5,6]Department of Electrical Engineering, Federal University of Rondonia, Brazil

[4]Department of Chemistry, Federal University of Rondonia, Brazil

[10]Department of Administration, Federal University of Rondonia, Brazil

[8]Department of Electrical Engineering, Uniron, Brazil

[3,7,10]Control and Automation Laboratory, Rondonia, Brazil

Abstract—*This article presents a digital control for a three-phase DC-AC converter with four wires with LCL filter that makes up the inverter module of a distributed microgeneration system, which guarantees a zero error in a permanent regime and can be connected to any generation and minimizes high-frequency current harmonics injected into the network. The inverter control system is based on a triangular carrier, which uses: an internal mesh to control the grid current. In the simulated tests, good functioning of this control technique was verified, even when faced with the variation of the impedance of the distribution network in the PCC, a satisfactory response of the dynamic behavior of the control system was obtained with the efficient control of the active and reactive power and the guarantee of a null error on a steady state.*

Keywords—*Converter DC-AC*,*Vector control, Filter LCL*, *Inverter, Distributed microgeneration.*

I. INTRODUCTION

Normative resolution No. 482, of April 17, 2012 [1], any consumer can adhere to the electric energy compensation system and that those who generate it have responsibility for damages caused to the electrical system, according to normative resolution No. 414, of 09 of September 2010 [2].Therefore, the quality of the energy generated must be in accordance with the procedures for the distribution of electricity in the national electricity system guided by the National Electric Energy Agency (NEEA) [3], [4].Disturbances such as harmonics, unbalanced loads, reactive power, voltage generated, power flow, grid peaks, among others, are frequent and are pointed out as causes of damage.

Static converters, with a frequency of the order of 2-15kHz, according to the IEEE-519-1992 recommendation, can be considered sources of harmonic generation when interconnected at the common coupling point.To mitigate this disorder, active or passive filters [5], [6], [7] and [8] can be used.

The use of an LCL resonant filter represents an approach that has some advantages, such as: inductors with lower inductance values when compared to an L filter, good attenuation of current ripples and decoupling between the filter and the mains. However, such a filter model has the disadvantage of resonance peaks that must be attenuated by active or passive damping techniques [9].This article presents a digital control for a three-phase DC-AC converter with four wires with LCL filter to guarantee zero error in steady state, minimizing high frequency current harmonics.

II. MODELINGOF THREE-PHASE CD-CA CONVERTERS

Static converters are used in various applications and operate in inductive or capacitive bands, according to the needs of the system. There are two types of inverters applied, the current source inverter (CSI) and the voltage source inverter (VSI - Voltage Source Inverter).The CSI keeps the current polarity of the DC side constant. The VSI keeps the polarity of the DC side voltage constant and the direction of the power flow is determined by the polarity of the DC side current. The voltage and frequency generated on the AC side depend on the control structure used. Figure 1 shows the blocks of the inverters with the respective voltage or current source [7], [8] and [10].
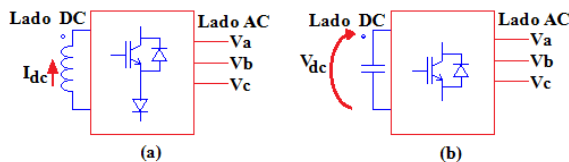

Fig.1: Types of converters: (a) CSI   (b) VSI

n systems that are connected to the electrical distribution network or isolated networks, it is desirable to obtain a sinusoidal voltage with fixed amplitude and frequency, for that, careful control is necessary. The most suitable converter type is a voltage source inverter (VSI) or simply referred to in the literature as a voltage inverter [13], [10] and [11].

The development stages of the inverters are the characterization of the modulation type, the characterization of the type of filter used and the control strategies [12].

Inverters that use pulse width modulation (PWM) are also known as PWM inverters [8].

To develop digital control for a four-wire DC-AC converter with LCL filter, it is necessary to develop the equations.

2.1 Clarke, Park and dq0 Transforms

Being a transformation of an algebraic conversion for biphasic reference (α-β) of voltages and three-phase currents (a, b, c) of four-wire systems, the Clarke transform or α-β-0 transform decouples the zero sequence components, as shown in equation 1 [11].

$$C^{-1} = \sqrt{\frac{2}{3}} \cdot \begin{bmatrix} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & -\frac{\sqrt{3}}{2} & \frac{\sqrt{3}}{2} \end{bmatrix} \quad (1)$$

The Park transform is a mathematical method that acts on a dynamic rotating system of angular velocity (ω). Equation 2 displays the method.

$$P^{-1} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \sin(\omega.t) & \cos(\omega.t) \\ 0 & \cos(\omega.t) & -\sin(\omega.t) \end{bmatrix} \quad (2)$$

The dq0 transform or dq0 transform is the product of the Clarke and Park transforms, according to equation 3. Expression 4 represents the resulting matrix.

$$T_{dq0} = B^{-1} = P^{-1}.C^{-1} \quad (3)$$

$$T_{dq0} = \sqrt{\frac{2}{3}} \cdot \begin{bmatrix} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ \sin(\omega.t + 0) & \sin(\omega.t - 120) & \sin(\omega.t + 1 \\ \cos(\omega.t + 0) & \cos(\omega.t - 120) & \cos(\omega.t + 1 \end{bmatrix} \quad (4)$$

It is known that to guarantee power is invariant, the transformation must be orthogonal (equation 5) [11].

$$T_{dq0}^{-1} = \sqrt{\frac{2}{3}} \cdot \begin{bmatrix} \frac{1}{\sqrt{2}} & \sin(\omega.t + 0) & \cos(\omega.t + 0) \\ \frac{1}{\sqrt{2}} & \sin(\omega.t - 120) & \cos(\omega.t - 120) \\ \frac{1}{\sqrt{2}} & \sin(\omega.t + 120) & \cos(\omega.t + 120) \end{bmatrix} \quad (5)$$

2.2 Voltages, current, powers in the dq orthogonal plane

Stresses in the orthogonal plane dq are represented by equation 6.

$$\vec{V}_{dq0} = T_{dq0}.\vec{V}_{123} \quad (6)$$

Currents in the orthogonal plane dq are represented by equation 7.

$$\vec{I}_{dq0} = T_{dq0}.\vec{I}_{123} \quad (7)$$

In the orthogonal plane dq, the instantaneous powers are defined as: real power [p (t)], imaginary power [q (t)] and zero sequence power [p0 (t)] and are obtained according to equation 8 [11] .

$$\begin{bmatrix} p_0(t) \\ p(t) \\ q(t) \end{bmatrix} = \begin{bmatrix} V_0(t) & 0 & 0 \\ 0 & V_d(t) & V_q(t) \\ 0 & V_q(t) & -V_d(t) \end{bmatrix} \cdot \begin{bmatrix} i_0(t) \\ i_d(t) \\ i_q(t) \end{bmatrix} \quad (8)$$

Therefore, the three-phase active power is the sum of the instantaneous powers and is given by expression 9.

$$P(t) = \frac{3}{2}[V_d(t).i_d(t) + V_q(t).i_q(t)] \quad (9)$$

On the other hand, the reactive power or imaginary power in the orthogonal plane dq is shown by the expression 10 or 11.

$$Q_{3\emptyset}(t) = V_q(t).i_d(t) - V_d(t).i_q(t) \quad (10)$$

$$Q(t) = \frac{3}{2}[V_q(t).i_d(t) - V_d(t).i_q(t)] \quad (11)$$

To facilitate understanding, the powers, real and zero sequence, p(t) and $P_0(t)$ respectively, flow between the system and the load while the imaginary power q (t) circulates between the phases [11]. Figure 2 shows the significance of the powers.
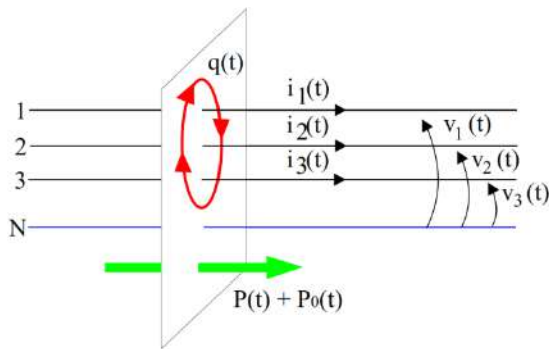

Fig.2: Meaning of powers p(t) e P₀(t) and q(t) [11].

2.3 Power Control

The block diagram of the typical three-phase power controller using the dq orthogonal plane is shown in Figure 3.
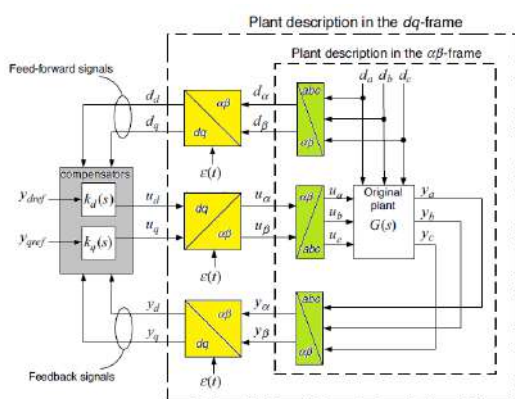

Fig.3: Three-phase controller of the dq orthogonal plane (modified from [14]).

Using the control of the orthogonal plane dq, the zero error value in steady state is achieved by including an integrator term in the compensator with the voltage controlV_{dc}.

For the connection of PWM converters to the electricity distribution network, only two types of filters are considered, the first order L filter and the third order LCL filter. When compared, the L filter has low attenuation forcing a high switching frequency to guarantee the necessary attenuation and the LCL filter with greater attenuation of current harmonics. Such a comparison usually leads to the choice of the LCL filter, which provides greater performance with reduced reactive consumption [15]. Figure 4 shows the LCL filter inserted between the converter and the distribution network.
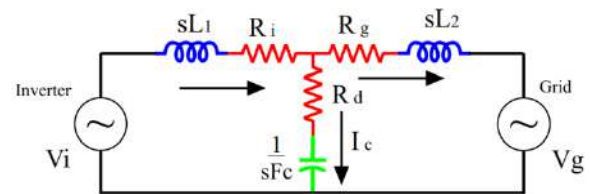

Fig.4: LCL filter Inserted between the converter output and the distribution network, modified from [16].

2.4 Resonant Filter Model

From Kirchhoff's laws, equations (12), (13), (14) and (15) represent the single-phase current and voltage laws in the S plane and from these equations the transfer function of the LCL filter can be obtained.

$$i_i = i_c + i_g \quad (12)$$

$$v_i - v_c = i_i(sL_1 + R_i) \quad (13)$$

$$v_c - v_g = i_g(sL_2 + R_g) \quad (14)$$

$$v_c = i_c\left(\frac{1}{sC_f} + R_d\right) \quad (15)$$

Where, i_i, $i_c i_g$ are the inverter, capacitor and grid currents, respectively, v_i, v_c e v_g are the inverter, capacitor and grid voltages, respectively, R_i e R_g, inductor resistanceL_1 e L_2, respectively, andR_d, damping resistor, connected in series with the filter capacitorC_f. The block diagram of the mathematical model is illustrated in figure 6.
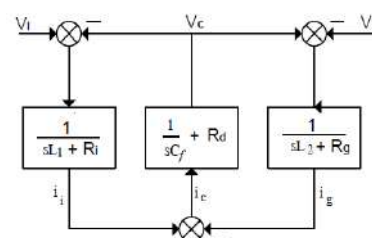

Fig.6: Block diagram of the mathematical model of the LCL resonant filter

2.5 LCL Filter Design

There are many criteria used to design the parameters of this filter, to obtain a good performance, some procedures must be considered, such as [5] and [17]: The value of the capacitor must be less than 5% of the base power; The total value of the inductance must be less than 10% of the base inductance; The resonance frequency must be greater than 10 times the network frequency and less than half the switching frequency.The project parameters are specified according to Table 1.

Table.1: Project Parameters

PARAMETER	VALUE
Switching frequency (f_{sw})	5040 Hz
Grid frequency (f_g)	60 Hz
Line voltage (E_N)	220 V$_{RMS}$
Ripple current (I_{ripple})	16 A$_{RMS}$
Rated output (P_N)	11 KW
DC bus voltage (V_{dc})	550 V

2.5.1 Calculation of the harmonic switching order (h_{sw})

$$h_{sw} = \frac{\omega_{sw}}{\omega_g} = \frac{2\pi f_{sw}}{2\pi_{sw}} = \frac{5040}{60} = 84 \qquad (16)$$

2.5.2 Calculation of base impedance (Z_b)

$$Z_b = \frac{E_N^2}{P_N} = \frac{(220)^2}{11.10^3} = 4,4 \ \Omega \qquad (17)$$

2.5.3 Calculation of base capacitance (C_b)

$$C_b = \frac{1}{\omega_g.Z_b} = \frac{1}{2.\pi.4,4} = 6,02874.10^{-4} \text{F} \qquad (18)$$

2.5.4 Calculation of the filter capacitor (C_f)

In distributed applications the recommended value is 5% of the base capacitance [5].

$$C_f = 0,05.C_b = 0,05.6,02874.10^{-4} \cong 30\mu F \qquad (19)$$

2.5.5 Calculation of the maximum ripple current of the filter output ($I_{ripple, peak}$)

The recommended value is 10% of the ripple current [5].

$$I_{ripple,peak} = 0,1 * I_{ripple}\sqrt{2} \cong 2,3 \ A \qquad (20)$$

2.5.6 Calculation of the total maximum inductance (L)

$$L = \frac{\sqrt{\frac{(V_{dc})^2}{3} - (E_{N,MAx})^2}}{\omega_g * I_{ripple,MAx}} \qquad (21)$$

$$L < \frac{\sqrt{\frac{(550)^2}{3} - (220*\sqrt{2})^2}}{2*\pi*60*16*\sqrt{2}} < 0,47 \ mH \qquad (22)$$

2.5.7 Calculation of the filter input inductor (inverter side) L_1

When calculating the inductance value of the inductor on the inverter side, the recommendation IEEE-519-1992 [5] should be considered, which recommends that the maximum permissible ripple current be around 3.5%. According to [17] the inductor can be calculated by equation 23.

$$L_1 = \frac{E_N}{2 * \sqrt{6} * f_{sw} * I_{ripple,peak}} \qquad (23)$$

$$L_1 = \frac{220}{2 * \sqrt{6} * 5040 * 2,3} \cong 4 \ mH \qquad (24)$$

2.5.8 Calculation of the filter output inductor (grid side)L_2

According to [17] and [5], the inductor on the grid side is typically 80% L1 and can be calculated by equation 25.

$$L_2 = 0,80 * L_1 = 0,8 * 4 * 10^{-3} \cong 3,2 \ mH \qquad (25)$$

2.5.9 Calculation of the filter resonance frequency (f_{res})

$$f_{res} = \frac{1}{2*\pi}\sqrt{\frac{L_1+L_2}{L_1*L_2*C_f}} \qquad (26)$$

$$f_{res} = \frac{1}{2*\pi}\sqrt{\frac{4*10^{-3}+3,2*10^{-3}}{4*10^{-3}*3,2*10^{-3}*30*10^{-6}}} = 689,18 \ Hz \qquad (27)$$

It can be seen that the limit criterion of the resonance frequency of the LCL filter (expression 28) was respected as shown in expression 29.

$$10 * f_g \leq f_{res} \leq 0,5 * f_{sw} \qquad (28)$$

$$600 \ Hz \leq 689,18 \ Hz \leq 2520 Hz \qquad (29)$$

2.6 LCL filter transfer function

Formed from equations 12, 13, 14, 15 and the relationship between the LCL filter output current(i_g)and the filter input voltage(V_i). Assuming that R_i and R_g are

equal to zero ohm (negligible), then the transfer function is expressed by equation 30 in the domain of plane S.

$$\frac{i_g(s)}{v_i(s)} = \frac{1+sR_dC_f}{s(L_1+L_2)+s^2(L_1R_d+L_2R_d)+s^3(L_1L_2C_f)} \qquad (30)$$

Not using the damping resistor (R_d), the filter transfer function is shown in equation 31.

$$\frac{i_g(s)}{v_i(s)} = \frac{1}{s(L_1+L_2) + s^3(L_1L_2C_f)} \qquad (31)$$

To better analyze the response of the LCL filter, an application was developed in LABVIEW, which is shown in figure 7. In this application, several functions are implemented, for example, the visualization of the equations in the poles and zeros gains format, the transfer function and the space state equations, output voltage, analysis of the gain and phase margins, diagrams of Bode, Nyquist, Nichols, Root Locus and the Map of poles and zeros.
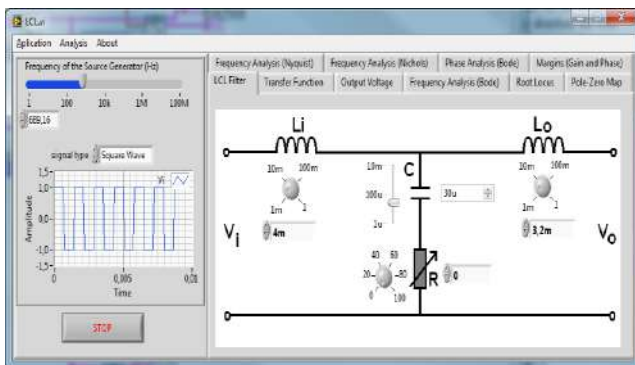

Fig.7: LCL resonant filter analysis

Since the value reported is of the symbolic type (figure 8) and can be edited, the transfer function can be modified, dynamically varying (figure 9) its values and promoting analyzes of its behavior at run time.It is also possible to check the filter behavior with other types of input voltage and frequency waveforms. The values reported for the LCL filter components are the same as those previously calculated.
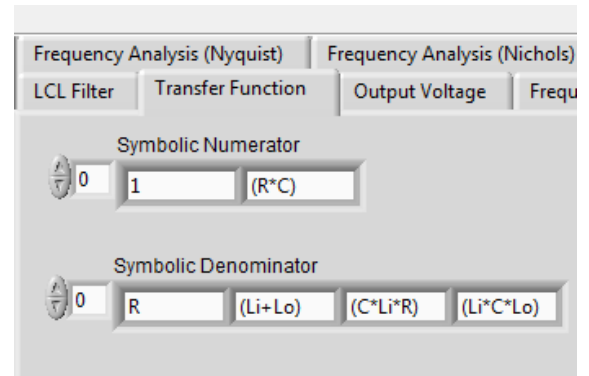

Fig.8: Analysis of the LCL filter
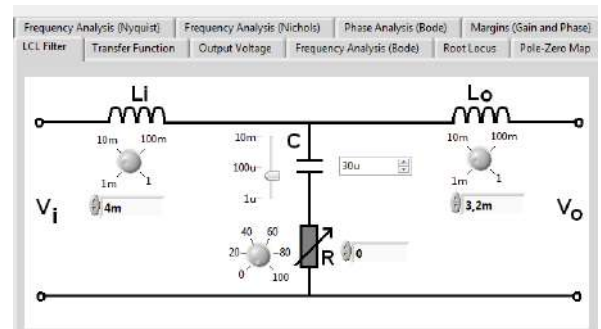
Fig.9: Dynamic control of symbolic values

The generated equations, with the actual values, are shown in figure 10.

Fig.10: Equations of the LCL filter transfer function.

For the purpose of analysis, figure 11 shows the Bode diagram as a function of frequency and figure 12 shows the behavior of the filter in relation to the phase, while figure 13 shows the map of poles and zeros of the filter, while figure 14 shows the output voltage when the filter is in resonance, ultimately figure 15 shows the gain and phase margins of the filter.

Fig.11: Frequency response of the LCL filter.

Fig.12: LCL filter phase margin.

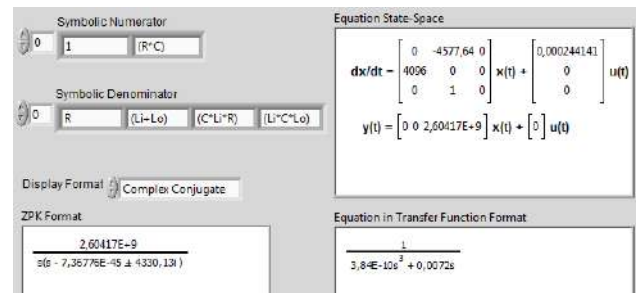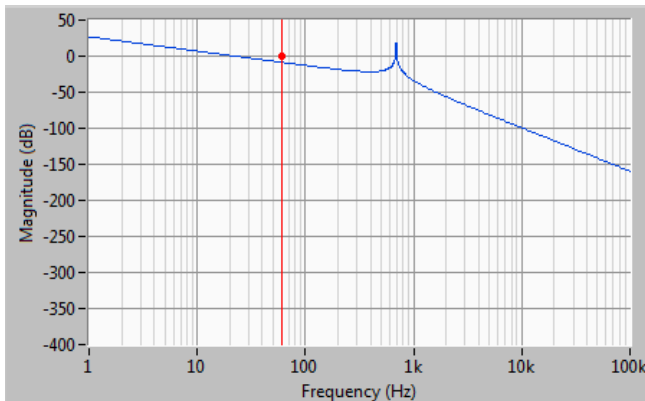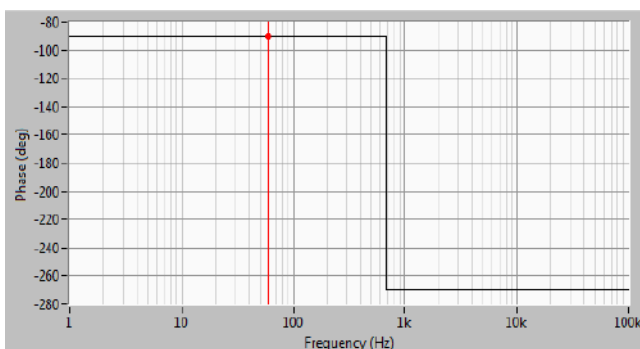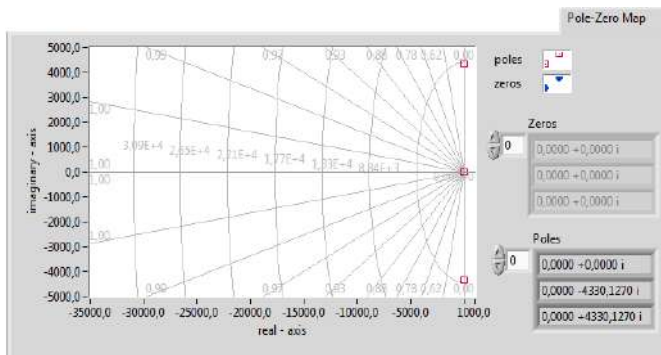*Fig.13: LCL filter poles and zero map.*
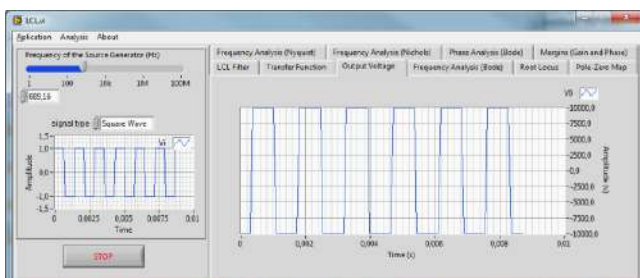
Fig.14: Filter output voltage at a resonant frequency (689,16 Hz).
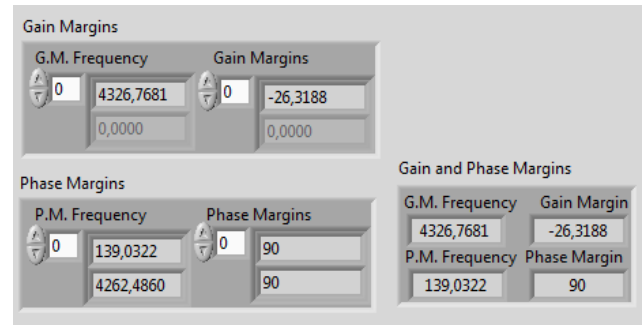
Fig.15: Gain margins and filter phase.

This application allows a quick visualization, for any application with filters, especially when in the prototyping stage, since the values can be changed, and the filter behavior can be independently analyzed.

To control the flow of active and reactive power independently, consequently the zero error of the steady state, it is necessary to apply reference signals on the base axes dq0. The use of the PLL technique allows us to estimate the phase angle, synchronizing the converter with the electrical distribution network, avoiding the permanent error of the regime [18].

Figure 16 shows the block diagram of the PLL system.
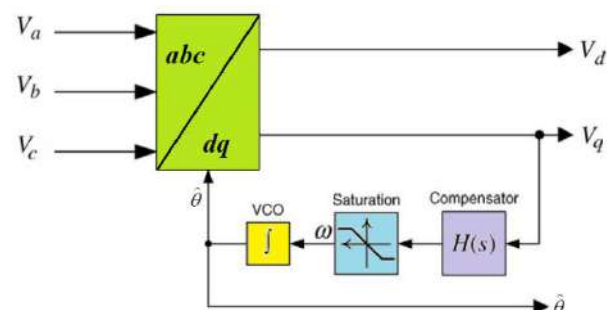
Fig.16: Block diagram of the mathematical model of the PLL circuit (modified [14]).

The transfer function block involving the reference angles are shown in figure 17, equation 32 describes the transfer function of the PLL circuit and figure 18 of its implementation.

Fig.17: Block diagram with the transfer function of the PLL circuit (modified [19]).

$$H(s) = \frac{\hat{\theta}}{\theta_{Ref}} = \frac{K_p s + K_i}{s^2 + K_p s + K_i} \qquad (32)$$

Fig.18: Block diagram with the transfer function of the PLL circuit (modified [12]).

The pulse width modulation technique is proportional to the amplitude of the sine wave, generated from the comparison between the sine reference and a triangular carrier with frequency f_c. Figure 19 shows the sinusoidal pulse width modulation and the output voltage V_O generated by the switching of 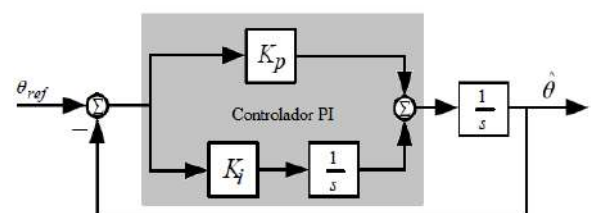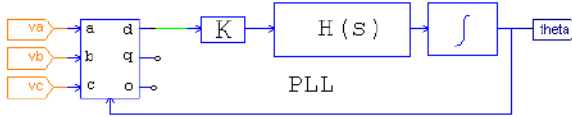g_1 e g_4, and for better understanding, figure 20 illustrates the switching network emphasizing the g_1 and g_4 switches. Commonly applied in industry, it has some advantages, such as: reduced distortion factor, very low order harmonics, the frequency of the reference signal determines the frequency of the inverter output, the amplitude of the reference signal controls the modulation index (figure 21), which consequently controls the effective output voltage [8], [17].
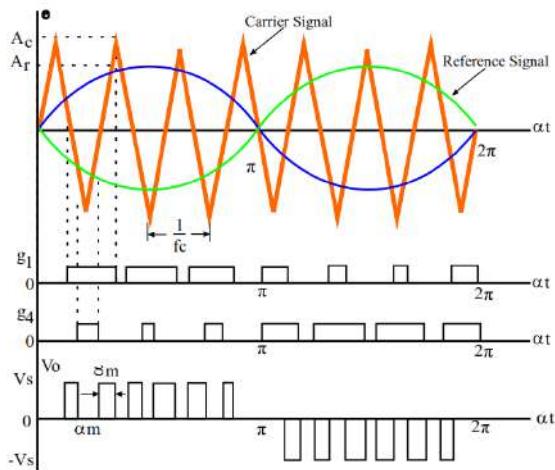
Fig.19: Sinusoidal pulse width modulation (modified [23]).

Figure 20 shows the switching for a three-phase network, there are eight combinations of spatial vectors as shown in table 2 in the orthogonal plane dq.
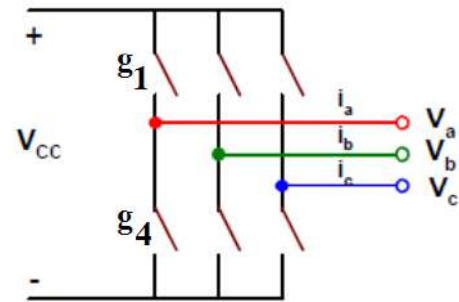
Fig.20: Switching network emphasizing keys g_1 and g_4 (modified [17]).

To obtain the modulation index, the maximum value of the triangular carrier signal must be divided with the reference sinusoidal signal. The modulation index less than one means that the current does not present harmonics of low order and the power factor of the signal is practically equal to one. Figure 21 shows the form of generation by unidirectional triangular carrier.
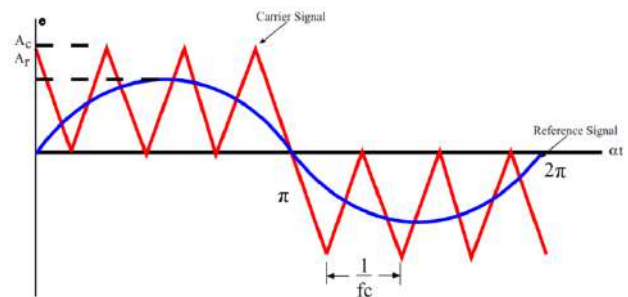
Fig.21: Generation of sinusoidal PWM by unidirectional triangular conveyor (modified [12]).

Existem dois métodos para o controle de potência ativa e reativa, consequentemente, erro nulo em regime permanente, o controle por modo de tensão e o controle por modo de corrente. O controle por modo de tensão é muito utilizado em aplicações de alta tensão e alta potência, mas, pode ser empregado em aplicações industriais.

A figura 22 ilustra este tipo de sistema VSC controlado por tensão.
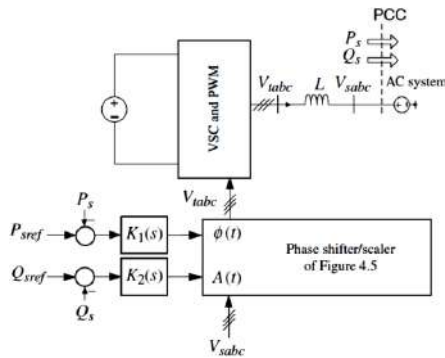
Fig.22: Diagram of the voltage-controlled VSC system for active and reactive power control [12].

The control by current mode, in this approach the active and reactive power is controlled by the phase angle and the amplitude of the line current of the VSI inverter and the voltage in the PCC.In this way the inverter is protected against overcurrent conditions, other advantages of current mode control are: Robustness against variations in parameters of the inverter and the distribution network.Superior dynamic performance and high control accuracy [12]. Figure 23 illustrates current mode control using the dq coordinate system and figure 24 shows the block diagram of the current controlled VSI system.
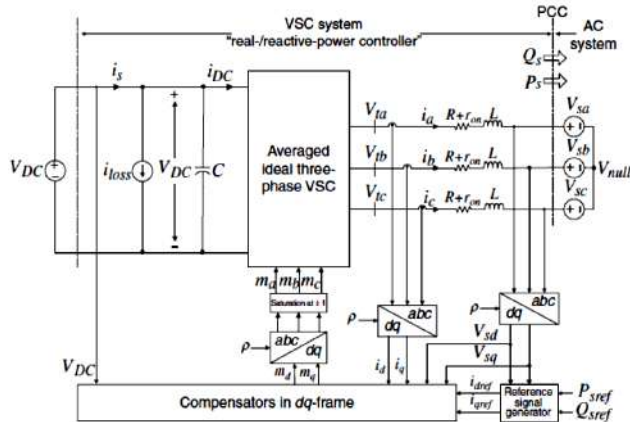
Fig.23: Diagram of the current-controlled VSI system for active and reactive power control [12].
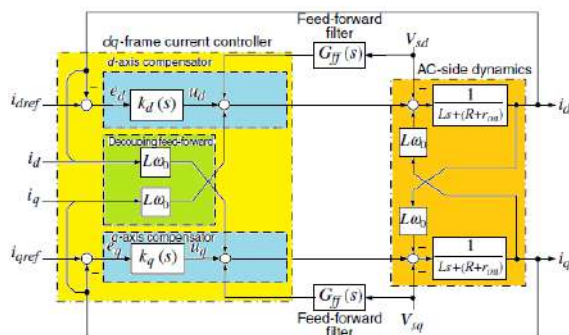
*Fig.24: Block diagram of the current mode control of the VSI inverter (*modified *[12]).*

III. SYSTEM SIMULATION

The control system for guaranteeing null error in steady state is based on [12], using the current mode control of the VSI inverter, for the advantages already presented, figure 25 shows the block diagram of the proposed control strategy.The controller consists of a DC voltage controller block, a current control block, a third harmonic injection block, a PLL block and the vector switch controller.
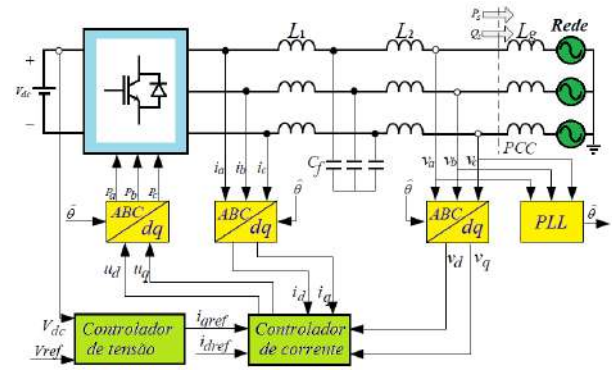
Fig.25: Block diagram of the proposed control strategy.

The circuit simulated in software with the connection to the distribution network with parametric uncertainties is shown in figure 26. To facilitate understanding, the circuit in figure 26 will be broken down and studied part by part.
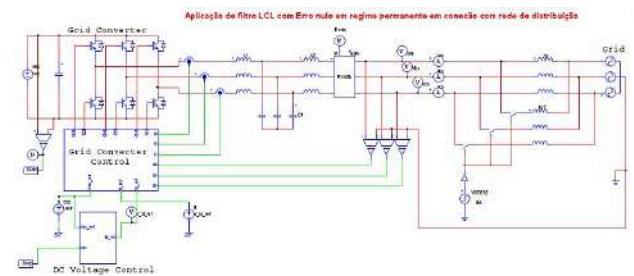
Fig.26: Simulated general circuit of the VSI converter with null error in steady state.

Acting as a bidirectional controller, whose function is to control the active and reactive power exchanged with the distribution network [12].

The DC voltage controller block is shown in figure 27. Equation 33 shows the transfer function of the DC voltage controller. The DC voltage control block circuit applied to the simulation circuit is shown in figure 28.
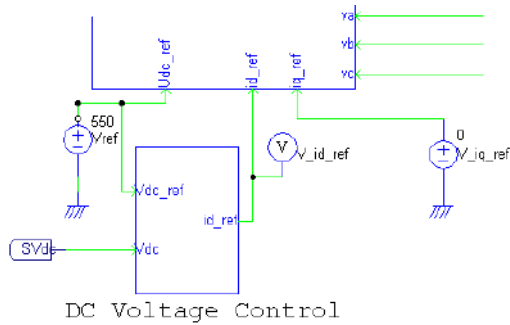
Fig.27: Block diagram of the Voltage control circuit.

$$H(z) = 0{,}2380955 \frac{(1 - 0{,}916z^{-1})}{(1 - z^{-1})} \qquad (33)$$
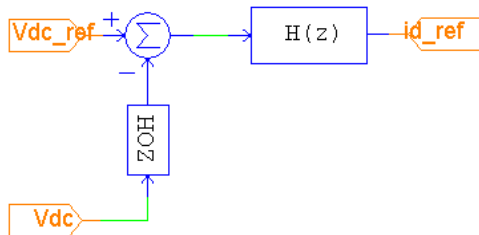
Fig.28: DC voltage control circuit.

For this work, the controller chosen was the controller in current mode, in addition to the advantages mentioned above, it keeps the current of the VSI inverter firmly regulated through the AC side [12], the controller in current mode has several stages, as illustrated in figure 24. The signaling required for this controller is shown in figure 29 in the block diagram of the digital current controller this stage consists of several blocks. The PLL block provides the angle so that the coordinate system transformations remain synchronized.The VSI inverter output current decomposition block for dq orthogonal coordinate system provides the current controller transfer function with the dynamic parameters of i_d and i_q, the output voltage decomposition block for the dq coordinate system provides the control signals e_d e e_q, voltage controller (figure 28) provides the reference for i_d (i_d_ref) and making i_q (i_q_ref) equal to zero, which guarantees the proportionality between the active and reactive powers in relation to i_d and i_q [12].
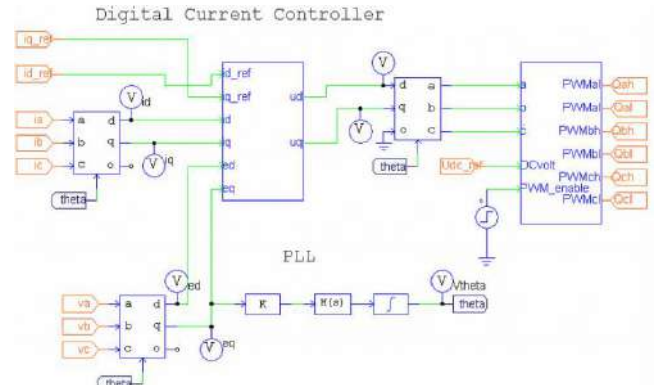
Fig.29: Block diagram of the circuits used for the current control.

The block diagram of the current controller is illustrated in figure 30, where it can be seen that the output of the current controller is converted from the orthogonal coordinate system to the stationary coordinate system o and thereby providing the necessary signals for the sinusoidal PWM control of the inverter keys.
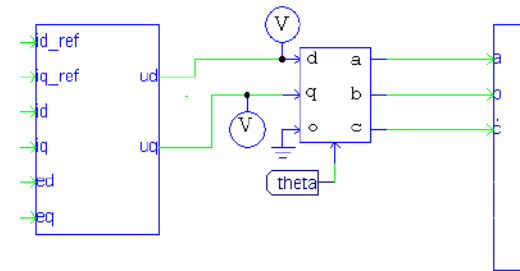
Fig.30: Block diagram of the Current control circuit.

Figure 31 illustrates the block diagram of the controller transfer function in current mode.The transfer function of the shaft compensator d is displayed in equation 34, the transfer function of the shaft compensator q shown in equation 35, the decoupling gain feedforward is expressed in equation 36 and the feedforward filter gain is written in equation 37. All values were used in this work.
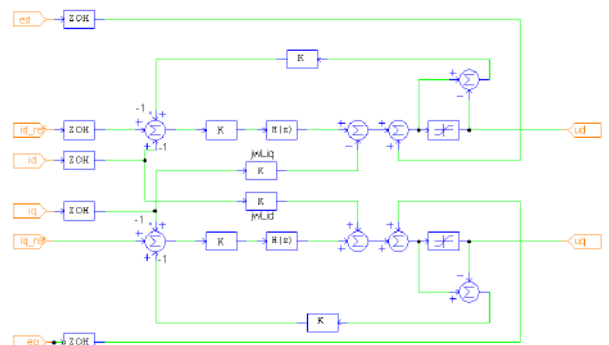
Fig.31: Block diagram of the control transfer function in the current mode.

$$Hd(z) = 16\frac{1 - 0.5z^{-1}}{1 - z^{-1}} \qquad (34)$$

$$Hq(z) = 16\frac{1 - 0.5z^{-1}}{1 - z^{-1}} \qquad (35)$$

$$H_{J\omega Llid}(z) = H_{J\omega Lliq}(z) = 0,3142 \qquad (36)$$

$$H_{FFd}(z) = H_{FFq}(z) = 0,025 \qquad (37)$$

The transfer function of the PLL circuit compensator on the q axis shown in equation 38.

$$H_{PLL}(s) = 311,13\frac{(695,42)}{s^2}\frac{(s^2 + 568,516)}{(s^2 + 1508s + 568,516)}\frac{(s^2 + 166s + 6889)}{(s^2 + 964s + 232,324)} \qquad (38)$$

Assuming that the network inductance is an uncertain parameter and that it belongs to a defined interval between 7,9μH and 79μH [15], then for this work inductors L_g and L_{g2} were inserted to simulate this variation of the extremes controlled by a switch that is activated at $t = 1s$ figure 32 shows this circuit.
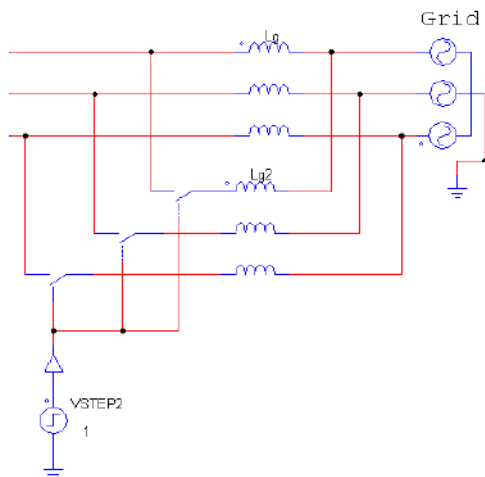
Fig.32: Variation circuit of the distribution network inductance uncertainty parameter with activation at $t = 1s$.

IV. RESULTS

A simulation of the micro generation system using a VSI inverter with control in the current mode for a null error in the permanent regime when connecting to a distribution network using an LCL filter, produced with the following information: Graph of phase currents on the AC side of the inverter (figure 33); Graph of the current phase frequency spectrum on the AC side of the inverter (figures 34 and 35); THD table measured from the phase currents on the AC side of the inverter (Table 2); Graph of the phase voltages on the AC side of the inverter (figure 36); Graph of the frequency spectrum of the phase voltages on the AC side of the inverter (figures 37 and 38); THD table

measurement of the phase voltages on the AC side of the inverter (table 3); Graph of behavior analysis of phase currents on the AC side of the inverter, when the parametric uncertainty circuit of the network is activated (figure 39); Graph of behavior analysis of the phase voltages on the AC side of the inverter, when the parametric uncertainty circuit of the network is activated (figure 40); Graph of the active power of the output circuit (figure 41); Graph of i_d and i_q supplied to the controller in the current mode, by transforming the static coordinate system into the dq orthogonal coordinate system (figure 42); Graph of i_d and i_q supplied to the controller in the current mode, transforming the static coordinate system into the dq orthogonal coordinate system when the network parameters variation circuit is activated at t = 0.85s t = 1.15s (figure 43); Reference voltage graph i_d_ref output of the DC voltage controller (figure 44); Graph of controller output signals in current mode u_d and u_q (figure 45); Graph of the reference voltages for the Sinusoidal PWM controller generated from the transformation of the orthogonal coordinates dq for the static coordinate system of the signals u_d and u_q, generated by the output of the controller in current mode (figure 46); Graph of the frequency spectrum reference voltages for the Sinusoidal PWM controller (figure 47 and 48); THD table measured from the reference voltages for the Sinusoidal PWM controller (table 4).
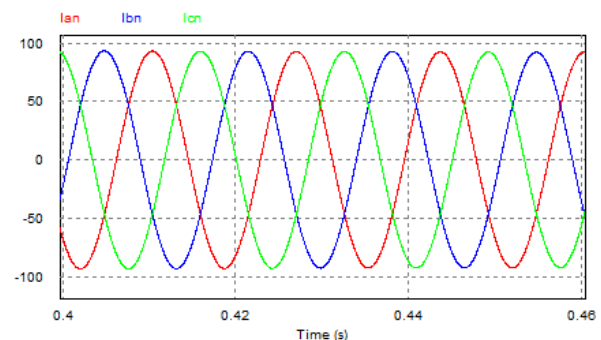
Fig.33: Phase currents on the AC side of the inverter at t = 0.4s and t = 0.46s.
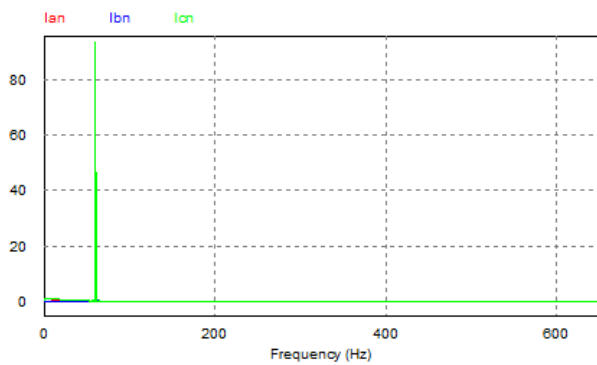
Fig.34: Frequency spectrum of the phase currents on the AC side of the inverter between 0 and 600 Hz.
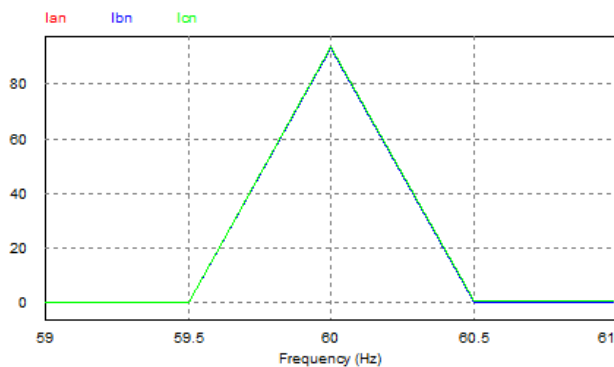
Fig.35: Frequency spectrum of the phase currents on the AC side of the inverter between 59 and 61 Hz.

Table 2: TDH measured in the AC side phase currents of the inverter (fundamental frequency 60 Hz)

Currents	TDH
I_{an}	2.5734774e-003
I_{bn}	2.9237398e-003
I_{cn}	2.5892936e-003
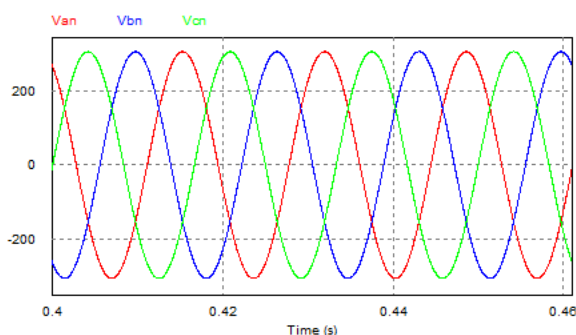
Fig.36: Phase voltages on the AC side of the inverter at t = 0.4s and t = 0.46s.
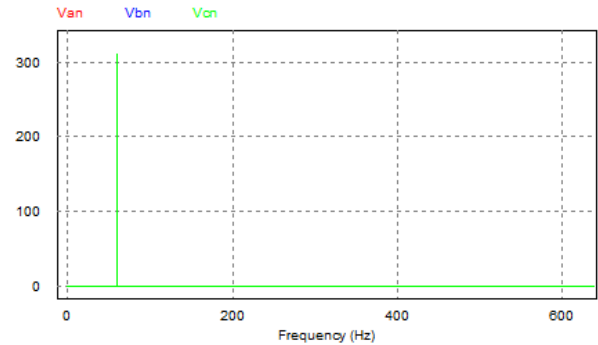
Fig.37: Frequency spectrum of the phase voltages on the AC side of the inverter between 0 and 600 Hz.
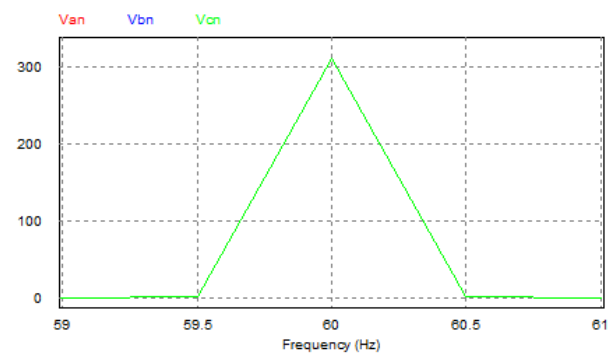
Fig.38: Frequency spectrum of the phase voltages on the AC side of the inverter between 59 and 61 Hz.

Table 3: TDH Measured in the AC side phase voltages of the inverter (fundamental frequency 60 Hz)

Currents	TDH
V_{an}	1.9891372e-003
V_{bn}	1.9917230e-003
V_{cn}	2.2451876e-003
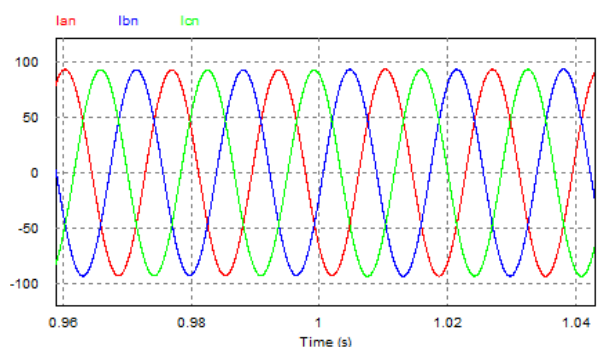
Fig.39: Phase currents on the AC side of the inverter at t = 0.96 s and t = 1.04 s.
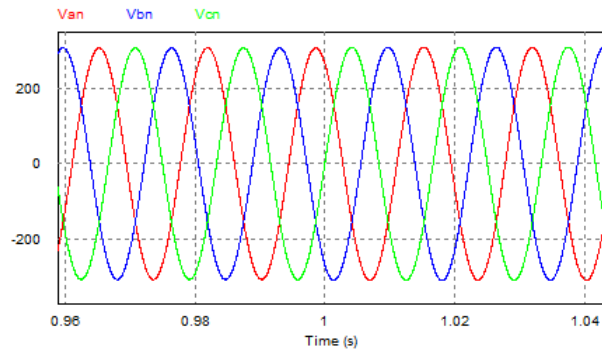
Fig.40: Phase voltages on the AC side of the inverter at t = 0.96 s and t = 1.04 s.

When analyzing figures 34, 35, 37 and 38, it can be seen that there are no low order harmonics and this is also reflected in tables 2 and 3, due to the low TDH index of the voltage and current output waveforms on the side Inverter AC.
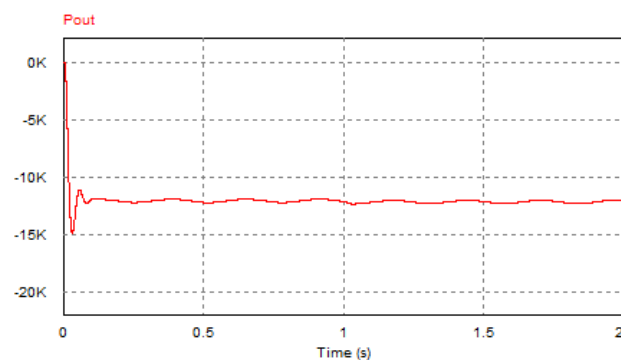
Fig.41: Active power of the output circuit.

When analyzing figures 41, the sign of the active power is negative indicating the supply to the power grid, a little more than 11 KW, within the project specification, due to the approximations in the calculations.
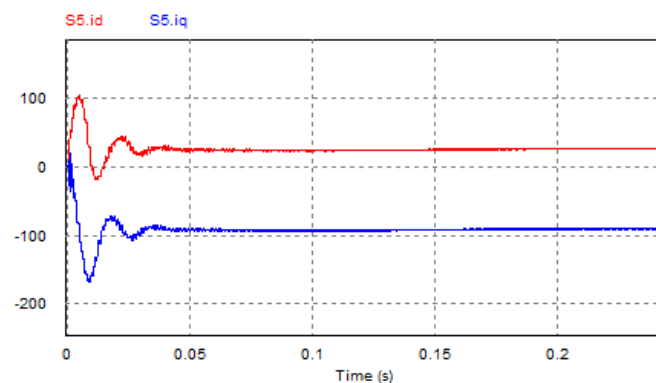
Fig.42: $i_d e\ i_q$ supplied to the controller in current mode.
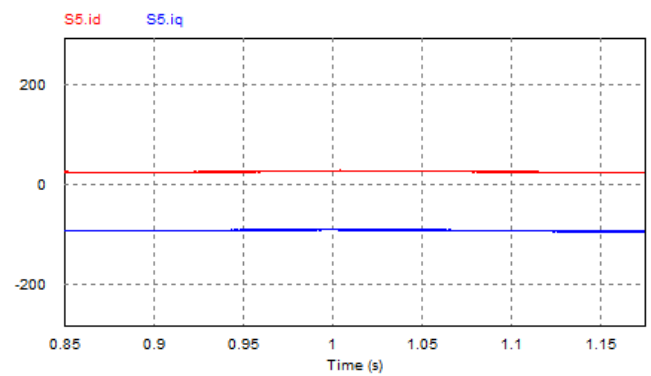
Fig.43: $i_d ei_q$ supplied to the controller in current mode, when the circuit of variation of the network parameters is activated at t = 0.85s and t = 1.15s

When analyzing figure 42, at t = 0.1s the system response is already in steady state.In figure 43, it shows the activation of the parameter change circuit it did not generate any changes, indicating the robustness of the control system.When analyzing figures 44, the signal (i_d_ref) remains constant, due to the fact that the DC bus supply is a source of continuous voltage of the order of 550V.
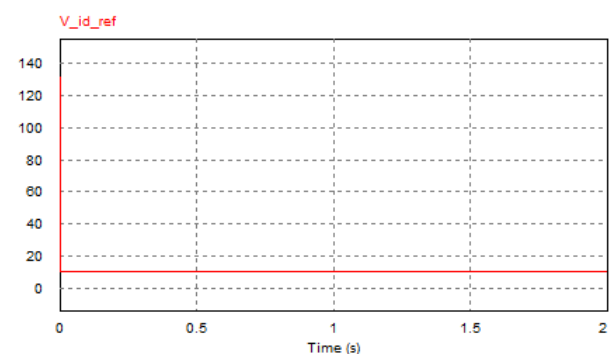
Fig.44: Reference voltage $i_{d\_}ref$ of voltage controller output.
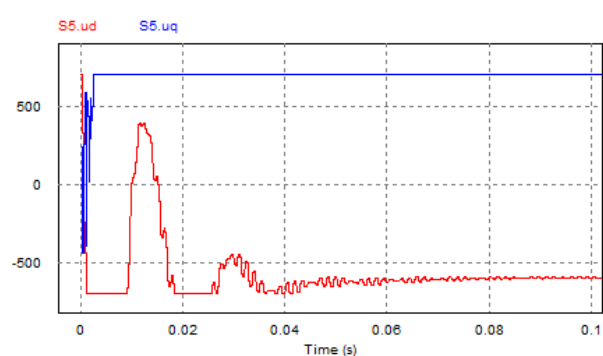
Fig.45: Controller output signals in current mode$u_d$and$u_q$from t=0s to t=0,1s.
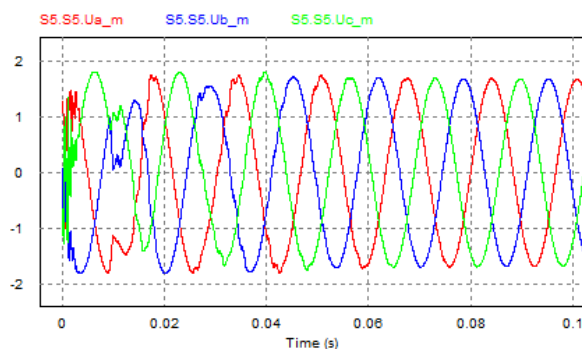
Fig.46: Reference voltages of the Sinusoidal PWM controller generated from the transformation of the orthogonal coordinates dq to the static coordinate system of the signals u_d e u_q, generated by the output of the controller in mode from t = 0s to t = 0.1s.
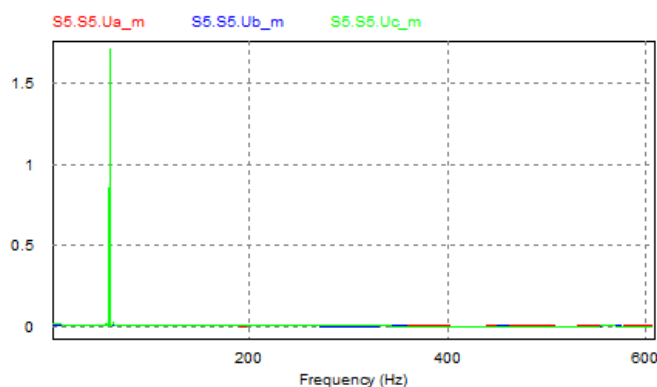
Fig.47: Frequency spectrum of the reference voltages for the Sinusoidal PWM controller between 0 and 600 Hz.
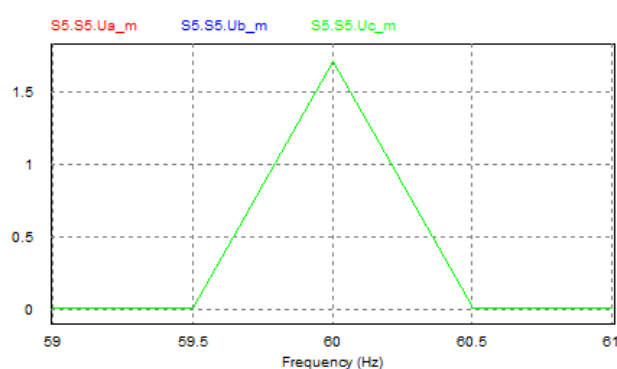
Fig.48: Detailed frequency spectrum of the reference voltages for the Sinusoidal PWM controller between 59 and 61 Hz.

Table 4: TDH measured in the reference voltage for the senoidal PWM controller (fundamental frequency 60 Hz)

Reference Voltage	TDH
U_{am}	4.4418154e-003
U_{bm}	4.4606674e-003
U_{cm}	3.9740673e-003

When analyzing figures 45, the signals u_d and u_q enter a steady state at t>0,1s. The u_d e u_q ssignals are transformed from the dq orthogonal coordinate system to the static coordinate system, where these voltages are the references for the sinusoidal PWM controller to activate the switches, distortions in the reference signal generate distortions in the currents. As in figure 45, figure 46 illustrates the accommodation of the circuit at t = 0.1s. When analyzing figures 47 and 48, it is noticed that there are no low order harmonics and this is also reflected in table 4, due to the low TDH index of the reference voltage waveform.

V. CONCLUSION

The premises for connection of systems interconnected with the distribution network for micro generation, as seen, were satisfactorily achieved, such premises, such as sinusoidal voltage with fixed amplitude, fixed frequency, steady state stability and immunity to variations in network parameters were achieved even with the variation of the distribution network's inductive parameter. The sets of factors that led to this performance start from the choice of the type of inverter and its control, passing through the LCL filter, to the control of the sinusoidal PWM switches. Starting from the literature indications that the most suitable converter is a voltage source inverter (VSI) and adopting the control strategy in current mode with the transformation of the static coordinate system to the dq orthogonal system, which transforms a problem of synthesis of three-phase quantities balanced in a regulation problem, it brings great ease when in its implementation in digital processors, with auto modulation index without distorting the converter voltages and currents producing a low harmonic content. A good dimensioning of the LCL filter and the standard use [5] and [6] produce a satisfactory performance. For this work, a LABVIEW tool was developed that allows a dynamic visualization of the LCL filter behavior that allowed to analyze whether the calculated values were within the criteria, in addition to being able to test the behavior with several input waveforms, frequency analysis and possibility produce the equation of the transfer function and the space-state

equations, among others. An important fact is that the calculation of the resonance frequency of the filter in relation to that calculated by the tool produced an error of 0.02 Hz, which was due to the approximation errors. A good tuning of the PLL controller, therefore, a good estimation of the lag angle produced the synchronism with the electrical distribution network, consequently, a strong contribution to null error in steady state. The way to calculate this PLL actuator can be found in [14]. Finally, the transformation technique for orthogonal coordinates dq allows the control of the flow of active and reactive power, independently, contributing to the condition of null error in steady state.

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Environmental Perception of Beauty Center Professionals on Solid Waste Management with Biological and Chemical Risks

Tamilyn Alencar Fontes de Freitas[1], Regina Celli Sarkis Muller[2], Érika Dávila Cardoso[3], Adriana Miranda Azevedo[4], Vanessa Martins Fernandes Pinheiro[5]

[1,3,4] Master's student in Science and Environment from the Federal University of Pará - UFPA.

[2] PhD in Chemistry from the University of São Paulo and Professor of the Postgraduate Course in Science and Environment - Professional Master's Degree, at the Federal University of Pará - UFPA.

[4] Physiotherapist and Master in Production Engineering from the Federal University of Amazonas - UFAM.

Abstract— The management of solid waste is part of the study of biosafety aimed at professionals in the beauty area, as they need to identify the possible limitations of an establishment in terms of safety, so as to minimize the risks that exist in that work environment during the handling of a certain composition. The risks that can be pointed out are classified by biological, chemical, physical, accidental and ergonomic, however in this work attention will be paid to solid waste with biological and chemical risks. Thus, the general objective of the present work is to sensitize the professionals of beauty establishments about the environmental impacts caused due to the poor management of solid waste disposal with chemical and biological risks. For that, it was used as methodology the descriptive and exploratory research, as well as the research in fields, where it was made collection with the employees of beauty salons of different zones of the city of Manaus. The results show that although the professionals have a knowledge of biosafety, it is still superficial and the necessary behaviors are not always adopted to safeguard their and customers' safety. As evidenced in a report by the professionals interviewed, the need for education and training in environmental issues, such as solid waste management and others, is considered. One of the biggest challenges is to obtain the permanent involvement of employees and responsible managers. The study alludes that the employees involved, working in groups and internal facilitators, supported by external experts, can develop their actions with more confidence and efficiency. The involvement of the external specialist with the participative management of the projects, involving other employees, is inherent to the development of environmental management programs in this market segment.

Keywords— Biosafety; Solid Waste; Awareness; Beauty professionals.

I. INTRODUCTION

Professionals specialized in beautification can work in the most diverse areas of aesthetics, and can be facial, body and capillary. Making use of the most diverse cosmetics and procedures such as hair removal, massages, haircuts, dyeing, relaxation, hydration, skin cleaning, makeup, manicure, pedicure and several others ,. They also work on skin rehabilitation and its attachments with the objective of stimulating the client's well-being, in aesthetic clinics, beauty salons, SPAs and sometimes even at home (GERSON, et al., 2011; GOMES & DAMAZIO, 2009 ; HALAL, 2010; REBELO, 2004).

Beauty establishments / centers are built with the objective of serving the population that seeks to highlight the most beautiful in itself, due to the concern with beauty and youth. This population is made up of different age groups and economic classes, reaching from the lower classes to the upper classes, in which they are increasingly demanding in beautification services. As a result, it is necessary to train professionals increasingly trained in knowledge and techniques, so that they can carry out their work in an ethical and efficient manner. In this context, it is important that these workers understand about chemical materials and compounds that are normally used and the

risks and benefits they cause to human and environmental health.

The Regulatory Norm of ABNT NBR 10004/2004, in its item 3.1, defines solid waste as: solid and semi-solid waste are the result of activities of industrial, domestic, hospital, commercial, agricultural, and other services, included those from water treatment systems, as well as liquids discharged into the public sewer network.

In this sense, beauty salons, due to their characteristics, use chemical products that strongly impact water, being therefore considered spaces that generate a large amount of solid waste.

The management of solid waste is part of the study of biosafety aimed at professionals in the beauty area, as they need to identify the possible limitations of an establishment in terms of safety, so as to minimize the risks that exist in that work environment during the handling of a certain composition. The risks that can be pointed out are classified by biological, chemical, physical, accidental and ergonomic, however in this work attention will be paid to solid waste with biological and chemical risks. The residues with chemical hazards produced in beauty establishments are mainly composed of packaging of chemical products previously used for the production of beautification in clients or patients, whereas the solid residues with biological hazards are generated through sharps potentially contaminated by viruses, bacteria or fungi. Many of the workers, due to the lack of knowledge, do not have sufficient training to correctly dispose of this material, thus resulting in the disposal in common dumps, which have consequences for population and environmental health, causing pollution of soil, air and even pollution. water, items of extreme importance for human survival.

Anvisa (2014) determines as biosafety standards for any beauty salon, hairdresser, barber and similar services: being independent of residence, having its own place for washing materials, always being clean and airy, cleaning combs for each client, brushes, bobies, etc., use clean towels for each customer, use only products registered with Anvisa, keep chairs and stretcher mattresses covered with impermeable material, have a sanitary license, do not use products containing formaldehyde and maintain routine sterilization of materials in invasive procedures.

It is noteworthy that, to date, there is no specific national waste plan for health establishments and the lack of knowledge of environmental standards generates great damage to the environment.

Ramos (2009) points out that biosafety constitutes a whole set of functional and operational processes aimed at

promoting the health culture within the health community and others interconnected to it. Its objective is to preserve the environment by controlling waste handling and disposal, preventing health risks and occupational accidents, as well as developing actions to control infections, which makes it vitally important for services health and, by extension, beauty. As a result, it is intended to include beauty establishments in the knowledge and practice of technical and scientific information on biosafety, teaching and transmitting a whole series of standardized conducts and routines.

Thus, it is considered that the correct disposal of waste produced from these establishments will be contributing to the environment, through a socio-environmental vision of waste management, being an innovative and intelligent attitude.

This study will be of great relevance, as it aims to raise the awareness of aesthetic professionals about environmental problems caused by the lack of concern regarding the management of these residues.

Thus, the objective of this article is to raise awareness among beauty establishment professionals about the environmental impacts caused due to poor management of solid waste disposal with chemical and biological risks.

II. MATERIALS AND METHODS

In the first stage, a bibliographic survey of studies that discuss the issue of biosafety was carried out, in particular, in beauty establishments.

Then a questionnaire was applied to professionals working in the specific area of beautification, being they from all and / or any area (east, west, north and south) of the Municipality of Manaus, capital of the State of Amazonas, in which it was identified how these professionals perform their tasks and dispose of their waste. The questionnaire was applied in order to understand the risks and safety in carrying out their tasks, from their own perspective.

The questionnaire was directed and collected to all study subjects through personal contact, always emphasizing that participation was voluntary.

In parallel, two beauty establishments were visited, located in the same Municipality mentioned above, in which observation work was carried out, in order to verify the common activities of solid waste management. This observation was carried out in order to contribute to the results obtained throughout this research.

For those who agreed to participate, it was requested, in compliance with Resolution No. 466/2012, to sign the Free and Informed Consent Term, since it is a questionnaire applied to adults. The same was applied in October this year.

Bearing in mind that the intended research involved, in the quantitative phase, a questionnaire with professionals in the area of selected establishments, all ethical aspects of research involving human beings contained in Resolution no. 466/12, of the National Health Council, such as:

a) The request for authorization from the establishments to conduct the research - Letter of Consent;

b) The free and informed consent of professionals, research subjects and the protection of vulnerable groups and those legally incapable (autonomy), who will always be treated in their dignity, respected in their autonomy and defended in their vulnerability, being developed preferably in individuals with full autonomy;

c) Obeyed the appropriate methodology, relying on human and material resources necessary to guarantee the well-being of the research subject, with an adjustment between the competence of the researcher and the proposed project;

d) Confidentiality and privacy have been ensured;

The knowledge that was intended to be obtained through the quantitative analysis was only possible through the questionnaire, therefore, it is justified because it is not possible to obtain it by another means.

In view of the results and with all the available data, a booklet with biosafety rules was prepared for professionals and beauty salons who agreed to participate in the research. same (professionals) were invited, those who answer the questionnaire. Finally, the establishments selected for the observation work contributed to the qualitative analysis.

III. RESULTS

This chapter corresponds to the analysis and interpretation of the data collected with the professionals and in the researched enterprises. The data collected were based on questionnaires and direct observations.

With the intention of capturing information inherent to the research, the work started with the presentation of the project and the research proposal to the beauty salons that served as a basis for direct observation as well as the professionals. These first contacts had the intention of exposing the research objectives, collecting information for directing and planning the tabulation of the data to be collected, looking for guidelines and legal indicators in the area of personal image. It was noticed in the first meetings that the environmental issues were of interest to the owners, but the main concern was with health surveillance rules and laws and their inspection, which caused distrust on the part of some professionals at the beginning of the interviews.

This limitation was soon solved with the preliminary presentation of the academic study declaration, the research proposal with the description of the action and a term of consent for the free and informed consent with the managers of the undertakings to carry out the data collection. The questions and direct observations sought to follow the practices, seek bibliographic references and documented evidence of the actions.

The research was subdivided into the questionnaire phases, analysis of the characteristics of the ventures aimed at the aesthetic market, their aspects and environmental impacts, following a proposal for waste management. For the development of the research, two establishments in the urban area of Manaus were selected for direct observations, inserted in the beauty salon sector. The number of professionals was a total of 120 employees, including contractors and freelancers. According to information from the Union of Salons of Barbers, Hairdressers, Beauty Institutes and Similars of Manaus - SISBISIM (2017), there are 780 formalized enterprises in the city of Manaus, with a total of approximately 9,000 establishments considered formalized and informal.

The inclusion criterion of each establishment for the research was: to be formalized, to consent to the study and to sign the informed consent form after presenting the proposal with the research objectives. The exclusion criterion for the investigation was: not being formalized, not consenting to the study and not wanting to sign the informed consent form. A project was excluded because it did not consent to the study, claiming that they did not have the time and people to collaborate. Such occurrence did not harm the study, because by similarity, another undertaking was chosen for the investigation, keeping the two proposed.

3.1 DESCRIPTIONS AND ANALYSIS

3.1.1 Description of the projects observed

In view of the characteristics mentioned above, the observation establishments were visited in the urban area of Manaus, this area is inserted in the south-central area of the city with different structures and clientele, but with similar productive activities. The enterprises identified themselves as beauty salons located on public roads. The names of the undertakings were kept confidential, as a condition for research consent.

The establishments visited offer hair services (cutting, dyeing, brushing, straightening), manicure / pedicure, waxing, facial / body aesthetics, makeup and some include professional podiatrists. The number of assistants ranged from 5 to 10 employees and 10 to 15 outsourced workers. The outsourced are independent professionals who occupy a place in the enterprise and are paid on commission for the service provided.

Regarding the approaches and the productive process of the beauty salons visited, according to what is described in Chapter 3, the following activities and their production processes were observed:

Cut, brush and dye hair

a) Cut

The service begins with the study and definition of the cut. The next step is to wash the hair in the washbasin using water, shampoo and conditioner (Figure 1).

Fig.1: Washbasin.

Source: Direct observation, 2019.

Then, the hair cut will be taken to the trash (Figure 2) shortly thereafter.

Fig.2: Trash.

Source: Direct observation, 2019.

In the case of male cuts, most go to the washbasin after cutting to remove the tiny pieces of hair, which will then go directly to the sewer. And, even in the short male and female cuts, it is observed that after cutting, there is an end with an electric cutting machine for finishing and / or using a razor with a disposable blade. It is noted that the cutting blade scrapes the hair along with the surface of the skin and is then disposable in the common garbage. It was not possible to analyze any process of hair removal with a razor in a beard, but it was reported that the blade disposal process is the same, except for establishments with podiatrists who, because they have a container for sharps, this material goes to the product box, waste from health services on public roads, to be collected by the company associated with the public service.

b) Brush

In the brush process, the process starts in the hair wash with shampoo and conditioner washing (Figure 3). Many cases of female hair are observed to be hydrated with creams or oil baths that should remain in the hair for a few minutes before removal and is occluded with aluminum foil.

Fig.3: Hair washing

Source: Direct observation, 2019.

After rinsing very well several times with water, to exclude the entire product, the client returns to the chair for

the brush with dryer and the flat iron (flat iron). Each professional has their hair dryer connected to their workbench. Often the hairdryer is used first and then the straightener in the hair. While the hair is drying the board is connected to a feeding source for heating the plates. At the end of the process, a product in the form of a spray, cream, lotion, oil or gel is applied as a hair fixative.

Project A, right after the first visit, as noted and the report of the administrator of the same, quickly created on its own initiative, a dump of biological products (Figure 4) for hairdressers and manicurists and dumps of common waste (Figure 5) in a location easily accessible and visible to customers and employees. In this same project, it was reported that there was a drain of fabric in the washbasin to support the hair remnants, protecting the environment and reducing the risk of plumbing clogging. It was also advised to periodically maintain and clean the air conditioning to ensure good quality of the air conditioning. air conditioning. The people in charge of the other project, as they are not the majority owners, have committed to take the improvement proposals forward, as they understood and became aware of the benefits not only in reducing costs, but also in improving the quality of customer service. In this way, it would be possible for the population to be more secure, contributing to the environment. This initiative could be a differential in the competitive market.

Fig.4: Recycle bin for organic products.

Source: Direct observation, 2019.

Fig.5: Dump of common waste.

Source: Direct observation, 2019.

c) Dyeing / straightening

For coloring or straightening, the professional observes the length of the hair and if it is natural or if it has already suffered some type of chemical. An analysis is also made as to the type of hair. Once the diagnosis has been made in view of the customer's evaluations and information, we proceed to the preparation of the chemical, which can be dyed with 20 or 30 volumes hydrogen peroxide, bleach or reagent, smoothing pastes, among others. In the case of locks in the hair, aluminum foil is used, which will be discarded with the chemical. After applying the product to the customer's hair, a specific time is required for the product's action, depending on the service to be performed. It was observed that when the coloring is not enough, the professional prepares a little more of the mixture and the leftovers are thrown into the washbasin. This procedure shows the loss and disposal of the toxic product to the environment. After the desired time, the hair it is washed with shampoo, conditioner and goes for drying with a hairdryer and board in most cases. In this process it is observed that there are odors characteristic of the mixture of the products in the customers' hair in the salon, but there was a report that there is no complaint from the customers. It is noteworthy that the halls observed are well lit and have an air conditioning system. In this context, an environment with atmospheric emission pollution and a high consumption of electrical energy is suggested.

d) Manicure / Pedicure

The workstation is prepared to receive the customer with the materials sterilized in the autoclave (pliers and stainless steel spatulas), as shown in Figures 6 and 7, disposable materials (foot and hand sandpaper, wooden toothpicks, gloves and boots). plastic with cream inside) and other materials for the preparation of the service (acetone, cotton, enamel, exfoliating, moisturizer).

Fig.6: Autoclave.

Source: Direct observation, 2019.

Fig.7: Sterile materials.

Source: Direct observation, 2019.

As directed by the Health Surveillance Division (DVSA) and the Hairdressers Union, the packaging of sterilized materials in the autoclave, as well as the packaging of disposables must be opened in front of the customer and the disposable materials must be discarded immediately after the use of each customer. Foot files must have a washable plastic base with a rough, sticky part that can be disposed of in the trash. It was observed the use of disposable plastic wraps to pack basins with water for feet and hands only in Enterprise A.

The beginning of the procedure performed by the professional is the removal of nail polish with cotton and acetone or nail polish remover. Then rinse with water and gloves or boots are put on with moisturizer to help remove cuticles (protective film of the nailfold that often advances the nail blade and makes it difficult to install the enamel). After a few minutes, the cuticles are pushed with a metal spatula and removed with pliers of appropriate cut. The nails can be cut with metal scissors and sanded after removing the old enamel. Then, the application of enamel and the removal of excesses with acetone soaked in cotton with wooden toothpick on the sides of the nails are observed. Cottons with enamel and acetone residue are discarded in the common garbage of establishments, as well as the cuticle skins that fall on the floor and are swept along with the hair residues and thrown in the common garbage container as well. The salons observed use the basins with water, and this material containing water, skin residues and cosmetics is discarded in the hall's sewage system.

3.2 QUESTIONNAIRE ANALYSIS

Firstly, we sought to outline a socioeconomic profile of the interviewed subjects, from the North, East, West and South Zones, 30 from each zone, as shown in the graphs below.

The largest number of respondents is in the age group of 31 to 45 years, with a total of 62 professionals, with the West Zone having the highest rate (17). The age group from 60 to 65 years is the least professional. In a survey conducted by SEBRAE in São Paulo, it is revealed that there is no age limit for working, a long-lived career, corroborating with the data of the present study. There are more married professionals (65) than single (50) and a small number of widowers (2).

It appears that the prevalence is of professionals with secondary education (69) and lower education in elementary education (15). Attention is drawn to the number of professionals with higher education (36), corroborating the findings of the study by Garcia, Bento and Gonçalvez (2012), which points out that professionals

today seek greater and better qualification, especially with the variety of Technological courses offered by higher education institutions.

Most professionals (72) receive from 1 to 5 minimum wages; 29 receive up to a minimum wage; 18 from 5 to 10 minimum wages and only one above 10 wages.

Professionals who work with hair admit that the industry is promising and that they get a good salary. According to data from Senac de Patos de Minas (2015), those who are starting can receive, on average, two and a half salaries. Those who work in the area, from R $ 3 to R $ 7 thousand per month.

There is a prevalence of hairdressers (79); manicures (29) and beauticians (12). There is no concrete data on the number of these professionals in the city, according to the Union of Barbers', Hairdressers, Beauty and Similar Institutions in Manaus (SISBISIM).

A significant majority of respondents have an effective contract with companies, with a total of 95 professionals; 25 are hired under the temporary regime. According to information from the Union of Barbers' Salons, Hairdressers, Beauty Institutes and Similars of Manaus - SISBISIM, there are 780 formalized enterprises in the city of Manaus, with a total of approximately 9,000 establishments covering formalized and informal.

It should be noted that Law 13,352, of October 27, 2016, amended Law 12,592 / 2012, to provide for the partnership contract between professionals who perform the activities of hairdresser, barber, beautician, manicure, pedicure, epilator and makeup artist and legal entities registered as a beauty salon.

It appears that most professionals have their own work tool, especially those in the South Zone, which has them in full.

Graph 1 shows the main procedures adopted for individual protection and Biosafety.
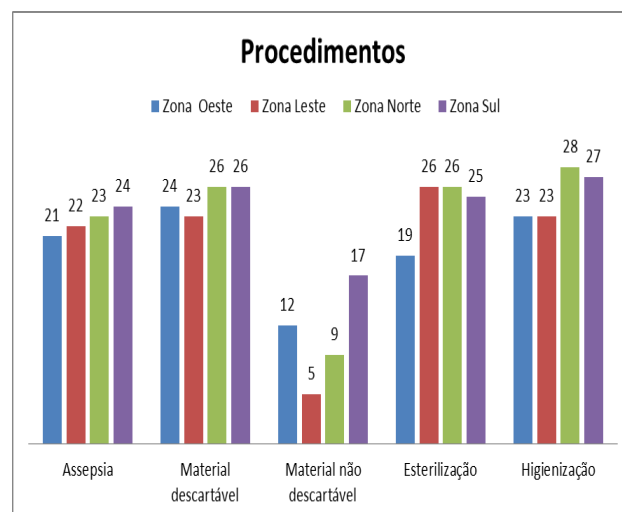
Graph 1: Regarding the interviewees' biosafety procedures.

Source: Field research, 2019.

According to Graph 1, the procedure most adopted by the interviewed professionals for individual protection and Biosafety is disposable material, with 99 respondents pointing out this alternative, however, sanitation presented the highest number of statements (28) in the northern zone of Manaus.

Most respondents use gloves, revealing that in the East Zone, all professionals use this protective feature; the least used is the hat. Garbaccio and Oliveira (2013) reinforce that disposable gloves are considered a type of PPE. They alone provide essential security for the care of both professionals and clients. And despite its importance, even as an ANVISA regulation rule, this is not taken as seriously as it should.

The greatest knowledge of the interviewed professionals is about the flu, hepatitis and AIDS, with leprosy and scabies still being neglected by the subjects.

Regarding the management of solid waste, it was questioned whether there is a separation of chemical and organic waste (graph 2).
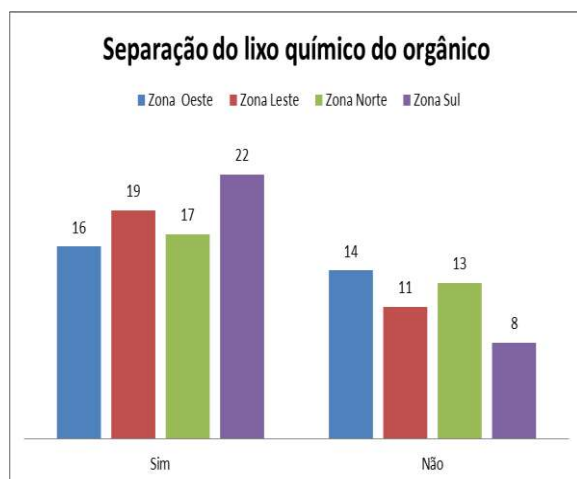
Graph 2: Regarding the separation of organic waste from chemical waste by respondents.

Source: Field research, 2019.

According to data in Graph 2, professionals from the South Zone mostly perform the separation of chemical and organic waste (22) and in the West Zone there is a smaller number (17).

It was also questioned whether the separation of residual toxic waste, empty paint tubes and containers containing other chemicals is performed (Graph 3).
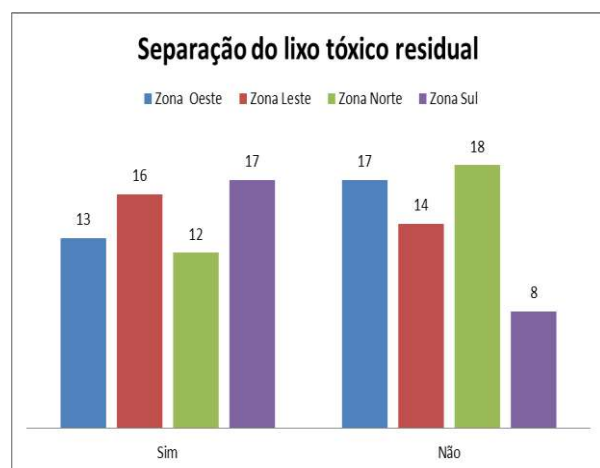
Graph 3: Regarding the separation of residual toxic waste by respondents.

Source: Field research, 2019.

According to Graph 3, most toxic waste is separated (17) by professionals in the South Zone of Manaus and not in the North Zone (18).

Most (14) of the professionals dispose of sharp and cutting materials such as blades and needles in the descarpak; In the West Zone, the most usual way is to dispose of it in the common garbage; and in the East Zone, other means of disposal are used.

In establishments where professionals work in the South Zone (16), there is an adequate place for segregation, packaging, identification and storage until external transportation. In the West Zone there is no such procedure (21).

Unfortunately, the survey data reveal that the enterprises, according to the interviewees, do not hire special collection services, especially in the East Zone of Manaus.

It was found that the establishments are not performing the proper separation of the waste generated. Through this diagnosis, it was found that the vast majority do not have knowledge of how to perform the separation of waste, as well as do not have a specialized company to do the collection and end up disposing of the waste together with the public collection of the municipality.

IV.   CONCLUSION

A model aesthetic establishment is one that performs the activity in a socially responsible manner, with ethical performance in the economic, environmental and social spheres. Currently, there is a growth of the aesthetic branch in society, therefore, the topics of biosafety and waste management of health services in these places should receive greater importance. Aesthetic establishments are spaces of intense flow of people, therefore, conducive to the spread of diseases. Thus, both professionals and customers are susceptible to health risks.

In this sense, the present study sought to contribute to the theme of waste management and biosafety practices in aesthetic establishments, demonstrating the importance of the subject, in order to measure the real health risks of the population living in the city of Manaus.

As for the method used in this research, it was satisfactory, because through the interviews, deficiencies in the disposal of waste were found in all stages of the management of the RSSS in the establishments visited, which are associated with the lack of knowledge on the subject by service providers.

As relevant results of the research, the following stand out: the opportunity for the researcher to know and make known the visited establishments internally, reinforcing the subject and its importance; the interviewees' point of view; having the opportunity to gain knowledge on the topic and stimulate the exchange of information, as well as establishing new attitudes to follow.

The present study made it possible to identify the lack of knowledge of professionals in the aesthetic field about the management of waste from health services. The results draw the challenge of the establishments regarding permanent education, with an approach to the Health Services Waste Management Plan, safety at work and the environment. The inclusion of topics related to waste management and the impacts of the production of this waste on the health of populations and ecosystems in curricular disciplines, training campaigns, continuing and permanent education on the generation, segregation, storage and collection of waste could prepare professionals to meet society's current demands regarding the production and disposal of waste.

RDC nº 222/2018, does not differentiate the services that generate waste from health services in terms of the administrative sphere or the nature of the organization and emphasizes the inclusion of aesthetic and beautification services, as generators of health services. Thus, it is understood that there will be greater inspection in these establishments, as well as greater demands from health and environmental agencies.

As evidenced in a report by the professionals interviewed, the need for education and training in environmental issues, such as solid waste management and others, is considered. One of the biggest challenges is to obtain the permanent involvement of employees and responsible managers. The study alludes that the employees involved, working in groups and internal facilitators, supported by external experts, can develop their actions with more confidence and efficiency. The involvement of the external specialist with the participative management of the projects, involving other employees, is inherent to the development of environmental management programs in this market segment.

With the preparation of this research, it is also expected that future projects will be developed in the aesthetic field, serving as a bibliographic source and also as an incentive for the continuation of this study. It is the responsibility of the National Association of Beauticians and Cosmetologists (ANESCO) as well as the Union of Barbers', Hairdressers, Beauty and Similar Institutions in Manaus, universities, technical schools, public bodies and private companies connected to the area to present information to professionals, emphasizing the correct conduct of biosafety and waste management, bringing, as a consequence, the improvement of services provided and sustainable development.

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The Balanced Scorecard as a Tool for Managing Strategic Decision Making

Maria Erilúcia Cruz Macêdo, Antoniel Dos Santos Gomes Filho, Antonio Wilson Dos Santos, Maria Bonfim Carmo Mascena,

Centro Universitário Vale do Salgado (UNIVS), Icó – Ceará, BRasil

Abstract— *Organizations, in order to remain warm and updated in the market, are looking for new ways to analyze performance and outline improvement measures. The Balanced Scorecard - BSC, appears as an innovative tool and capable of analyzing the company in a broader view and, thus, allowing its managers an easier way to execute their strategies in order to achieve the expected objectives. This article aims to propose the use of the BSC as a tool to support decision-making, demonstrated in a descriptive manner based on bibliographic research. Throughof research, it was possible to observe significant changes arising from the use of the tool in question, bringing to the studied organization, greater understanding in the management process, improvements in growth and achievement of the goals set.*

Keywords— *BSC. Tool. Strategy.*

I. INTRODUCTION

Controllership in response to the evolution in the management processes of organizations to fulfill their function, has been adopting tools capable of producing responses before challenges in the decision-making process (BEUREN, 2002).

Taking into account the aforementioned fact, it is undeniable that, in view of the considerable increase in the application of controllership, it became necessary to search for tools that, in aggregate, would have a greater impact compared to the main objective of organizations. With this in mind, Norton and Kaplan, motivated by the belief that the existing methods for assessing business performance, generally supported only by accounting and financial indicators, created the Balanced Scorecard (BSC), a tool capable of seeing other dimensions and thus reaching planned strategic objectives.

Therefore, it is necessary that there is a deepening about this tool, taking into account its breadth, dimensions and modernity in view of the organizational needs since, continuing with traditional strategic plans, no longer match the reality and expectations coherent to the proper functioning of a company.

In view of the role of controllership in the management process, it is perceived the importance of it to the BSC tool as it is a system capable of showing performance beyond financial and non-financial, which has a direct influence with the realization mission and business strategy, leading to the following question: How important is BSC in decision making?

Thus, it is necessary to analyze and present the Balanced Scorecard as an important control tool in decision making aiming to write about the Controllership and its contribution to the management as well as to analyze the management decision making from the BSC and to discuss the relevance of the control as a tool for organizational effectiveness in order to clarify to organizations about the possibilities of its evaluation and growth.

For this purpose, as a methodology, a descriptive and exploratory interview was conducted in a company in the disposable and hygiene products distribution business that has been in the market for over 15 years and serves the entire interior of Ceará, Paraíba and Pernambuco with 64 employees and more than 1,500 different items in your inventory.

As a result, it was possible to observe that some objectives such as the alignment in strategic processes, their analysis before customers and their collaborators , performance analysis , strategic learning in order to decide and control and mainly, the impact on the decision-making process decisions, emphasizing that, although some goals do not reach 100%, it will continue to use and indicate the Balanced Scorecar to other

organizations and making it clear that, in support of decision-making, the BSC was able to analyze its situation in a broad way, making it easier for managers assertive.

II.   THEORETICAL FRAMEWORK

CONTROLLER

In order to meet the evolution of accounting science, organizational and user requirements, it was necessary to have a new function capable of controlling the needs of the company in order to ensure its continuity and manage it in a broader sense, initiating the Controllership process.

According   to M osimann and Fisch, (1999) , co-control is the set of principles, procedures and methods from the sciences of administration, economics, psychology, statistics and, mainly, accounting, which deals with the economic management of companies, with the purpose of guiding them towards effectiveness .

For Padoveze, 2010, controllership is responsible for the company's management accounting information system, and its mission is to ensure the company's results. To this end, it must act strongly in all stages of the company's management process, under penalty of not exercising its control and reporting function properly in the planning correction".

These authors, controllership was born, mainly, from the need for a broader management that would supply the new demands that arose during its evolution, leaving aside the only profitable view analyzing other dimensions and theories pertinent to decision making.

Controllership is able to assist managers and control activities for the execution of the company through its four main distinct functions (CAVALCANTI, 2001);

a) Planning: Manage the process of identifying what needs to be done, the deadline for execution and how it should be done. This process is dynamic, since it seeks to highlight the resources available and necessary for the company to face the competition;

b) Organization: Seek to identify qualified professionals, technology and facilities so that the Controllership can fulfill its role effectively;

c) Management: Ensure synergy between human, financial, material and technological resources, aiming at fulfilling the company's mission and future vision;

d) Evaluation: Develop a system for measuring the objectives and goals established by the company in order to interpret the results achieved by the company, so that it can define trends and interrelations between the variables that

are affecting, in a positive and / or negatively the company's business.

It is clear that the role of controllership is to support the organizational functioning process adopted from planned strategies relevant to each area and function of the companies.

For Padoveze (2004), the controllership's mission is to support the business management process through its information system, which is a management support system.

In the view of Catelli (2001), the controllership's mission is to ensure the optimization of the organization's economic result.

It is clear a more intense connection of control came and accounting, so Catelli (2001, p. 37) , the author reports on the responsibility of controlling by the Accounting Management Information System in order to ensure the results can assume s regulatory functions. In this way, it divides the controllership into the accounting and tax area, which is responsible for corporate, tax and custody information and the planning and control area, incorporated by the budgetary part, projections and simulations, costs, and accounting by responsibility. In addition to these activities, the controllership must be aware of the influences of its internal and external environment and the necessary changes in its management process while maintaining the integrity of the company.

Controllership in turn assists the management process as a management unit for information systems, in the decision-making process (MOURA and BEUREN, 2000).

Padoveze, (2012), explains the decision-making process as a logical sequence of steps that express the rationality with which managers seek optimal solutions to the company's problems.

In the opinion of the aforementioned authors, controllership plays a supporting role and guarantees its continuity based on strategic plans carried out in stages designed according to the reality of each company reaching the decisions relevant to its continuity in the face of obstacles.

In short, controllership stands out as an organ of control support and manager that is indispensable to organizations, since it sees and analyzes the company in a broader perspective.

2.2 FUNCTION OF THE CONTROLLER

According to Beuren (2002), controllership has some basic functions: supervision of general accounting,

cost accounting, auditing, taxes, insurance and statistics; application of the accounting function to solve future administrative problems.

Kanitz (1976) cited by Mosimann and Fisch (1999), establishes as a primary function of controllership the direction and implementation of the systems of:The. Information: comprising the company's accounting and financial systems, payments and receipts system, payroll etc.

Motivation: related to the effects of control systems on the behavior of people directly affected.

Coordination: aiming to centralize information with a view to accepting plans from an economic point of view and advising the company's management, not only alerting to unfavorable situations in some area, but also suggesting solutions.

Evaluation: in order to interpret facts and evaluate results by result center, by area of responsibility and managerial performance.

and. Planning: in order to determine whether the plans are consistent or viable, whether they are accepted and coordinated and whether they can really serve as a basis for further evaluation.

Monitoring: related to the continuous verification of the evolution of the plans drawn up for the purpose of correcting failures or reviewing the planning.

Uniting the thoughts of the aforementioned authors, it is possible to clearly meet the organizational requirements, taking into account that these functions are exercised by the Controller , that is, the professional responsible for controlling.

2.3 CONTROLLER FUNCTIONS

For An thony and Govindarajan (2011), the *controller* generally performs the following functions as responsible for the design and operation of the management control system:

- Design and operate the information and control systems;

- Prepare statements, financial reports and non-financial reports;

- Making and analyzing performance reports;

- Supervise the internal audit and accounting control procedures;

- Develop the capacity of personnel in your area and participate in the improvement of management level personnel in matters related to the Controllership function.

Figueiredo and Gaggiano (2004) emphasize that the functions of the controller are not restricted only to

accounting functions and what is most expected is that he will expand his performance to the development of accounting in management applications.

Thus, the controller plays a fundamental role in controllership, giving companies, the stakeholders interested in the management process in order to guarantee its integrity.

III.   BALANCED SCORECARD

As the organizational field suffers challenges and calls for survival, new management techniques are implemented with the purpose of obtaining agile and satisfactory results to the established standards.

With that in mind, Robert Kaplan and David Norton, professors at Harvard Business School, 1982, based on studies, developed a tool with the aim of offering managers new perspectives for performance analysis far beyond financial measures, and the main objective was to investigate whether companies were over-measured by the financial side and what risks they suffered as a result.

With the publication, in 1992, of an article in Harvard Business Review entitled " *The Balanced Scorecard that Drive Performance* ", the Balanced Scorecard (BSC) tool became known (Kaplan and Norton, 1997) . Some organizations started using BSC, always under the guidance of its creators, Kaplan and Norton. With the passing of the top, the tool was improved, moving from its initial concept of performance measurement tool to the more noble use, that of clarifying and communicating the strategy and managing it.

The BSC measures organizational performance through four distinct and complementary perspectives (Kaplan and Norton, 1997): financial perspective, customer perspective, internal process perspective and learning and growth perspective.

For Lunkes (2007, p.170) cited by Oliveira, (2011):

> The BSC consists of an integrated set of performance measures that are derived from the company's strategy. Thus, these measures direct, monitor and evaluate the evolution of the organization's strategic objectives. In this way,

the BSC assists the company's top management in translating the strategy, making employees understand and develop actions aimed at achieving the objectives and

goals; consequently, the method helps to carry your strategies into the day-to-day business.

For Kaplan and Norton (1997), the BSC is an innovative model for business performance and evaluation, which acts as a support system for decision and strategic management. Literally, it means, "Balanced performance indicators".

They understand, therefore, that the BSC is a management methodology that allows the conduct of its strategic objectives until the action, covering the organization in its vertical and horizontal forms, so that the results are achieved and each component is able to have its own BSC and thus, understand the needs of the organization.

Thus, it is clear that the application of this management tool, the Balanced Scorecard, is extremely important since, as a strategic differential, it allows the company to evaluate its performance in the short and long term based on perspectives and theories that certainly will favor making better decisions.

3.1 BALANCED SCORECARD OBJECTIVES

For Bezerra (2014), "the main objective of the Balanced Scorecar is to achieve the alignment between the company's strategic planning and the operational activities it performs. It translates the mission and strategy into objectives and measures, organized through indicators that will inform employees about the vectors of current and future success. When articulating the results desired by the company, the executives hope to channel the energy, skill and knowledge of all employees of the organization to achieve long-term goals.

For that, it is necessary to take some actions, such as:

➢ Clarify and translate the vision and strategy: companies often do not have a clear vision or strategy. Having them in a well-informed manner by everyone facilitates the organization's success. The Balanced Scorecard

(BSC) helps to clarify what actions should be taken, through a list of causes and effects;

➢ Plan, establish goals and align strategic initiatives: the definition of objectives brings employees' commitment to their achievement. Said earlier, that it is necessary that everything is clear and with well-defined goals, easily understood by everyone involved;

➢ Communicate and associate strategic objectives and measures: employees are only committed to the organization when the goals and objectives are aligned with what the managers intend. Thus, employees must really feel the need to achieve the goals set and "wear the shirt" of the company to achieve them, and this is only done when there is clear communication between all hierarchical levels as to the importance of each of them for the the success not only of the company , but of the individual who is in it;

➢ Improve feedback and strategic learning: monitoring the organization is essential to know how things are working or not. This is done through your prospects .

3.2   BALANCED   SCORECARD   (BSC) PERSPECTIVES

According to Cabral (2016), "the BSC translates the mission and strategy into objectives and measures, organized according to 4 different perspectives: financial, customer, internal processes and learning and growth, which represent the main variables of the organization that in balance, they will provide managers with conditions to plan and control strategic actions".

3.2.1 FINANCIAL PERSPECTIVE

The main indicators and goals established in this perspective are related to the growth and *mix* of revenues, the reduction of costs and the improvement of productivity, the use of assets and the investment strategy. Financial objectives serve as a focus for the objectives and measures of other perspectives, in a chain of cause and effect relationships that culminate in the improvement of financial performance (CABRAL, 2016).

Gusmão and Batista (2010) , confirm that these indicators show whether the implementation and execution of the company's strategy are contributing to the improvement of results. Typical financial goals relate to profitability, growth and shareholder value.

3.2.2 CUSTOMER PERSPECTIVE

For Cabral (2016), the indicators (results measures) from this perspective represent goals for the

operations, logistics, marketing and development of companies' products and services. Are they:

1. Market share : proportion of business in a given market;

2. Customer acquisition: intensity with which new customers or businesses are conquered;

3. Customer retention : the intensity with which a business unit maintains ongoing relationships with its customers;

4. Customer satisfaction : customer satisfaction level according to specific performance criteria within the value proposal;

5. Customer profitability: net profit of customer or segment, after deducting specific expenses to support these customers.

This perspective requires a wide translation in order to protect the client in all its aspects, understanding the client as a fundamental part of the company's growth and progress.

3.2.3 PERSPECTIVE OF INTERNAL PROCESSES

According to Cabral (2016), the processes of a company focused on the customer start with activities with the understanding of the customer's need and end with the delivery of the expected value quickly and at an appropriate cost. In addition, such processes must aim at the profitability of the business and consequently that of the shareholders.

Gusmão and Batista (2010) , confirm that these indicators should reflect the organizational processes that have the greatest impact on customer satisfaction - factors that, for example, affect the duration of the cycles, quality, the ability of employees and productivity. Companies must also strive to identify and measure their core competencies, the critical technologies necessary to ensure continued market leadership.

3.2.4 LEARNING PERSPECTIVE AND GROWTH

Kaplan and Norton (2004) suggest that the following question be used to guide the process of assembling the learning and growth perspective: *"to achieve our vision, how will we sustain our ability to change and improve"* ?

The organization's learning and growth comes from three main sources: people, systems and organizational procedures. It is the basis for achieving the objectives of the other perspectives, representing the greatest interest of the chief executive and the architects of the long-term business plan. It also identifies the capabilities that the company must have in order to achieve

internal processes capable of creating value for customers and shareholders. As important indicators can be considered: level of employee satisfaction, employee turnover, profitability per employee, employee training and training and employee participation with suggestions for reducing costs or increasing revenues (BALZANI, 2006).

In agreement with the authors, it is correct to state that this perspective is of great importance since, adding the vision, values and understanding of the BSC, it is possible to measure the degree of satisfaction of those who make the organization and thus generate growth and improvement to achieve the objectives.

3.3 BALANCED SCORECARD AS A TOOL FOR DECISION MAKING

Modell (2009) reports that in the last two decades, a wave of innovations in management and control practices has been witnessed to enable companies to remain competitive and active in the market. The BSC can be mentioned among the biggest innovations.

According to Kaplan (2004, p.530) mentioned by Ribeiro, Costa and Costa (2013), the Balanced Scorecard model reflects the first attempt to develop a performance measurement system that focuses attention on the organization's objectives, coordination of decision making and provision of an organization's learning base.

Based on the citations of the authors, the relevance of using the Balanced Scorecard to support decision-making is noted, since this tool is able to analyze the situation of the organization in a broad way, facilitating its managers, an assertive analysis in relation to the objectives and expected results by focusing only on the essentials.

IV.   METHODOLOGY

The research is of a bibliographic order, with the purpose of substantiating and showing the current scenario of the theme being addressed. According to Gil (2010, p.29), the bibliographic research is based on material already published. Traditionally, this type of research includes printed material such as books, magazines, newspapers, theses, dissertations and annals of scientific events.

From the point of view of its objectives, this work fits as an exploratory and descriptive research, based on well-founded references that allow a deepening about the Balanced Scorecard. To this end, it was necessary to describe about Controllership, as well as its contribution to management, analysis in management decision making

from the BSC, reaching a discussion of the importance of the referred tool for organizational effectiveness. Your results will be obtained through an interview.

According to Andrade (2010, p. 112), exploratory research is the first step in all scientific work in order to provide more information on a given subject; facilitate the delimitation of a work theme; define objectives or formulate research hypotheses or discover a new type of approach for the work that is in mind. Descriptive research. Regarding descriptive research, the author reports that the facts must be observed, recorded, classified and interpreted, without the researcher interfering in them.

It is a case study applied to decision making using the Balance d Scorecard. Data collection was carried out through a structured interview applied on April 10, 2017 to the management of a company in the distribution of disposable and hygiene products operating in the market for over 15 years.

According to the thoughts of Marconi and Lakatos (2015), a structured interview consists of asking a series of questions to an informant, according to a pre-established script. This script can be a form that will be applied in the same way to all informants, in order to obtain answers to the same questions.

V. ANALYSIS AND DISCUSSION OF RESULTS

The researched company has been in the market for more than 15 years, operating in the distribution of disposable and household products and serves the entire interior of Ceará, Paraíba and Pernambuco with 64 employees and more than 1,500 different items in its stock.

The research aimed at obtaining information about the Balanced Scorecard, as well as its objectives, perspectives and its direct influence on decision making. Regarding the main reasons that led the company to adopt this tool, the interviewee emphasizes the company's alignment with strategic planning, confirming Bezerra's (2014) thinking when she says that the main objective of BSC is to achieve alignment between the company's strategic planning and the operational activities it carries out, making clear the scope of the objective set. Still under the thought of Bezerra (2014), inquiring the importance of the information of the indicators to the employees making them articulate in search of improvements making them more skilled and energetic, the results generated after the implementation of the Balanced Scorecard are positively confirmed .

The aforementioned company reports that the impact on the decision-making process has improved a lot with the implementation of the BSC as well as its analysis before customers and their employees, bringing to the fore the perspective of customers represented by goals for logistics operations and product development and services of the company cited by Cabral (2016). In the face of budgeting processes, performance analysis, strategic learning in order to decide and control, objectivity in communication, there was also an improvement emphasizing that, without the use of the Balanced Scorecard, these improvements would not have been achieved. According to Kaplan and Norton (2004), for the company's learning and growth process, it is necessary to ask the following question: "To achieve our vision, how will we sustain our ability to change and improve "? Thus, the company interviewed always seeks to propose changes in order to remain in the market as a flexible and quality company. There was also an improvement in their financial analysis, confirming the knowledge of the authors Gusmão and B atista (2010) when they confirm that the implementation and execution of the company's strategy are contributing to the improvement of results.

It is notorious that the company has strictly followed all the analyzed points and strategies outlined in view of its perspectives, demonstrating that the use of the Balanced Scorecard, in support of decision-making, managed to analyze its situation in a broader way, making it easier for managers to make more assertive decisions.

Therefore, it is clear that BCS strengthens this company in the managerial sense of its tactical and operational measures in a vertical and horizontal way, allowing its managers and collaborators a realistic view in the short and long term, justifying the author Kaplan (1998) regarding the implementation of the BSC which aims to facilitate business analysis, reducing the information needed for decision making and a minimum number of vital and critical indicators that translate the organization's business. Based on this, the interviewed company felt the return on investment, commenting that "the benefit that BSC brings is more than financial, it is of alignment, communication and satisfaction of both employees and customers and in the end, with strategic planning, it ends up that increases profitability". It also reiterates its satisfaction with a score of 8 and says that its implementation makes it possible to measure the degree of satisfaction of those who make the organization generating growth and improvement for the organization.

Modell (2009) cited by Boligon (2009) , reports that in recent decades a wave of innovations in

management and control practices has been witnessed to enable companies to remain competitive and active in the market. The BSC can be mentioned among the biggest innovations. The company in question, with the opportunity to be part of this harvest, chose to use the Balanced Scorecard, allowing yourself to be measured and seen in t ll their sectors, giving its managers and employees , greater understanding with regard to their role in the market. In view of the positive achievements after the implementation of the BSC tool, the company tells other organizations that "although it is complex in theory, after it is applied it makes the company's processes easier and more integrated".

In view of the above, the responses to the interviewee reaffirms the importance of using the Balanced Scorecard in organizations since it allows a broad analysis encompassing all sectors, determining the strategies that must be adopted to reach the objectives outlined, encouraging the citations of the aforementioned authors in the theoretical framework in this project.

VI. FINAL CONSIDERATIONS

Organizations, in the face of a constant process of change, are increasingly looking for tools capable of guiding them both in their continuity process and in their decision-making and the Balanced scorecard - BSC emerges as a proposal for changes and achievement of the desired objectives.

In this article, we sought to show the importance of the Balanced Scorecard as a tool for decision-making, referenced theoretically and with specific approaches regarding its objectives, with the intention of making the role of this tool public.

In view of the role of controllership and its contribution to organizations, it was found that, without the help of the Controller, it is practically impossible to plan and seek subsidies in order to improve it, highlighting that the implementation and execution of the BSC depends on the union of this professional and the company requesting the services relevant to the controllership.

As for the management decision-making regarding the use of the Balanced scorecard , it can be seen that they become easier after the analyzes made in view of the objectives outlined, such as: clarifying and translating the vision and strategy, planning and setting goals, communicate and associate strategic objectives and measures and improve feedback. All of this, translating the company's mission and vision and aiming at the financial perspectives of its customers, as well as its internal

processes and learning and growth. In this way, it becomes clear, from the results of the interviewed company, that this broad view allows management and its decisions much more practicable when one has a more in-depth knowledge of the goals and objectives set , although it does not reach 100% of the goals established because employees are often unaware of their role in the company's strategies.

The literatures translate the Balanced scorecard as one of the greatest innovations capable of keeping companies competitive and active in the market, and based on the authors mentioned above in the theoretical framework and analysis of the results, we note the relevance of using this tool together with the techniques aimed at to controllership in favor of companies in order to keep them aware of their role and greater understanding of the various spheres that surround it.

Thus, it is clear that the Balanced scorecard- BSC, is a guiding vehicle for companies, offering all the possibilities and goals to achieve the desired objectives, but with the freedom of decision to what is convenient, thus revealing the importance implementation in organizations as a tool to support decision making.

It makes it interesting, in light of the above, to continue using the Balanced Scorecard in the perspective of reaching 100% of the goals set with the determination to provide organizations with the certainty of the expected results and confidence in the partnership with the controllership professionals.

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Bolsa Familia Program: The perception of beneficiaries, public managers and community leaders as an instrument for evaluation in Urucuia-MG, Brazil

Aliciane Pereira Alves[1,] Roberto Lúcio Corrêa de Freitas[2], Mabel Diz Marques[3], Raphael de Oliveira[4]

[1,2]Federal Institute of Education, Science and Tecnology of northen Minas Gerais, Arinos MG
[3,4]Federal University of Bahia, Salvador-BA

Abstract— *This work is a case study in Urucuia town in Minas Gerais state, which aimed to characterize the perception of Bolsa Familia Program(BFP) effectiveness by the conception of 64 beneficiaries, 6 public managers involved in BFP (a Social Assistance Reference Center coordinator team (CRAS); two community health agents; a municipal secretary of administration representing the Executive; a councilman representing the legislative branch and a councillor of the Social Assistance Council of the municipality) and 2 community leaders. Therefore, the research undertaken here was carried out through descriptive analysis of the primary data and the interviews by content analysis. The results suggest that the BFP has contributed to include families who, without the program, would be in extreme poverty, and without access to basic services. However, the group of families who are satisfied and frequently satisfied with the resources received is very restricted, not exceeding 15%, and for 72% of the selected sample the financial resources available are still insufficient to maintain the support of the family group. On the other hand, public managers and community leaders understand that better management in the supervision of the program is necessary, as well as adherence of the local population in the awareness and clarification actions promoted by Cras.*

Keywords— *Bolsa Família Program, Public Policy, Public policies Effectiveness, Social inclusion.*

I. INTRODUCTION

The Bolsa Família Program (BFP) was created through a provisional measure in 2003, unifying federal government social benefits (School Bag, Food Bag, Food Card and Gas Aid) and expanding the benefited family's access (BRASIL, 2003). In January 2004, this program was transformed into Law Nº. 10,836 (BRASIL, 2004).

According to Silva (2007) the program became the main instrument for transferring direct income from federal government, with objectives: (i) mitigating hunger, poverty and inequalities by transferring a financial benefit associated with ensuring access to basic social rights – health, education, social assistance and food security; and (ii) promote social inclusion, contributing to beneficiary families emancipation, building means and conditions so

they can emerge from the vulnerability situation in which they are (WEISSHEIMER, 2006; SILVA, 2007).

In Brazil, amid in its apogee, in 2013, the BFP benefited more than 14 million families, transferring about R$ 32 billion (IPEA, 2018). In Minas Gerais state alone, in the same year, approximately 1.1 million families benefited, totaling R$ 872.4 million of the resources (IPEA, 2018), while Urucuiatown located in the north of Minas Gerais, received approximately 2.29 million serving 1,195 families in that year.

Due to its scope and large resources linked to its execution, the program has aroused interest in the literature on efficacy. Recent studies have sought to evaluate BFP effectiveness from Brazilian society look (CASTRO et al., 2009), of the beneficiaries (COSTA et al., 2003; TESTA et al., 2013; ZIMMERMANN; ESPÍNOLA, 2015), as well as

program managers (AUXILIADORA; MONTEIRO, MR. MONTEIRO; RIBEIRO, 2017) among others, vis-à-vis inclusive public policies determined by Brazilian state. Immersed in this debate, this article is inserted in literature by seeking to identify the perception of beneficiaries, public managers and community leaders about the program, at the local level, specifically in Urucuiatown about BPF.

And its specific objectives, it seeks to analyze the beneficiary's perception about sufficiency resources to meet the basic needs stipulated by BPF and the satisfaction perception of the care performed by the program executing agency in the municipality. As for public managers and community leader's perception, it seeks to analyze BFP effectiveness perception in relation to care provided community and its execution.

Analysis the program in Urucuia town is justified, both by the high participation of the population assisted by BFP in the town under analysis, as well as the resources allocated to it.

16,929 inhabitants estimated by Brazilian Institute of Geography and Statistics (IBGE, 2019) in 2020, approximately 24% benefited from BFP in March of that year. So, 4,063 people were directly benefited by the Program, representing 1,240 families.

As for the resources allocated to the town, in March 2020, R$ 241,355.00 were transferred to families included in the Program, and the average benefit passed on was R$ 194.64 per family (MDS, 2020). However, the amount and types of benefits received vary according to income profile, size and family composition.

Finally, it is appropriate to emphasize the program coverage was 73 % from estimate of poor families in Urucuia town in March 2020, as pointed out in the Report of the Bolsa Familia and the Unified Registry, of the Citizenship Ministry - National Income and Citizenship Office. This estimate is calculated based on the most current data from the Demographic Census, conducted by the Brazilian Institute of Geography and Statistics (IBGE). In this context, it is pertinent to conduct studies that seek to understand the effectiveness perception of the agents involved in the program, as the BFP is an important instrument for mitigating the socioeconomic disparities and vulnerability of the country (MDS, 2013).

Thus, in addition to this introduction and final considerations, this work is organized into three more sections. The next section seeks to characterize the BFP as a public policy that has allowed millions of Brazilians a minimally dignified life with access to basic services, as well as greater financial autonomy of these beneficiary

subjects, in view of the structural framework of social inequality in Brazil. In the following section, the methodological procedures adopted in this research are exposed. Followed by the presentation of the main results.

II.   THE BOLSA FAMÍLIA PROGRAM

The Bolsa Familia Program is a public policy that aims to ensure the human right to life, through conditional cash transfer actions. The program was instituted on January 9th, 2004, from Law 10,836 and regulated by Decree 5,209 of September 17th, 2004, through Unified Registry of Social Programs (Cad Unico) under former President Luiz Inácio Lula da Silva (BRASIL, 2019).

The BPF unified the procedures the management and execution of the actions of cash transfer of the Federal Government, especially those of the National Program of Minimum Income linked to education "Bolsa Escola", the National Program for Access to Food - PNAA, the National Program of Minimum Income linked to health "Food Bag", the Gas Aid Program, and the Single Registration of the Federal Government (BRAZIL , 2004; MEDEIROS et al, 2017).

In these terms, the BFP can be characterized as a demand subsidy (GUERRA et al, 2012), since direct to families in exclusion economic situations, in order to improve their access possibilities to public services. Furthermore, it has as one of the main proposals the stimulus to the development of human capital, since it is necessary to keep the children and young people in schools.

In this respect, Costa (2005) argues that income transfer programs, such as the BFP, in addition to benefiting needy families, make it possible to expand monetary liquidity in the local economy. Moreover, as indicated by a study conducted by the Institute of Applied Economic Research (IPEA), a federal public foundation linked to the Ministry of Economy and published by the MDS (2020), for every R$ 1.00 transferred to the program families, the municipal Gross Domestic Product (GDP) has an increase of R$ 1.78.Therefore, it should be considered besides contributing to the families inclusion in the economic system, the BFP enables the expansion of income flow and local market.

With regard to the beneficiary inclusion, this procedure occurs from the registration in the Unified Registry of Social Programs (Cad Unico), which in the second moment is directed to the sector of the Bolsa Familia Program closest to your region / residence. The registration is carried out, preferably by the assisted family responsible woman, with a minimum age of 16 years and who is

resident in the same property as the other family members (MSD, 2011).

To have the program access, criteria are necessary for selection, among them, the per capita family income by R$ 178.00 (updated in April 2020). It is important to mention that the registration does not imply the immediate entry of families to the program and receipt of the benefit, as this will be included, after checking the requirements proposed in the program (MDS, 2011). In moreover, the program requires some conditionalities that are necessary to ensure the right to receive the benefit of the program, which are related to education and health. Regarding education, families with children and adolescents between 06 and 15 years old must have mandatory active enrollment, with a minimum monthly frequency of 85%. Students aged 16 to 17 years must have a frequency of at least 75%. Regarding the health scope, the benefited family must make a commitment to follow up on vaccines, maintaining nutritional development for children aged up to 07 years. Moreover, women aged between 14 and 44 years should also follow-up the vaccination card, and if pregnant or nursing, perform prenatal examinations and monitor their and baby's health (MDS, 2012).

Notice that families do not comply with these conditionalities will be identified by the government and after analyzing the reasons for not performing the necessary follow-ups, will be oriented to compliance, and if there is an incidence of non-compliance may have the benefits canceled and in some cases without the reversal possibility of the benefit. Point up that the objective of these conditionalities is to ensure the provision of basic actions and enhance the family's quality life and contribute to their social inclusion (MSD, 2012; MOURÃO; FERREIRA, MR. FERREIRA; Jesus. 2012).

Also in relation to the BFP, Guerra and others (2012) and Castro et al. (2009) warn the existence of other particular program characteristics, among them highlights the BFP attendance refers to the family nucleus, and not to individuals alone and the programme management is, and should be maintained decentralized between the Union, States and Municipalities, to possible improving the program continuously.

Given the more general BFP characteristics, expected the program will also have a long way to walk and adequately meet the objectives that motivated its creation.

Moreover, the beneficiaries and managers perception investigation involved in their actions, whether in inclusion, execution, maintenance and supervision has been the study object of the pertinent literature, given the

recognition of their advances and limitations (WEISSHEIMER, 2006).

Regarding society's perception of the BFP effectiveness, Castro et al. (2009) indicate the program recognition by society, and understands it is being used appropriately, even considering problems in its execution. Additionally, the authors conclude the BFP has acquired legitimacy from Brazilian society given the policy's level knowledge and even support for its existence and argues about the importance of seeking and considering the society opinion as an important element of public policy evaluation.

Costa et al (2003) analyzed BFP effectiveness, from beneficiary's perspective in Manaus through a quail-quantitative research with 50 beneficiaries. The results suggest the beneficiaries perceive as a result of their insertion in the BFP the increase in income and the improvement of their family's life quality. However, they observe failures occurrence of some program objectives, mainly related to the sustained families' emancipation.

In relation to the program managers perception, Auxiliadora, Monteiro and Ribeiro (2017) found from semi-structured questionnaires applied with BFP study managers, that the learning processes resulting from MDS evaluation surveys to BFP with the states were low, and the learning perception is more related to the managerial aspects (linked to the BFP execution) than more instrumental and conceptual aspects that enable these actors to assume a more active and independent with the program management.

In this context, there is still no unanimity in the studies regarding the BFP effectiveness in reducing social problems in Brazil. If, on the one hand, there is evidence that the BFP has not exercised an emancipatory function aimed at the effectuation citizenship (MENDES; Barbosa, RODRIGUES, 2009; DENUBILA; FERREIRA; MONTEIRO, 2010). On the other hand, there are findings showing that the PBF plays an essential role in ensuring initial food security and well-being of assisted families (TRALDI; ALMEIDA; FERRANTE, 2012), as well as the access application to literacy, professional training, support to family agriculture, generation of occupation and income, microcredit and health services for children (SÁ; SILVA, 2012; FIGUEIRÓ, 2010).

III. METHODOLOGICAL ASPECTS

In view of the objectives listed, the research desired here has an exploratory nature and based on both quantitative and qualitative data. Quantitative data are derived from the

application of structured questionnaires with representative of the BFP family nucleus residing in Urucuia-MG municipality. The qualitative data are derived from semi-structured interviews with managers and professionals related to inclusion, execution, monitoring and supervision of the BFP in the municipality under analysis.

In line with the study object, the questionnaires and interview scripts were developed based on theoretical framework (CASTRO et al., 2009; COSTA et al., 2003) aiming to identify the beneficiaries perception about the sufficiency resources to meet the basic needs stipulated by the BFP and the satisfaction perception of the care performed by the executing program agency in the municipality. As for the perception of public managers and community leaders, regarding the BFP effectiveness regarding the service provided to the community and its execution. Furthermore, the scripts were evaluated by four specialists in the area (two professors and two doctoral students) as a content process evaluated.

Regarding the questionnaires structure, it follows two formats: (i) multiple choice and (ii) five-point psychometric responses, based on Likert scale. The anchor scales of the Likert metric were: "never", "sometimes", "often", "always" and "does not apply". This scale was used to enable respondents to specify their agreement level with the statements presented and to avoid neutral responses.

The interviews follow the semi-structured format and were conducted with eight professionals involved in BFP actions in the municipality under analysis, being six public managers (one team coordinator of the Reference Centers of Social Assistance (Cras); two community health agents; a municipal secretary of administration representing the Executive; a city councilor representing the legislature and; a councilman of the municipality's Social Assistance Council) and two community leaders of the municipality.

Concerning the sample space location of the questionnaires, the research was developed in the Unified Registry Sector, together with the municipality's Social Action Assistance Office. The selected families were in the Social Action Assistance Office waiting room to update the Cad Unico information, and who were willing to answer the questionnaires. The interviews were conducted in the work facilities of the public servants mentioned, and the interviews with the community leaders took place in municipality's Social Action Office facilities.

Emphasize that before starting the questionnaires application and interview, each participant received the Informed Consent Form - TCLE, that is, to start the application of the questionnaire and the interview required the interviewee consent. This term describes the objective of the research with an academic character and the interviewees' voluntary participation, as well as present the explanations about the anonymity and confidentiality of the collected responses. In these terms, established this study results aim to understand only the perception of individuals and not identify the individuals investigated.

Additionally, since not all respondents were literate, the reading of the questionnaire was performed orally by the researcher, and the answers were recorded, since the questionnaire consisted of closed questions. The mean time of questionnaire completion was 15 minutes and each semi-structured interview was recorded and transcribed and had an average time of 30 minutes.

Once the general methodological aspects have been described, the results are treated and grouped as follows.

IV.   ANALYSIS AND DISCUSSION

4.1 Selected BFP beneficiary's profile analysis

72 families that were investigated, 64 were selected for the analysis for receiving benefits from the federal government, specifically the BFP. In the group analyzed, was identified 91% of the family members were female and only 9% male. This result converges with the profile of the municipality, considering in 2019, 87.1% of the responsible families were female, as pointed out by the MDS (2020). This finding consistent with the priority of the program, considering the BFP provides for the payment of financial benefits to be made preferably to women, with the objective of contributing to the development of female autonomy both in the family space and in their communities (MDS, 2012).

Regarding the age group of the family representative, there is a concentration in the 18 to 25 years age group (39%), followed by 26 years to 34 years (36%), 35 years to 50 years (20%), 16 years to 18 years (5%), being the range of 51 to 64 and above 65 years without any representativeness (Graphic 1). This result reveals the high number of young individuals who are responsible for the family nucleus, since the share of representatives aged between 16 and 25 years corresponds to 44% of the families benefited total number.

Graphic 01 - Age group (%):
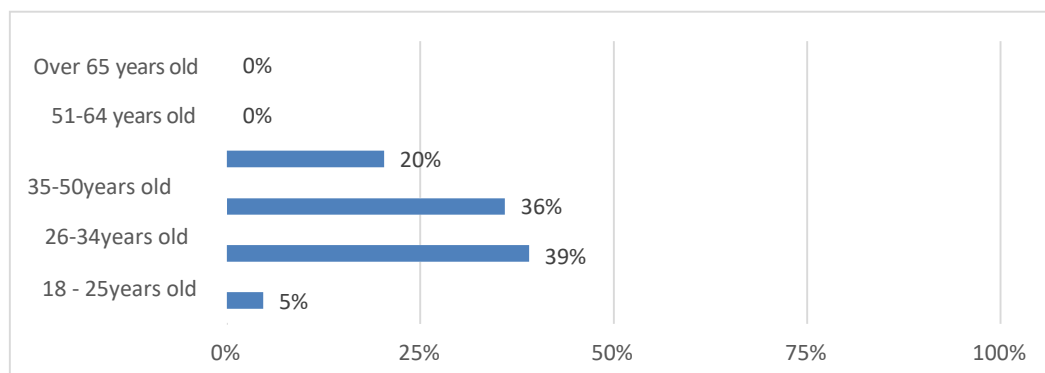
Source: Own elaboration based on field research, 2020

In addition to age group, 83% of the selected sample lives in the urban area and only 17% live in the rural area. This result converges to the Brazilian standard, in 75.3% of the population that benefit from the BFP live in the urban area (Cad Unico, 2013).Regarding the family group leaders, occupational profile, it is possible to note the program has acted more on families that have representatives in greater situations vulnerability and volatility in the income stream, are the cases of people focused on home activities (19%), Unemployed (14%),Students (11%) and Autonomous (9%), which together make up 53% of the analyzed group (Graphic 2).

Graphic 2 - Occupational profile (%)
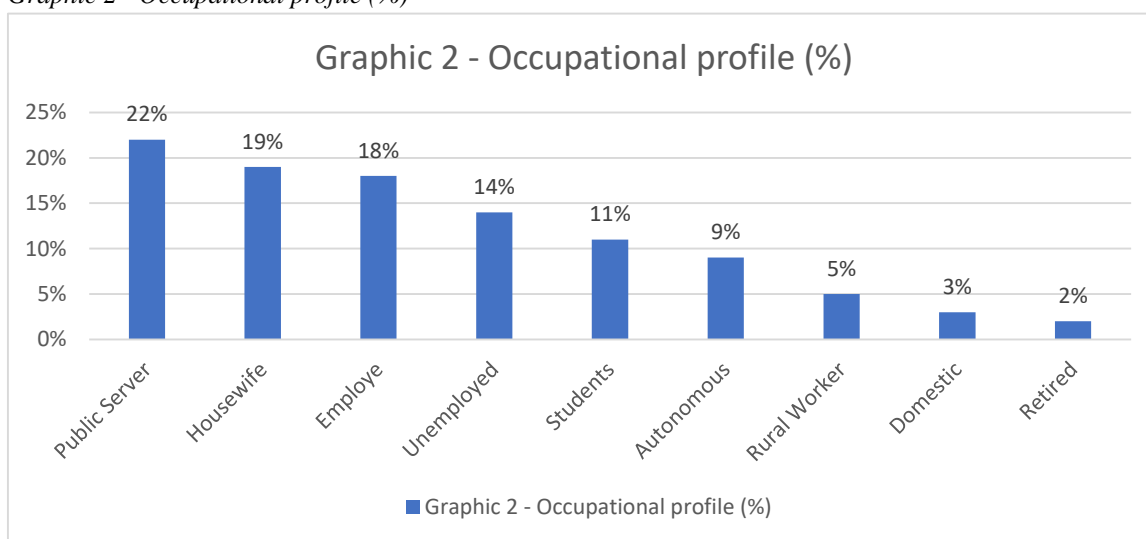
Source: Own elaboration based on field research, 2020.

Graphic 3 shows the income range of the BFP beneficiaries selected in this research. As can be seen, 66% of the interviewees have a monthly family income between R$ 500.01 to R$ 1,000.00, followed by the range of R$ 100.00 to R$ 500.00 (22%), which makes the condition aggravating, once 70% of the families interviewed have three people or more in the same residence. In the highest income range, above R$ 4,000.00,did not express any representation. Expected result, since the income range of the beneficiaries of the target group should be up to R$178.00 per capita in the family group.

Graphic 3 - Monthly family income (%)
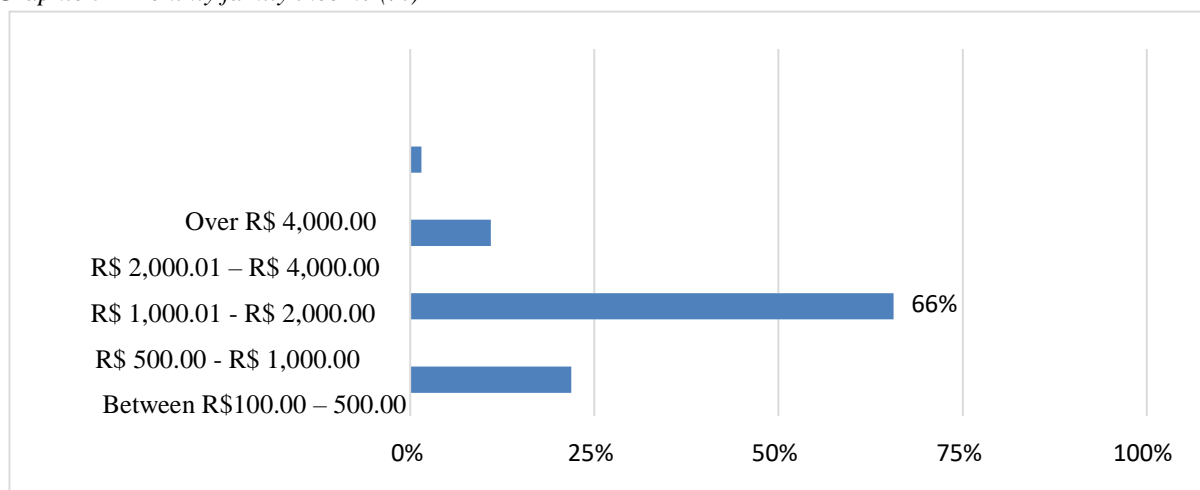
Source: Own elaboration based on field research, 2020.

In the aspect of the type of residence the beneficiary resides, highlights the own residence represents 58% of the sample (Graphic 4). This result opens space for future research to investigate the relationship between the beneficiaries of BF and whether these are also assisted by "My House My Life Program", considering that this program of the Federal Government seeks to combat the country housing deficit, and the target families are those concentrated in the monthly income ranges of up to three minimum wages.

Graphic 4 - Type of residence (%)
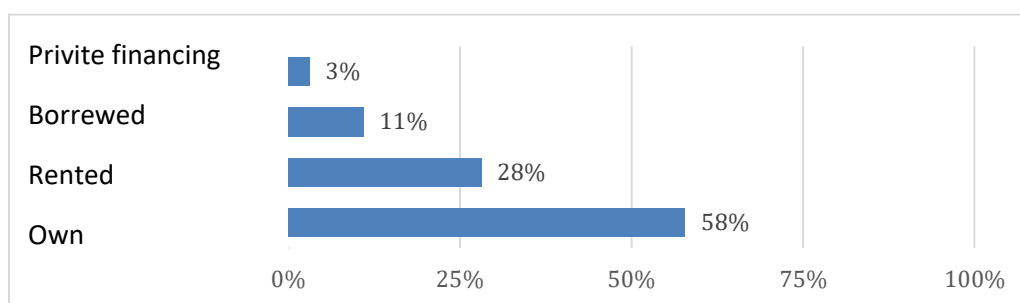
Source: Own elaboration based on field research, 2020.

Also regarding the type of residence, 28% of the beneficiaries have monthly spending on housing, 11% are transferred and only 3% are financed by private entities (Graphic 4).

4.2 Perceptions of the PBF from the beneficiary perspective in Urucuia municipality

This section seeks to present the perception of the PBF effectiveness in Urucuia municipality under the beneficiary's program perception. Initially, sought to analyze whether the social resource transferred helped in education and health of their family. In this respect, 42% claimed always helped and 17% frequently, this demonstrates, at least for 59% of households, the resource helps in the supply of the policy's target expenditures (Graphic 5).

Graphic 5-After receiving the social benefit helped in your family's education and health? (%)
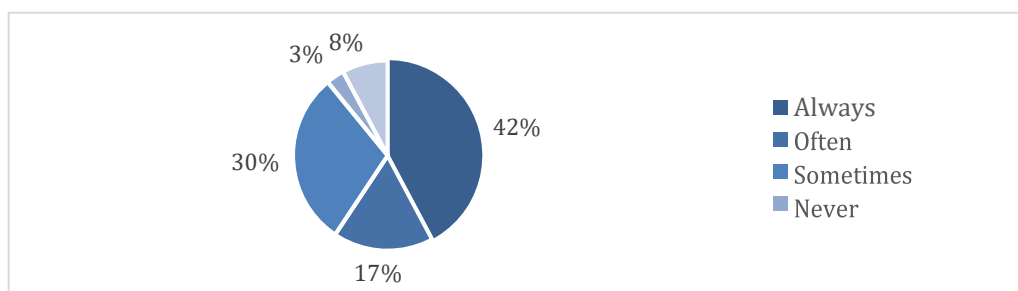
Source: Own elaboration based on field research, 2020

When asked if the benefit is satisfactory for the family nucleus support, for only 6% of them the benefit is always satisfactory, for 42% claimed sometimes and 30% never. In these terms, perceived for 72% of the population the resources allocated are still insufficient to maintain the family group support (Graphic 6).

Graphic 6 –Beneficiary's satisfaction regarding the resources received (%)
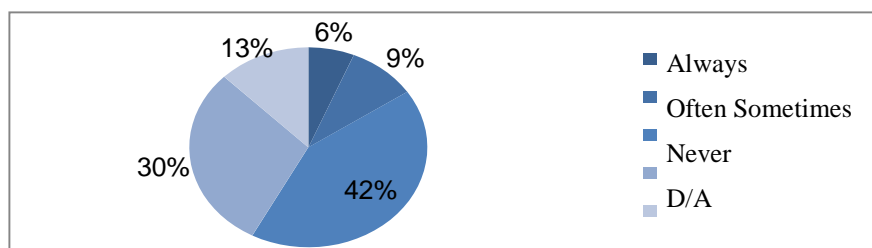
Source: Own elaboration based on field research, 2020.

Later, we sought to understand the interviewees' perception of reception. First, they were asked about the family's participation in socio-educational events with the municipality's Social Assistance Reference Center (CRAS), only 2% claimed they always participate and 3% participate frequently, so perceived that there is a low adherence of families to Cras clarification events (Graphic 7).

Graphic 7 –Family Participation in socio-educational events with the Social Assistance Reference Center (CRAS %)
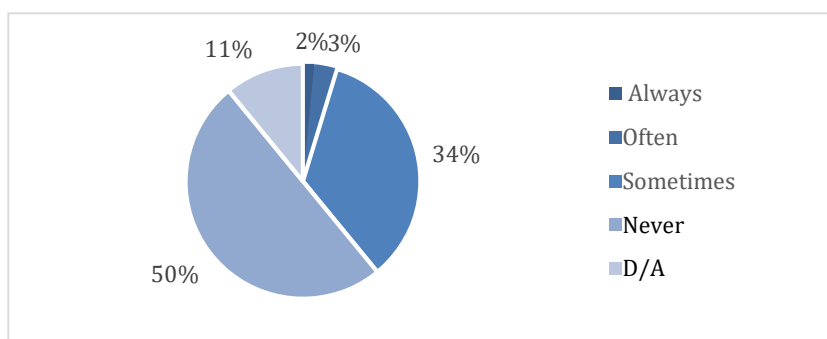
Source: Own elaboration based on field research, 2020

When asked about the actions city hall mobilization in order to guide families to keep the register updated, 33%

answered the city hall always performs and 14% often, that is, for 47% has demonstrated a higher degree orientation effort of the family centers (Graphic 8).

Graphic 8 – City hall mobilization action in families' guidance to keep the register updated (%)
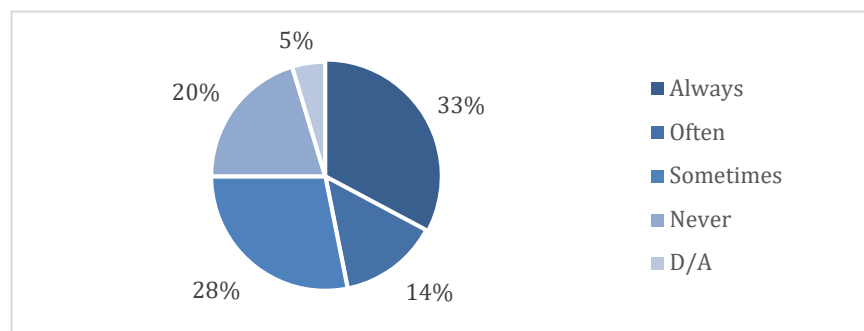
Source: Own elaboration based on field research, 2020

In relation to interviewees satisfaction regarding the reception received at the BFP service stations in municipality under analysis, 47% emphasize, sometimes, and 12% claim that they often have a satisfactory service.

Thus, about 59% of the interviewees have the highest perception levels of the reception effectiveness received by the body responsible for the BFP execution (Graphic 9).

Graphic 9 - Beneficiaries Satisfaction regarding the reception received (%)
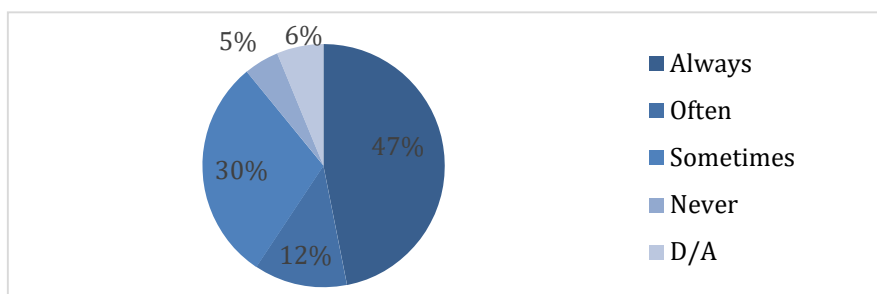
Source: Own elaboration based on field research, 2020

However, 35% reported not being fully satisfied with the reception received, since the requirements not met by the beneficiaries may result in benefit blocking, this causes many to draw the conclusion that it was the reception team that performed the suspension of the benefit (Graphic 9). This perception may be linked to the lack of clarification of the beneficiaries regarding the operation of the program, considering that there is a low public adherence to CRAS clarification events (Graphic 7).In moreover, among the interviewees under the program's reception efficacy, one of the beneficiaries mentioned : "The Social Action Secretariat should propose improvement in the quality of reception for users in the sector, put people with appropriate profile for care because they deal with several people who are very needy and the family grant team cannot meet all the needs of these users, another situation

is always maintain supervision in days, because I think it has beneficiaries who have no need to receive".

In addition, we sought to identify the perception of the beneficiaries about the clarifications provided by the servers of the Cad Unico. According to the results, 66% of the beneficiaries believe that the servers have information and knowledge about the program. From this observation it is essential to express that reception can be improved so that the assisted population has greater satisfaction in terms of care provided, because this item is a fundamental factor to increase the BFP efficacy.

In this reflection, perceived that the group that is satisfied and frequently satisfied with the resources received is very restricted, not exceeding 15%, which may reflect an insufficiency of the resource to bear the needs of these families. On the other hand, 35% of the interviewees are

not satisfied with the reception provided by the executing body. Due to the fear of bureaucracy and fear of losing the benefit at any time. This high contingent may be associated with low population adherence to the clarifications provided in the program executes body events in the municipality. Perhaps, if a new strategy was adopted for clarification, with closer and direct communication with the population through schools and/or health centers, would be possible to better elucidate the program criteria and the updating registry relevance, as well as reduce the benefit fear cutting.

4.3 BFP perceptions from the public managers and community leaders perspective in Urucuia municipality

In addition to the beneficiary profile assisted by BFP, this research also sought to understand Bolsa Familia Program effectiveness perception under the view of the program managers. According to Unified Registry manager analysis, "this program has improved the population living conditions that is in poverty in the municipality, because from the receipt improved their living conditions, but it is possible to identify poverty is still prevalent in the socioeconomic families aspects, some users still say Bolsa Familia's value could be higher to help meet all the family's expenses."

At a certain point in the research, the Unified Registry manager was asked if Urucuia municipality carries out actions to raise awareness among Bolsa Familia Program users? According to the interviewee: "No, but it should. Unfortunately the municipality is flawed when it comes to being alerting and giving greater transparency to the population about Bolsa Familia benefit, since people are not always aware of informing their true reality, because it is notorious that several families do not fit, but receive the benefit".

From Bolsa Familia program it is possible to verify the improvement in the financial condition of the families analyzed. According to reports from a community leader, "before some families received this benefit things were very difficult, because many were parents and in some cases even starved. Many families faced a lot of difficulty because they had no income and today these families are already in a less vulnerable situation."

Moreover, according to an interview with the legislative power representative, when asked about the supervision by the Legislature in relation to social benefits distribution in Urucuia-MG municipality, and whether there is any investigation by the legislature in relation to Bolsa Familia. According to the interviewee (the Legislature), "To date there is no kind of inspection or investigation of the municipal legislature in relation to Bolsa Familia Program,

what has been proposed so far was a public hearing in the program that by the way has not yet happened". During the research, was possible to notice some abnormalities regarding the distribution of the values passed on to the beneficiaries, since there are people with profiles do not fit the BFP requirements and are benefited, while there are low-income families, specifically, 8 families interviewed with basic needs are not being met by the program. According to the technicians who perform a function in the control and BFP monitoring in the municipality, "this demand was already foreseen in the research, because the lack of public policies aimed at improving life ensuring social development and growth still leave to be desired in Urucuia municipality located in the North of Minas Gerais."

Therefore, notes the BFP in Urucuia municipality has gaps to be filled and improved with regard to the control and inspection process and, especially in the families inclusion should be assisted by the program and that have not been incorporated to date.

V. CONCLUSIONS

The present work investigated the Bolsa Familia Program effectiveness (BFP) by the perception of 64 beneficiaries, six public managers (one team coordinator of the Reference Centers of Social Assistance (Cras); two community health agents; a municipal secretary of administration representing the Executive; a city councilor representing the legislature and; a councilman of the municipality's Social Assistance Council) and two community leaders of the municipality. involved in the process of inclusion, execution, monitoring and supervision of the BFP in Urucuia municipality, in Minas Gerais state.

In a rough way, noted the BFP has contributed to include families who, without the program, would be in extreme poverty and without access to basic services. Regarding the BFP effectiveness perception from the beneficiary's program view in the municipality under analysis, the group of families who are satisfied and often satisfied with the resources received is very restricted, not exceeding 15%, which may reflect an insufficiency of the resource to bear the needs of these families. Furthermore, for 72% of the selected sample, the resources allocated are still insufficient to maintain the alimony of the family group. Point out that 35% of the interviewees benefited by the BFP are not satisfied with the service provided by the executing body. This high contingent may be associated with low population

adherence to the clarifications provided in the events of the body that executes the program in the municipality.

Regarding the public managers and community leaders perception in regard to BFP effectiveness in the municipality, noted the program has improved the population living conditions that is in poverty in the municipality, however to date there is no kind of supervision or investigation by the municipal legislature in relation to the program , as reported and described by the councilor interviewed.

In this respect, the managers perception is that supervision is extremely costly financially for a municipality with a small contingent of servers and financial resources. Another important finding, being convergent both by the conception of the beneficiaries and of managers and community leaders, was the low participation of the local population in the awareness and clarification actions promoted by the Cras, considering only 2% of the beneficiaries claimed they always participate and 3% who participate frequently. This behavior should not be given as structural and they see the future as an amplified present. On the contrary, there should be greater articulation with the institutions responsible for the development of such actions, and they are carried out beyond their physical facilities, such as in health posts and schools (public and private).

Finally, note the difficulties encountered in this work development, in which the insecurity of the respondents was the main cause on the part of the beneficiaries, because some expressed distrust in providing the information, due to fears of the benefits being suspended.

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Classification and Detection Rice leaf Diseases Using Information and Communication Technology (ICT) Tools

Professor Dr. fan fan, Tanmoy Roy, Kalpotoru Roy

Management Engineering Department, Chongqing University of Posts and Telecommunication, China

Abstract— *Despite sustainable development, increase in use smartphones, drones, satellite and other information communication technologies for data collection and analyzing for decision marking. Crop losses due to insect pests and diseases are a major threat to farming communities globally. In the case of rice, up to 37% of economic losses are caused by insect pests and disease infestation. Timely and accurate disease and insect pest diagnosis and management can not only reduce crop losses. In the last decade, Information and communication technologies (ICTs) have been increasingly used for information sharing. With mobile internet services becoming available in even the furthest locations, ICT-based agricultural solutions are finding a foothold on the farms of poor smallholders. ICT-based tool that supports diagnosis of insect pests and diseases and enables farmers to make timely decisions for better pest management. To identify the rice diseases at any untimely phases is not yet explored. Early classify and detection for estimation of severity effect or incidence of diseases can save the production from quantitative and qualitative losses, reduce the use of pesticide, and increase country's economic growth. The main challenges is to minimize the impacts of attacks. Detection of plant disease through some automatic technique is beneficial as it requires a large amount of work of monitoring in big farm of crops, and at very early stage itself it detects symptoms of diseases means where they appear on plant leaves. In this paper we review different disease classification techniques that can be used for plant leaf disease detection. Also we describe the data collection by information communications technology for rice leaf, different disease classification approaches that can be used for rice diseases detection. Thirdly we suggested the framework for convolutional neural network in Agricultural sector for detection and identification for innovation technology in agriculture.*

Keywords— *Agricultural, ICT, Image Processing, Rice Disease classification and Detection.*

I. INTRODUCTION

Agriculture is the main source of the income in Bangladesh. Agriculture is the second largest in farm output production in the world. Information and communication technology in agriculture is developing and applying innovative ways to use ICTs in the rural domain, with a primary focus on agriculture. ICT in agriculture offers a wide range of solutions to some agricultural challenges. It is seen as an emerging field focusing on the enhancement of agricultural and rural development through improved information and communication processes.

Sometimes farmers are unable to pay attention to the diseases or face difficulty in identifying the diseases, which lead to loss of the crop. Every disease has a different remedy to work out. The current approach of disease detection is manual, which means farmers mainly depend on the guide books or use their experiences to detect and identify of rice leaf diseases using support vector machine and particle swarm optimization techniques[1].

The main issue is an absence of nonstop monitoring of the rice plants. The rice plant diseases are one of the cause of quality and quantity of agriculture[2]. Each plant disease has different stages of growth. Whenever the disease occurs on a plant, farmers have to keep eyes on the

infection. This approach of disease detection is time-consuming and requires some precaution during the selection of pesticides. The Bangladeshi farmers are not very good for aware information of the disease and it occurrence period. And the continuous monitoring system my fight against disease infection. The classification and detection of a rice plant disease is most significant research field in the agriculture domain.

The performance of a plant disease detection system can be evaluated by measuring the accuracy of the image processing algorithms (classification)[3]. Existing systems cannot provide better accuracy due to limited image features, bad selection of classifiers, and bad selection of features.

Due to possibility of various alternatives at different states of plant disease identification, researchers have attempted various alternatives in both image processing operations and deep learning model. In this article the objective is to emphasize impact of ICT for data collection, and apply concept of image processing and deep learning for build and train to analyze images of rice diseases and identify its disease based on four classes such as health, hispid, leaf blast and brown spot. We carry out a survey on different techniques and approaches used for classification of the Rice plant diseases.

We investigation both image collection and processing techniques and convolutional neural network techniques. Furthermore, utility of the presented image processing and findings is shown in our proposed work in the same direction.

This paper is divided into 4 section. Section II related work for different ICT tools for high resolution data collection and other methods for image processing. Section III Image plant disease identification and discusses various operation. Section IV proposed framework about plant leaves and identification of disease in rice plant based on build and train a model. Finally, Section V, discussion and conclusion.

II. LITERATURE RIVIEW

In this chapter we reviewed importance of ICT in data collection and some traditional image processing in order to understand input and output applications with image processing[4]for making formers decision.

Despite dramatic increase in use of internet, smartphones and other ICT technologies, substantial digital divide exists between service providers and seekers. Moreover, several ICT-based farm tools are not readily applicable for agricultural systems in for plant diseases as well as rice disease identification using pattern recognition techniques[5]. This presentation provides details of ICTs for disease diagnosis and decision making.

No matter the distance or time spotting of plant diseases, consultation with experts, access to global data and analysis and disease identification and the remedial solution has been easy with ICT tools and IoT[6]. Geographic Information System, Radiofrequency Identification Mobile applications help in identification of diseases associated with the crop. In case of a crop disease farmer clicks a picture of the diseased foliage, uploads the image on the central repository then scientists and plant pathologists study data and analyze it. Crop disease is then identified by experts. Feedback and remedies are shared with farmer via phone messages or social media.

After data collection thought different ICT tools such as smartphones, drones, satellite etc. the different methods that are involved in the classification disease detection are acquisition of image, preprocessing, of image, feature extraction, classification according to[7]. We started read the image, with different types of format images such as jpg, tif, bmp gif can be used. This step of the system is the acquisition of image, involves capturing the images in suitable form. After identifying the images, various processing methods could been concerned with concrete issues of the image for acting the several task.

After digital image processing, we had a massive storage, with preprocessing improves the quality of the image data by reducing artifacts which mean it removing the redundancy present in captured images without affection the details that play a key role in overall process by different steps such as image re-sizing and filtering with low pass filter or high pass filter. RGB model images are converted into gray image using color conversion. To increase the contrast are used different contrast enhancement method or techniques like, stretch to minimum-maximum[8], stretch and clip to Min-Max, histogram equalization and contrast adjustment. In segmentation group of pixel into regions, thereby defining the boundaries of the region of interest, partitions of the image of the distinct regions that pixel containing the similar attributes are used in the images.it separates image

into meaningful region. The approach or methods like Ostu algorithm, K-means, FCM, PCA, MPSO and PSO are processed.

Feature extraction and selection provides the measurement vectors, should be defined as the interest part of an image and will be detected in different images of the same scene. Classification, also called feature selection, deals with extraction attribute that result in some

quantitative information of interest, is a method for identifying the images. All the classification algorithms are based on the assumption that the image depicts one or more features. They are different types of classification features such as fuzzy classification, SVM (Support Vector Machine)[9][10], ANN (Artificial Neural Network), Convolutional Neural Network (CNN). This feature extraction, uses different types of feature values like texture feature, structure feature and geometry feature.
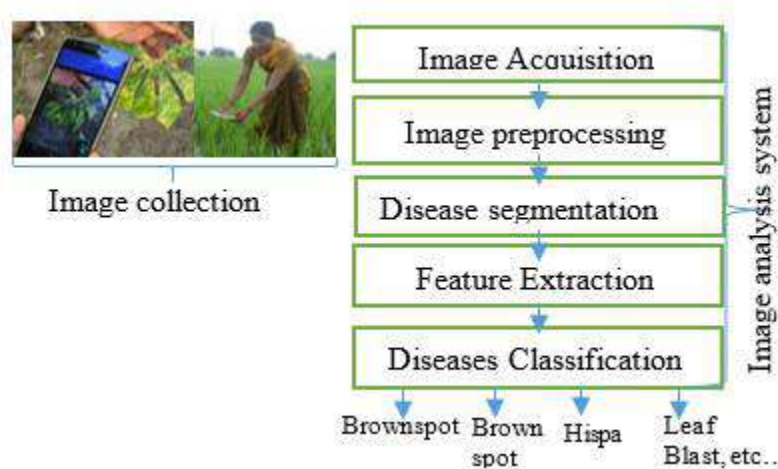

Fig.1: General framework for ICT image collection and plant disease classification approach.

Figure 1 present the generic block diagram of Image analysis system. It includes data collection with image acquisition involves capturing the image in the suitable form. Preprocessing improves the quality of the data by reducing artifacts. Segmentation groups pixels into regions, it defines the region of interest. Feature extraction and classification for different rice diseases. Mathematically, an image may defined as a two dimensional function $f(x, y),$ where x, y are spatial coordinates and the amplitude of f is called the intensity or gray level of the image at that point.

ICT Tools for data collection capturing the images if infected leaves and finding out the information about the disease is best way to know and understand the loss of crop due to disease infection. As a monitoring system which is automated response of this issue or problem, ITC tools such smartphone, drone, satellite with best camera can be installed or deployed at a certain area in the farm to capture images periodically. These images could been sent to a

central system for analysis of disease, and the system could been classy and detect the disease and give the feedback information about the disease and pesticide selection.

Challenge for Bangladesh and Rice disease is the foremost staple food in Bangladesh, and provides more than 40% of national employment. It has been estimated that by 2020, rice production in Bangladesh will have to be increased by 60% to feed the growing population. The average land-use intensity has already reached 180% in Bangladesh, one of the highest in the world. The susceptibility of MVs to several major pests and diseases is a common reason for production losses.

Table1: Common rice disease and causal in Bengali

Disease	Causal organism
Rice blast*	Magnaporthe grisea
Brown spot	Cochiobolus miyabeanus
Narrow brownspot	Cercospora oryzae
Sheath blight*	Rhizoctonia solani

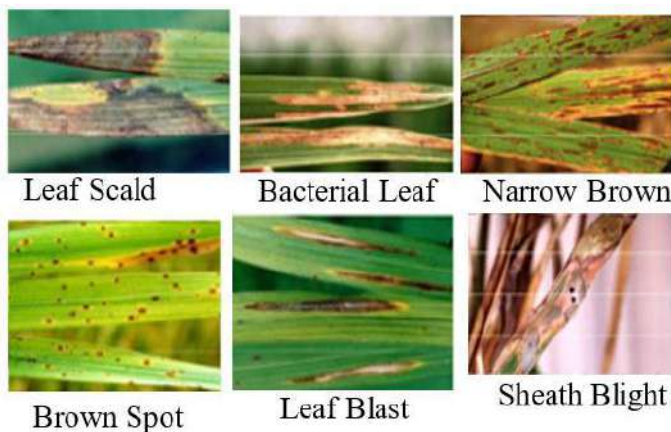|	
Sheath rot	Sarocladium orysae
Stem rot	Sclerotium oryzae
False smut	Ustilaginoidia virens
Foot rot and bakane	Fusarium moniliforme
Bacterial blight*	Xanthomonan campestris
Bacterial leaf streak	Xanthominan campestris
Tungro	Rice tungro virus
Grassy stunt	Rice grassy stunt virus (RGSV)
Root knot	Meloidogyne spp.
White tip	Aphelenchoides bessyi

Fig.2: Different types of rice diseases, source of images

III. METHOD BASED MULTI-TASK PROCESS OF PLANT DISEASES IDENTIFICATION

This section explains the General process of plant disease identification. The process is divided into two parts: (1) Image processing and (2) CNN.

A. Image Processing Tasks

1) Image Acquisition

Image must be captured by a camera and converted into a manageable entity. This is the process known as image acquisition. The image acquisition process consists of three steps; energy reflected from the object of interest, an optical system which focuses the energy and finally a sensor which measures the amount of energy[11].

An image database specifically for rice disease pictures is available at International Rice Research Institute. Therefore, we need to prepare image database by our own, which requires image acquisition from live farm. In this process, images are captured from the farm using a digital camera to get them directly in digital form with numerical values[1]

2) Image Preprocessing

For getting better results in further steps, image preprocessing[12] is required because dust, dewdrops, insect's excrements may be present on the plant; these things are considered as image noise. Furthermore, captured images may have distortion of some water drops and shadow effect, which could create problems in the segmentation and feature extraction stages. Effect of such distortion can be weakened or removed using different noise removal filters. There may be low contrast in captured images; for such images contrast enhancement algorithms can be used. Sometimes background removal techniques may also be needed in case of region of interest needs to be extracted. In case of the images captured using high definition cameras, the size of the pictures might be very large, for that reduction of image size is required. Also, image reduction helps in reducing the computing memory power[13]. See the following image segments:
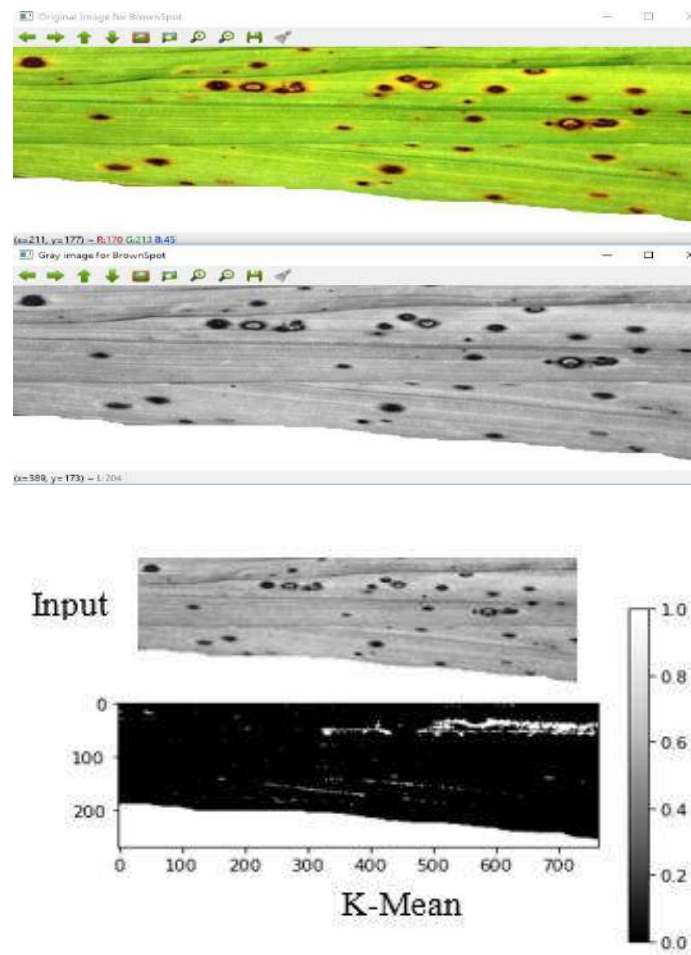
Fig.3: Image segmentation from original image to the grayscale image with the K-mean segment.

3) Image Segmentation

Image segmentation can play a vital and important role in plant disease detection with different prediction rule[14]. Image segmentation means to divide the image into particular regions or objects. The primary aim of segmentation is to analyze the image data so one can extract the useful features from the data. There are two ways to carry out the image segmentation: (1) based on discontinuities and (2) based on similarities. In the first way, an image is partitioned based on sudden changes in intensity values, e.g., done via edge detection. While in the second way, images are partition based on the specific predefined criteria, e.g., thresholding done using Otsu's method. 4) Feature Extraction The feature extraction aspect of image analysis focuses on identifying inherent characteristics or features of objects present within an image. These features can be used to describe the object. Generally, features under following three categories are extracted: color, shape, and texture. The color is an important feature because it can differentiate one disease from another. Furthermore, each disease may have different shape; thus system can differentiate diseases using shape features. Some shape features are area, axis, and angle. Texture means how color patterns are scattered in the image[15].

Table 2: Comparative Study of Segmentation Techniques

Technique name	Thresholding Type	Segmentation type	Complexity	Segmentation effect	Merit	Demerit
OSTU'S Method	Global	Thresholding	Very high	Good & stable	Regardless of uniformity &shape measures, it works on real world images	Takes more in processing
Fermi energy based	Global	Thresholding	Low	Better compared to OSTU&k-mean	Overcomes the limitation of selecting proper threshold value	Only works when non-uniform illumination is present
k-means	Local	Clustering	Low	Accurately distinguish infected & uninfected regions of plants	Minimizes sum of square distance between object and centroid	Difficult to predict K with fixed number of clusters
Grey-level thresholding	Global	Thresholding	Normal	More accurate compares to OSTU'S method	Grey level transformation (2G-R-B) provides contrast for disease region and background	Every time needs to select proper threshold value for getting better result in segmentation
Fuzzy C-Means	Local	Clustering	High	Better compared to ostu and k-mean	Uses partial membership, therefore, more useful for real problems	Sensitive to initialization condition of cluster number and cluster center

Table 3. Analysis of machine learning operations applied in rice

Ref.	Types of classifier	Parameters for classification	Inputs	Accuracy
[16]	Nearest Neighbour	RGB range, shape, length, width, diameter	Membership function	Rice blast-80%
[17]	Support Vector Machine	Radial Basis Kernel Function	Image Features	Model-97.2%, model2-88%, model3-11.1%
[18]	Support vector machine. Neural network, Ensemble learning, Quadratic Discriminant analysis	Default parameters	Image features	SVM,EL,QDA-85%, NN-80% , SMV+RBNF-98.3
[19]	Support Vector Machine	Not specified	Image Features	82%
[20]	IF-Then Classifier	Color and shape features	Images features	75%
[21]	Bayes classifier Support Vector Machine	Not specified	Image feature	Support vector Machine-68.1%, Bayes classifier-79.5%
[22]	Backpropagation neural network	3 hidden layers	R,G and L pixels	90%
[23]	Production rule with forward chaining	Not specified	Image Features	Local entropy-100%
[24]	Rule generation	Feature, value pair	Image features	92.29%
[5]	Self-organizing map neural network	50 epochs	Gray values of pixels	RGB Sport -92% Fourier transform of spot-84% rotation of 50% spot-82%

B. Convolution neural net (CNN)

1) Classification: Is mapping the data into specific groups or classes. Classification is usually called as supervised learning approach[21]. Classification is a two-step process: First the classifier model is generated which describes predefined set of classes[25] . This step is called as learning phase (Training step), where classification algorithm develops the classifier by "learning from" the data with their specific class labels. In the second step, the model, which is generated in first step, is used for classification[26]. In other words, test data is used to estimate the accuracy of the trained model by evaluating how good it performs on the test data.

In the plant disease classification, the diseases are classified according to the features extracted from the images. Different classification models are support vector machine, neural network, nearest neighbors, and rule-based classifier.

2) Clustering is a process of grouping data into different groups based on the similarity of the data. It means the data points with the similar objects are grouped into one group and dissimilar objects are grouped into another group[27]. Clustering is also called as data segmentation because it partitions large data into groups based on their similarities. Clustering is an unsupervised learning approach. Unlike classification, clustering does not depend on the predetermined classes, due to this clustering is called as learning by observation not learning by examples. Clustering is also used for color image segmentation, because in an image different objects may have different color intensities. Therefore, clustering can group similar intensity pixels in one cluster and other different intensity pixels into other clusters.
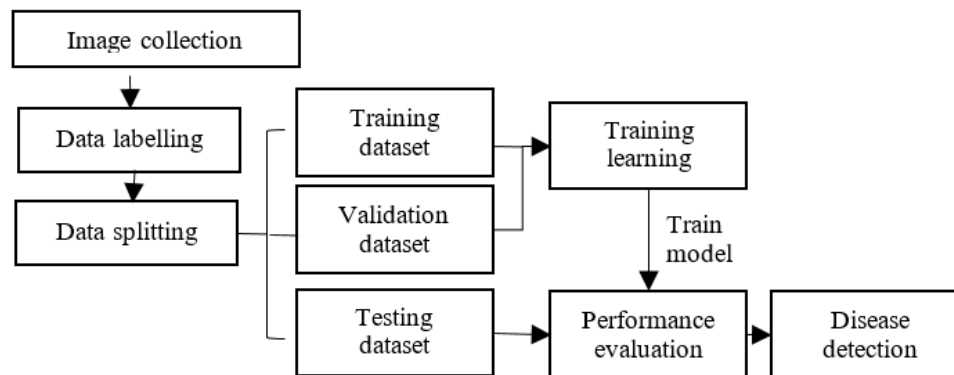

Fig.4: framework Convolutional Neural Network (CNN) Plant Disease detection from different Images

The first step of this rice plant disease, is for data collection which is a challenge for identifying the rice diseases and pests. By using CNN architectures for classification, we need huge data collected in different season such as winter, summer, printer and son. To make sure that you have all data for all period which can be affected by different bacteria. We will also captured images if disease part in both summer and winter, this will help with training the model in way that can do well in real life scenario in different weather. Similarity and dissimilarity is a necessary feature of any real life image.

Secondary is for improving or increasing classification accuracy, when you captured an image of disease area of a rice plant in rice field, you meet with different background composed on the other rice pants like soil, people or other objects. By detection with heterogeneous background makes some difficulty to segment the region of interest.

Thirdly, the training model for CNN architectures we will been used a large number of trainable parameters such as VGG16[28] which applied to automatic detection of tomato disease. Training from scratch. And by reducing model size because of lack of network or some ICT infrastructure in rural areas of developing countries, CNN models need to run offline in rice disease and pest detection for oriented mobile applications. We should reduce the number of parameter in CNN models, to obtain the classification capability can been decreasing which can reduce their utility as a tool for diseases and pest classification module.

Sample data collection

Rice disease happen in different parts of the plant, for training my model I used kaggle open source dataset of 3355 images which have four classes, Health, Hispa, BrownSport and LeafBalst. These leaf have different symptoms of different disease with labelled, table2 for the number of each images per class. By define transform and create data loaders, we suggest a train with transform randomly 45 rotation, rising by 224, horizontal flip and normalized for two vector. And with augmented data for validation was resized by 224x32 with 224 transformation of center crop with the same normalizing of training. The number of sub process to use for data loading with zero number works, and samples per batch size 20 and 0.2 valid size as percentage of training set to use as validation. After creating data loader we specified class names as rice diseases classification. Data visualization, we define the

help function to un-normalize and display image and to obtain one batch of training images with different iteration lastly, we plot the images in batch with their labels by display 20 images see figure 6. Build and train the classifier by used pre-trained models VGG to achieve high accuracy with less time on training, by download the pre-trained model will different steps by initialized training model with tracking for minimum validation loss and monitor training and validation loss and save the model if validation loss has decreased. Lastly we predict plant disease with the model as you see figure 5

Table 4: labelled dataset per each category

Categories	Number of images/ category
Health	1488
Hispa	565
Leaf Blast	779
BrownSpot	523
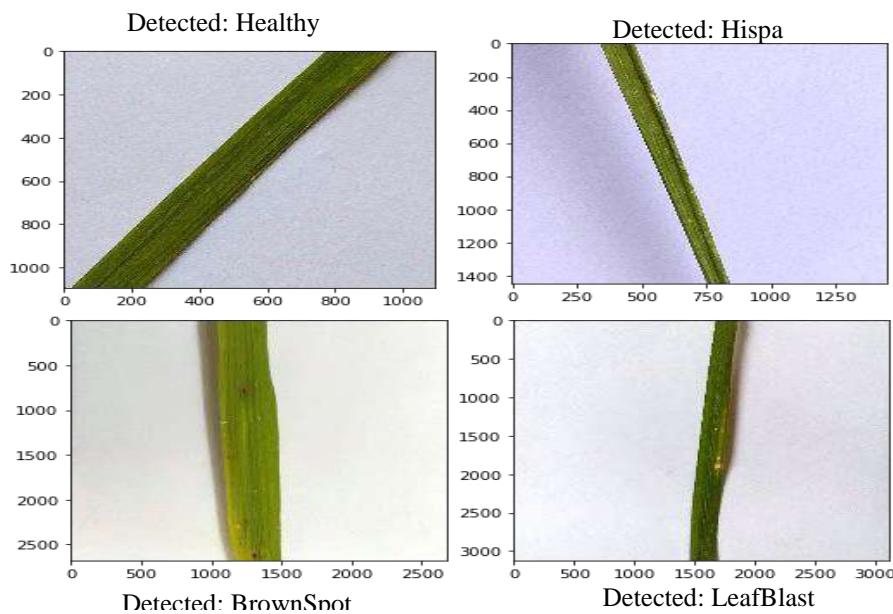
Fig.5: predict plant disease with VGG model, by different detected disease label.
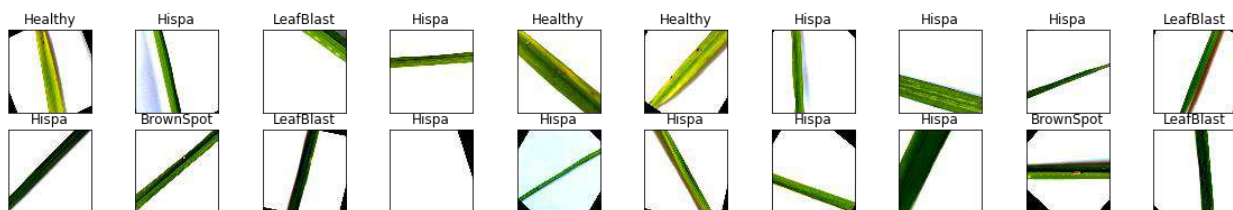
Fig.6: Image of rice disease visualizing in their different batch of training

IV.   DISCUSSION

We discussed with ICT tools due to the disease image processing. Because of the some poor infrastructure which are not reached to the rural farm area, we explain different method for image processing. But after model reduced the even some rural aria will be better and easily using. Lastly we train some dataset from kaggle.com by using CNN and VGG model by pre-trained, we suggesting after have been done our data collection to the Bangladesh will be better to train our system for rice disease detection.

V.   CONCLUSION

In this paper we describes the ICT roles to data collection and acquisition, the image processing methods to detect and classify rice disease. Identifying the disease through the ICT tool for data collection is the main purpose of the proposed method. The result indicate that it is an efficient method, which can help an accurate classification of rice disease in a huge computational effort.

In further work, I will collecting the leaves from rice for Bangladesh farm using Canon EOS 1500D and preparing a dataset of images of rice plant leaves having a main rice disease. After applying traditional image processing techniques and then convolution neural network to build and train a model to analyses images of these collected dataset for different classes or categories in order to improve rice monitoring system timely. Secondly I will continuing compared with other methods in way of getting a best accurate.

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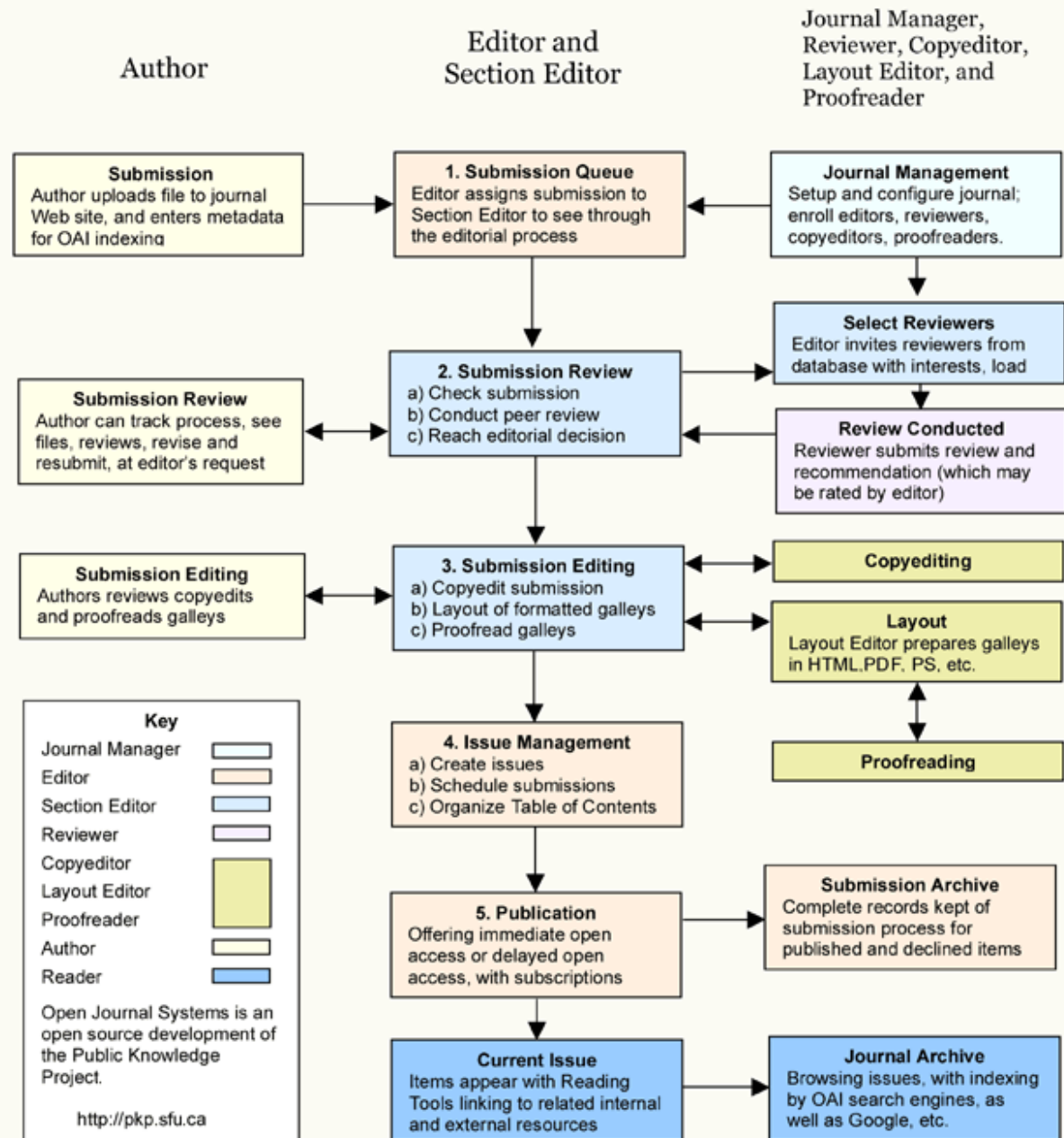
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