

ISSN: 2349-6495(P) | 2456-1908 (O)



International Journal of Advanced Engineering Research and Science

(IJAERS)

An Open Access Peer-Reviewed International Journal



Journal DOI: 10.22161/ijaers

Issue DOI: 10.22161/ijaers.83

AI PUBLICATIONS

Vol.- 8 | Issue - 3 | Mar 2021
editor@ijaers.com | <http://www.ijaers.com/>

International Journal of Advanced Engineering Research and Science

(ISSN: 2349-6495(P)| 2456-1908(O))

DOI: 10.22161/ijaers

Vol-8, Issue-3

March, 2021

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Publisher

AI Publication

Email: editor.ijaers@gmail.com; editor@ijaers.com

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FOREWORD

I am pleased to put into the hands of readers Volume-8; Issue-3: 2021 (March, 2021) 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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Proposition of New Cost Management Models Applied to Agribusiness

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Received: 14 Dec 2020;

Received in revised form:

01 Feb 2021;

Accepted: 13 Feb 2021;

Available online: 05 Mar 2021

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Keywords — *Costs, Costing Methods, Reduction, Simulation, Soybean Planting.*

Abstract — *The conscientious use of information about costs must be a constant practice by entrepreneurs, however, there are countless ways of working with them, determined as a costing method. These costing methods allow a more conscious decision-making, making its users aim to gain competitive advantages. This research demonstrated the importance of costing methods, demystifying and breaking possible paradigms regarding their use by agribusiness, more specifically in agriculture, in the condition of the from inside the gate, which is a peculiar term used in the agribusiness chain to refer to those who is dedicated to planting, handling, harvesting and processing. The applied methodology was the simulation in a case study carried out on a farm located between the state of Sao Paulo and Parana, Brazil, with an area of 380 ha, for the 2019/2020 soybean harvest. The comparison was made between the costing methods by absorption, variable and production effort unit (PEU), where the latter were adapted to a condition of mono production, demonstrating that this is one of the contributions of this work, however, the most important, is that it was possible to identify that this method could be a precursor in the generation of competitive advantages for its users if used systematically, allying with its results the search for the cause and effect in the generation and consumption of resources used in production.*

I. INTRODUCTION

Brazilian agribusiness has a fundamental role in the country's development, being responsible for more than 23% of the Gross Domestic Product (GDP) and 61% of the total exports, showing itself to be the only activity with increasing results during the pandemic scenario, so it must be studied and supported in all aspects (Ministry of Agriculture, 2020). It has proved to be one of the safest and most profitable activities that exist in Brazil, given that the fertile and productive land reaches 388 million hectares; water, as an indispensable resource, is found in abundance; and the climate, has fluctuations that are favorable to several productions, giving Brazil benefits for

agribusiness and all its productive chains (Silva et al., 2010).

According to the 2017 Census of Agriculture, there are more than five million agricultural establishments in Brazil, which means that the sector generates more than 20 million jobs, half of them coming directly from the family farming sector. In addition, agribusiness is responsible for the largest contribution of Brazilian GDP, as already described (IBGE, 2017). Callado and Callado (1999), already stated that cost management is one of the most relevant administrative aspects for a sector, however, it reveals that after decades the agribusiness sector still

calculates costs in a precarious way, without using a standard or appropriate methodology (Schouchana, 2015).

In the strategic and tactical field, it is necessary to advance the use of techniques already established in other economic sectors, such as cost management, recognized as one of the elements that form competitive advantage. Similar conditions to these, such as a dynamic business environment, high technological development, market segmentation, have driven companies in Kosovo to change cost management to a strategic focus, and have allowed many to start to generate competitive advantage (Berisha, 2017). Nevertheless, it is worth remembering that cost management is an important source for the generation of indicators, which should always be present in the analysis of organizations, assisting in the implementation and improvement processes, identifying goals, controlling processes and verifying results (Müller, 2003).

Chen et al. (2016) had already detected these similarities and decided to carry out a research specifically involving the strategic direction of agribusiness in Taiwan, for this purpose, they interviewed entrepreneurs specialized in agribusiness, and using the concepts defended by Pearce and Robinson regarding the strategic management model, the competitive forces defended by Porter, the growth matrix used by Boston Consulting Group and not least the McKinsey model for business portfolio, came to the conclusion that three dimensions must be observed, namely external, internal and sustainability, where cost management is intrinsic part in the process of generating competitive advantage.

Cost management in agribusiness seeks to be efficient, seeking to maximize the resources that are scarce and reduce production costs (Lizot et al, 2016). Lopes and Santos (2019) evidenced in research with 65 small rural producers in the Ivinhema region in Mato Grosso do Sul, Brazil, that although the vast majority of these producers knew the reality of their costs, none of them applied a formal accounting or registration method of the same. Even more aggravating is the decision-making about planting and agricultural financing, which is done without having as basis the expected production costs.

Nunes and Michelin (2019), in a similar survey, in the state of Rio Grande do Sul, in the region of Encruzilhada do Sul, heard small rural producers associated with a credit cooperative, noting that most of them have a lot of skill in conducting crops, however low knowledge in management and little or no use of management techniques for decision-making.

With these initial surveys, it is possible to affirm that cost management for the sector is fundamental, needing to evolve and be applied on a daily basis. Therefore,

knowledge needs to have its status quo modified, so that its users can make conscious decisions, seeking improvements not only in productivity, but also in processes that consume resources and generate costs. Thus, the producer starts to have a clearer view of his business, of the predominant factors, solving bottlenecks, optimizing the use of resources, with the goal of generating competitive advantage, supported by one of the bases of the internal dimension, which is management of costs.

Therefore, these premises justify important questions, and that brought to research, should be studied more appropriately throughout this work, analyzing the advantages and disadvantages of some costing methods, aiming to identify in them the condition of being precursors of generating competitive advantage for agribusiness. This research seeks to demonstrate the importance of costing methods, demystifying and breaking possible paradigms regarding their use, since they will be applied to agribusiness, more specifically in agriculture, in the condition of inside the gate, which is a peculiar term used in the agribusiness chain to refer to those engaged in planting, handling, harvesting and processing. Therefore, it is assumed that costing methods, as allocators of expenses incurred in the production of products and services, are more than a repository, in fact they are sources of information for the analysis of cause and effect in the consumption of resources that have been transformed into expenses, and therefore, in addition to being reduced, they can generate some competitive advantage for its user.

To this end, this work was divided into five sections, the first being a brief contextualization of the agribusiness scenario and the objective of the research, the second a theoretical synthesis of the main costing methods in addition to the advantages and disadvantages of each when applied in agribusiness based on in research published in Brazil and abroad. The third section deals with the methodology used so that the results could be brought in the fourth section, and in the fifth and last section, the research findings are presented in the form of final considerations.

II. COSTS AS A COMPETITIVE ADVANTAGE

For the elaboration of this section, articles, dissertations, theses and books were consulted that could support the research questions, seeking to understand the logic and applicability of costing methods as allocators of expenses to the products and services generated, since the leadership in cost was defended by Porter (1985) among other recognized authors who approached the subject of competitive advantage as such. Le and Lei (2018)

confirmed in research that the majority of Chinese companies achieved competitive advantage through leadership in innovation and low cost.

However, there is a concern with developing countries regarding the formulation of policies on the generation of competitive advantage in the face of the growing competition from global agribusiness. Countries like the United States, Brazil, China, do not compete for the same goals, which causes fear in the world community, as both are extremely important for the supply of inputs from the first chain. The study also revealed that the current system for measuring the generation of competitive advantages used by agribusiness must be modified, expanding the quantity and quality of indicators, which will place greater emphasis on the formation of microeconomic results (Sachitra, 2016).

Corroborating this idea, when analyzing export data for products of agricultural origin between 2000 and 2014, it was observed that Russia has been improving its position in world trade, with emphasis on processed products derived from fish, cereals and oils vegetables (Irena et al., 2017). This finding goes against the results evidenced, reaching the conclusion when analyzing methods of developing competitive strategy in agribusiness, that there are many strategies for this, however, they will necessarily go through differentiation and cost reduction, always focused on market requirements. This implies, not only producing commodities, but understanding the added value that the customer wants (Tynchenko et al., 2019).

In Brazilian agribusiness, strategies that add value to the sector need to deal with price variability, needing to know the instruments present in the market for risk management (Soares & Jacometti, 2016). In a survey carried out on strategic cost management practices and strategic positioning in a survey, involving 169 companies in the 400 largest agribusiness, a higher frequency was identified for the practices of logistical costs, standard cost and quality cost, and, as strategic the most used is focused on cost leadership, followed by logistical and quality costs (Grando, 2017).

However, in all the researches carried out there was no clear relationship stamped between the cause-and-effect relationship. Therefore, it is believed that this can be evidenced by costing methods, and when properly applied, they can generate useful information for decision-making, allowing the idealization of strategies to achieve competitive advantages. It can be seen that organizations need a costing system for their business, as a whole, to be more effective. From this view, the factors that determine the success of the most viable costing method for the company should be explored, bringing to the fore the

possibility of generating competitive advantages (Brierley, 2010).

Thus, the following sections will serve to demonstrate the main costing methods, their advantages and disadvantages and the applicability or not for agribusiness.

2.1 Absorption Costing

In Brazil, this is the method of required use for all legal entities in relation to the preparation of corporate accounting, also known as tax or financial, that is, that intended for the external public. This does not prevent these legal entities from adopting other costing methods for the purposes of decision-making or calculation of management accounting, more focused on the internal public of that legal entity.

Absorption costing is characterized as the method where all production costs participate in the composition of the cost of the good or service, so that the expenses are not part of the cost of that good or service. Expenses are charged directly to income, while fixed costs are apportioned to products and taken to inventory for those products not sold during the calculation period (Leone, 2007).

There is an advantage in using this method, mainly in terms of price formation, which is based on a basic principle that consists of the method itself in separating costs and expenses, however it will not be of great value where prices are dictated by the market, such as example in agribusiness, where most products are commodities (Bruni & Famá, 2005).

The application of this method in the determination of costs in a milk production located in the interior of the state of Santa Catarina showed that a great help in the management of production, since the spreadsheets used generated useful information for decision-making, such as, for example, the primary and factory cost, showing that the unsatisfactory performance in the results was not due to the costs, but to the difficulties that the activity encountered (Segala & Silva, 2007).

In a survey conducted in the state of Mato Grosso, considering the corn crops from 2014 to 2017, Da Silva et al. (2016) tested the three ways of applying absorption costing (partial, modified partial and integral absorption), concluding that each one has its usefulness. As for the partial absorption cost, where direct and indirect costs are allocated to the products, they concluded that it is more suitable for fiscal bookkeeping and for purposes of calculating financial statements.

In the modified partial absorption costing, only variable costs and fixed operating costs are allocated to the products, helping to better observe the costs of the

products, since structural costs, not inherent to the crop itself, are left out of this calculation. Finally, when testing the applicability of full absorption costing where the total costs and expenses are allocated to products, they reached the same result as the first one tested, that is, partial absorption (Da Silva et al., 2016).

Savic et. al (2014) in research in the Republic of Serbia, identified that absorption costing is more used by that nation's agribusiness as an element of communication with external agents (stakeholders) while for managerial and strategic purposes by agribusiness in that nation are used more activity costing, lean costing derived from lean production, target costing and costing derived from the supply chain. These results had already been pointed out in a survey conducted in the state of Paraná, Brazil (Castanheira et al., 2014).

It can be seen from the quotes presented that the absorption costing method has its ramifications, advantages and disadvantages when used by agribusiness, but in none of the sources researched, it was mentioned that it could be a precursor in the generation of competitive advantages for agribusiness. To arrive at this statement, several sources of research have been used in a considerable period of time, that is, in the last 15 years.

2.2 Variable Costing

The variable costing method is one in which only the variable costs will make up the cost of the good or service, assuming that the fixed costs are already committed by the organization, as they will not suffer changes in value with the pre-established volume produced or contracted (Megliorini, 2012). Used only for management information purposes, it takes into account only the factors and / or volumes that may change with the production or product volume.

The variable costing method can be well-used by producers who, in addition to registering their costs, have control over the establishment for management purposes, the contribution margin of production and also the applicability of their techniques, in order to obtain a greater operational efficiency for your business (Silva et al., 2013).

Some advantages imposed to the variable costing method are: the practice of apportionment does not occur and obtain the necessary data for the analysis of the cost / volume / profit relationships quickly from the accounting information system. Therefore, some disadvantages of the method are: in practice, the separation of fixed and variable costs is not as clear as it seems, as there are semi-

variable and semi-fixed costs, which may incur continuity problems for the company in direct costing; and the increase in the proportion of fixed costs in the cost structure of organizations, due to the continuous investments in technological and productive training (Leone, 1997).

For Segala and Silva (2007), it is extremely important that the rural manager is informed in relation to what happens in his business, as well as the market trends that he must follow and the functioning of the same, which, because it is a rural business, is influenced by external factors such as climatic fluctuations, for example. For them, this costing methodology will help the gatekeeper inward, however, it is not able to show the relationship between cause and effect in the generation of costs, a key factor to leverage a competitive advantage.

Among the advantages and disadvantages of this method, there is the final valuation of inventories, since excluding the fixed costs incurred in other periods, it may cause an understatement. In addition, it underestimates the behavior of fixed costs for a short-term view, as they will tend to change over time (Padoveze, 2010).

It was not identified in the literature mentioning that this method may be the precursor in the generation of competitive advantages.

2.3 Cost per Unit of Production Effort

The costing method per Unit of Production Effort (PEU) is based on the unification of production, in which its objective is based on it, having the creation of a common measurement unit for organizations with diversified productions (Morozini et. Al, 2006). Thus, the method aims to simplify the management control process starting from just two items, the costs of the raw material and the costs of the transformation, and, with this, the performance analyzes of the company, start to be carried out from costs and measured as effectiveness, efficiency and productivity (Bornia, 2010).

Being able to transform a diversified production into a unified one, the PEU method incorporates both economic and technical aspects to the multi-producing companies, providing all the facilities that the companies that manufacture a single product have in their production management (Allora & Allora, 1995).

The PEU method can be characterized as versatile and can serve as a basis for planning, programming and also the control of production processes, facilitating and simplifying the management of the organization's complex production processes as shown in Fig. 1 (Neto, 1995).

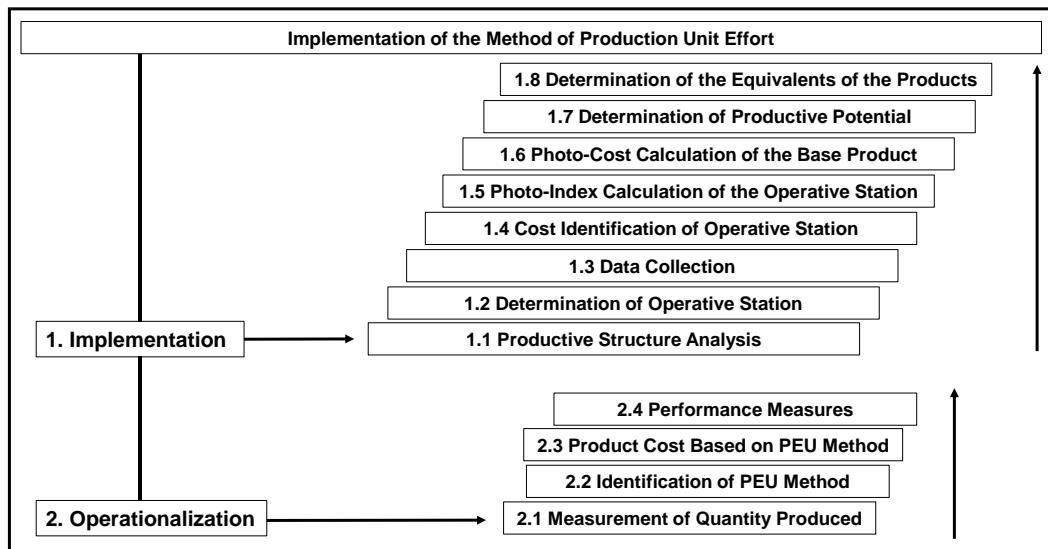


Fig.1: Basic scheme of the PEU costing model

Source: Adapted from Morgado (2003)

The cost per Unit of Production Effort has its priority focus on determining the cost through the transformation of raw materials into final products from the expenses used in the operations (Zanin et al., 2019).

Citing some general advantages of the method, unification of production can be taken into account, facilitating management and comparison of performance between periods; the use of information for financial accounting, among others, and, nevertheless, some of its main limitations are the need for constant review and also about not considering expenses and expenses of the company's structure (Wernke et al., 2020).

Since the PEU can facilitate the analysis of the profitability of manufactured products, according to Lembeck and Wernke (2019), the evaluation of this is able to optimize the marketed mix, giving increasing levels of value and market presence for the institution. In addition, it is possible to account for the measurement of installed, used and idle capacity, as well as to monitor production with the use of fiscal measures (Zanin et al., 2019; Wernke; Junges & Zanin, 2019).

The main advantage of this method consists of its simplicity of operation, where after knowing the productive potentials and equivalents of the PEU of the products, the calculations are easy and fast. Some other advantages of this method are characterized by providing an indexer so that production is more uniform and with fewer variations; allows the visualization of activities that are not adding value to production; it makes it possible to measure the cost-benefit using new technologies (through resources such as benchmarking); adheres to macro

strategies seeking costing as a goal and leadership in costs; among others (Bornia, 2010).

Although the PEU method requires commitment and dedication from the producer, it is beneficial for organizations in the agribusiness sector, since it allows a detailed view of the production process of each product and the composition of costs, allowing the manager to monitor these costs and the choices of strategies they should take (Oenning, 2010).

However, some disadvantages of this method are related to the difficulties in treating the organization's waste, since only productive operations are considered, moreover, for agriculture, its use is not advised if there is a large rotation of production crops (Abbas et al., 2012).

For Meyssonier (2003), hidden operations in the implementation of the method can be seen as a disadvantage, since it assumes that the relation of the operational stations remains over time, disregarding possible improvements in the process, in addition to the subjectivity that the method needs to adopt in relation to the precise time estimates to keep production times up to date (Pereira, 2015).

Therefore, all advantages and disadvantages must be weighed according to the characteristics and objectives of the business to be used as the main costing method.

2.4 Other Costing Methods Applied to Agribusiness

The activity costing method, or ABC costing, starts from the idea that it is the organization's resources that are consumed by the activities, and these, consumed by the good or service provided by the organization (Abbas et al.,

2012). In turn, this method can be applied both to companies in all economic sectors, since the analysis of the method comprises the examination of the cost structure of each department and the factors that influence the demands of each one.

One of the advantages of this method is found in its relevance in situations where it is necessary to analyze specific processes seeking improvements and restructuring (Souza & Carvalho, 2012). However, some disadvantages of activity costing are that data storage, processing, presentation and survey are expensive. Another disadvantage is that the method is not usable or easily adaptable to new circumstances (Kaplan & Anderson, 2007).

The use of the ABC method is considered suitable for use in the agribusiness sector, since the model enables a cost management system that is capable of providing the rural producer with managerial information regarding decision-making, which increases competitiveness and business sustainability (Almeida et al., 2009).

The research by Kabinlapat and Sutthachai (2017) confirms this position when analyzing the implementation of the ABC method in a food processing company, having chicken as its main input, where they could see that the attribution of the ABC method brings with it the possibility of providing more information accurate on costs for the management of companies, showing that the method can bring competitive advantages, since it will be possible to better understand its bottlenecks.

But the question that may be latent at this moment is, if this can be a costing method that can generate a competitive advantage. The research by Do Nascimento et al. (2016), Ebele and Meshach (2016), Lu et al. (2017), Altawati et al. (2018), Rossi and Von Egert (2019), report that yes, although most of them have not been applied in agribusiness, however, they demonstrate that the system provides the relationship between cause and effect through cost drivers, even modifying on many occasions the way of making a product or service, which adheres to the macro business strategies, especially with regard to leadership in costs and differentiation.

The German Reichskuratorium für Wirtschaftlichkeit (RKW) method of costing homogeneous sections, however, has the main characteristic of dividing the organization into a cost center, that is, all fixed and variable costs and expenses and direct and indirect costs are allocated manufactured products (Abbas et al., 2012). This condition is only possible to be achieved, since costs are separated into items, where the company is divided into a cost center with identification of the primary distribution, secondary to the final, causing the costs to be

redistributed according to the production stage (Pamplona, 1997).

The RKW method enables and guides the organization so that it reaches the total of products, considering the expenses that occurred before, during and after their production, bringing benefits to the entity once the decision-making of it becomes clearer (Santos & Filho, 2017).

Abbas et al. (2012) identified some advantages and disadvantages in this method, one of the advantages being taking into account all costs incurred in an organization, without exceptions, in addition to justifying prices and arriving at the costs of producing and selling. The RKW method also has the advantage that the method is allocated, in the products, the total expenses related to the effort to produce, manage and sell these (Magalhães et al., 2017).

This advantage in agribusiness was tested through a case study in an agricultural cooperative where it was possible to identify the most accurate application of all costs on the deposited grains, giving the producer a clearer view of the costs of cleaning, storage and commercialization of its production (Backes et al., 2007).

However, according to Abbas et al. (2012), one of the main disadvantages is the power to lead the manager to mistaken decisions for not distinguishing fixed costs from variables, not eliminating the arbitrariness of the criteria for apportioning indirect expenses, even if it suggests tracking as realistically as possible, demonstrating that their vulnerability lies in the risk of distortion in the measurement of the cost per product and also per unit produced (Magalhães et al., 2017).

Among other methods, the Theory of Constraints (TOC), can be understood as a refinement of direct costing joining the technique of linear programming (Cogan, 2002). This method reinforces that the overall performance depends on the efforts that each element that makes up the system offers, concentrating three major measures - earnings, inventory and operating expenses - so that, as a final conclusion, the TOC can use the data demonstrating the bottleneck capabilities and organization earnings (Dias & Padoveze, 2007).

III. RESEARCH METHODOLOGY

Based on the definitions of Bromiley and Jhonson (2005), this research is considered to be of an applied nature, as it consists of generating knowledge of practical application for specific purposes. As for the objectives, it is considered exploratory, whose phase is embryonic and its main purpose is familiarity with the problem, being associated with bibliographic research and case study.

The research adopted as a methodological process, replacing the case study, a comparative study, which can also be called simulation. The simulation process can be understood as “the manipulation and construction of an operating model representing all, or part of a system or process that characterize it”, thus reflecting on a method in which the central characteristics of a system, process or environment, be it real or proposed (Olsen & Morgan, 2005).

The adoption of the simulation process occurred due to the impossibility of using financial data from the farm, object of study, located on the border between the states of São Paulo and Paraná, Brazil. The production unit has an extension of 380 hectares (ha) and has a working day in accordance with the current labor legislation, totaling 176 monthly hours.

Using the simulation process, we sought to compare the absorption, variable and PEU costing methods, given that the methods synthesized in section 2.4, would require another methodological process, changing the nature of the operations carried out by the farm. Therefore, three simulations were carried out, presented in the next section.

The operational data used are from the farm on fire, and the financial data, available in Annex 1, represent the average occurred in the state of Paraná. This state was chosen, due to the fact that most of its suppliers are located in that region.

As the simulation was carried out from the moment the plants were in the R6 reproductive stage (full pod), the predicted production coincided with the same informed in Annex 1. For valuation and billing determination, quotations from bag according to the Castro / PR region, on the dates when grain production was commercialized (Agrolink, 2020).

There was an adaptation of the PEU method to the reality of agribusiness, for an activity considered within the gate, as this method foresees its application for several products at the same time (Bornia, 2010), however, in agriculture, the adaptation of the product occurs in relation to driving crop, which can occur during two periods in the agricultural year, called harvest, which in most of Brazil, are summer and winter.

IV. COMPARATIVE STUDY BETWEEN METHODS

4.1 Steps Taken in Soybean Cultivation

In order to guarantee the feasibility of the simulation, the steps in soybean cultivation on the mentioned farm will be demonstrated. For a better understanding, these steps were divided into tables, which will serve to understand

the comparative, described in the previous section. The detail described in the tables summarizes in 90% the activities / operations carried out during the implantation and conduction of the crop, which may vary from crop to crop, or from farm to farm.

The tables represent activities that consumed resources at each stage of the soybean crop, briefly described and monetarily measured according to Annex 1, in the items of mechanized operations, labor and aircraft operations. As this is not the main focus of the article, the details of the operations presented in Tables 1 to 4, present basic characteristics, which can be identified and replicated by other studies or essays. The operations developed in the pre-planting stage are shown in Table 1.

Table 1: Operations performed in the Pre-Planting stage

Specification	Detailing	Equipments
Soil sampling	15 simple samples for every 10 ha of area to be cultivated	Dutch auger, bucket, sample bags
Desiccation	Mechanized application of herbicide	Self-propelled sprayer
Liming	Loading, distribution and incorporation of limestone	Tractor, trailer and limestone distributor
Seed treatment	Seed treatment with pesticides and inoculant application	Inoculator

As for soil sampling, it is done every two years, and requires manual labor, requiring a few days of work, depending on the number of men and equipment employed. This same activity could be replaced by the use of modern soil analysis techniques with equipment aimed at Agriculture 4.0 (Carraro et al., 2019).

Before planting, it is necessary to desiccate the area to eliminate weeds that may compete with the development of the crop to be planted. This activity is carried out by a self-propelled sprayer, which takes five working days to cover the entire arable area, under normal weather conditions, that is, with winds of up to 10 km / h, and obviously without rain. Liming is not an activity performed every year, being demanded according to the results indicated in the soil analysis.

Seed treatment is done as planting takes place, using inoculators coupled to seeders, not requiring extra labor-related activity. Considering an average of one year for the other for the activities described in Table 1, there is

approximately 80 hours of work for the entire team to carry out the pre-planting activities in the 380 ha.

The chronological analysis is a very important record for any company, and it must be carried out constantly in order to know what their productive potential is, therefore, it is important to make it clear that the specifications, details and equipment shown in Tables 1 to 4, were raised in the field. In sequence, the operations developed at planting were shown, shown in Table 2.

Table 2: Operations carried out at the planting stage

Specification	Detailing	Equipments
Seeding	No-till system	Tractors and seeders
Fertilizing	Carried out together with sowing	Tractors and seeders
Irrigation	Only in case of lack of rain in the planting window	Center Pivot
Support	Refilling the seeder with seeds and fertilizer	Tractor, winch and trailer

The sowing and planting fertilization stage has two tractors and two seeders, one with nine and the other with six rows. In addition to the tractor drivers, two operators are also used in the seeders to certify the correct drop of seeds per row. The two seeders together, in an 8-hour work shift, reach an area of 6 ha of planting.

Therefore, using a simple mathematical calculation, for planting 380 ha, mathematically rounding upwards, there is a consumption of 507 working hours (380 ha divided by 6 ha / day, multiplied by 8 hours daily). It is true that in agribusiness, especially within the gate, issues related to labor legislation suffer adjustments, because of climatic issues, to achieve a good result in planting, the shifts are increased, in addition to the work teams taking turns. In this way, what would take almost two months is reduced to approximately one month of uninterrupted work, except on days with heavy rain. This is done to take advantage of the ideal planting window, comprised of the photo period, temperature, soil moisture, suitable for the chosen cultivar.

Irrigation is done autonomously, where the equipment (pivot) is programmed for the exact amount of time you want to irrigate. The time spent with the seed and fertilizer seeders recharge operation is computed in the sum of hours of work already presented. The operations carried out in the management of the crop are described in Table 3.

Table 3: Operations carried out in the field of conducting the crop

Specification	Detailing	Equipments
Survey of pests and diseases	Identification of pest and disease attacks	Employees
Insecticides	Pest control application	Self-propelled sprayer
Fungicides	Disease control application	Self-propelled sprayer
Herbicides	Application for controlling invasive plants	Self-propelled sprayer
Cover fertilization	Fertilizer distribution	Tractors and distributors
Irrigation	Water complementation	Center pivot

Inspections are carried out weekly on each planting frame / plot, aiming to raise pests and diseases. In addition to the survey of the responsible agronomist, which is carried out by sampling over 380 ha, teams of collaborators are also drawn up, usually between 3 and 5, at a rate of 1 ha per hour of work, with the aim of locating insects and picking weeds. This activity aims to identify any flaws or inefficiency in the mechanized application of insecticides, fungicides and herbicides by the self-propelled sprayer, whose productivity has already been mentioned in Table 1.

The cover fertilization is made by haul, and according to the equipment used, a production of 5 ha per hour is reached. The sum of all the activities specified in Table 3 reaches 260 hours considering the deployment of the team on work fronts. The harvesting operations are described in Table 4.

Table 4: Operations performed at the harvest stage

Specification	Detailing	Equipments
Harvest	Desiccation and mechanized harvesting	Harvester
Transport	Transportation of grains from the field for processing	Trucks
Pre-cleaning	Removing impurities in sieves	Vibrating screen
Drying	Only if it is non-standard (above	Dryer

	18%)	
Storage	Awaiting commercialization	Metal silos

This farm uses a harvester with a capacity of 10 ha per 8-hour shift. The harvest starts around 9 am, when the dew is gone, and ends at the beginning of dusk, when the dew starts to return. Normally, the harvest is carried out with the grain moisture at around 18%. For commercialization, soybean moisture is accepted with up to 15%, therefore, the moisture difference is extracted in the pre-cleaning, drying and distribution process in the silos, which takes an average of 3 hours for every 12 tons of soybeans.

In the processes specified in Table 4, three workers are used, one for the combine, one for the truck and one for the dryer, totaling approximately 300 hours of work.

In the next section, simulation and comparison between costing methods is demonstrated.

4.2 Simulation by Absorption Costing

Using the concepts and observations described in section 2.1, in addition to the information provided in section 4.1 and in Annex 1, it was possible to elaborate the simulation by the absorption costing method, presented in Table 5.

Table 5: Absorption cost

Item	Amounts (US\$)	Calculation memory
Revenues (R)	522.500	380 ha x 55 bags/ha x US\$ 25.00/bag
Total cost (TC)	175.491,30	380 ha x US\$ 461,8192
Operating profit	347.008,69	OP = (R – TC)

It is noticed that this method does not take into account the information in Tables 1 to 4, that is, it works only with the accounting of the monetary values spent during the harvests, thus meeting the legislation in force in Brazil. This finding corroborates the results pointed out by Castanheira et al. (2014), showing that the method can be beneficial with its ramifications and advantages for the agribusiness sector.

Due to the fact that it has a very simplistic view, since the method unifies all costs (fixed and variable), the results presented do not generate adequate management information for a more effective decision-making, especially with regard to the optimization of the resources

used. in production, contrary to the results found by Segala and Silva (2007).

In addition, according to Leone (2007), two factors weigh against this method, which is the apportionment used arbitrarily to allocate indirect costs to products and the allocation of part of the fixed costs incurred in the period when there is a stock of products in preparation or finished.

There are numerous studies in the literature that point out advantages and disadvantages about this costing method, but none of them was categorical in stating that it is a precursor in generating competitive advantage to its users.

4.3 Variable costing

Using the concepts and observations described in section 2.2, in addition to the information provided in section 4.1 and in Annex 1, it was possible to elaborate the simulation by the variable costing method, presented in Table 6.

Table 6: Variable costing

Item	Amounts (US\$)	Calculation memory
Revenues (R)	522.500	380 ha x 55 bags/ha x US\$ 25.00/bag
Total variable cost	(121.245)	380 ha x US\$ 319,0653/ha
Total contribution margin	401.255,15	
Total fixed cost	(54.246,46)	380 ha x US\$ 142,7538
Operating profit	347.008,69	OP = (R – TC)

The first observation to be made is that there are no stocks on the property referring to the soybean harvest that was conducted between 2019/2020, for this reason, the absorption and variable costing methods show the same result for the operating profit line.

It is clear that the variable costing method is able to bring more useful information to decision-making, mainly the separation between variable and fixed costs (Megliorini, 2007).

Taking into account that the great part of the Brazilian agriculture makes two harvests per year (summer and winter), for Silva et al. (2013) there is an advantage in using this method, which is the information generated about the contribution margin of each harvest for the

payment of fixed costs during the year. The contribution margin, in turn, is part of an analysis called cost, volume and profit, which can be linked to other managerial artifacts, such as operational leverage, thus determining the degree of operational leverage used by the farm.

However, there is a limitation in the method regarding the analysis of fixed costs, because according to Leone (1997), the fact of accumulating them and isolating them in the result, does not allow the understanding of how they behave, thus hindering their management. Corroborating this condition, the results of the research by Segala and Silva (2007), demonstrate that this method has difficulty in treating the relationships between cause and effect in the generation of costs.

Thus, it is worth mentioning that this method has its contribution to cost management, however, according to what was evidenced, the condition of being a precursor in the generation of competitive advantage was not identified in it.

4.4 Cost per Unit Production Effort

In the cost simulation using the PEU method, it was necessary to make some adaptations to the scheme presented by Morgado (2003) in Fig. 1.

Table 7: Phases 1.1 to 1.3 of the basic scheme of the UEP costing model (Figure 1)

Agriculture	Pre-planting	Planting	Driving	Harvest	Time
Soy	80	507	260	300	1,147

Table 7 shows the productive structure, following the determination of operating stations and data collection. These steps may seem obvious, but in many cases, because they are so usual, agricultural producers end up not giving much importance to operations, but only to processes and the final product, not performing a chronological analysis of the times consumed during operations that occurred during the harvest. This is declared as a big mistake, as a first reflection on productive capacity and the implementation of improvements is lost there.

Therefore, Table 7 began, a first relevant point of this costing method, because by dividing the farm into operational posts (adaptation to the method), a detail was obtained of how the hours of work are consumed,

Initially, there was a transformation of the operational posts in phases / stages of the crop, the main one being that it is a single product (soy). Therefore, in item 1.6, which is the calculation of the photo-cost of the base product, where for a multi producer company, it would be the time to choose a product that best represents the average of the passage times, using the passage time chosen as the denominator in a division where the numerator will be the hourly cost per post, thus showing the calculation of the cost of the base product.

Having presented these initial considerations, it is shown from Table 7, the calculations performed to determine the phases required by the method and shown in Fig. 1.

Table 7 presents two phases carried out together, which is an adaptation for the demonstration of the measured results, that is, the disclosure of the division of the operational stations (Phase 1) and the passage times in hours that according to the method are called photo indexes (Phase 3) in a single table.

considering not only labor, but all fixed expenses as described in Annex 1.

Ascertaining the passage times in hours for each operating station, according to the division (crop phases) already presented in Tables 1 to 4, in section 4.1., The first step was taken to build the indexer called UEP. This first step must be detailed and formalized, as from this division, it is that the performance of the operational posts will be planned and controlled, seeking a reduction in the value obtained for the UEP, from the initial survey in monetary standard, represented by Table 8.

Table 8: Phase 1.4 of the basic scheme of the PEU costing model (Fig. 1)

Cost item / Operating station	Pre-planting	Planting	Driving	Harvest	Total
Labor	24	17.60	104	16	161.60
Mechanized operations	78.75	110.96	237.08	137.93	564.72
Airplane Operations	0	0	16.00	0.00	16.00

Total (US\$)	19.76	24.72	68.67	29.60	142.75
Number of hours/month	80	507	260	300	
Cost per hour (US\$) per ha	1.28	0.25	1.37	0.51	

The information on labor, mechanized operations and operations with aircraft were extracted from Annex 1, and totaled in columns by the farming phases, which subsequently served as a numerator in a division where the denominator became the hours consumed in each phase, thus, obtaining the hourly cost of fixed expenses per hectare, ending phase 1.4 of the basic scheme of the PEU costing model, shown in Fig. 1.

The tendency is for the costs measured by inflation to rise, given inflation and the indexation of wages, among

Table 9: Phases 1.5 and 1.6 of the basic scheme of the UEP costing model (Fig. 1)

Operating station	Pre-planting	Planting	Driving	Harvest	Total
Cost / hour put (US\$)	0.2461	0.0480	0.2635	0.0981	0.6557
Transit time (hours)	0.75	0.75	0.75	0.75	0.75
Base product cost (US\$) per ha	0.1846	0.0365	0.1981	0.0730	0.4942

These two phases represent the crucial point in the application of the method. In a multi productive industry, a product would be chosen that best represents the time spent in operating stations, and would be used as a multiplier (middle row in Table 9), in an operation where the product (result of multiplication) is the cost in monetary standard of the base product, which means that, according to the method, this is the index to be worked on by business management. One could also use a time that is understood as ideal for the various products produced.

Table 9 presents yet another adaptation, by unifying two phases of implantation of the method, adjusting them to the reality of the inside of the gate, where one product is produced at a time in a specific plot, where two products are usually grown per year, respecting the agronomic calendar for summer and winter crops.

The passage time used in Table 9 was calculated by dividing 1,147 hours by four operating stations, thus reaching an average result of 286.75 hours for each operating station. It is true that this average is much higher, for example, than what is spent in the pre-planting phase, however, it represents well the last two phases of the crop. This result was divided by the size of the property, which is 380 ha, reaching a multiplier of 0.75.

Using this average transit time in hours (0.75), the cost of the base product per hectare was US\$0.4942. This value, shown in the last column of Table 9, is quite

other fixed costs. Therefore, it is a mistake to compare costs between periods monetarily. According to Oenning (2010), this is the first indication that the method can build a competitive advantage. The next step is to multiply the result obtained in Table 4 by the passage time of the base product, which is one more adaptation made to the method, represented in Table 9.

different from the sum of Table 8, which, if evidenced, would be US\$0.6557 (US\$0.2461 + US\$0.0480 + US\$0.2635 + US\$0.0981). Therefore, in the next phase (Table 10), this result ends up becoming the denominator, where the higher, the worse the result, that is, the lower the total number of PEU consumed for the period, giving a false impression that had been obtained operational efficiency. This is another contribution of the method, which forces managers to seek a reduction in time and application of fixed resources in production.

Table 10: Phases 1.7 of the basic scheme of the PEU costing model (Fig. 1)

Operating station	Pre-planting	Planting	Driving	Harvest
Cost/hour put (US\$)	0.2461	0.0480	0.2635	0.0981
PEU (US\$)	0.4942	0.4942	0.4942	0.4942
Productive potential (PEU/hour)	0.50	0.10	0.53	0.20

By dividing the hourly cost in monetary standard of each operating post by the monetary value of PEU in the first application of the method, there is the creation of the indexer called productive potential (PEU/hour), which in

the next soybean harvest, will be converted into a standard after accounting for fixed costs.

The result shown in Table 10, is the performance to be achieved, which must be analyzed from the first moment of planning, seeking to reduce it. Even if there is an increase in fixed costs due to the indexation of various expenses such as salaries, electricity, among others, even

Table 11: Phase 1.8 of the basic scheme of the UEP costing model (Figure 1)

	Pre-planting	Planting	Driving	Harvest	Total
Transit time	80	507	260	300	
Productive potential of the post	0.50	0.10	0.53	0.20	
Σ PEU equivalent	40.00	50.70	137.80	60.00	288.50

The result of 288,50/ha, calculated as the sum of the equivalents in PEU, is another adaptation of the method to the purpose that is being outlined for this study, that is, in the traditional method for multi-producer companies, at that moment the consistency between the equivalents would be analyzed in PEU of products. Here the consistency between the operational stations is analyzed. In this case, the driving phase ended up largely overcoming the planting phase, even the latter using a higher consumption of hours.

Certainly, this difference will be analyzed and measured by means of an indicator, providing the manager with a concrete goal, regardless of the monetary cost, which will become a consequence and no longer cause as in most analyzes made by other costing methods. It is certain, therefore, that the determination of the equivalents in PEU for the farming conduction phase, will take greater care, as it ends up consuming more units of production efforts, that is, 2.7 times more than the predecessor phase.

When analyzing the last paragraph under the agronomic aspect, in fact the result calculated by the sum of the equivalents in PEU for the phase of driving the crop, although it does not consume so many hours actually worked, is the most expensive of them, where various equipment is used, increasing spending on machine hours, in addition to the cost of hours of specialists (agronomists and technicians) for analyzing the stages of crop development, as well as its phytosanitary status.

Table 11 represents the last phase of the implementation of the PEU method. After this trajectory of calculating operations that consume time and financial resources, converting them into an index, the operational phase begins, as shown in Table 12.

so, seeking to reduce the values of the productive potential, a reduction in costs will be obtained. This condition is in line with the results presented by Sachitra (2016) and Le and Lei (2018), who argued that the method seeks to generate advantages from the constant analysis of the consumption of resources in production, especially those from fixed expenses.

Table 12: Phase 2.1 of the basic scheme of the PEU costing model (Fig. 1)

	Soy
Quantity bags produced	20.900
PEU equivalent	288.50
Total PEU	6.029.650

By multiplying the quantity of bags produced by the PEU equivalents, an amount of PEU used for the crop under analysis was created. This amount should be the target to be exceeded for the next harvest. Obviously, this will not happen without the proper planning and analysis of the relationship between cause and effect, corroborating the results presented by Brierley (2010). Table 13 shows the conversion of PEU as an index to monetary standard.

Table 13: Phase 2.2 of the basic scheme of the PEU costing model (Fig. 1)

(a) Total Production Cost	380 ha x 139.68/ha = US\$53.078,40
(b) Total PEU consumed in production	6.029.650
Unit value of PEU (a/b)	US\$0.0088

The result found in Table 13 should be analyzed from crop to crop, obviously seeking to reduce it.

It will also serve for the formation of the guiding price for the sale of the product, described in Phase 2.3. In the case of agricultural commodities, this result will determine the safety margin that the producer will be obtaining, this being the difference between the marketed price and the guide selling price determined by the PEU method.

The last phase of operation, identified as 2.4 (Performance Measures) in Fig. 1, is the beginning of the feedback of the data obtained between past, present and future harvests. Therefore, according to Bornia (2010), the method has great potential for improving operational performance for users who have serial products, allowing the benchmarking of operations and processes, making it possible to know the real production capacity, consequently the determination of machines and people for supply identified bottlenecks, balancing operational posts, seeking global production efficiency.

V. CONCLUSION

Before showing the results obtained with this study, it should be noted that the simulation used, took into account the specifications, details and equipment described in Tables 1 to 4, which are exclusive to the case studied. When seeking to replicate this work in other properties, adjustments to the method must be made, depending on the size, operations and processes performed, quantity and quality of available equipment. In this case, the adaptation to the mathematical reasoning developed in the comparison of costing methods must be made.

Once this condition is understood, the results found in this study allow us to affirm that the costing method called PEU may be a precursor of competitive advantage to Brazilian agribusiness, mainly for those who are “within the gate”, commonly suppliers of serial products, becoming if its application is ideal, as the search for cost reduction becomes a premise that focuses on the cause of costs, aiming at the optimization of resources used in production.

The comparative study, methodology to present the application of costing methods, together with the presented literature, assist producers in their decision-making regarding the use of costing methods, becoming a guide for their replication.

This was possible thanks to the adjustments presented in the study, specifically those related to the PEU costing method, for a serial product, but unique during the current harvest for the same plot, adapting it to mono production, this being one of the contributions presented throughout that study.

The adaptation of the method in phase 1.6 demonstrates the importance of the average time used for the construction of the PEU, thus seeking to reduce

consumption in the use of resources that make up fixed costs, mainly the depreciation and maintenance of agricultural machinery, since the determination of maintenance periods and resale values of this equipment are determined, among other factors, by the hours of work recorded by the machines' hour meter.

Another advance demonstrated by the study is the adaptation of phase 1.8, which deals with the determination of product equivalents (sum of equivalents in PEU), where in the original method the results were compared between the various products that a company produces, in this study, the adaptation took the comparison between the operating stations, as if these were the products. Therefore, we start from the assumption that are the phases of conducting the crop, the operations that consume resources, in this method called PEU.

Therefore, the results of 288,50 for the sum of the equivalents in PEU and 6 million PEU consumed for the soybean harvest of the period of 2019/2020, are results that should be incorporated in the planning of the next harvest, and, therefore, become points of discussion as important as cultivars, inputs, agricultural insurance, financing, among other vital points for a good result of a harvest. It is believed that with the results presented, that the PEU costing method can be a strong ally in the generation of competitive advantages for agricultural producers.

As future contributions, we highlight the application of Phase 2.4 Performance Measures of Fig. 1 as a complement to the study on the same property, however, starting with another research method, probably an action research. In addition to this contribution, this study allowed mechanisms for reflection and replication of the method by other researchers and producers.

From experience, it is also believed that it is possible to merge the PEU method with other methods, especially those that deal with the view on cause and effect, in addition to those that work restrictions (gaps) in the production system, thus opening up more opportunities for research.

Annex 1: Table of costs incurred in the 2019/2020 soybean harvest in the state of Parana-Brazil

PARANA			
Description	US\$/ha	US\$/bag	%
Pre-planting			
Mechanized operations	15,1442	0,2750	3.3
Employees	4,6154	0,0847	1.0
Agricultural correctives	7,3847	0,1347	1.6
Pesticides	9,9327	0,1808	2.2
Step total	37,0770	0,6750	8.1
Planting			
Mechanized operations	21,3385	0,3885	4.6
Employees	3,3847	0,0616	0.7
Pesticides	6,5385	0,1193	1.4
Fertilizers	66,2981	1,2058	14.4
Seeds	37,0193	0,6731	8.0
Step total	134,5789	2,4462	29.1
Driving the crop			
Mechanized operations	45,5923	0,8289	9.9
Employees	20,0000	0,3635	4.3
Pesticides	174,3366	3,1693	37.7
Airplane operations	3,0770	0,0558	0.7
Step total	243,0058	4,4193	52.6
Harvest			
Mechanized operations	26,5250	0,4827	5.7
Employees	3,0770	0,0558	0.7
Freight	17,5577	0,3193	3.8
Step total	47,1597	0,8577	10.2
Total operating cost	461,8193	8,3962	100.0
Reference for soy in state of Parana, average productivity of 55 bags / ha			

Source: Adapted from Scot Consultoria (2020).

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Production and characterization of caffeic acid-loaded microfibrous polycaprolactone mats obtained by electrospinning technology

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Received: 28 Nov 2020;

Received in revised form:

03 Feb 2021;

Accepted: 15 Feb 2021;

Available online: 05 Mar 2021

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Keywords—Polycaprolactone, caffeic acid, electrospun microfibrous mat, electrospinning.

Abstract— Microfibrous polycaprolactone (PCL) mats containing caffeic acid were manufactured by electrospinning technology. Electrospun PCL fibers were processed with different concentration of caffeic acid, such as 0.10, 0.25, 0.50, and 1.00% in mass (m/m). The morphologies were observed by scanning electron microscopy (SEM). All produced fibers exhibited random direction and different values of diameters. The caffeic acid did not significantly affect the diameters of the PCL fibers in terms of mean±SD, but some compound concentrations caused the anomaly formation in the electrospun fibers' structure, with the exception of 0.10% CA. Wettability tests in the microfibrous PCL mat with or without caffeic acid showed hydrophobic behavior due to air effect, same with the caffeic acid amount increase. On the other hand, contact angle measurements decrease with the caffeic acid amount increase. The same occurred with the caffeic acid-loaded PCL films. The chemical characterization by FTIR showed the influence of the concentrations of CA in the PCL microfibers, indicating the presence of hydrogen bonds, with the exception of 1.00% CA. We suggest that the 0.10% caffeic acid concentration is the most suitable, mainly due to the absence of anomalies on the surface of the PCL microfibers for future investigations, such as antimicrobial and cytotoxicity tests, drug release, etc.

I. INTRODUCTION

Electrospinning is widely used to produce fibers, generally of a polymeric nature [1]. These electrospun fibers are obtained from a polymer solution or polymer melt [2]. The technique is low cost and easy to implement when compared to other fiber manufacture methods [3]. Moreover, other techniques, i.e., dual syringe [4], coaxial [5], melt [6], and multiple needle electrospinning [7], are derivations of traditional electrospinning. For this reason, electrospinning technology has been used extensively in manufacturing fibers that can acquire nanometric dimensions [1-3].

The electrospun fibers during their processing are deposited on a grounded metallic collector [8]. After this continuous deposition, a fibrous mat is formed with typically porous, light weight, and flexible characteristics [8,9]. Other denominations for the fibrous mats obtained via electrospinning are found in the literature, i.e., nanofibrous membrane [10], membrane [11,12], nonwoven mat [13], -nano and -microfibrous mats [14,15].

The applications of electrospun fibers are diverse and include the sensors [16], biosensors [17], filtration [18], purification [19], biomedical [20], and pharmaceutical fields [21].

Concerning the biomedical field, electrospun fibers have achieved prominence in the controlled release of drugs, which are delivery devices that generally combine biodegradable and biocompatible polymers with drugs [19-22]. And in the production of scaffolds for cell proliferation aiming application in tissue engineering [22].

The most widely used biodegradable and biocompatible polymers in the biomedical field are poly (glycolic acid) (PGA), poly (L-lactic acid) (PLLA), poly (lactic-co-glycolic acid) (PLGA), poly (L-lactide) (PLA), poly (D-lactic acid) (PDLA), and poly (ϵ -caprolactone) (PCL) [22,23].

PCL is a biodegradable polymer of synthetic source, aliphatic polyester and semicrystalline, has interesting properties, such as good mechanical properties, is biocompatible, and non-toxic [23,24]. PCL is soluble in organic solvents and is considered a polymer excellent to produce PCL fibers by electrospinning [24,25].

Electrospun PCL fibers with diameters of $1.660 \pm 1.120 \mu\text{m}$ were prepared using chloroform and acetone as solvents. The PCL fibers of micrometric scale exhibited a smooth surface in their morphology shown by SEM image [25]. Nevertheless, Li et al. [26] produced PCL fibers of nanometric diameters around $200 \pm 78 \text{ nm}$ with a diameter maximum of 613 nm and diameter minimum of 97 nm. The authors reported that this optimization to reduce the

fiber PCL diameters was due to the use of H_2O as an additive in the PCL solution in glacial acetic acid that increased the electrical conductivity due to the acetic acid ionization.

The versatility of the electrospinning technology allows the production of electrospun fibers containing others material types [1], i.e., polymer nanoparticles [25], metallic or ceramic nanoparticles [1], drugs [1,3], oils [2], and bioactive compounds [27].

Caffeic acid is a phenolic compound from vegetables widely used in pharmacological and cosmetic areas. It is an excellent antioxidant used to prevent premature aging; it has antimicrobial activity and is even capable of acting as a cancer inhibitor [28].

Electrospinning has been used to manufacture caffeic acid-based biodegradable polymer fibers [29-31]. These electrospun fibrous mats presented potential biomedical and packaging applications.

This work aims to show the production and characterization of PCL fibers containing caffeic acid to define the suitable concentration of phenolic compound in electrospun fibers.

II. EXPERIMENTAL

1.1 Materials

Were used poly(caprolactone) (PCL, $\text{MM}=80,000 \text{ g/mol}$) and caffeic acid (CA, $\text{MW}=180.16 \text{ g/mol}$) purchased from Sigma-Aldrich. The solvents chloroform and acetone were purchased from Labsynth. Potassium bromide (KBr, $\text{MW}=119.00 \text{ g/mol}$) purchased from Merck. Deionized water with electrical conductivity of $0.5 \mu\text{S/cm}^2$ was used.

1.2 Prepare of the solutions

The PCL solution was prepared by mixing chloroform (3.16 g) and acetone (3.16 g) into a glass flask under mechanical stirring for 15 minutes. Posteriorly, 1g of PCL was added to the solvent mixture for dissolution, which lasted 24 hours.

Caffeic acid was only used after preparing the PCL solution, and different amounts of the compounds given percent by mass, such as 0.10, 0.25, and 0.50% CA, were added to the solution under mechanical stirring for 4 hours until its complete dispersion.

1.3 Prepare of the PCL fibers loaded with caffeic acid

In order to prepare the caffeic acid-loaded PCL fibers, the PCL solution containing the caffeic acid was placed into the syringe with a metallic needle of diameter $\varnothing_{\text{needle}} = 0.8\text{mm}$. After that, conducted to the electrospinning, which

was parameterized with flow rate of $Q=8\text{mL/h}$, applied tension of $V=14\text{ kV}$, and work distance of $d_w=180\text{ mm}$. The electrospun fibers were manufactured on the grounded metal rectangular collector at temperature of $T = 22.0\pm0.5\text{ }^\circ\text{C}$ and relative humidity of $\text{RH} = 57.0\pm1.0\%$. Fig. 1 shows a schematic illustration of the experimental setup this work.

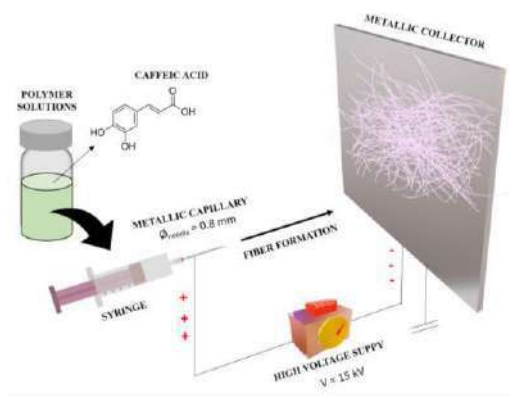


Fig. 1: Schematic illustration showing basic electrospinning items and the PCL solution with CA.

1.4 Morphological characterization

The morphology of the electrospun PCL fibers and caffeic acid-loaded PCL fibers was observed by Scanning electron microscopy – SEM (ZEISS, Evo MA-15 model). Before analyzing the samples in SEM, they were coated with gold sputtering (BAL-TEC, SCD 050 model).

1.5 Measurements and Statistical analysis of fiber diameters

ImageJ software (free version) was used to measure the fiber diameters from SEM images of 1,000X magnitude. The average values and standard deviations (average \pm S.D.), minimum diameter (D_{\min}), and maximum diameter (D_{\max}) were represented based on methods described in the literature [25].

1.6 Chemical Characterization

Chemical characterization was performed by infrared spectroscopy – IR. Samples were mixed with potassium bromide (KBr) in 1:100 and pressed to 2.5kN for 5 minutes to produce tablets with 15 mm diameter containing the samples. After that, they were analyzed in the spectrometer (Thermo Scientific – NICOLET iS5, model) in the $400 - 4000\text{ cm}^{-1}$ range, 16 scans with a spectral resolution of 4cm^{-1} .

1.7 Wettability and Contact angle measurements by ImageJ software

The wettability test was performed using water, where on the surface of the sample was placed a $10\text{ }\mu\text{L}$ drop using a pipette. The water drop was observed with a digital microscope (TQC – Lite plus model, with 1.000X

resolution) at room temperature. ImageJ software (version free) obtained the contact angle measurements (in triplicate) using the Low Shape Axisymmetric Drop Shape Analysis tool. Casting films with and without CA were prepared for comparative study.

III. RESULTS AND DISCUSS

Fig. 2 shows the SEM images of the PCL fibers with 500X magnitude and $20\text{ }\mu\text{m}$ scale (a), 1,000X magnitude and $10\text{ }\mu\text{m}$ scale (b), 5,000X magnitude and $2\text{ }\mu\text{m}$ scale (c). They reveal the morphological characteristic of the electrospun fibers that exhibited random direction. This effect is typical in electrospun fibers produced with a static rectangular metallic collector [32]. Fibers with different diameters were observed. About this, the main disadvantage of electrospinning technology is no guarantee of equal diameters for all electrospun fibers [33], which was expected.

In Fig. 2c is presented the surface morphology of the PCL fibers, showing the rough surface of the fibers. This surface morphological characteristic for electrospun PCL fibers occurs due to the solvent nature used [34] or the effect of the humidity [35]. On the other hand, it is more common to observe smooth surface morphology in electrospun PCL fibers, as reported Moraes Segundo *et al.* [25] that obtained PCL fibers of smooth surface.

The Fig. 2d – 2p are shown the morphology of the caffeic acid-loaded PCL fibers with different amounts of the compound. All the SEM images showed that the electrospun fibers remained in random direction.

In particular, the PCL fibers with 0.10% CA did not present anomaly in their structure (see Fig. 2d and 2e), whereas the Fig. 2f shows the caffeic acid existence in the fibers.

PCL fibers produced with 0.25% CA showed that the amount of caffeic acid used to bring on an excess of the compound out of electrospun fibers can be seen by SEM images in Fig. 2g and 2h. Moreover, the presence of precipitated caffeic acid was observed and is showed in Fig. 2i. However, this concentration did not cause the formation of anomalies in the fiber structure. Differently for the concentrations of 0.50 and 1.00% CA, the anomaly formation and CA precipitation were observed, as shown in SEM images of Fig. 2j – 2m and Fig. 2n – 2p, respectively.

Electrospun PCL fibers presented diameters of $2.50 \pm 1.12\text{ }\mu\text{m}$, $D_{\min} = 0.48\text{ }\mu\text{m}$, and $D_{\max} = 4.60\text{ }\mu\text{m}$. These values on the structural dimensions of the micrometric-sized fibers explain the name given to the nonwoven mat, like a microfibrinous PCL mat.

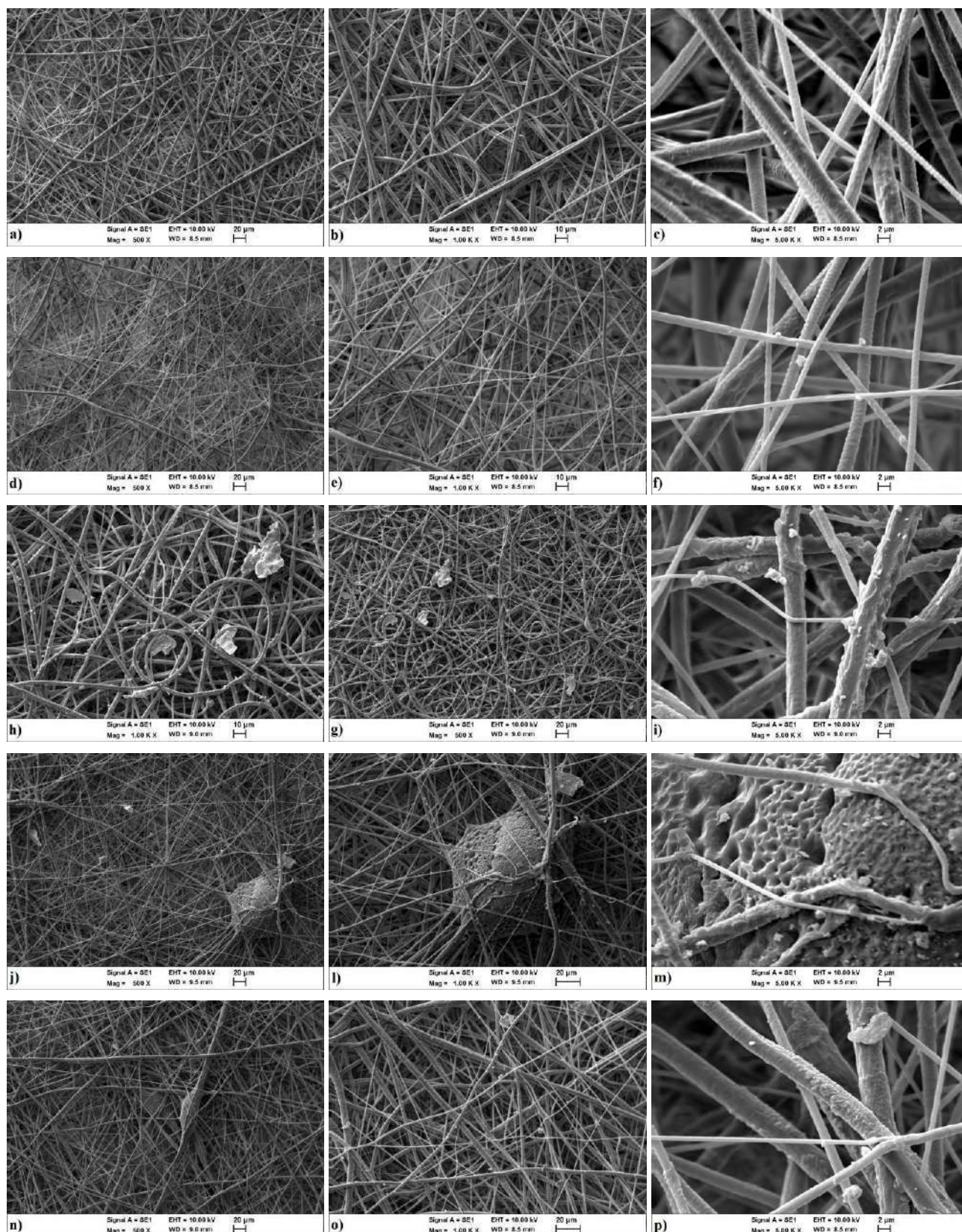


Fig. 2: SEM images of the PCL microfibrillar mat (a – c), and with 0.10 % CA (d – f), 0.25% CA (g – i), 0.50% CA (j – m), and 1.00% CA (n – p), showing the morphologies of the fibers produced by electrospinning.

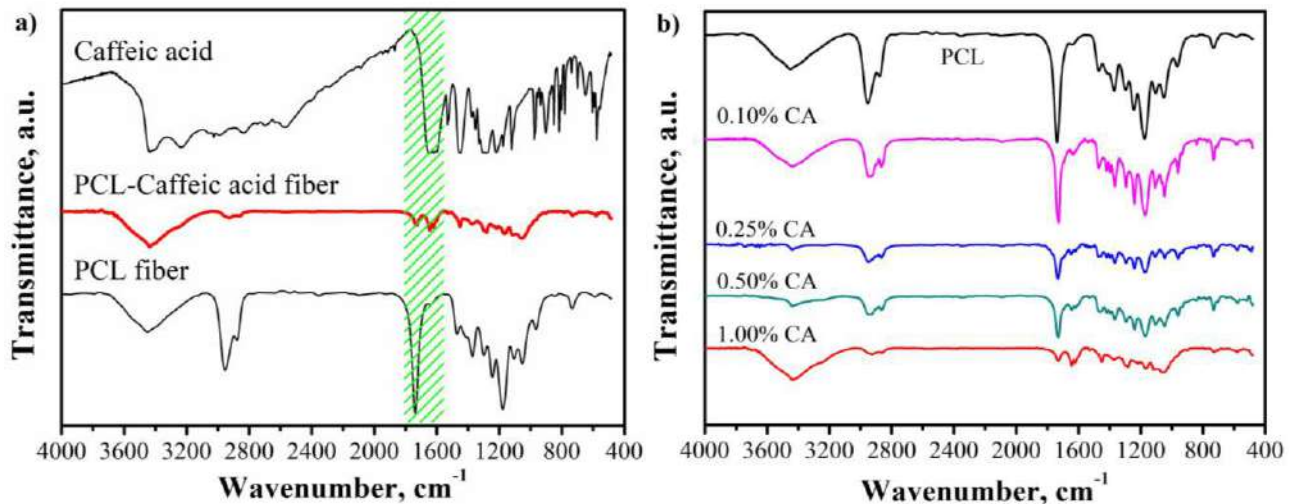


Fig. 6: Comparative FTIR spectra of caffeic acid, PCL fibers, and caffeic acid-loaded PCL fibers (a). FTIR spectra of PCL fibers without and with caffeic acid of 0.10%, 0.25%, 0.50%, 1.00% CA (b).

The diameter values of the PCL fibers with and without caffeic acid are listed in the Table 1. The results showed that we did not obtain nanometric size fibers to any concentration of caffeic acid used. Furthermore, the caffeic acid did not significantly change the fiber diameters that were expressed in mean \pm S.D. In the graph presented in Fig. 3a show this effect.

Table.1: Structural measurements of the microfibers obtained from SEM images.

Microfibrous	Diameters (mean \pm SD)	D_{min} (μ m)	D_{max} (μ m)
PCL	2.50 \pm 1.12	0.48	4.60
PCL + 0.10% CA	2.03 \pm 1.05	0.25	4.94
PCL + 0.25% CA	2.40 \pm 0.95	0.40	5.15
PCL + 0.50% CA	1.96 \pm 1.40	0.45	8.20
PCL + 1.00% CA	2.41 \pm 1.53	0.33	10.23

CA = caffeic acid

Under other conditions, the Fig. 3b present the graph considering the mean and maximum (D_{max}) values of the fiber diameters containing caffeic acid. Then, we observed that the presence of fibers with larger diameters is related to the addition of caffeic acid.

Briefly on incorporating caffeic acid, small amounts of CA were incorporated successfully in PCL fibers by electrospinning technology. However, we suggest the concentration of 0.10% CA, which did not present anomalies in its structure and did not influence the diameter of the fibers, being the most suitable for future

application studies, i.e., antimicrobial tests, cytotoxicity tests, drug release, etc.

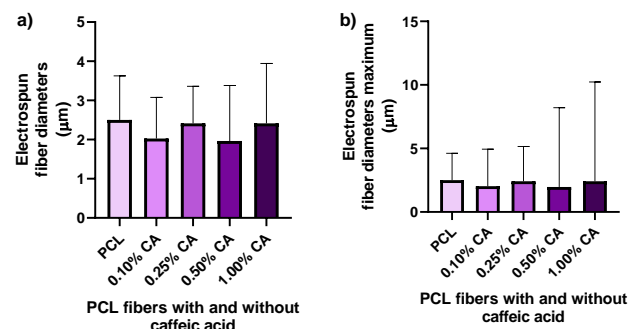


Fig. 3: Graphs of the fiber diameters expressed in mean \pm S.D (a) and D_{max} (b) with and without CA.

Fig. 4 presents the graph of the contact angle measurements of the microfibrous mats and films with different CA concentrations. Contact angle when higher than 90° classifies a surface as hydrophobic and less than 90° as hydrophilic, using the water as solvent [36].

All microfibrous mats with or without CA showed contact angle greater than 90° , differently for the films with or without CA that exhibited contact angle less than 90° , as shown in Fig. 4, which shows the influence of the presence of air in the electrospun mats due to its porosity that forms air pockets [37].

PCL is considered relatively hydrophobic [38,39], which may be related to the hydrophilic carbonyl groups present in its structure. The PCL film had a contact angle of $79.88^\circ \pm 3.25^\circ$ (less than 90°), corroborating with the literature [40].

Contact angle measurements also examined PCL films containing caffeic acid and cast films with concentrations of 0.10, 0.25, 0.50, and 1.00% CA that exhibited a contact angle of $78.11^\circ \pm 6.02^\circ$, $77.04^\circ \pm 11.83^\circ$, $72.04^\circ \pm 5.93^\circ$, and $72.41^\circ \pm 2.65^\circ$, respectively. High S.D. values may indicate a heterogeneous and aggregated distribution of CA on the surface of the PCL film.

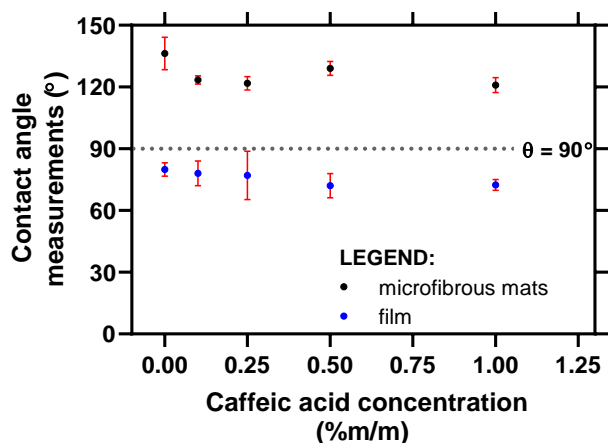


Fig. 4: Graph of the contact angle measurements versus different CA concentrations.

The contact angle for microfibrous PCL mats indicated a hydrophobicity because the contact angle was of $136.32^\circ \pm 7.84^\circ$ (higher than 90°). In Fig. 5b is shown the graph of the contact angle for microfibrous PCL mats with CA concentrations (0.10, 0.25, 0.50, and 1.00%), where was decreased to $123.44^\circ \pm 1.06^\circ$, $121.81^\circ \pm 3.23^\circ$, $129.08^\circ \pm 0.43^\circ$, and $120.96^\circ \pm 3.65^\circ$, respectively (see the red dashed line in Fig 5b), indicating the influence of CA in reduce the hydrophobicity of microfibrous PCL. In Fig. 6b, a red dashed line shows the changes caused by the presence of CA, mainly for the concentration of 0.10% of CA that presented less variation in the contact angle, therefore, showing a better distribution of CA on the surface of the PCL fibers.

The chemical characterization was performed using infrared spectroscopy to determine the vibrational modes present in the polymeric matrices obtained before and after the addition of the antioxidant caffeic acid.

Fig. 6a shows three FTIR spectra corresponding to caffeic acid, caffeic acid-loaded PCL fibers and PCL fibers comparatively.

For caffeic acid, the main vibrational bands were identified, the -OH stretching from adsorbed water and hydroxyls present in the molecule at 3428 cm^{-1} and 3233 cm^{-1} , respectively; the -CH stretching at 2981 cm^{-1} ; the carbonyl C=O stretching of the carboxylic acid at 1643

cm^{-1} ; and the aromatic C=C stretching present in the aromatic ring at 1445 cm^{-1} [41-43].

For the PCL, the most relevant vibrational bands were determined, the asymmetric and symmetrical double of CH_2 at 2952 cm^{-1} and 2873 cm^{-1} , respectively; the carbonyl C=O stretching of the ketone group at 1735 cm^{-1} ; and the -OH stretching of water adsorbed at 3449 cm^{-1} [44,45].

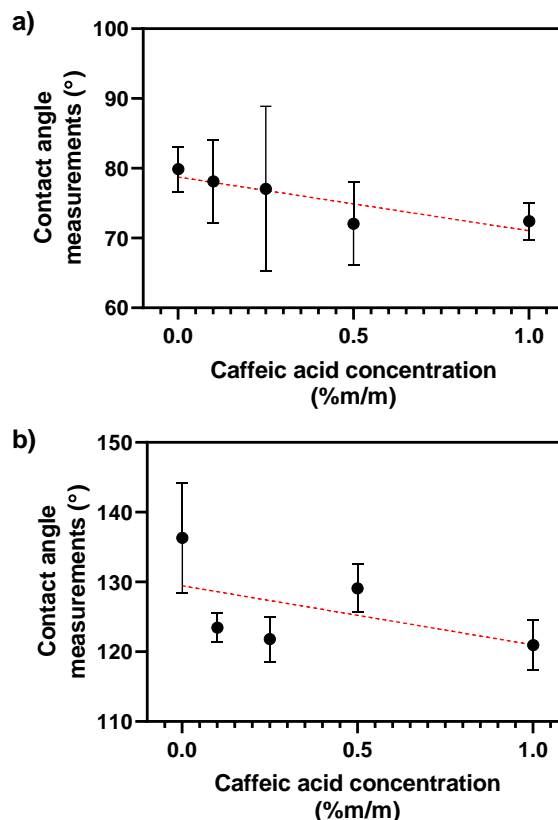


Fig. 5: Graph of the contact angle measurements versus different CA concentrations of the (a) films and (b) microfibrous mats.

Note that in the FTIR spectrum for the caffeic acid-loaded PCL fibers (red curve), there is a strong decrease in the intensity of the vibrational modes in the fingerprint region ($1800 - 700\text{ cm}^{-1}$) referring to the polymeric matrix of caprolactone indicating that the caffeic acid interacts strongly with the PCL polymer chains. In the vibrational region of the carbonyl (green region), the presence of two different types of carbonyl inherited from the ketone group of the PCL and the carboxylic acid of the caffeic acid is observed.

After the gradual addition of CA, we observed the chemical influence of CA in the PCL matrix. Fig. 6b shows the chemical influence of the progressive presence of the CA molecule in the polymeric matrix of the PCL. The increase in the concentration of CA reflects the

decrease in the transmittance of the vibrational bands of the PCL.

However, there is a limit. In concentrations below 1.00% CA, there is only interference in the transmittance of the vibrational modes, i.e., the intensity of the vibrational bands is reduced due to the action of the hydrogen bonding interactions between the CA and the PCL.

However, from 1.00%, there are significant changes in the shape of the vibrational bands in the fingerprint region of the PCL. In addition, the ratio between $C=O_{CA}/C=O_{PCL}$ has changed dramatically, indicating a strong internal interaction of the caffeic acid molecules with PCL, probably due to the chelating property of the phenolic antioxidants to which the molecule belongs. Caffeic acid has a considerable antioxidant action and also a metal ion chelating capacity [46,47].

These results showed that the incorporation of small amounts of CA in the PCL fibers form the hydrogen bonding interactions, fundamental in drug delivery systems and CA carriers, with the exception of 1.00%.

This reinforces the suggestion of the concentration of 0.10% of CA, since it did not present anomalies in its structure, being the most suitable for antimicrobial tests, cytotoxicity tests, drug release, etc.

IV. CONCLUSION

Caffeic acid-loaded microfibrillar PCL mat was prepared by electrospinning, testing different caffeic acid concentrations. The CA concentration that best produced electrospun fibers without anomaly was 0.10%. The SEM morphologies showed that all processed fibers had random orientation, and the addition of 0.10% of CA did not significantly change the diameters of PCL fiber ($2.50 \pm 1.12 \mu\text{m}$), whereas for fibers of PCL loaded with 0.10% CA was $2.03 \pm 1.05 \mu\text{m}$. In addition, the wettability changed, and the contact angle decreased from $136.32^\circ \pm 7.84^\circ$ to $123.44^\circ \pm 1.06^\circ$, respectively. The chemical characterization by FTIR showed that the increasing presence of CA affected in the decrease of the transmittance of the vibrational bands due to the action of the hydrogen bonds between CA and PCL, an important attribute in the caffeic acid-loaded microfibrillar PCL mat, with the exception of 1.00% CA.

Through these results, we suggest using a 0.10% concentration as a reference for future research, mainly in the pharmaceutical and cosmetic fields.

2. Acknowledgements

The authors would like to thank Amazonas State Research Support Foundation – FAPEAM (proc. 062.00113/2016), SisNANO Program, MCTIC, CNPq for financial support.

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Myocarditis as a serious complication of COVID-19

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Received: 29 Oct 2020;

Received in revised form:

26 Jan 2021;

Accepted: 08 Feb 2021;

Available online: 05 Mar 2021

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Keywords— COVID-19, SARS-CoV-2,
Myocarditis.

Abstract— Recently, the identification of a new line of coronavirus, which was called SARS-CoV-2, has become the subject of studies worldwide, reaching pandemic proportions. In line with this, this virus was identified as the etiological agent of a clinical entity called COVID-19, characterized by potentially severe pneumonia. In addition to respiratory involvement, the cytokine storm inherent to the pathophysiology of the disease constitutes a cascade of inflammatory activation, mediated by cytokines, which can lead to numerous multisystemic complications, including myocarditis. It is also postulated that myocardial involvement is due to direct viral cytopathic effects, as well as lymphocytic cell cytotoxicity, generating myocardial injury and cardiac dysfunction. This study aimed to describe the presence of myocarditis as a serious complication of SARS-CoV-2 infection, to better guide health professionals to consider this association as a diagnostic hypothesis in the face of the current scenario, in order to promote early diagnosis and management. The reported patient, aged 32, presented with typical manifestations of COVID-19, did not have cardiovascular risk factors and had preserved cardiac function at admission. We report the evolution of the condition with impaired cardiac function within 72 hours, describing the investigation, management and positive outcome with recovery of ventricular function.

I. INTRODUCTION

At the end of 2019, a new line of coronavirus emerged in China, called SAR-CoV-2. Its origin is attributed to a spillover process, possibly related to the contact and consumption of wild animals, such as bat and pangolin. High transmissibility of the viral agent, even in

asymptomatic and convalescent phases, has made contact with infected people an important source of viral spread, so that the virus has quickly spread throughout the world, reaching worrying pandemic proportions [1,2].

Likewise, the new coronavirus was appointed as the etiological agent of Coronavirus Disease of 2019

(COVID-19), an entity whose clinical course has multiple possible facets, from asymptomatic to severe pneumonia, with extensive pulmonary involvement, serious complications and even death. SARS-CoV-2 pneumonia is characterized by a rapid evolution from a focal presentation to diffuse involvement of both lungs, evidenced by a frosted glass pattern in the image. In addition to respiratory manifestations, general symptoms such as fever, asthenia, prostration, headache, flu-like prodrome, nausea, vomiting, diarrhea and anosmia stand out, with great variability, depending on the age group. In view of the multiple clinical courses of this recent disease, management is challenging, given the lack of consensus on first-line drug therapies [3,4].

Numerous complications have been reported in patients with COVID-19, many of them, with multisystemic consequences, with pathophysiological mechanisms that are still not very well elucidated. Among them, it is possible to mention thromboembolic manifestations, encephalitis, Guillain-Barré syndrome, delirium, acute kidney injury and even cardiac involvement, such as arrhythmias and myocarditis [5,6,7].

Myocardial involvement does not yet have its pathophysiological pillars completely elucidated; however, it is postulated that the cytokine storm intrinsic to COVID-19 plays a key role in the genesis of myocardial tissue inflammation. In addition, a possible direct viral cytopathic effect on cardiomyocytes is questioned, which may lead to the appearance of this potentially fulminant complication [8,9,10].

II. OBJECTIVE

To describe the association of COVID-19 with myocarditis of viral etiology as a serious complication, through the construction of a case report, aiming to highlight the importance of early diagnosis and treatment in optimizing the prognosis.

III. METHODOLOGY

Construction of a case report based on information obtained through analysis of the patient medical record, presenting a description of the condition, results of exams and procedures adopted, correlating them with the available literature and other cases already reported.

IV. CASE REPORT

Case presentation

A 32-year-old male patient, without cardiovascular risk factors, with a history of dry cough for 9 days, associated with continuous fever for 4 days and moderate dyspnea for 2 days. He was admitted to the emergency room with hypoxemia, 87% pulse oximetry and tachypnea of 26

incursions per minute, being admitted to the Intensive Care Unit (ICU).

Initial Management

Treatment with oxygen therapy by nasal catheter at 4 liters/minute, ceftriaxone, azithromycin, olsetamivir and hydroxychloroquine. Initial pulmonary ultrasound (Lung score 7), echocardiogram with preserved right and left ventricular systolic function (LVEF (Left ventricular ejection fraction): 64%, absence of segmental alteration), computed tomography of the chest with evidence of approximately 25 to 50% of frosted-glass pattern and PCR-RT SARS-CoV-2 positive.

Evolution and Investigation

After 72 hours of hospitalization, he presented with acute respiratory failure and severe hypoxemia, requiring orotracheal intubation. Pulmonary ultrasound was performed again, evidenced by LUS 18, and the echocardiogram showed a new segmental alteration, lower hypokinesia and left inferior-lateral ventricle and reduced ventricular function (LVEF: 44%).

Conduct and Follow-up

Hemodynamic optimization measures, association of positive inotropes (dobutamine) and diuretics were started, with improvement after 48 hours. After 14 days of hospitalization, the patient was discharged with drugs for ventricular dysfunction (beta-blocker, angiotensin-converting enzyme (ACE) inhibitors, diuretic and spironolactone). He was asked to return to the cardiology outpatient clinic and a new echocardiogram was performed after 30 days with improved ventricular function (LVEF: 64%).

V. DISCUSSION

COVID-19: General Aspects and Cytokine Storm

The emergence of the disease by the new coronavirus and its rapid distribution around the globe, causing hundreds of thousands of fatal victims, points to the need for understanding the pathophysiological mechanisms and complications that this disease causes. SARS-CoV-2 is a single-stranded RNA virus of the coronavirus family and has an envelope and four structural proteins: spike, membrane, envelope and nucleocapsid. Glycoprotein that makes up the spikes has an affinity for receptors for the angiotensin-converting enzyme 2 (ACE-2), where the virus adheres and invades cells. This receptor is expressed in several cells, and has been widely identified in epithelial cells of upper respiratory tract, pneumocytes I and II, myocardial cells and the renal epithelium [11,12,13].

The new coronavirus is transmitted from person to person through aerosols dispersed in the air and through fomites. Once in contact with the respiratory epithelium, the virus invades the cell and begins its viral replication

process. The degree of clinical repercussions varies not only by the direct cytopathic lesion caused by the virus, but also by the systemic inflammatory reaction triggered by the host's immune system [14,15,16].

Apoptosis of infected cells generates an inflammatory reaction with a storm of cytokines and chemokines produced by immune cells. IFN- γ production triggered by intracellular infection by means of auxiliary standard CD4+ T cells (Th1) causes cytotoxic cell lysis. Auxiliary lymphocytes Th17 recruit neutrophils and macrophages through the production of IL-17, IL-21 and IL-22. The production of these cytokines and activation of the Th1 and Th17 patterns lead to the extensive production of pro-inflammatory cytokines, such as IL-1, IL-6 and TNF- α . These cytokines alter the function of the vascular endothelium and interact with these cells, activating the coagulation system and causing an increase in the activity of the coagulation system, provoking arterial and venous thromboembolisms [17,18,19,20].

In addition, once in the bloodstream, virus can reach other systems and invade cells that have the ECA-2 receptor. Considering that cardiomyocyte has this receptor, it is evident the relationship that the virus has with these cells, and it is imperative to understand the mechanisms permeating this relationship, in order to avoid important cardiovascular complications and decrease morbidity and mortality rates [21,22,23].

Myocarditis and SARS-CoV-2: Presentation and Mechanisms Involved

Myocarditis consists of an inflammatory-based disorder of the myocardial tissue, characterized by inflammatory infiltrates and cardiac damage without association with ischemic causes, which mostly affects males. It is commonly correlated with viral etiologies, and its pathophysiology is related to the combination of direct cell damage and cytotoxicity mediated by lymphocyte activity. In this light, the participation of cytokines such as interleukin 6 (IL-6) seems to be a central trigger in the cytokine storm cascade, orchestrating the activation of lymphocytes with the consequent production of more cytokines, in a hyperbolic manner, leading to a pro-inflammatory loop and consequent tissue damage, including myocardial. Moreover, a possible T cell cardiotropism is postulated, mediated by molecular interactions [8,24].

Myocarditis can present clinically in several forms, and it is possible to mention symptoms such as thoracalgia, fatigue, palpitations and even under presentations with high morbidity and mortality, such as cardiogenic shock and sudden cardiac death associated with ventricular arrhythmias. It is common for the

myocardial condition to be preceded by a viral prodrome, manifesting through fever, respiratory distress, myalgia and gastrointestinal complaints [9,24].

Myocarditis has been reported as a complication in patients with COVID-19 of different age groups. Indeed, viral RNAs from the Middle East Respiratory Syndrome (MERS-CoV) and SARSCoV coronaviruses, agents extremely similar to the new coronavirus, were found in cardiac tissue of infected animals, evidencing a probable cardiotropism inherent to coronaviruses [8,9].

Furthermore, as already mentioned, the entry of SARS-CoV-2 into cells is known to be mediated by the connection between viral protein spikes and the ECA2 membrane protein. This enzyme was not only found in the respiratory epithelium and type II pneumocytes, but also expressed in cardiomyocytes, making them possible targets for the virus. Thus, a cardiac involvement related to a positive regulation of these receptors is postulated [8,25,26].

Myocarditis Associated with COVID-19: Investigation, Associated Complications and Management

Echocardiography is an important tool to aid in the diagnosis of myocarditis, allowing, through a non-invasive procedure, to make differential diagnoses and rule out other cardiac conditions of similar clinical presentation, such as valve diseases, ischemic events, septic and stress-induced cardiomyopathy (Takotsubo Syndrome). Possible suggestive findings visible on transthoracic echocardiography include: global left ventricular hypokinesia, ventricular dilation and/or hypertrophy, regional abnormalities in wall movement and reduced left ventricular ejection fraction, which is the most commonly reported finding in cases of myocarditis associated with COVID-19 [8,27].

The investigation may still use other alternatives that support the determination of the diagnosis. In fact, electrocardiogram is an accessible and non-invasive alternative, which may show conduction abnormalities. In addition, cardiac enzymes such as troponins and brain natriuretic peptide may have elevated serum levels. Inflammatory markers such as C-reactive protein, even though nonspecific, may be increased, contributing to diagnostic direction. Imaging tests such as magnetic resonance and computed tomography can also be used in more detailed investigations. In the event of an unviable or doubtful diagnosis, myocardial biopsy can be suggested, which may demonstrate inflammatory infiltrate, edema, necrotic areas and detection of viral particles [28,29,30].

Nevertheless, a possible complication strongly related to myocarditis is arrhythmia. Arrhythmogenesis in myocarditis related to SARS-CoV-2 infection has acute and chronic pathophysiological mechanisms. Among the

acute mechanisms liable to precipitate arrhythmias are direct viral effects on cardiac cells, pericardial edema and effusion, and microvascular ischemia. While the chronic processes include dysfunction of intercellular junctions secondary to the action of cytokines, such as IL-6, especially in predisposed patients, as well as the formation of scar and fibrotic tissue. Among the possible arrhythmias, it is possible to mention bradyarrhythmias and supraventricular and ventricular tachyarrhythmias. Early recognition and intervention of this complication are essential to avoid fulminating outcomes [22,31,32].

Therapeutic management presents variability, according to the clinical presentation and consequences of myocarditis in each patient. In general, potentially fulminant cases include the adoption of a cardiogenic shock protocol, with administration of inotropic agents and vasoactive drugs, as well as mechanical ventilation. In some cases, the use of ECMO (Extracorporeal Membrane Oxygenation) is a rescue alternative and bridge for effective and beneficial lung transplantation, as well as the use of External Ventricular Assist Devices. In cases of greater hemodynamic stability, pharmacological therapy with inotropes and vasopressors is sufficient to promote improvement in cardiac function. In general, habitual therapy for acute ventricular dysfunction is established, obtaining resolution of the condition and prognosis correlated with the patient's severity through prognostic scores. The use of immunosuppressants as corticosteroids and the use of immunoglobulins remains controversial, given the results of studies that do not demonstrate the benefit of this therapy. The use of Tocilizumab, anti-IL-6, may be beneficial in reducing the cytokine storm, however, further studies that support its clinical use should be encouraged [8,9,33].

Correlating Reported Cases

The case described here demonstrates in a patient without cardiovascular risk factors, who, during a confirmed diagnosis of COVID-19, developed a cardiac complication, acute myocarditis. Initially, heart function was shown to be preserved on echocardiogram, however, after 72 hours of admission to the ICU, he presented severe hypoxemia, so that the new echocardiographic examination already showed a reduction in cardiac function, with LVEF of 44%. Supportive therapeutic measures and classic heart failure therapy were adopted, with improvement in 48 hours. The patient in question evolved well, with a good prognosis and discharge with preserved cardiac function.

We reported here a patient with a typical presentation of COVID-19, manifested by fever, dyspnea and hypoxemia. However, myocarditis can be a complication even in cases with atypical manifestations of SARS-CoV-2

infection. The case report described by Rehman et al. [34] demonstrates a 39-year-old male patient whose clinical presentation was chest pain, with no fever and respiratory symptoms. The patient evolved with increased levels of troponin and the electrocardiogram was inconclusive, after a thorough investigation, the diagnosis of COVID-19 and associated myocarditis was established.

In addition, we demonstrate here a patient with a good evolution and prognosis, however, the scenario is not always this. In the case reported by Khatri, Wallach [35], the patient developed acute hemodynamic dysfunction, myocardial injury and reduced ventricular function, refractory to supportive therapy and management of SARS-CoV-2 infection and myocarditis, presenting an outcome of fulminant myocarditis. The heterogeneity of myocarditis as a serious complication of COVID-19, with potential mortality, points to the need to consider this association in the current scenario, in order to identify and intervene early.

VI. FINAL CONSIDERATIONS

Myocarditis as a complication of COVID-19 is heterogeneous, so the prognosis depends on the severity of the patient's condition and associated organ dysfunctions. It is known that myocardial involvement associated with SARS-CoV-2 can manifest itself through unspecific cardiac complaints and present from resolution and improvement of cardiac function with appropriate drug therapy, to potentially lethal conditions. Also noteworthy is the prevalent association with arrhythmia, a contributing factor to the aggravation of cardiac morbidity and mortality in COVID-19. Therefore, the report shows the need for an early diagnosis of myocarditis as a serious complication of COVID 19, as well as rapid and effective management. The early diagnosis of myocarditis in an intensive care unit in the face of the current scenario of COVID-19 is necessary to implement intervention measures at an early stage, aiming to minimize negative outcomes. The construction and publication of reported cases can help guide health professionals to consider myocarditis as a possible complication in the presence of patients with COVID-19, in order to further encourage the establishment of early diagnosis and interventions.

FUNDING

There was no financial support for the work from person/organization.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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Synthesis of Si_3N_4 powder by powder metallurgy method in atmospheric pressure N_2 : A review

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Received: 15 Nov 2020;

Received in revised form:

02 Feb 2021;

Accepted: 22 Feb 2021;

Available online: 06 Mar 2021

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Keywords— Si_3N_4 , direct nitridation, metals catalyst.

Abstract— Catalytic effects of metals, which are often involved in the fabrication of silicon nitride product, on the direct nitridation of silicon have been reviewed through this study. A nitridation enhancement effect has also been observed with the addition of some metals. The metals are mixed with Si in separate mass ratios before reaction. The results showed that the conversion from Si to Si_3N_4 increased markedly with increasing content of the catalyst. From there, it helps to reduce the reaction temperature as well as energy costs for the direct nitridation process. Besides, metal catalysts also react with Si to create Me_3Si_3 compounds that reduce the high-temperature resistant properties of Si_3N_4 . Therefore, it is necessary to choose appropriate catalysts so that the product retains its preeminent properties.

I. INTRODUCTION

Silicon nitride (Si_3N_4) is one of the most promising structural materials for high-temperature and high mechanical-stress applications because of its excellent properties such as high strength retention at elevated temperature, good thermal shock resistance, high-temperature deformation resistance as well as high corrosion resistance [1-12]. Thus, Si_3N_4 -based materials are extensively used in a variety of areas such as in chemical reaction vessels, heat exchanger bearings, engine and gas turbines, high-temperature components, automotive parts and aerospace vehicles [13-15]. Si_3N_4 exists in two main configurations: the α - Si_3N_4 begins to form at 1400°C and turns into β - Si_3N_4 at temperatures above 1600°C. There is also a very rare γ - Si_3N_4 , but this configuration is formed at very high pressure and temperature[1] and hence beyond the scope of this investigation.

As far as concerned, there are three main methods and several unpopular methods used for the production of Si_3N_4 powders [17-23]:

➤ Carbothermal reduction method

The carbothermal reduction of SiO_2 powder under nitrogen was the earliest used method for Si_3N_4 production.



➤ Direct nitridation method

The Si_3N_4 powder can be prepared by heating powdered silicon up to between 1300°C and 1400°C in nitrogen atmosphere.

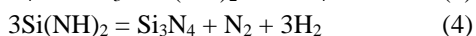
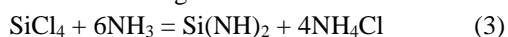


During the reaction, the silicon sample weight increases progressively due to the chemical combination of silicon and nitrogen.

➤ Silicon amide method

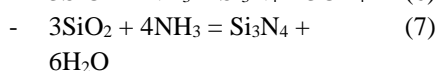
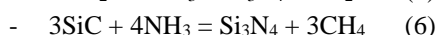
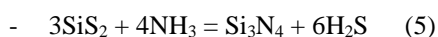
The development of the long-known but little-used silicon amide route relies on the increasing availability of

low-cost silicon tetrachloride (SiCl_4). The decomposition of silicon diimide ($\text{Si}(\text{NH})_2$) results in amorphous Si_3N_4 , which is converted to the α - Si_3N_4 by heating up to 1400°C – 1500°C under nitrogen.



➤ Other methods

Several alternative production methods of Si_3N_4 have been presented; however, they have not been used widely for various technological or economic reasons, such as high cost, slow reaction kinetics or the development of undesirable particle morphologies. Some of the listed as below:



The direct nitridation of Si powder is regarded as a low-cost and straightforward route for the large-scale production of Si_3N_4 powder and bulk Si_3N_4 based materials[2], but the high nitridation temperature and long reaction time are the major problems of the method that need to be solved.

One of the strategies considered to solve this problem is to use a suitable catalyst for the

nitridation process of Si. Several investigations have shown positive effects of metals on the process such as on removing the silica layer[1] or the formation of Me_xSi_y which promotes the nitridation process[2]. Recently, many reports have been used a catalyst to apply the nitridation of Si at lower temperatures [1,13,24-30]. Fe is the most popular catalyst for enhancing the nitridation of silicon and is generally an impurity in low-purity silicon powder[3]. The catalytic effects of other metals, such as Fe, Cr, and Co on the nitridation of silicon have also been investigated [13,24-27].

II. THE EFFECT OF METALS CATALYSTS

1. Iron metal (Fe)

Iron as a transition metal will have positive effects on removing the silica layer and aid the overall nitridation process by forming a liquid phase composition of FeSi_2 at temperatures exceeding 1212°C [4].

Figure 1 shows the effect of Fe catalyst on the nitridation of Si. It can be seen that only a small amount of Fe (1000 ppm) has promoted the process significantly (from 30% without Fe to ~38% with 1000 ppm Fe). When Fe content increases to over 1000 ppm, mainly β - Si_3N_4 phase was formed.

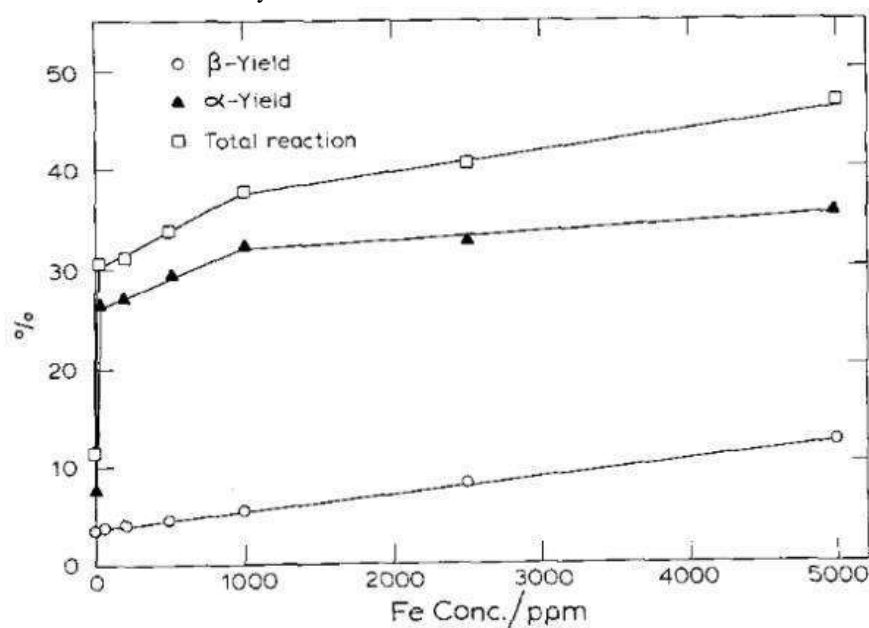


Fig1: Effects of Iron content on the overall conversion of silicon at 1350°C for 10h[1]

2. Chromium metal (Cr)

Chromium is considered as a typical candidate to promote direct nitridation. Because chromium, chromium nitride, and Cr_xSi_y phases all have high melting points and good high-temperature properties, their remaining after the nitridation will not have significant negative effects

on high-temperature properties of the final product materials.

The study of Feng Liang et al [2] showed the positive expression of the metal catalyst Cr. Figure 2 displayed the relationship between Cr content and the overall conversion of Si with different temperature.

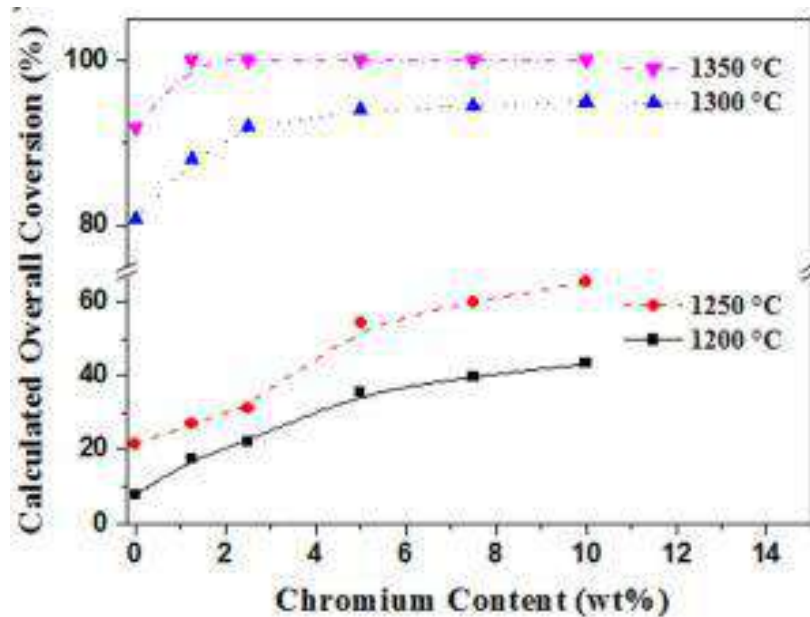


Fig.2: Effect of Cr content on the overall conversion of Si in samples resultant from 3h nitridation at different temperature[2]

As can be seen, the addition of chromium affected the nitridation process significantly. At 1200°C and 1250°C, the overall conversion (OC) of Si to Si_3N_4 in the reference samples without Cr was low. However, it increased evidently with the increasing Cr content. For example, at 1250°C, the OC was only ~21% in the case of no Cr addition but increased significantly to ~66% in the sample containing 10 wt% Cr. At higher temperatures such as 1300°C and 1350°C, the effect of the catalyst reaches the conversion rate limit even with low added Cr content (~94% with 5 wt% Cr at 1300°C and ~100% with 1.25 wt% Cr at 1350°C). Overall, Cr catalyst reduces the nitridation process temperature of Si and the product still reaches a high ratio Si_3N_4 .

Figure 3 presents the XRD patterns of samples containing 0-10% Cr after 3h nitridation at 1250 °C and 1350 °C respectively. At 1250 °C, unreacted Si peaks remained as the main phase in the sample without catalyst. With increasing Cr content, the α/β Si_3N_4 peaks appeared noticeably and Cr_2N was detected in the sample containing 10 wt% Cr. At 1350°C, α - and β - Si_3N_4 were identified in the reference sample, along with some unreacted Si. On the other hand, in the sample containing 1.25 wt% Cr, Si disappeared and only α - and β - Si_3N_4 phases were present. With more than 5 wt.% of chromium, α - and β - Si_3N_4 remained as the primary phases; however, minor Cr_2N and two other impurity phases (appeared to be Cr_5Si_3 and Cr_5Si_3) were detected.

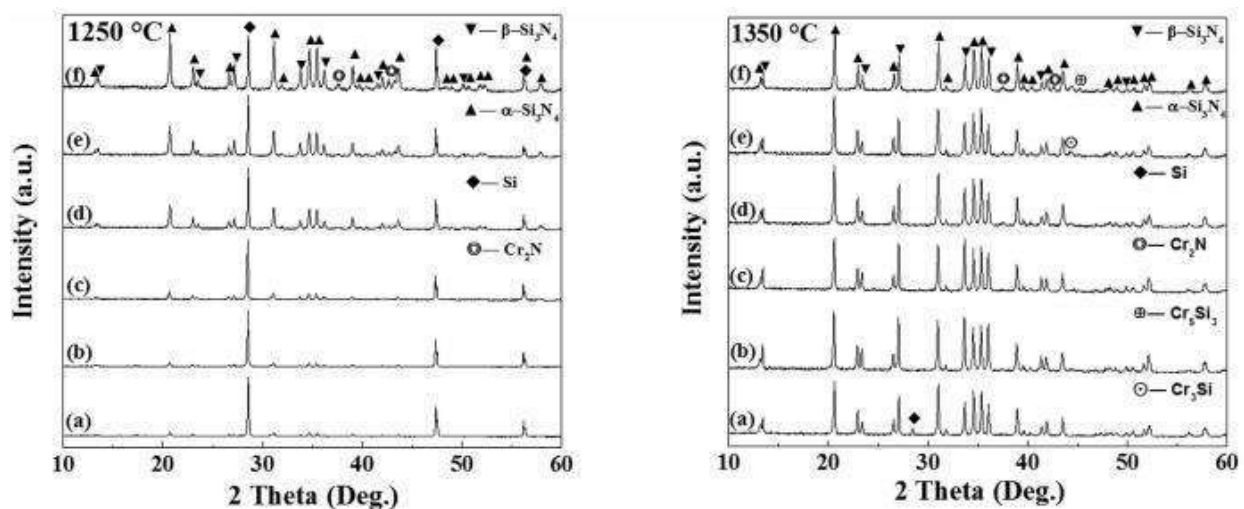


Fig.3: XRD patterns of samples containing various amounts of Cr: (a) 0, (b) 1.25, (c) 2.5, (d) 5, (e) 7.5, and (f) 10 wt%, after 3h nitridation at 1250°C and 1350°C, respectively[2]

3. Cobalt metal (Co)

According to the study of Juntong Huang et al[5], the nitridation process of Si is driven by metal Co. The effect of Co on the direct nitridation of Si is displayed in Figure 4.

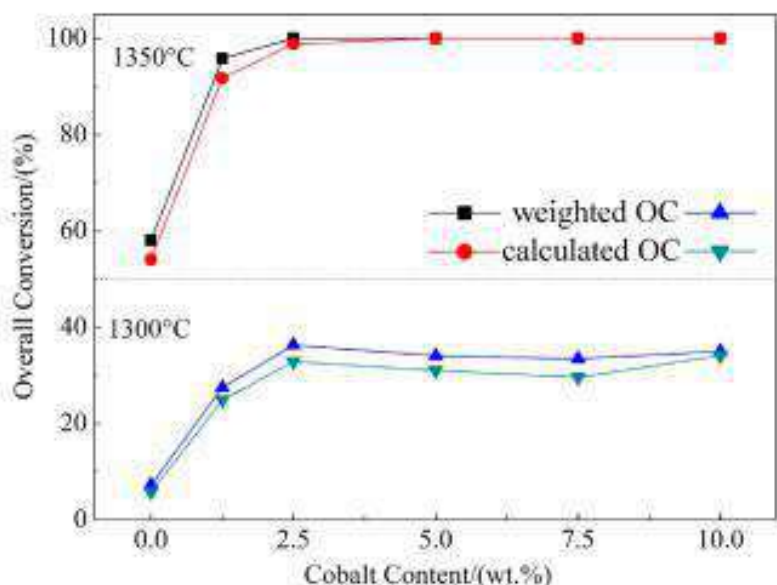


Fig.4: Effects of cobalt content on the overall conversion of silicon at different nitriding temperatures for 3h[5]

At 1300 °C, the nitridation extent (OC) in the reference sample without Co was very low (only 7%). However, it increased evidently to maximally 38% in the Co catalyzed samples. Upon increasing the temperature to 1350 °C, the OC in the reference sample increased to 54%, whereas a much greater OC was achieved in a Co-catalyzed sample. For example, with the addition of 1.25%

Co, >90% OC was achieved, and with the addition of 2.5% Co, nearly all of the Si had been converted. The above results indicated that Co exhibited a strong accelerating effect on the conversion from Si to Si_3N_4 .

Shown in Figure 5 are XRD patterns of the samples containing 0-10% Co after 3h nitridation at 1350 °C.

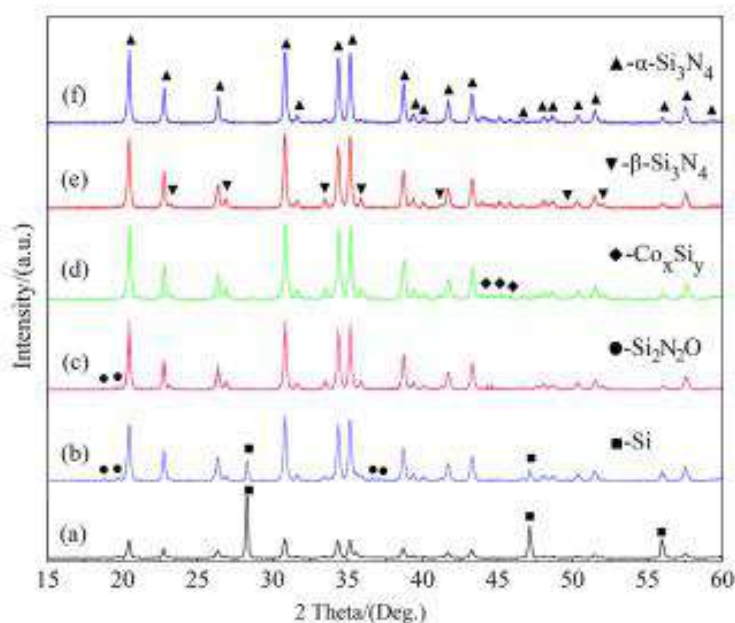


Fig.5: XRD patterns of the samples containing various amounts of cobalt after 3h nitridation at 1350°C: (a) 0, (b) 1.25, (c) 2.5, (d) 5.0, (e) 7.5 and (f) 10%[5]

Without Co, the peaks of Si appear very clearly. When Co increased to 1.25%, the intensity of α - Si_3N_4 peaks increased evidently while the intensity of the Si peaks decreased. On increasing Co to 2.5%, the Si diffraction peaks disappeared, and only α - Si_3N_4 along with a small amount of β - Si_3N_4 were identified, indicating a complete conversion from Si to Si_3N_4 . On further

increasing of Co to $\geq 5\%$, there were no obvious changes in the primary phases but minor amounts of impurity phase (presumably Co_xSi_y) were detected.

4. Copper metal (Cu)

Like the above metals, Cu also has positive effects on the nitridation of Si.

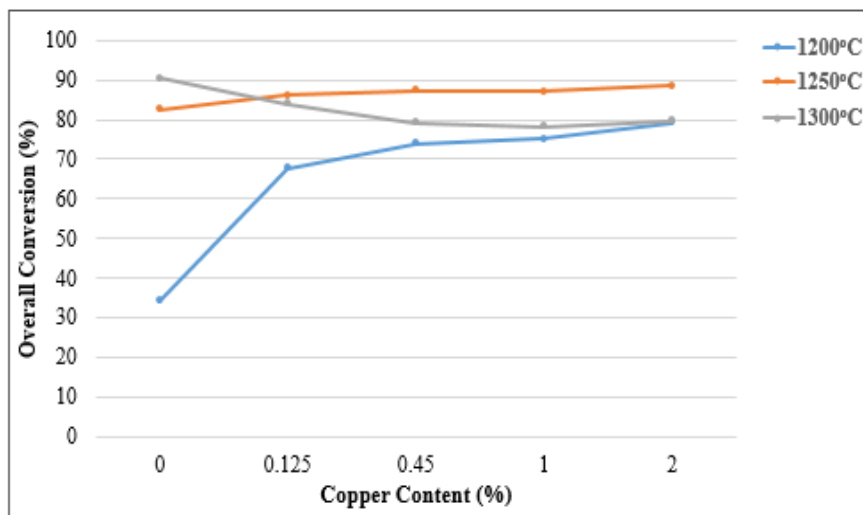


Fig.6: Effects of copper content on the overall conversion of silicon at different nitriding temperatures for 3h[6]

As shown in Figure 6, the nitridation of Si with 0.125% Cu at 1200°C yields an overall conversion as high as almost double that from bare Si. The overall conversion at 1200°C also increases with the Cu content and approaches the conversion level achieved in the nitridation of bare Si at 1250°C. But when the temperature is increased to 1250°C, the effects of Cu on the nitridation of

Si are also unclear. It even decreased when raised to 1350°C.

5. Calcium metal (Ca)

Ca is the metal, among all the metals investigated, that enhances only the formation of α - Si_3N_4 . Purified α - Si_3N_4 can be obtained with only a small amount of Ca (0.125%) added.

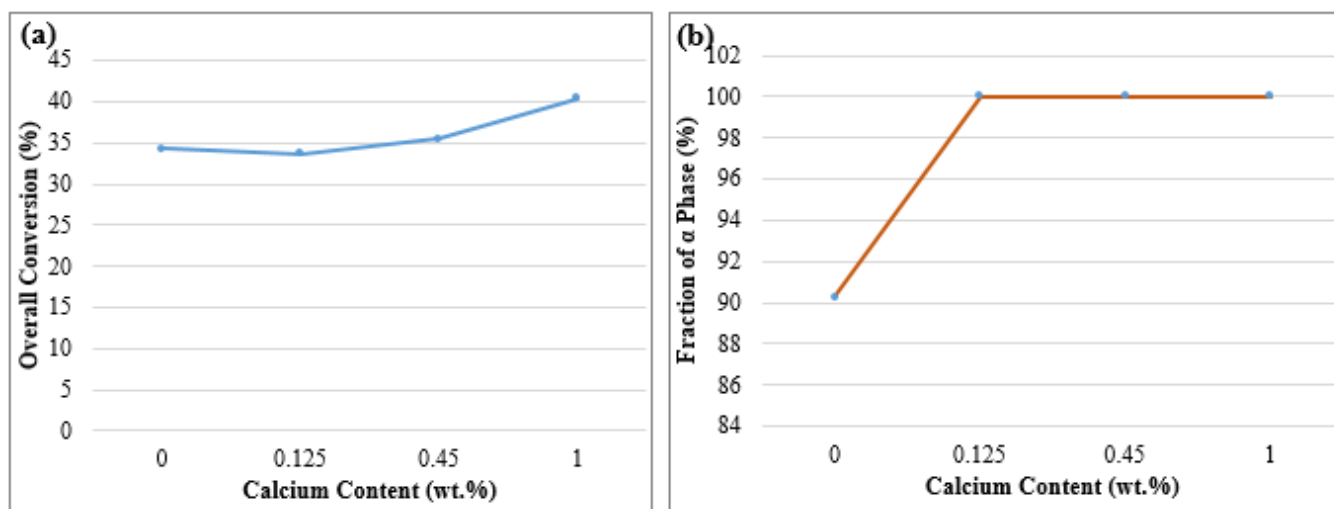


Fig.7: Effects of calcium content on the (a) overall conversion and (b) formation of α -phase after 3h nitridation at 1200°C[6]

III. CONCLUSIONS

Metal catalysts have a positive effect on the nitridation of Si as the content of the catalyst increases, the nitridation process is accelerated. The used metal catalysts was an attractive method to reduce the reaction temperature and due to its high functionalization and high efficiency for realizing energy consumption saving. However, it should be noted when selecting the metal catalysts and the content in a reasonable manner as the nitridation process will create Me_xSi_y compound that can reduce the high-temperature resistant properties of Si_3N_4 . Future studies on Si_3N_4 ceramics should focus on adding attractive properties, such as high thermal conductivity and high wear resistance, while maintaining good mechanical properties.

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Basic Human Needs Theory and SARS-CoV-2: An integrative literature review

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Received: 29 Nov 2020;

Received in revised form:

09 Feb 2021;

Accepted: 19 Feb 2021;

Available online: 06 Mar 2021

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Keywords— COVID-19; Basic Human Needs; Pandemic; SARS-CoV-2.

Abstract— Purpose: To relate the SARS-CoV-2 virus to Basic Human Needs (BHN) proposed by nurse Wanda de Aguiar Horta. Methodology: Qualitative method of literature review, through exploratory research of bibliography. Results and discussions: 22 materials were analyzed and organized in a table of 5 topics: Title, authors, methodology, year and description. The basic human needs were divided into 2 categories: Psychobiological needs and psychosocial needs. Each need was related to the interaction of the virus in the human body and to social changes during the pandemic. Conclusion: The direct influence of SARS-CoV-2 on the individual's body and the consequences of the pandemic on interpersonal relationships were observed. Also, the studies on the topic are scarce and need to be expanded.

I. INTRODUCTION

Wanda Aguiar Horta, born on 1926 (Belém - Pará - Brazil), was a nurse of remarkable importance and prominence since she created the Theory of Basic Human Needs. The theory was created from the need to establish nursing as a science that views the human being in all its complexity, which interacts with the environment where it is inserted [1].

According to Horta [2], Basic Human Needs (BHN) are conceptualized as "[...] states of tension, conscious or unconscious, resulting from the homeodynamic imbalances of vital phenomena." Therefore, when the individual is in dynamic balance, the basic human needs

are not manifested, but they are latent and can manifest when there is some imbalance. Thus, BHN are universal, common to all human beings, differing in the type of

manifestation and how to satisfy it so the homeodynamic balance become reestablished [2].

It is possible to observe the influence of Abraham Maslow and João Mohana at Wanda's theory, both have their own theories on Basic Human Needs [3] and from that and their own impressions on the theme, they created the following classification for the Basic Human Needs: Psychobiological, psychosocial and spiritual.

Psychobiological needs:

Oxygenation: The respiratory system has as its main function gas exchange, absorbing oxygen and eliminating carbon dioxide, when the air is inhaled it makes its way to the lungs, reaching the pulmonary alveoli. [4]

Hydroelectrolytic balance: The hydroelectrolytic balance is the balance between water and electrolytes, which are important in the permeability of the cell membrane and the consequent acid-base balance. [5]

Nutrition: Food is a source of energy that make the human body functions properly. It is responsible for the growth and maintenance of the body. Good nutritional status comes from adequate intake of essential nutrients and energy-producing foods. [5]

Urinary and intestinal elimination: During the physiological process, many residues are produced and go directly into the bloodstream. They must be removed through the elimination organs, which are the kidneys, intestines, lungs and skin. [6]

The mechanism of renal elimination is the urine production and occurs through three processes: filtration, reabsorption and secretion. Thereafter, the detoxification process is maintained, eliminating superfluous and toxic substances and metabolites. [6]

Comfort, sleep and rest: Changes in the pattern of sleep modifies the homeostatic balance, moods, and psychological and immunological functions. In addition to that, they cause fatigue and increase the need of naps. Sleep and rest have the importance of restoring the body to prevent physiological changes [7].

Locomotion, mobility and body mechanics: The basic human need for body mechanics is a process that involves the participation of the musculoskeletal and nervous systems. Both use their mechanisms and particularities to perform the basic movements of daily life, in addition to maintaining posture and balance. [8]

Sensory perception: Sensory need is based on the 5 senses of the organism: sight, hearing, touch, smell and taste. In order to be interpreted by the brain, there must be a stimulus in the receptors located in the organs responsible for each sense. They can be affected by excessive or insufficient stimuli, or by deficiencies in the organs [5]

Psychosocial needs:

Sexuality: For Diamantino et al. [9], sexuality "refers to the impulse and emotion that the proximity of sex can produce. It transcends physical definitions and places itself as something more diffuse permeating all moments of life". Given this, it can be understood that the meaning of sexuality goes beyond what is culturally disseminated, that it was linked only to human reproduction. [10]

Security: According to Benedet and Bub [11], security is related to the emotional and sentimental trust of other people to themselves. An imbalance on that can result in mental and emotional consequences for the individual [5].

Love and gregariousness: This need (belonging to a group) is important, as it is a type of social need for interaction and social communication. Love and affection bring a feeling of well-being and home, where you feel safe, understood and accepted [2].

Freedom: According to Health Sciences Descriptors [12], freedom is the "Individuals' right to act and make decisions without external constraints". In other words, the individual must have the power to follow what he or she best evaluates for himself. [13]

Self-image and self-esteem: Self-image is the body's way of seeing the individual in the face of society and its standards. Self-esteem is directly proportional to self-image, it is the reflex that it produces about itself, in the face of their social interaction and through feelings, such as anguish, fear of acceptance, insecurity, or happiness and satisfaction [14].

Religiosity and spirituality: Religiosity has a structured basis and standardized behaviors. On the other hand, spirituality is an abstract concept [15].

Self-realization: It represents what a person believes is destined to be, involving abilities, talents and vocations. The characteristics of self-fulfilled people are creativity, spontaneity, autonomy, resistance to indoctrination, and also identification with the human species in general [16].

Health Education: Dialogue is essential for an educator, since there is a need of reflection and action on the individual in order to become a transforming agent. To establish this dialogue in a positive and effective way, trust and patience are required, as it is in the educator's observation that individuals are encouraged to talk about themselves and their health [17].

Philosophy of life: Philosophy of life fits into the natural need of human beings to seek the meaning of things, as a way of organizing their point of view and vision about the world [18].

Therefore, it is possible to relate BHNs to COVID-19 disease, caused by the new coronavirus, SARS-CoV-2 [19]. It was discovered on December 31, 2019 in China, where in 1 month it accumulated 11,821 cases and 259 deaths. On March 11, 2020, according to World Health Organization, it became a pandemic, when more than 110 thousand cases were registered in 114 countries [20]. By the beginning of October 2020, it had accumulated 34,706,736 cases worldwide with 1,029,969 deaths [21], whereas in Brazil this number is 4,915,289 cases and 146,352 deaths [22].

Coronavirus is a family of viruses that cause respiratory infections. There are seven types that are known as pathogens in humans. In general, they are associated with flu-like syndromes and were responsible for more contagious epidemics, being the Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS) [19]. They are RNA-type viruses, enveloped and single-stranded. [23]

The Covid-19 transmission occurs through air or contact with contaminated saliva droplets, aerosols and fomites followed by contact with the mouth, nose or eyes [24]. According to the Ministry of Health, symptomatic people may have a flu-like condition with the following symptoms: "Cough, Fever, Runny nose,odynophagia, anosmia, ageusia, nausea, hernia, diarrhea, asthenia, hyporexia, Dyspnea", which can develop into a condition pneumonia [25].

Due to the fact that SARS-CoV-2 acts mainly on the respiratory tract, some people are included in the risk group, as there is the possibility of a more serious stage of the disease. Among them are: "Age 65 or older; people interned in long-term institutions; patients with chronic obstructive pulmonary disease, asthma (moderate to severe) and oxygen-dependent; people with serious or decompensated heart problems; decompensated hypertensive patients; diabetics; carriers of chromosomal diseases or a state of immune weakness; individuals with advanced chronic renal failure; high-risk pregnant women; people of any age with severe obesity (BMI > 40); and medical conditions (Silva, Moreira, & Martins, 2000)" [26].

Hypertensive patients, for example, are present in this group due to the fact that the virus uses the same receptors drugs in the ACE inhibitor (angiotensinogen converting enzyme) class [27].

The initial estimate of the basic breeding number (R_0) of SARS-CoV-2 ranged from 1.6 to 4.1, meaning that an infected person could transmit on average to an additional

2 to 4 people [28]. Therefore, it was necessary to implement social distance as a way of prevention. Also washing your hands with soap and water frequently and using 70% alcohol; wearing masks; avoid physical contact; not sharing objects for personal use; social isolation in case of symptoms; cover your mouth and nose with the inside of your elbow when coughing or sneezing; among others [25].

Taking into consideration the emergence of the SARS-CoV2 pandemic, the importance of basic human needs for the functioning of the organism and the well-being of the individual, and the scarcity of scientific publications relating these issues, the need to link them was noted.

II. METHODOLOGY

In order to make this study, exploratory bibliographic research was used with a descriptive study of articles, thesis and books between the months of October and November of the year 2020. With that, the following keywords were used: "Covid-19", "Pandemic" and "Basic Human Needs".

Thus, this work was developed from the analysis of 51 articles, 11 of which were published between 1974 and 2003 and 40 between 2010 and 2020. These were researched on digital platforms such as: "Google Scholar", "Scielo" and "PubMed". The data collected were analyzed and organized in order to relate the emergency issue of Covid-19 with Basic Human Needs, in view of the scarcity of publications focused on this theme.

Table1: Distribution of materials according to: title, authors, methodology, year and description.

Títulos	Autores	Metodologia	Ano	Descrição
COVID-19 should concern nephrologists? Why? The Emerging Stalemate of Angiotensin Blockade.	Luca Perico; Ariela Benigni; Giuseppe Remuzzi.	QUALITATIVE	2020	To analyze Analyze the latest findings on the effects of SARS-infection CoV-2 in kidney disease and review the effects of SARS-CoV-2 infection on kidney diseases.
COVID-19: renal and cardiac system	Carolina Magalhães Britto Rodrigues Nathália Barboza da Costa Vinícius Rosseto Vieira Edmo Atique Gabriel Sthefano Atique Gabriel	QUALITATIVE	2020	An article that will relate the physiology of SARS-CoV-2 to the renal and cardiac systems
Nutritional intervention in Covid-19 patient	Lino Mendes, Marisa Cebola, Diana Mendes, Aníbal Marinho,	QUALITATIVE	2020	To present a possible nutritional intervention to patients with covid-19 and preserve their nutritional status

	Antônio Sousa Guerreiro			
Technical note and clinical guidelines on Injury Kidney Disease in patients with Covid-19: Brazilian Society of Nephrology and Brazilian Intensive Care Associations	José Hermógenes Rocco Suassuna; Emerson Quintino de Lima; Eduardo Rocha; Alan Castro; Emmanuel de Almeida Burdmann; Lilian Pires de Freitas	QUALITATIVE	2020	Informations about how Covid-19 affects the renal system and a guideline to health professionals.
	do Carmo; Luis Yu; Mauricio Younes Ibrahim; Gustavo Navarro Betônico; Américo Lourenço Cuvello Neto; Maria Olinda Nogueira Ávila; Anderson R. Roman Gonçalves; Ciro Bruno Silveira Costa; Nilzete Liberato Bresolin; Andrea Pio de Abreu; Suzana Margareth Ajeje Lobo; Marcelo Mazza do Nascimento			
Acute renal failure in patients with COVID-19: an uroanalysis perspective	José Antônio Tesser Poloni	QUANTITATIVE	2020	Reports the implications of Covid-19 at the patient's renal system
Clinical case of covid-19 with gastrointestinal symptoms (coronavirus)	Sanar Medicina	QUALITATIVE	2020	Clinical case of a covid-19 patient who presented gastrointestinal symptoms
What has changed in the sleep routine with the pandemic?	PNEUMOSONO	QUALITATIVE	2020	Explain the changes In the sleep during the COVID-19 pandemic and its impacts
National plan to combat the covid-19 pandemic	ABRASCO, CEBES, Rede Unida, ABrES, ABRASME, ABRASTT, ABEn, SBV, SBB, CNS, SBMT, SOBRASP, RMMP, ABMMD, SBMFC	QUALITATIVE	2020	Propose policies and coordinate emergency actions based on scientific evidence to control overcoming and reduce the economic and social impacts on the Brazilian nation due to the covid 19

Early Physical Rehabilitation in the ICU: A Review for the Neurohospitalist	Pedro A. Mendez-Tellez, Rasha Nusr, Dorianne Feldman, Dale M. Needham	QUALITATIVE	2012	analyzes evidence related to safety, feasibility, barriers and benefits of early measures in ICU patients
Anosmia and dysgeusia in the coronavirus patient: narrative review	Melyssa de Carvalho Cardoso Letícia Silva Guimarães	QUALITATIVE	2020	This is an article that will relate the physiology of sars-cov-2 with the symptoms of anosmia and dysgeusia
Clinical case of covid-19 with gastrointestinal symptoms (coronavirus)	Sanar Medicina	QUALITATIVE	2020	Clinical case of a covid-19 patient who presented gastrointestinal symptoms
What has changed in the sleep routine with the pandemic?	PNEUMOSONO	QUALITATIVE	2020	Explain the changes In the sleep during the COVID-19 pandemic and its impacts
National plan to combat the covid-19 pandemic	ABRASCO, CEBES, Rede Unida, ABrES, ABRASME, ABRASST, ABEn, SBV, SBB, CNS, SBMT, SOBRASP, RMMP, ABMMD, SBMFC	QUALITATIVE	2020	Propose policies and coordinate emergency actions based on scientific evidence to control overcoming and reduce the economic and social impacts on the Brazilian nation due to the covid 19
Early Physical Rehabilitation in the ICU: A Review for the Neurohospitalist	Pedro A. Mendez-Tellez, Rasha Nusr, Dorianne Feldman, Dale M. Needham	QUALITATIVE	2012	analyzes evidence related to safety, feasibility, barriers and benefits of early measures in ICU patients
Anosmia and dysgeusia in the coronavirus patient: narrative review	Melyssa de Carvalho Cardoso, Letícia Silva Guimarães, Isaías Jonatha Melo de Andrade Arthur Handerson Gomes Silva Giovana Carla Souza Letícia Araújo Menezes Castro Jonas Campos Cruz Letícia Machado Couto Luciana Menezes Nogueira Martins Andressa Vinha Zanuncio	QUALITATIVE	2020	This is an article that will relate the physiology of sars-cov-2 with the symptoms of anosmia and dysgeusia
Performance Drop Sexuality in Men and Women During Pandemic of the New Coronavirus - Covid-19	Leonardo de Souza Alves	QUANTITATIVE	2020	This is a survey that will relate sexual dysfunction during the covid-19 pandemic

Physiotherapist performance in therapy units intensive in the context of the COVID-19 pandemic	Fernando Guimarães	EDITORIAL	2020	Editorial about the physiotherapist's performance in the ICU in the Covid-19
Prospective assessment of the occurrence of infection in critically ill patients in the intensive care unit	Mery Ellen Lima, Denise de Andrade, Vanderlei José Haas	QUANTITATIVE	2007	Article that seeks to evaluate cases of infections in ICU patients
Lockdown is the world's biggest psychological experiment- and we will pay the price	Elke Van Hoof	QUANTITATIVE	2020	Analyze the increase in psychological illnesses in the COVID-19 lockdown
Distanciamento e isolamento sociais pela Covid-19 no Brasil: impactos na saúde mental	Rossano Cabral Lima	QUALITATIVE	2020	Analisar o impacto do distanciamento social na saúde mental em tempos de pandemia
Distancing and social isolation by Covid-19 in Brazil: impacts on mental health	INTER-AGENCY STANDING COMMITTEE	QUALITATIVE	2020	Propose activities recommended for a humanitarian health programming, in relation to the current scenario of COVID
Constitution and Restriction on Fundamental Rights in Pandemic times of COVID-19: a brief study of the blockade in the State of Maranhão	ANA PAULA DA SILVA SOTERO RICARDO;	QUALITATIVE	2020	Chapter of a book that sought to analyze the lockdown in the state of maranhão, in a right view
Self-image, self-esteem and self-realization: quality of life at university	Juan José Mouriño Mosquera; Claus Dieter Stobäus.	QUANTITATIVE	2006	Analyze the relationships between self-image, self-esteem and self-realization of students and their university professors, with consequences on their self-realization and quality of life.
Spirituality in times of pandemic	Claudio Oliveira Ribeiro	QUALITATIVE	2020	Analyze the effects of the new coronavirus pandemic on spirituality .
Affection and relationships in times of isolation social: intensified use of social media for interaction during the COVID-19 pandemic	Alex Primo	QUANTITATIVE	2020	As the changes in social life in the face of the covid-19 pandemic reflect emotional well-being and the use of media in this coping process
About the disease - how to protect yourself	Brazilian Ministry of Health	QUALITATIVE	2020	Prevention measures against coronavirus
From disinformation to chaos: an analysis of	João Henriques de Sousa Júnior, Michele Raasch,	QUALITATIVE	2020	Analysis on the use of the term "Coronavirus" in fake news

fake news in the face of the pandemic of coronavirus (covid-19) in Brazil	João Coelho Soares, Letícia Virgínia Henriques Alves de Sousa Ribeiro			
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Category I: The influence of SARS-CoV-2 on psychobiological needs

Oxygenation: When SARS-CoV-2 invades the respiratory system, it starts the viral replication process, spreading rapidly through the lung, as stated by Cespedes [29]. This impairs hematoses and airway clearance, which triggers tissue hypoxia and acute respiratory distress syndrome (ARDS), due to poor oxygen uptake and distribution [30]. **Hydroelectrolytic balance:** SARS-CoV-2 can cause renal dysfunction or even worsening renal failure in chronic patients, which consequently compromises the hydroelectrolytic balance. There are 3 hypotheses as to how this can occur: the affinity of SARS-CoV-2 with ECA2 that is present in the kidneys; by the indirect action of cytokines generated by SARS-COV-2 and accumulation of immunocomplexes of SARS-COV-2 antigens. [31]

Nutrition: Preventing and treating an individual's malnutrition is of paramount importance to reduce complications in individuals who may contract COVID-19 in the future and in patients who already have the disease. Among the symptoms of COVID-19 are nausea, vomiting and diarrhea, which directly affects food intake and absorption and reduces the individual's nutritional status [32].

Urinary and intestinal elimination: The chances for infection in the renal system by covid-19 are: the process of crosstalk or crossed lines, leading to Acute Renal Failure (ARI), generating a systemic collapse that is caused when the intubation process starts orotracheal and mechanical ventilation in the affected individual [33]; or else, some cytopathic effect caused by the virus or a type of inflammatory response. The lesion in the podocytes leads to intense proteinuria, thus impairing the filtration process; The entry of SARS-CoV-2 into the systemic circulation can also lead to AKI [34].

Gastrointestinal symptoms in covid-19 are rarely reported, however research currently conducted has shown that the ECA2 receptor (angiotensin-converting enzyme 2) is also found in cell epithelial cells of the esophagus, ileum and colon. [35]

SARS-CoV-2 can cause mild leakage in the abdominal cavity, dilation and narrowing of segments of the intestine, viewed microscopically [35]. Another cause of gastrointestinal symptoms is related to the amount of drugs

that an individual infected with covid-19 takes, which can harm the organs of the digestive tract, altering the flora intestinal [36]

Comfort, sleep and rest: During the pandemic, there was an increase in sleep disorders and changes in habits. These changes reflect in productivity, concentration, irritability and tiredness, bringing to light situations of stress and anxiety. Therefore, these changes in sleep interfere negatively in the homeostatic balance and functions psychological and immunological. [37]

Locomotion, mobility and body mechanics: Due to restrictions such as social isolation and lockdown, individuals need to remain inside their homes, compromising the skeletal and nervous muscle systems [38]. Inpatients are subject to reduced muscle strength, disuse of muscles and loss of innervation. All of these factors cause the weakening of joint strength and atrophies [39].

Sensory perception: The reason for anosmia and ageusia for this to occur is not fully known, but there are hypotheses in order to explain. One of them is linked to the fact that SARS-COV-2 has an affinity with the angiotensin-converting enzyme 2 (ECA2) and with the transmembrane serine protease 2 (TMPRSS2), so that it spreads in the body. Both are present in olfactory neuroepithelial cells, but only in ACE2 is present in the oral mucosa. Thus, the binding of the virus with these enzymes causes neurotransmitter dysfunction and, consequently, the presentation of anosmia and ageusia. [40]

Category II: The influence of SARS-CoV-2 on psychosocial needs

Sexuality: The Covid 19 pandemic has also influenced sexual relations between men and women, whether they are married or single. Given this, there are two factors that may have contributed to this result: the physiological, where disturbances can be generated due to trauma and stress; and the physical, due to social confinement, where single people were unable to go out for dates and married women ended up losing their freedom due to the interaction of other people in the same property and because they often perform the same activities every day. [41]

Safety: With the worsening of covid 19 symptoms, 15% of hospitalized patients require a bed in an intensive care unit (ICU) [42]. This compromises their integrity and their safety, considering the patient's length of stay in the ICU and the invasive procedures performed are directly proportional to the risk of infection [43].

Love and gregariousness: Social detachment and isolation, has already been exposed as “the greatest psychological experiment in the world” [44] and brought a feeling of helplessness, irritability, boredom, sadness, loneliness, and a variety of fears (such as contracting illness, losing loved ones) [45,46]

Freedom: With the lockdown decree, there is the blocking of a certain area, interruption of economic activities, except the essential ones. These measures, even if they hurt the right to freedom, are justified by the fact that with the pandemic the territory is in public calamity, which gives extreme measures to contain the virus [47].

Self-image and self-esteem: The current context, of social isolation, causes the individual to withdraw from his environment, can bring psychological changes, such as frustrations, fear of what is to come, tensions and uneasiness. [48]

Religiosity and spirituality: Spirituality, religious or not, has been reinforced during the covid-19 pandemic, due to concerns, fears, fears and diverse reactions around the world. This is due to the confrontation of social, financial, emotional difficulties, physical weaknesses, deaths, insecurities. [49]

Self-realization: Since social interaction is an action that can balance relationships and reduce the state of loneliness, the lack of this social communication, with social isolation, alters the quality of life [50]. This prevents the individual from being full in the sense of feeling able and able to change the situation around him, to believe in his potential and to believe that these scenarios can change.

Health education: Health education actions become indispensable in the control and prevention of covid19, in view of the measures taken to do so. Therefore, one can exemplify with teaching the importance of frequent and correct washing of hands with soap and water or 70% gel alcohol, coughing and sneezing covering the mouth and nose, the correct use and handling of masks [25].

Philosophy of life: The covid-19 pandemic directly affects the philosophy of life of the human being from the moment that the media spread various news about the pandemic and also because of the changes in the daily lives of individuals. In addition, the internet propagates so-

called “fake news”, causing instability and inconsistency about information about pandemic. [51]

III. FINAL CONSIDERATIONS

Based on Wanda Horta's Theory of Basic Human Needs, it was possible to relate nursing problems in the psychobiological and psychosocial categories with the impacts of the new coronavirus pandemic, comprehensively covering the individual, in the pathological repercussions, as identified, and also in the repercussions family and social. .

Among the most affected needs are: oxygenation, body mobility, sleep and rest, sensory perception and freedom.

It is expected that the identification of these affected NBs can contribute to greater attention by the multiprofessional team, aiming to eliminate possible gaps in care, thus favoring the collection of user data, the classification of diagnoses that can guide the planning of interventions, improving patient results, as well as ensuring safe care.

The limitations of the study refer to the lack of study materials that relate the two themes. It is suggested to produce other works that deal with this process, in view of the direct influence of SARS-CoV-2 on the organism and on interpersonal relationships.

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Environmental Education as an Instrument for the Sustainability of the Paleoagroecosystems

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Received: 09 Dec 2020;

Received in revised form:

03 Feb 2021;

Accepted: 26 Feb 2021;

Available online: 06 Mar 2021

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Keywords— Education, Environment, Agroecosystem, Paleoecosystem.

Abstract— The development of humanity throughout history has greatly impacted the natural resources of the Earth, jeopardizing the survival of mankind that lived for a millennium in harmony with the natural ecosystems. This paper started because of the concern that has been verified from the degradation processes of paleoagroecosystems. This study intended to analyze how the environmental education contributed as an instrument for the sustainability, standing out for the socio-environmental sustainability. It is based on the dialectic method, and has a qualitative approach, with a descriptive and exploratory bias, constituting a bibliographic research. The results show the necessity of an increase of knowledge about the relevance of the environment education as a theory and practice, intending to sensitize the society to suppress the impacts on ecosystems and paleoagroecosystems.

I. INTRODUCTION

Intending to produce food and consumer goods, the human activities, through the capitalist system, explore the earth's natural resources and jeopardize the ecosystems. Nevertheless, these activities do not consider the capacity of regeneration of these natural resources, which is limited and not as fast as the degradation of the ecosystems

These actions have caused many consequences in different areas of Society, such as agriculture, cattle raising, food security and other forms of production. This implicates in the soil erosion, salinization, desertification, soil contamination, riverbed's contamination, affecting mainly the agroecosystems (Vargas, Fontoura and

Wizniewsky, 2013) and putting the humanity life in risk. In this perspective, the environmental education presents itself as a transformative paradigm of the social praxis, offering the modification of man in such a way that it can provide a just and solidary society.

This way, the proposal of Environmental Education, that was discussed in Tbilisi's (URSS) 1977 and Thessalonica's (Greece) 1997 Conferences, among others, seeks to create a new conscience of the environment's value intending the reorientation of the knowledge's production based on the interdisciplinarity and transversality. By this way, it will be possible to provide new experiences of creative and innovative environmental education in different segments of society in its various

levels of education. These experiences are based on the concepts of a new ethics, cultural identity, and sustainability.

This study aims to analyze how the Environmental Education contributes as an instrument for the agroecosystems' sustainability. So, it presents itself as a fundamental piece for the changing of the anthropocentric paradigm, showing that it is possible to develop in line with the environmental conservation. This study theme is based on the necessity of attention of the collectivity in a participative way, with a holistic and systemic focus on agricultural production and cattle raising systems, resulting in the sustainability of the agroecosystems, in order to promote economic, social and environmental balance.

In this regard, Bianchi, Lawich and Herzog (2006, p.2) state that "There are several concepts of agroecosystems, but, in a general, the concepts are presented in a similar way", concluding that the human manipulation and the ecosystem change are substituted for the objective of agriculture and cattle raising implementation, and it introduces many changes in the structure and functioning of the natural ecosystem. On the other hand, the paleoecosystems are environments originated in the past ages, with a high level of vulnerability and atypical characteristics that are very different from the today's climatology. This kind of environment reports to an uncertain past, but it points, for sure, to a natural dynamic that is imposed on environments and societies, requiring management practices for conservation and/or preservation of these paleoenvironment (Pacheco, 2020a).

Furthermore, the environmental complexity requires new habits from the social actors when appropriating the environment. Inside this relationship between practice and knowledge about the collective practices, that provides new identities and common values, it is unleashed solidary actions into the reappropriation of the environment, building a dialogue capable to assure the socioenvironmental changes that do not endanger the ecological and social systems (Jacobi, 2003). Thus, the good news is that the public policy is aiming to construct of a political-pedagogical proposal of a sustainable education. By this way, it is possible to form people and a Society responsible for improving the quality of life and the environment where they live.

Therefore, the term sustainability shows a broad dimension beyond the economic and environmental aspect. The possibility to attend the present generation needs without compromising the future generation supplies is related to the quality of society's life, and it also can be called sustainable Society.

So, this study is based on the dialectic method, using a qualitative approach, with a descriptive and exploratory slant, structured in a bibliographic research. The findings of this research are necessary and of a great relevance for the environmental education as theory and practice. This study seeks to raise awareness on Society to resolve the impacts caused daily on ecosystems and on the paleoagroecosystems, understanding that when the environmental education is diffused in an effective way, it is able to produce a sustainable environment causing a great quality of life and social welfare (Oliveira, 2016).

II. THEORETICAL REFERENCE

In this topic it is presented conceptually the theoretical dialogues that guide this study, which is structured in three sections. The first section is overview about the Environmental Education in the Paleoagroecosystems Sustainability perspective. The second one is directed to the variable sustainability, describing about the structure and functionality. The third section shows the importance of the Paleoagroecosystems' preservation.

2.1. The Environmental Education in the Paleoagroecosystems Sustainability perspective

In the harmonic familiarity between man and nature perspective, it is highlighted the need to respect the limits normally imposed by the scarcity of resources available to humanity. This way, it is observed that the established economic development form, as well as the human consumer behavior, evidenced with greater intensity after the industrial Revolution (century XVIII) substantiated on technology and innovation, promotes not only a change in the production process, but also in the humanity consumption behavior. Before this Revolution, the production process was handmade, but after that it became to be produced on a large scale with a great diversity of products. So, the humanity became eager for novelties and stimulated by advertising and easy access to credit, understood that happiness and well-being, are directly, linked to consumption.

It is important to notice the need to seek the balance between production and consumption in order to meet the need of the present generation without compromising the future generation necessities, thus achieving a sustainable development (social, environmental, and economic), as an essential requirement for the humanity preservation on Earth (Camelo, 2015).

In this context, the agriculture, also driven by technology, implements the monoculture, through deforestation, with an intensive use of the soil, chemical fertilizers, agricultural pesticides, and an unruly use of

water, with the justification of a large-scale productivity, which is generally destined to the foreign Market. These actions end up promoting an instability between the agriculture and the natural ecosystems, modifying the way nature works, causing imbalance to the agroecosystem. (Corrêa and Manesch, 2017).

After observing and experiencing the results from the cases reported before, the Society and the global leaderships started to organize conferences, non-governmental organizations, and social movements, aiming to reflect and find solutions for the environmental crisis installed in the world.

These social movements began in 1970, awakened by the great impacts caused in the environment because of the predatory exploitation of the natural resources and the damage done to society. Through the Stockholm Conference in 1972, it is started the discussion about the environmental issues evidencing an environmental criticism of the current development model. In this conference these issues received a public visibility on the international agenda environment.

Since de 90s, with the World Conference in Rio de Janeiro (1992), the concept of sustainable development has been sought in the most diverse forums, on the slogan of environmental activists, topics of papers, etc. In this period, because of the discussions about the environmental theme, two opposite interpretative currents arise: The first one - economic and technical-scientific - was grounded on the economical increasing and environmental preservation; the second one was grounded on an environmental criticism of the contemporary way of life. This way, it is possible to characterize the currents as the one that predicted abundance and the other that predicted catastrophe.

Thus, it is necessary to intermediate a proper reordering between social, environmental, and economic objectives. This reorganization will promote the regression of growing social inequality, the containment of environmental degradation and equity in the income distribution. So, the access to information and Environmental Education are ways to reverse socio-environmental degradation, through awareness and individual co-responsibility in the supervision and control of environmental degradation. This happens because misinformation is the preponderant factor for the individual and collective practices denial in favor of social involvement and participation.

Therefore, the Environmental Education is consolidated through huge events, as previously mentioned (Stockholm Conference 1972 and Rio Conference/92) as The Belgrade Charter 1975; Intergovernmental Conference

about Environmental Education in Tbilisi 1977, Thessaloniki Conference 1997, and others that served as a pillar for the diffusion of the Environmental Education aiming to awake the collective participation in solving the environmental issues (Jacobi, 2005).

Then, intending the agroecosystems balance, harmony in man's relationship with the environment, and to establish a connection between nature and agriculture, the Environmental Education presents itself as an instrument of intermediation (between man and nature) as a way to achieve sustainability, in order to promote the management of ecosystems respecting their natural functioning.

This way, it's verified through the magnitude and relevance of the events mentioned before, the consolidation and evidence of Environmental Education in the planetary context as a model of harmonious coexistence between man and nature. According to Guimarães, (2020), over this period, the Environmental Education was consolidated based on the following characteristics:

Therefore, it is possible to notice that, over this period, the Environmental Education has been outlined as eminently interdisciplinary, and oriented to face local problems contextualized in a global reality. It is participatory, community, creative, and values the action. It is a critical education of the reality, forming citizenship. It transforms individual and collective values and attitudes through the construction of new habits and knowledges, creating a new ethic, sensitizing and raising awareness of the integrated relationships between Human Beings/Society and Nature aiming at local and global balance, as a way of achieving the improvement of the quality of all living standards (Guimarães, 2020, p.48).

It's important to highlight that many other events before, after and concomitant with these were held and had/have great importance for the development of the environmental education. In the perspective of this intermediation between man and the environment, in the search for respect for the natural laws, the proper management of natural resources, and the preservation of natural ecosystems, the Environmental Education is an excellent instrument for the sustainability of agroecosystems.

2.2 Sustainability: structure and functionality of Paleoagroecosystems

In the contemporary world, the concern with the environmental sustainability is increasingly present in the

daily life of humanity on our planet. This way, it is important to reflect about this context, questioning: what are we doing today to assure the conservation and the sustainability of the ecosystems aiming at using it for present and future generations?

We live in an extremely consumerist society where economic issues always comes before the environmentalist, the individual above the collectivity, the wealth of few people to the detriment of the poverty of most population, and from the perspective of easy profit, even if it destroys the nature, instead of distributing the income proportionally. Allied to a collective practice of preserving natural resources that still exists. From this observation, and from many others, it is noticed that the Earth will not withstand for a long time economic growth based on the current pattern of extraction and consumption of natural resources (Goodland, 1997).

Thus, dialogue about sustainability becomes increasingly important in our daily lives. In Benetti's (2006) understanding, sustainability is something that cannot be obtained instantly, it is a process of change, constant improvement and structural transformation that must have the participation of the whole population, and the consideration of its different dimensions. For Conway (1987), sustainability is defined as the ability of an agroecosystem to maintain its productivity when subjected to a major disturbance. The disturbance can be caused by intense pressure, capable of generating cumulative effects, such as salinity, toxicity, erosion, decline in market demand, drought and floods, examples of such disturbances.

In this perspective, there is a real need for conservation of the agroecosystem, ensuring its productivity as long as there is balance within this environment. So, the use of science and new technologies imposed a new management of natural resources, replacing local knowledge and, thus, nature began to be dominated by man. The man aiming at profit and the conquest of markets, began to replace the management of natural resources and ecological bases through production with biological processes (Vargas, Fontoura and Wizniewsky, 2013). It should be noticed that this study is also justified by the relationship between sustainability and the agroecosystems. Hart (1980) confirms by stating that the agroecosystem is an ecosystem with the presence of at least one agricultural population, so it can be understood as a work unit in the case of agricultural systems, differing fundamentally from natural ecosystems because it is regulated by human intervention in the search for a certain purpose.

From this perspective, the agroecosystems, in a generic way, can be divided into three types: 1. Those with a crop

subsystem; 2. Those consisting of an animal subsystem; 3. Those with a subsystem with plant and animal species. There are also other types of agroecosystems: aquatic, forestry, or agroforestry, silvopastoral and agroforestry (Hart, 1980).

Following this line of reasoning, Gliessman (2001) recognizes an agroecosystem as a place of agricultural production - an agricultural property, for example - understood as an ecosystem. The concept of agroecosystem provides a structure which we can analyze the whole food production systems, including their complex sets of inputs, production and connection between the parts that compose them. Therefore, it is realized the relevance of the agroecosystems, as well as their preservation for human survival on earth.

Conway (1987) reiterates that agroecosystems are ecological systems modified by humans to produce food, fiber, or other agricultural product. They often have a complex dynamic structure, but their complexity arises, first, from the interaction between socioeconomic and ecological processes. It is a complex economic-ecological and social system. It is worth emphasizing that in addition to the biological and survival characteristic, the social concept is also evident, when interdependent individuals, who relate to each other, live within a collective productive structure. Thus, Marten (1988) states that an agroecosystem is a complex of air, water, soil, plants, animals, microorganisms and everything else that is in the area modified by humans for agricultural production purposes.

Therefore, such concepts aim to a macro-environmental integration with the main structuring elements of an agroecosystem. Considering the structure and functionality of the agroecosystems, it is worth explaining some characteristics inherent to the perspective of environmental preservation, without losing sight of their importance within the market context.

According to Marten (1988), the structure of an agroecosystem is how it is organized, that is, a consequence of the agricultural technology system and also the set formed between the environment and the social in which the technology is applied. The structure includes all the elements of the agroecosystem and how they are functionally connected to each other. Thus, depending on the diversity of existing concepts, the structure of an agroecosystem can also be characterized by the presence of several species of animals, which, from the use of traditional and/or modern techniques, a certain production is obtained

So, it is important to state that for the maintenance and balance of the agroecosystem, it is necessary to properly

manage and raise awareness in the use of the natural resources [finite], since they are increasingly scarce, thus contributing to the maintenance of natural supplies.

The structure of an agroecosystem is how it is organized, that is, it is a consequence of both the agricultural technology system and the set formed between the environment and the social in which technology is applied (Marten, 1988). Given the above, considering the coverage and complexity of the agroecosystems, it is increasingly clear that man should rationally use technologies that minimize negative impacts, which can reduce the productive potential in this kind of environment.

D'Agostini (1999) apud Cunha (2006), defines the structure as the physical or spatial dimension where the agroecosystem is physically and spatially demarcated and the relations between the different populations present operate, including man, as well as between these populations and the environment in which they are located. Thus, it is evidenced the importance of the geographical and spatial context in the agroecosystem, pointing to the path of conservation of this environment. In this care process the man is the central figure, without forgetting the sustainability variable creating a perspective of productivity and continuity for current and future generations.

The agroecosystems and the environmental education are directly related within the paradigm of conservation and production, from how it is structured to the form of agricultural production, through care for the environment and life in its entirety. This means that its understanding is beyond the consolidation of a single form of production, using advanced or rudimentary technology, from the technological point of view and the resources used.

Based on this, the Environmental Education has its transforming aspect, starting from these assumptions and making the counterpoint to the conservationist's point of view, that results from the dominant paradigm. Nevertheless, it has a common point with the perspective of sustainability in agroecosystems as shown in this study. This is because the traditional perspective, by understanding education in its individual dimension, contributes to the depoliticization of educational practice, using behavioral pedagogies and with little problematization of the reality (Loureiro, 2006).

Therefore, what brings this perspective closer to agricultural practices and interests related to the Green Revolution and groups that want to maintain a model of conventional and exploratory agriculture of natural resources (Silva and Machado, 2015), is the interest to privilege profits over quality and equality of life and

production systems. This privilege comes from the current, unequal, and selfish capitalism system. It becomes more evident every day that it is not the large latifundia that provide the food of societies, even though 75% of the concentration of land for large-scale production is exported, but the 25% of land used by family farming. Because of these realities that it is so urgent to discuss about the relevance of a change of habit, posture, methods, and practices in the production process in the agroecosystems and/or paleoagroecosystems.

2.3 Paleoagroecosystems: Importance, preservation, and conservation

The Law nº 12.651/2012 known as the "new" Forest Code enables ecological restoration with agroforestry systems, as a way for recomposing Permanent Preservation Areas (PPA)¹ and Legal Reserve (LR)², which is defined from the size of the property, of up to four fiscal modules. According to Embrapa, it is possible to use the crop-livestock-forestry integration (CLFI) system as a viable production alternative for the recovery of altered or degraded areas (Balbino, Barcellos, and Stone, 2011).

The scenery of soil degradation has induced the scientific community to seek sustainable production systems, to harmonize the increase in plant and animal productivity, with the preservation of natural resources. The main objective of the CLFI is to change the land use system, based on the integration of the components of the production system, aiming to reach increasingly high levels of product quality, environmental quality and competitiveness.

The CLFI presents itself as a strategy to maximize desirable effects on the environment, combining increased productivity with the conservation of natural resources in the process of intensifying the use of areas already deforested in Brazil. (Balbino, Barcellos, and Stone, 2011).

Furthermore, the CLFI is a sustainable production strategy, which integrates agricultural, livestock and forestry activities, carried out in the same area. In intercropping, in succession or rotated. It seeks synergistic effects between the components of the agroecosystem, including environmental adequacy, the valorization of man

¹ Area protected or not, covered by native vegetation, with na environmental function of preserving water resources, landscape, geological stability and biodiversity, facilitate the fauna and flora's gene flow, protect the soil, and assure the well being of the humans' population (Art. 3º, II, Law nº 12.651/2012).

² Area located within a rural property or possession, delimited in accordance with the art. 12, with the function of ensuring the economic use in a sustainable way of the rural property natural resources, assist in the conservation and rehabilitation of ecological processes, and promote the conservation of biodiversity, as well as the shelter and protection of wildlife and native flora. (Art. 3º, III, Law nº 12.651/2012).

and economic viability (Balbino, Barcellos, and Stone, 2011).

According to Gliessman (2000), the agriculture can become sustainable because one of the Agroecology's aspect is that it restores the productive capacity of agroecosystems. It is a concept, a way to see how the systems work, how do we determine whether there is sustainability and how we connect ecological knowledge with economic and social knowledge. So that all the elements of the agroecosystem - soil, water, forests, animals, and also humans - parts of the systems come together. Another fundamental aspect is that the Agroecology gives a way to see how the human being is a integrated aspect to the system.

So, it is possible to state that the agroecology is able to preserve the systems that somehow has been destroyed by human actions. It can happen through a new way of managing natural resources, from the participation of interested parties, thus constructing a new sustainable model.

According to Altieri (2009), the agroecosystem is productive and health if these rich and balanced growth conditions prevail; also, if plants remain resilient in order to tolerate stresses and adversities. Still according to Altieri, the development of a self-sufficient, diversified and economically viable agroecosystems will arise from new integrated agriculture systems, with technologies within farmers' reach and adapted to the environment.

Pacheco (2017; 2020a 2020b) brings a discussion about the paleoecosystems, or paleoenvironmental systems. This system was originated in the past ages, when the edaphoclimatic conditions were totally different from the current one. One of the paleoecosystems worked by the author is the paleodunes, which are numerous dune fields located at the riverside of the São Francisco river and built by it, in a not so distant past, but due to the rework of the winds and human actions, have suffered irreversible impacts.

At the same time, in these paleoenvironmental areas, several agroecosystems are interposed, named by Pacheco (2020b) as 'paleoagroecosystems', that is, paleoenvironmental system, natural [dune formations] in addition of numerous areas of agricultural crops [conventional and agroecological]. Extensive and intensive livestock activities (bovine farming, goats, sheep, horses, etc.), artisanal fishing, (in)sustainable tourism, construction of irregular and unlicensed housing by environmental agencies, illegal exploitation and removal of native timber and sand, among others.

About this reality, the mentioned author has categorized such areas according to the level of impactation

suffered by paleoenvironments and based on the Ecodynamics of Tricart (1977) has designed in her research models of Environmental Conservation Plans (ECP)³ these paleoagroecosystems, aiming essentially to preserve some areas and conserve others. It also aims to restore the highly impacted areas, restoring the natural configuration from proper soil management and agrobiodiversity.

III. METHODOLOGY

3.1 Study design and population

This study is a bibliographic research with a qualitative approach. With regard to the objectives, a descriptive research was developed. It has an exploratory character, since it sought to develop a broader view of the object studied, providing greater explanation, and understanding about the subject (Gil, 2019). The population that was considered for this study was composed by scientific papers, taken from the following databases: SciELO⁴, SPELL⁵, Web of Science and Google Scholar o, as well as journals and books.

3.2 Procedures for data collection

The search for papers was made in the following databases: SciELO, SPELL, Web of Science e Google Scholar, using the key words "Environmental Education", "Agroecosystem", "Sustainability" and "Paleoecosystems". The inclusion criteria for the research of papers were to use only scientific papers, published worldwide in all years on the topic addressed, and 8,052 articles were found.

From this approach, the research limited to the years 2016 to 2020, reducing the contingent to 3,410 articles, abbreviating to 2,716 through the refinement of papers analyzed by peers. However, when the keywords were combined, 441 papers were selected, reducing to 361 through the refinement of "peer analyzed papers", which by reading the titles or abstracts it was possible to choose 40 to elaborate the present study. The others were disregarded for being part of the exclusion criterion and not meeting the purpose of the study. Thus, the difficulty in finding scientific papers in the researched databases that addressed the theme "Paleoagroecosystems". Then, it was idealized to find through this study a research gap to be filled on the subject of this study, from the preparation of publications on the respective theme.

³ For each categorized area, a ECP model was designed (PACHECO, 2020).

⁴ Scientific Electronic Library Online.

⁵ Scientific Periodicals Electronic Library

IV. RESULTS AND DISCUSSIONS

Through the selected papers, as described in the methodology topic, it was possible to observe the relevance of the theme and show at the same time, some gaps that require new researches and constructions. It was noticeable the need to approach Environmental Education as an instrument capable of raising awareness in society, through the educational process (formal, non-formal or informal), and to change the habits, postures, and also to cause change in the methods and practices to minimize the destruction on the paleoecosystems, aiming for the construction of a more balanced paleoagroecosystem in order to restore harmony between society and nature, for its own good.

This way, the chosen papers, which talk about the Environmental Education, state that this education happens firmly when the results of events held over time, showing and demonstrating real facts about the need to rethink and re-educate the relationship between man and nature since this has been a catastrophic relationship for both. Still talking about the Environmental education strengthening, it happens because of its first characteristics, transversal and interdisciplinary, therefore, it becomes a guiding instrument of contextualized and experienced reality in a liberating and innovative way.

Then, the Environmental Education continues to perform and develop its functionalities in individual and collective actions, awakening society to reestablish harmony from a part of the whole by interacting and intertwining divergent and convergent areas of coexistence. Consequently, from the perspective of sustainability in paleoagroecosystems, it is a great instrument for the preservation and conservation of the environment.

Within these discussions, there is the evidence that the Environmental Education plays its role with great relevance, with regard to education. About this, Freire (1983) and Delors et al, (2003) defend education as liberating, transformative, participatory, and creative. Guimarães (2020), complements this statement with all the characteristics mentioned, adding awareness, which leads man to visualize the socio-environmental balanced, having the environmental dimension in the education for a better quality of life.

Thus, the researched Environmental Education is fundamental and extremely important for the agroecosystems, whether it is already built or to be built as long as there is harmony between man and nature. Therefore, recognizing the need for this integration is urgent and necessary to visualize sustainability for a sustainable development.

The texts that talk about sustainability warn of the concern for the survival of the human species, as well as the conservation of natural resources, where the model of capitalist consumerist society is doomed to failure. Then, a human collective consciousness is urgent in relation to the whole environment; a conservation alternative that could be the agroecosystems, ensuring productivity and balance, not being possible to disconnect it from the Environmental Education. From the perspective of environmental conservation to benefit this and future generations on our planet.

In addition, the authors who discuss ecosystems and agroecosystems point the need for sustainable rural production seeking synergistic effects between the components, adapting the environment, economy and valuing people. Considering that the advances would result in better water utilization, because under the same water regime and water volumes there is an increase in agricultural production and an increase in the accumulation of organic matter, in the amount of biomass and in the effects on gas emissions. Besides, regarding environmental conservation and recovery, there are effects related to physical and chemical degradation based on the new Forest Code (2012), increasing the resilience and availability of pastures.

Finally, when discussing paleoagroecosystems, it is possible to notice that there is still a gap in the discussions, considering it to be a new term resulting from the junction of agroecosystems and paleoecosystems. These gaps come from the few studies about these themes and point to the possibility of developing unprecedented research on such issues, since, despite the limited literature, it is already possible to see some productions about 'agroecosystems', its dynamic of functioning, and its need for recognition as a system that brings together the natural and the humanized. With regard to paleoecosystems, the literature is even rarer, but some authors have already emerged with publications at national and international level, characterizing, categorizing and pointing out suggestions for mitigating impacts in these environments from various instruments, with the Environment Education being one of them.

V. CONCLUSION

This study brings the discussion about the necessity to know more about the relevancy of the Environmental Education as an instrument to solve conflicts, adjust postures, convert untenable habits, and, above all, provide knowledge to the people who live next to the Paleoecosystems or paleoagroecosystems with the

exploitation of agricultural and livestock activity, in order to promote integration between man and nature.

It is essential to keep in mind that the systems, whether called ecosystems, agroecosystems, paleoecosystems or paleoagroecosystems, require sustainable management and efficient practices for their conservation and/or preservation, depending on the level at which it is categorized. Therefore, it is essential that the people who live in these territories are aware of the genesis and evolution of these systems, that they know about the importance of preserving them and, above all, understand that it is from this natural environment that these societies withdraw their own livelihoods.

Besides, this study does not have the intention to end on itself, since the subject is very instigating, and may provide new studies about its theme with other holistic, systemic, and epistemic looks. Therefore, the results show greater knowledge about the relevance of the Environmental Education as a policy and as a practice, seeking to raise society's awareness to resolve the impacts caused daily on the ecosystems, agroecosystems and paleoagroecosystems.

ACKNOWLEDGEMENTS

To the Postgraduate Program Master in Dynamics of Development of the Semiarid Region (PPGDIDES/UNIVASF).

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Speedy and Effective Dispute Resolution through Virtual Mediation as an Environmental Protection Tool

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Received: 09 Dec 2020;

Received in revised form:

03 Feb 2021;

Accepted: 26 Feb 2021;

Available online: 06 Mar 2021

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Keywords— Virtual Mediation, Paper,
Environmental Preservation.

Abstract— Natural resources are renewable, however, they need time to recover, being essential to guarantee a healthy environment, for the benefit of future generations, attitudes of preservation and non-degradation of the environment. The carbon dioxide emitted by vehicle engines was a major cause of global warming of the earth. This work will show environmental impacts caused by the emission of gases from the burning of fuel and the unnecessary use of paper by the Court of Justice of Pernambuco. The theme has great relevance in view of the pressing need for everyone's contribution to sustainability, and the Judiciary Branch must demonstrate its collaboration through sustainable practices, within new paradigms, to minimize the impacts that some of its activities cause to the environment. In view of this, the main objective here is to demonstrate how the disuse of paper and the use of electronic means in mediation sessions at the Center for the Resolution of Conflicts and Citizenship in Recife, will contribute to the reduction of carbon dioxide in the atmosphere due to the mitigation of deforestation. This work was carried out in the Municipality of Recife, based on a case study developed at the Rodolfo Aureliano Forum, in a specified way, at Cejusc - Recife. To this end, semi-structured interviews and questionnaires were carried out, as well as bibliographic research, with the methodology used being mixed (qualitative / quantitative) and exploratory; the case being understood in accordance with the Sustainable Logistics Plan indicated by the National Council of Justice and the Sustainable Logistics Plan itself of the Pernambuco Court of Justice. Depending on the exposure in the discussions of this work, it is important to highlight one of the main results found in this case, considering that in 2019 64,020 new processes were distributed (TJPE), if they were resolved by virtual mediation, 1,707.2 (one thousand , seven hundred and seven point two) eucalyptus trees, which means that an average of 150 (one hundred and fifty) tons of carbon dioxide would be sequestered from the atmosphere, thus making it possible to verify the environmental gain, as well as the economic and social gain , in a win-win process, where the courts, the Court itself, as well as the whole society win, with the speed, effectiveness and sustainability presented by the approached system.

I. INTRODUCTION

At the United Nations Conference in Stockholm, 1972, the principle was defined that man has the fundamental right to freedom, equality and to enjoy adequate living conditions, in an environment of such quality that allows him to lead a life dignified, enjoy well-being and has a solemn obligation to protect and improve the environment for present and future generations (GENTIL, NOVAIS, 2011).

The United Nations World Commission on Environment and Development, when it met in 1987 in Norway, produced a document called "Our Common Future" also known as the Brundtland Report, where the signatory governments committed themselves to promote development economic and social in accordance with environmental preservation (GONÇALVES, 2005).

In this report, the definition of sustainability or sustainable development was presented, as one that seeks to satisfy the needs of the current generation, without compromising the ability of future generations to meet their own needs. It means enabling people, now and in the future, to achieve a satisfactory level of social and economic development and human cultural achievement, while making reasonable use of the earth's resources and preserving species and natural habitats, without compromising the right to meet their own needs (UN, 1987).

The renewal of existing natural resources does not happen at the same speed since some of them take longer than others to recover. Consumption at a too fast pace and not following the renewal of natural resources, implies the finitude and depletion of these natural goods. Attitudes of preservation and non-degradation of the environment can guarantee a good social / economic development of society and public and private companies without destructive environmental impact (ZANIRATOI, ROTONDARO, 2016).

In this sense, sustainable development is based on economic, social and environmental growth in harmony. It is the tripod of sustainability, composed of the results of any organization and measured in social, environmental, and economic terms (GONÇALVES and CATAPAN, 2016).

For there to be sustainable economic and social development, it is necessary to reconcile the economic, social and environmental aspects, becoming an orientation for people and companies in their processes of production, operation, commercialization and use of goods and services. services provision (ESTENDER, PITTA, 2008).

Economic development can be considered the great villain of global warming of the earth, given that its greatest growth occurred in the industrial period, along with the creation of machinery and equipment dependent on energy considered unsustainable and emitting polluting gases (COSTA, 2019).

On the other hand, although there is evidence that economic growth has caused damage to the environment, one cannot forget that it is necessary and indispensable for the growth of a society made up of people and any organization, it is called sustainable development. The term sustainable development was first used in 1980 by a private research organization, the World Alliance for Nature (RAUPP, 2020).

The preservation of the environment is established in the Brazilian Constitution, at the level of the fundamental principle of the Brazilian nation, since it is closely linked to the right to life (CF, art. 225).

In this context, the Judiciary of the State of Pernambuco, as a public entity, has the responsibility for sustainable development, requiring a change in its own paradigm, which has been in place for a long time and this is an important point of this work.

The idea to be presented here is that stimulating and encouraging mediation as an alternative and quick way of resolving conflicts, combined with virtual technology, will lead the state government to contribute to a sustainable development of the Pernambuco judiciary and to be a model of practice by other courts.

In this regard, the possible impacts on the environmental sphere, caused by the emission of gases from the burning of fuel by means of motor vehicles, as well as using paper unnecessarily in the processes and procedures will be verified.

The general purpose of this work is to analyze the mitigation of greenhouse gas emissions and the environmental benefits due to the non-use of vehicles and the use of paper in conflict resolution through virtual mediation at Cejusc-Recife.

To this end, the environmental damage caused by the emission of gases by motor vehicles used by the courts, lawyers, public defenders, civil servants and magistrates to go to the Rodolfo Aureliano Forum and the consumption of paper in processes and procedures will be addressed in a first step (pre-processes).

Subsequently, it will be demonstrated that the Pernambucano Judiciary, as a driver of public policies and through changes in the traditional dispute resolution process, can contribute to the environment.

Finally, the gains presented by means of virtual mediation will be evaluated either by the non-use of motor vehicles by the courts, lawyers, public defenders, civil servants and magistrates, or by the non-use of paper in the judicial activity, showing that this alternative method of solving conflict is a sustainable practice and therefore a tool for protecting the environment.

II. METHODOLOGY

STUDY AREA

The Rodolfo Aureliano Forum was the place chosen to produce this work. The realization was carried out, more specifically, at Cejusc - Center for Conflict Resolution and Citizenship of the District of Recife, sector that is part of Nupemec - Permanent Center for Consensual Conflict Resolution Methods, with the said forum, located about Ilha do Leite, in Recife, Capital of the State of Pernambuco.

The building that houses the Rodolfo Aureliano Forum, located in the Ilha do Leite neighborhood, is the most important of the Pernambuco State Judiciary, being responsible for 25% of all materials used by the TJPE, which demonstrates the importance of this Forum for work (Figure 1).



Fig.1: Part of the Map of Recife - Ilha do Leite Neighborhood.

METHODOLOGICAL STEPS

Initially, a bibliographic research was carried out in this work to build a theoretical basis to have data in a later discussion and analysis of the concepts involved here. Information was captured to seek an idea, an improvement in the conflict resolution system in the local judiciary.

Later, some literature dealing with the subject matter of this work was analyzed and, from that point on, the theory can be applied in existing practice, checking possibilities of increment for an improvement in the form and result, in the dispute resolution system. Therefore, this research can be classified as applied.

The problem presented was approached both quantitatively, through data and numbers, and qualitatively, which were instruments to reach the conclusion.

Thus, this research is of the mixed, quantitative / qualitative type, being used the quantifiable data, identified both in the questionnaire, as in the productivity and data provided by Nupemec and the qualitative elements, provided by the interview, with all the results presented in the form of graphs and a subjective analysis of the problem encountered.

There was an identification and collection of information on the spot and, therefore, it can also be indicated as an exploratory and field research.

- Survey of primary data

This work is configured in a mixed method research - procedure of collection, analysis, and combination of quantitative and qualitative techniques in the same research design (PARANHOS, 2016). Taking this statement as a reference, this work was delimited in two stages.

The first involves the realization of a qualitative phase, with the gathering of information and theories related to the object of the research, through bibliography, from the legal literature in its broadest scope, doctrine, legislation, positions of authorities and scholars in the topics addressed, scientific articles, websites and journals specialized in the subject, for greater familiarity with the content and improvement of ideas, enabling the deepening and discussion of the studied topic, which also denotes an exploratory research.

The second step, follows the quantitative orientation, encompassing procedures for data collection, validation and analysis, with survey application, which is based on the questioning of users / participants (MALHOTRA, 2015), through questions about certain characteristics, way of life, their intentions, attitudes, behaviors, perceptions and motivations, etc., allowing the collection of a quantity of information about each respondent at once.

Therefore, this research is aimed at data exploration, based on the application of structured questionnaires and the use of information collected from a sample of the target population (PINSONNEAULT; KRAEMER, 2016).

- Research Locus

The research was carried out from the collection of real data at the Judicial Center for Conflict Resolution and Citizenship of Recife - CEJUSC, located at the Rodolfo Aureliano Forum, in the Ilha do Leite District, in this Capital.

SEARCH OPINIONS

The method used in the survey of opinions was mixed (qualitative and quantitative), with bibliographic research, to compose the theoretical basis, and with survey type research, to collect data and information from the characteristics and opinions of the chosen group, where the result found can be extended to the entire studied universe, considering the group that represents a certain population. The survey is widely used in academia, as it proves to be of great use for scientific research, as emphasized by Babbie (2016).

In the desire to understand with precision the local reality of the TJPE about the topics verified in the present work, a structured opinion poll was carried out, based on pre-formulated questions about the theme and with closed answers, and an open question, intended to collect suggestions to increase the amount of information on the topic in the TJPE. This interview was carried out using a Googleforms tool, whose form was prepared using the Likert Scale, which allows measuring attitudes and knowing the interviewee's degree of compliance with the proposed statements.

The investigated population is configured among the servants and magistrates of Rodolfo Aureliano's Forum. The population is 8000 people, with a sample of 367 people, considering the users who participated in the survey, from August 17 to September 3, 2020.

For the 95% confidence level and 5% error estimate. The following formula was applied:

$$N = 8000, Z/2 = 1,96,$$

$$E = 5\% = 0,05$$

$$n = 0,25 \times 8000 \times (1,96)^2$$

$$0,25 \times (1,96)^2 + (7999) \cdot (0,05)^2$$

$$n = 367 \text{ samples}$$

Thus, the sample number of 178 is acquired, where:

$$n = \text{sample number} = 174$$

$$N = \text{population number} = 200$$

$$Z/2 = \text{equivalent critical value Grade of 95\%}$$

$$E = \text{margin of error} = 5\% = 0.05$$

The target audience of the opinion poll were TJPE employees who are directly or indirectly involved in the topic, as well as judges, lawyers and public defenders who participated in mediation sessions in a virtual way and were selected exactly for this link to the matter. The scope of the questionnaire also included managers and civil servants who act mediately or immediately with mediation, and, finally, other employees who study, who nurture or

are unfamiliar with the subject also participated in the assessment. To maintaining ethical confidentiality of the source, the respondents were not identified.

DATA ANALYSIS TECHNIQUES

The research method used was the survey, and the research instrument was based on the model of Ainin, Bahri and Ahmad (2016), combined with the dimension "ease of use", of the TAM model, suggested by Davis (1989), the to assess the impact on end user satisfaction. The method is used, through a questionnaire, to collect information about the actions or beliefs of an established group of people, which represents a specific population to be studied. Models, on the other hand, consider constructs that impact user satisfaction in relation to the use of a given system.

CASE STUDY

According to Coutinho (2011), the case study is one of the methodological references with the greatest potential for studying the diversity of problems that are posed to a social scientist.

This author also states that: the characteristic that best identifies and distinguishes this methodological approach, is the fact that it is a research plan that involves the intensive and detailed study of a well-defined entity: the case (COUTINHO, 2011).

The case study is a methodological approach that consists of a detailed observation of a particular context, or individual, from a single source of documents or a specific event (MERRIAM, 1988).

For the success of this work, it was used as a fundamental starting point with a bibliographic review on the topic and later for the development of activities, the research will consist of data collection: a case study was made in a specific building of the Court of Justice from Pernambuco. After collecting these data, the analysis and interpretation of facts and phenomena were carried out that allowed a better way to develop the objectives established in the present study.

In the investigation of contemporary events, the case study is the preferred approach in relation to historical investigation, although the case study uses techniques from which a story is used. However, in the case study, it is possible to add the observer's physical presence, direct observation, and systematic interview, which makes it possible to attend to a wide variety of evidence, such as documents, artifacts, interviews, and observations (MERRIAM, 1988).

For some critics, the case study is seen as an investigation for beginners, as it is considered easier than other types of investigation: It is not by chance that most

researchers choose, for their first project, a case study (COUTINHO, 2011, p.89).

As a research strategy, we opted for the development of a case study, which, according to Yin (2015), is preferred when the control that the investigator has over the events is very reduced, or even when the temporal focus is on contemporary phenomena, within the context of real life. Godoy (1995, p. 25) further states that, "adopting an exploratory and descriptive approach, the researcher who intends to develop a case study must be open to his discoveries".

In addition to the questionnaire already mentioned, an individual semi-structured interview was carried out later, with the construction of the script for the interviews elaborated from the theoretical framework. The semi-structured interview, although commonly conducted in person, needed to be adapted and migrated to digital format so that the interviewee did not need to leave the house, due to the social isolation measures that were imposed due to the pandemic of the new Corona virus, thus obeying, the established standards.

Thus, based on a pre-defined script, developed in a flexible way; both in the questionnaire and in the interview, there were questions that made it possible to extract from the respondent's information about knowledge related to TJPE mediation. The interviewees were informed about the purpose of the empirical investigation and the importance of their collaboration for the study, as well as about the guarantee of confidentiality.

Respondents were not identified due to confidentiality and secrecy and therefore the names, positions and any other forms of identification of respondents are not mentioned. The analysis was of a qualitative and interpretative nature, based on the evaluation of the content of the responses of the interviews carried out and on the comparison of the results with the items of the theoretical framework used and. no statistical methods were used.

In relation to the population investigated for the second instrument applied, the opinion poll, the chosen population was configured among users who attend the TJPE, magistrates, civil servants, lawyers, and public defenders who work at the Court of Justice of the State of Pernambuco, Brazil.

III. RESULTS AND DISCUSSION

- Students

The CFB of 1988, provides in its article 225 that "Everyone has the right to an ecologically balanced environment, a good for the common use of the people and

essential to a healthy quality of life, imposing on the government and the community the duty to defend it. and preserve it for present and future generations." With sustainability as a supreme value, there is no doubt that there is a need for a change in the insatiable and destructive model of life / consumption in which society is made. [...] because of the synapse of the constitutional commands in question, the constitutional value of sustainability emerges crystalline, with its pluridimensionality (ethical, social, economic, legal-political and environmental), demanding a complete, reconfiguration of the traditional model development, in order not to restrict it to the mediocre, limited and limiting sphere of unjust material growth (FREITAS, 2011).

In this sense, sustainable development begins to be the concern even of the law, as a way of supporting sustainability from a legal point of view and with supreme value, since it is protected by the country's largest law, which is the Brazilian Federal Constitution (CF, art. 225).

In this way, there is no longer the possibility of trivializing both sustainable development and environmental degradation; bearing in mind that the Magna Carta guides the practice of sustainable development together with the achievement of the fundamental objectives inserted therein.

Although the primary activity of the judiciary is that of being an instrument of pacification, it could not remain passive in the face of the worldwide need for cooperation from all of society for the benefit of the planet, and its participation and encouragement of sustainable public policies is very necessary.

And the Court of Justice of the State of Pernambuco, in accordance with the provisions of Resolution No. 201/2015, of the National Council of Justice, which determines the implementation of the Sustainable Logistics Plan in the organs and councils of the Judiciary, took care to establish the guidelines organ's environmental requirements.

Published Ordinance No. 18/2018, published in the Diário de Justiça de Pernambuco, on September 25, 2018, which regulates the Sustainable Logistics Plan within the scope of the Judiciary of the State of Pernambuco, making it mandatory for all to comply with it. The magistrates, civil servants, interns, and outsourced employees of the TJPE.

It determines that normative, in its art. 4th, II, as one of the attributions of the Sustainability Management Commission, the identification and proposal of the improvement of methods, techniques and tools to be used in the PLS Planning and Monitoring process.

When it comes to resolving pre-procedural and procedural conflicts, through mediation in a virtual way, the way mediation sessions are being held at Cejusc in Recife, since the beginning of the pandemic, mediation already has characteristics to be framed as a method, technique, or tool to be improved in the Planning and Monitoring of the TJPE Sustainable Logistics Plan.

To discuss the subject matter of this research, it is important to highlight Law No. 11.419 / 2006, which provides for the computerization of processes, with this rule leading to the effective introduction of virtual procedure into the judiciary. This norm, presented in the jurisdictional activity, a transformation relative to the understanding before the judiciary of the necessary look at paradigm changes for the benefit of the jurisdiction and, also, of the environment.

With the advent of the legislation, enabling the use of information technology as a means of transmitting procedural data, the Judiciary, full of pathologically slow demands, was definitively inserted in the era of technological development and is currently striding towards full compliance. effectiveness of effective judicial protection (BARBOSA, 2013).

After the implementation of the electronic process, the procedural process took on the pace of technological and social development of the world population. The provision of jurisdictional protection is leaving the stigma of dissatisfaction in the past in the past, which, every day, renews its confidence in the just judicial provision (BARBOSA, 2013).

The computerization of the judicial process, following the dynamics of new technologies, is a useful instrument for the modernity of justice, and it honors the premise of everyone's access to a fair legal order that is in line with the human pretensions of today (BARBOSA, 2013).

SOCIAL PACIFICATION

The consequence of the implementation of computer technology in the TJPE can be seen in the comparative graph in Figure 2, which demonstrates the real result of approval of the virtual mediation system, established in Cejusc-Recife, after the pandemic and the use of the virtual method for mediation sessions, authorized by Joint Resolution No. 05/2020, of the TJPE.

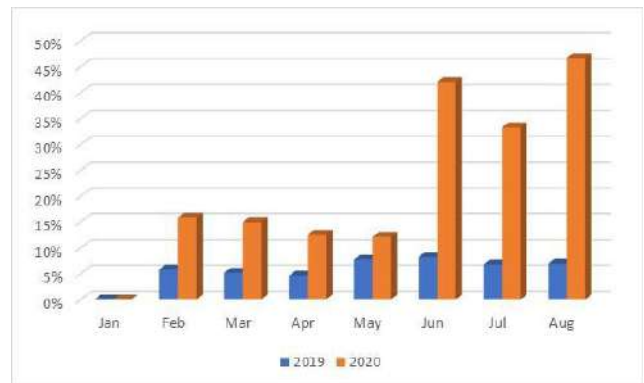


Fig.2: Agreements made by sessions held.

Source: TJPE (2020).

The percentage of agreements increased considerably after the implementation of the system of mediation sessions by remote means; thus, demonstrating many disputes resolved quickly, effectively, sustainably and leading to the social pacification sought by the judiciary.

The custom of Brazilian society is the cult of litigation, precisely because of the absence of institutional spaces aimed at the communication of people in conflict. Along this path, to make the fundamental right of access to justice effective, it is necessary for the State to promote the use of extrajudicial means of conflict resolution, such as conciliation, mediation, and arbitration (SILVA, 2018).

The concept of access to justice goes beyond the limits of accessibility to the courts and includes the guarantee and satisfaction of the rights that are part of the legal order, whether through the judicial process or other means, as consensual methods of confronting conflicts (HESPANHOL et al, 2018).

Thus, it is necessary that there be a variety of mechanisms available to society, to provide individuals with awareness and confrontation appropriate to the nature of the conflict, since it deserves a deeper analysis, considering that their formation has multiple factors, such as social, economic and political factors. And for that, it is necessary a deep process of reflection of those involved (HESPANHOL et al, 2018).

That was when the need arose for a system in which the party that demands the resolution of their conflict is made possible.

The Multiport Court can contribute to inserting the population without an active voice, who has little opportunity to participate in the process, in the center of the actions. The lack of interaction, inside and outside the court, ends up generating more conflicts and exclusion, which underscores the potential of alternative methods,

which enable the integration of those who were deprived of expressing their opinion properly (SILVA, 2018).

This multiport system could provide citizens with the opportunity to exercise participation, choosing the conflict resolution process, experimenting with a different form of conflict resolution, and offering new options - in addition to courtrooms and court enforcement measures. as the main mechanisms for conflict resolution (SANDER; CRESPO, 2012)

Mediation, as one of the alternative means of resolving conflicts, aims more than the agreement, also seeks to restore relations and a deeper reflection on the conflict, aiming to unveil the legal, social, and economic situation involved in that situation. Thus, there is the search for autonomy and the construction of adequate and meaningful responses to the conflict (HESPANHOL et al, 2018).

The conciliative justice participates, in summary, in three spheres (1) a social one, which is directed towards true social pacification, because it is concerned with the sociological conflict that is at its base and does not stick to the conflict merely presented in the records, as occurs in a jurisdictional process. (2) A politician, for providing a direct dialogue between the citizens involved in the search for a common solution facilitated by trained conciliators and mediators. And (3) a functional one, which is the easing of the justice crisis due to its ability to relieve it (GRINOVER, 2012).

Thus, mediation as a way of resolving disputes, occupies a privileged place as an appropriate method of conflict resolution, since in addition to being able to establish or restore communication between those involved in the dispute, it brings social pacification more effectively in reason that the litigants are the protagonists of the resolution.

ECONOMIC RESULTS

Reducing costs with the elimination of waste, developing clean technology and cheap recycling inputs are more than environmental management principles. They present conditions for survival in the current global capitalist world. (ALMEIDA et al, 2000).

The combination of self-composed forms for resolving disputes, especially mediation, combined with technology, presents a restructuring of the Judiciary, both from a social, environmental, and economic point of view (MONTESQUIO; IOCOHAMA; NETTO, 2020).

The Judiciary lacks material means of having technical conditions that make it possible to resolve conflicts in a short period of time, given the emergence of new rights. The causes of a delayed and backward jurisdiction do not

stop there. Excessive procedural and process resources, insufficient number of judges or servants of the Judiciary, outdated legislation, overload of work for magistrates, useless or unnecessary demands, etc. also contribute to such a crisis (COSTA, 2011).

Financial and time savings are among its characteristics. In contrast to the slow legal proceedings, which prove to be costly, the disputes brought to discussion through mediation tend to be resolved in a much shorter time than they would have been if debated in a traditional court, which ends up causing a decrease in indirect cost, behold, the more the pending lengthens, the greater will be the expenses with its resolution (BARBOSA, 2013).

When the form of resolution is established through mediation, when the dispute is resolved by agreement, the interested parties will only travel to the Rodolfo Aureliano Forum, on the day of the mediation session and, if necessary, the depending on the case, one or two more days (NUPEMEC / CEJUSC).

And with mediation remotely or virtually, as established by the TJPE, through Normative Instruction No. 05/2020, everything is done electronically, virtually, with no need for the parties, their attorneys, and the respective servers to move. In contrast, in the traditional form of decision, when dealing in most cases, it lasts for years, awaiting the decision of a judge.

Thus, if the dispute is resolved through mediation in a virtual way, there will be a decrease or even absence in the number of people who will circulate in that forum and, consequently, no elevator, bathroom, electronic equipment will be used, causing a reduction of costs by the Court of Justice of Pernambuco with energy, water and, mainly, paper.

THE SUSTAINABLE ROLE OF VIRTUAL MEDIATION

The production and use of paper is harmful to the environment, not only with respect to cutting down trees, but also with respect to the carbon dioxide emitted into the atmosphere and possible to be absorbed by the tree when in life (ADÁRIO, 2011).

The manufacture of paper causes great damage to the environment because in the manufacture cellulose is used as a necessary raw material, which is found inside the tree, in its cell (RODRIGUES, 2018).

The pollution generated in large urban centers originates mainly from the burning of fossil fuels, basically gasoline and diesel, which are substances of mineral origin formed by carbon compounds, resulting from the decomposition of organic materials, which lasts

millions of years. Therefore, they are considered non-renewable natural resources. The burning of these fuels happens incompletely when used in thermal machines and motor vehicles, this process results in the release of a large amount of carbon monoxide and dioxide (carbon dioxide) into the atmosphere, making these great villains about global warming and greenhouse effect (DRUMM, 2014).

In the global balance of carbon in the atmosphere of our planet, of about 8 billion tons of carbon emitted annually in the form of carbon dioxide (CO₂) by burning fossil fuels and changes in land uses, about 3.2 billion remain in the atmosphere, causing an increase in the greenhouse effect (increased heating of the surface and troposphere due to the absorption of thermal infrared radiation by various trace gases present in the atmosphere, mainly carbon dioxide). The rest is reabsorbed by the oceans and terrestrial biota (NOBRE and NOBRE, 2002).

According to an estimate by CETESB (2004), motor vehicles are responsible for 83.2% CO emissions; 81.4% HC; 96.3% NO_x; 38.9% of PM₁₀ and 53% of SO_x in the Metropolitan Region of São Paulo, concluding that they produce more air pollution than any other human activity and, with this, become great agents that attack the environment and public health. motor vehicle means any vehicle with an engine, of light or heavy category (DRUMM, 2014).

Motor vehicles are an important source of emission of these gases, both directly through the emission of gases through the exhaust, and through the emissions produced during the production processes of the fuels used by the vehicles (SILVA; SOUZA, 2019).

Due to air pollution, problems related to human health can emerge from mild allergies, cardiorespiratory diseases to the development of cancers and increased rates of morbidity and mortality in urban areas are examples (SALDIVA et al., 1995; SILVA; SOUZA, 2019).

Nature itself can combat this carbon dioxide emitted by motor vehicles. Trees are capable of absorbing carbon dioxide in the air through the process of photosynthesis and, therefore, the most appropriate forest species is eucalyptus, given that it has a high photosynthetic efficiency (CHANG, 2002).

The concept of carbon sequestration was enshrined by the Kyoto Conference, in 1997, with the objective of containing and reversing the accumulation of CO₂ in the atmosphere and with the intention of minimizing environmental impacts, related to climate changes as regards global warming and the rise of greenhouse gases. Carbon sequestration refers to the removal of atmospheric carbon gas and, according to Renner (2004), it can be defined as the photosynthetic capacity that plants have to

fix CO₂ from the atmosphere, in which it is synthesized through light in the form of carbohydrates that are deposited in the cell wall of the vegetable.

Although the sequestration of carbon dioxide is a source of reduction of carbon dioxide in the air, there is dissonance among authors on the subject, with two aspects regarding the use of this process to combat global warming of the earth (CHANG, 2002).

In Brazil, there are opposing opinions, in the sense that this process constitutes an obstacle to compliance with the Kyoto Protocol on the reduction of domestic emissions of polluting gases by industrialized countries. They understand it as if it were an authorization for these countries to remain emitting carbon dioxide and not actually worry about taking actions aiming at the reduction desired by the Kyoto Protocol (CHANG, 2002).

On the other hand, there are those who defend the sequestration of forest carbon, on the grounds of the existence of a vast forest in the country, adding that this process would attract environmental investments to Brazil, generating jobs and income for the people around it. Another argument raised by the supporters of this current would be the low cost to implement the carbon sequestration technique, among the other existing mechanisms (CHANG, 2002).

However, going against this great benefit of nature in favor of the environment is the excessive and unnecessary use of paper by the judiciary.

The science of law, for many years, proved to be plastered from a procedural point of view. Because of his activities, he has always stood out as a huge consumer of labor and paper (MOREIRA, 2012).

During the process, until the dispute is resolved, thousands of information are cataloged in a single process, perpetuating over time, in the so-called forensic archives, without any possibility of reusing the raw material used.

The conventional judicial process, since its creation in remote times, has always had the presence of paper as a striking feature, being responsible for fixing the initial and irresignatory ideas of the parties, in addition to the entire manifestation of the judges responsible for the demand (MOREIRA, 2012).

As a result, the Brazilian judicial system has been accumulating criticisms of the most diverse nature and by all sectors of civil society every year. The way of entering the Judiciary through the so-called traditional way, causes many other obstacles to the emergence of a fully effective Judiciary Power, that is, one that gathers concern with the environment, with its procedural aspects, understood as the speed and acceleration in processing information, in

addition to the effectiveness from the social point of view, about facilitating access by virtual means (MOREIRA, 2012).

The use of sheets of paper in organizational spheres has gradually declined over the years. This achievement has as one of the main factors the great expansion of the use of technologies that make the production and processing of documents wide and flexible. However, the use of leaves is still high, and this problem stems from several factors, many of them intrinsic to organizational factors, such as lack of incentive, education, among others (QUIRINO, 2018).

Approximately 0.013% of the trunk of an eucalyptus tree is used to make a sheet of A4 type paper. An entire trunk generates approximately 7,550 sheets of paper of the indicated type, around 15 reams of paper, each with 500 sheets.

According to data collected from Nupemec-Cejusc-Recife, a process solved by the traditional method of decision, that handed down by a magistrate, on average, about two hundred sheets of paper are used. On the other hand, in the resolution of processes and procedures through mediation sessions remotely, virtually, without paper.

Using computer technology, the virtual way, as mediation sessions are being carried out, since the beginning of the pandemic, the use of paper is unnecessary because they are carried out through the WhatsApp application or by video conference, as established in Normative Instruction nº 05/2020, of the Pernambuco Court of Justice (TJPE).

The following relationship between the process and deforestation can be extracted:

Table 1. Relationship between Process and Deforestation

Type of Procedure	Number of Pages	% Deforestation
Traditional Process (physical)	200	2.6% of a Eucalyptus tree
Virtual Mediation Process	0	0

Source: The Authors (2021).

In this case, a whole trunk of a eucalyptus tree would be necessary to produce approximately 39 (thirty-nine) processes, these being processed by the traditional method of conflict resolution.

In this line, considering that in 2019 64,020 new court cases (TJPE) were distributed, being electronic, approximately 1,665 (one thousand, six hundred and sixty-five) eucalyptus trees would be spared deforestation, which means that they would be kidnapped, on average, 150 (one hundred and fifty) tons of carbon dioxide from the atmosphere (LIMA, 2015).

Therefore, of great relevance to the environment, the use of mediation as a method of conflict resolution in a virtual way by the TJPE, bearing in mind that this procedure, by not using paper, protects deforestation, thus contributing to a greater capture by trees, of carbon dioxide in the atmosphere and naturally. Likewise, the non-use of vehicles by users of the remote dispute resolution method will mitigate the direct emission of polluting gases.

In the scenario outlined by the IPCC, the future of humanity depends not only on eliminating fossil fuels, such as coal and oil, and zeroing deforestation on a global scale to reduce emissions, but also protecting forests, savannas, and other forms of natural vegetation to capture the excess of CO₂ that is already in the atmosphere and what will still be emitted in the transition phase to a carbon neutral economy (GERHARDT, 2018).

In fact, as shown by the results indicated, the sequestration technique should be encouraged and well received by Brazil, as it is a country that has a vast forest, rich in humid forests, large carbon sequestrators and at low cost. Corroborating this understanding, there is also a strong argument that this natural carbon absorption system opens up possibilities for investments in Brazil and, consequently, generation of jobs and income (CHANG, 2002).

In addition, the main argument in defense is that carbon sequestration is significant in combating the greenhouse effect, caused by the excess of carbon dioxide in the environment, resulting from the burning of fossil fuels and deforestation (CHANG, 2002).

Thus, due to the results found in the case under study, virtual mediation, as a fast and effective method of consensual resolution of conflicts, with the use of computer technology, in the way that mediation sessions have been held in Cejusc-Recife, since March 2020, it is a tool for protecting the environment and a sustainability model to be followed by the other courts in the country.

INTERVIEW RESULTS

In an interview with users of the virtual mediation hearings system, implemented by the TJPE since the beginning of the pandemic, with the aim of analyzing the satisfaction of the jurisdictions and the environmental

gains brought by using this form of dispute resolution, the result was verified responses according to the graphs bel.

It can be seen here a minimum percentage of 7.3% of the interviewees who prefer to hold the hearing in person, the vast majority (92.75), at least, being satisfied with the virtual form of production of the audience; including, most respondents rated it as an excellent way to conduct an audience.

It remains to be seen from this result that many respondents live at least 10 km (ten kilometers) from the Rodolfo Aureliano Forum.

Almost all respondents use a passenger vehicle to travel from their homes to the Rodolfo Aureliano Forum, where mediation sessions / hearings are held, and it should be noted that the passenger vehicle emits a high percentage of polluting gases.

It was observed that automobiles, light commercial vehicles, and motorcycles, were responsible for approximately 90% of carbon dioxide emissions, in the period presented there (years from 2009 to 2020), proving that there was an increase in the emission of polluting gas by automobiles increased from 48% in 2009 to 51% in 2020 (CETESB, 2020).

All respondents / users of the mediation hearing, held virtually, would use transportation to travel to the Rodolfo Aureliano Forum, where the session / audience would be held, if it were in person and, thus, the percentage of one hundred percent of the respondents understood that the mediation audience in a virtual way contributes to the mitigation of pollutant gas emissions.

Due to the constant and progressive concern with the sustainable use of natural resources, the electronic process brings significant collaboration in terms of sustainability, proving to be an effective instrument to be used by the State to correct the social costs of environmental degradation (SILVA, 2012).

It was also observed that all interviewees, users of mediation hearings through virtual means, whether parties, lawyers or public defenders, understand that the Pernambuco Court of Justice should invest and encourage sustainable practices.

Despite the adversities, countless alternatives are being taken to reduce or make the use of paper more effective in government agencies. After the installation of systems such as the electronic Judicial Process (PJe) and the Electronic Information System (SEI), the use of paper in organizations that have adapted to these systems has reduced up to 70% in some entities, according to data shown in the Report of Performance of Goals - 2016,

organized by the Court of Justice of the Federal District and Territories (TJDFT) in 2016. (QUIRINO, 2018).

SEARCH RESULTS

The elaboration of research had the intention to verify the idea that has about the mediation through virtual, as a fast, effective and sustainable way and still, to analyze the participation of the Judiciary Power in the effective commitment with paradigm changes related to the means of solution of conflicts in order to achieve social pacification.

It was observed that many civil servants (53.2%) participating in the survey have more than 20 years of service at the Pernambuco Court of Justice.

Regarding the area of operation of TJPE employees, 76.3% answered the questionnaire about the practice of mediation. Regarding mediation as an adequate form of solution, almost an unanimity (99.2%) among the respondents' answers, demonstrated that mediation reached its objective as a convenient means of social pacification. Corroborating this understanding, the National Council of Justice itself, as a body that controls the administrative and financial activity of the Brazilian judiciary, has mediation as an appropriate mechanism for resolving conflicts (Resolution No. 125/2010).

The survey also proved the existence of a high percentage (92.3%) of people who understand that when the dispute is resolved through dialogue between the parties involved, where they themselves create the solution, they are more likely to be fulfilled than when the solution is determined by a judge.

Mediation, as one of the alternative means of resolving conflicts, aims more than the agreement, also seeks to restore relations and a deeper reflection on the conflict, aiming to unveil the legal, social, and economic situation involved in that situation. Thus, there is the search for autonomy and the construction of adequate and meaningful responses to the conflict (HESPANHOL et al, 2018).

The TJPE civil servants demonstrated that they consider that the resolution of conflicts through virtual mediation, reduced the judicialization, bringing to the Pernambuco Court of Justice great savings with expenses with water, energy, and hours of work of the civil servants and magistrates.

The emergence of mediation was important to remedy the lack of understanding and dialogue between people, a fact that reduces the culture of litigation and decongests the Judiciary with any conflicting issue (HENCHEN, 2020).

It was noticed that 96.4% of respondents understand virtual mediation as a better way of resolving disputes than the traditional way of resolving, as it is faster, more efficient and restores relations between litigants, because through it, the dialogue is stimulated and the dispute resolved, by the parties involved, different from the traditional way of making decisions, which is adversarial.

Regarding conflict resolution by consensual method, therefore, it is a consensual method of resolving deadlocks, also called non-adversarial method, which appears in the Brazilian scenario to assist in conflict resolution. However, Cappelletti and Garth (1988, p. 28) explain that mediation: "It is not restricted to the agreement between the parties, as this is only one of its purposes, since it also motivates the dialogue between the parties thus rescuing the relationship among them so that together they can get back to dealing with their interests".

As in the result of the interview answered by the users of the virtual mediation system, in the questionnaire carried out with the TJPE servers, they understand, in almost all the responses, that virtual mediation brings benefits to the environment due to the nonuse of paper and shipping.

According to Warat (1999, p. 5): "[...] mediation is an ecological way of resolving social and legal conflicts; a way in which the desire to satisfy the desire replaces the coercive and outsourced application of a legal sanction" (HENCHEN, 2020).

It remains proven in this result that the respondents, in an extremely high percentage (84.3%), agree that there was an increase in the number of consensual resolutions through mediation, from when the mediation hearings / sessions started to be held in a virtual way, being corroborating with this result the data provided by Nupemec / Cejusc-Recife, indicated in this work.

People were also asked about the need and importance of the involvement of public power in the environmental issue. Practically, all people stated that the participation of the state power in contributory management is relevant and, in a way, aimed at sustainable develop.

To be able to achieve what we call socio-environmental responsibility and sustainability, business organizations and public authorities and even society, must structure themselves to reduce the negative actions that act on the environment. But it is not only linked to the environment, as stated by VEIGA (2010) it is essential that its users break with naivety and inform themselves about the available answers to the question "what is sustainability?" (LACORTT, 2018).

IV. CONCLUSION

The perspectives presented here relate to the history of the traditional and lengthy procedure for judging disputes by the judiciary, passing through the alternative method of mediation, as a faster and more effective solution to conflicts and the advent of computerization in the judiciary.

In view of the bibliographic expositions by some authors, as well as, through the results demonstrated and discussed, both in the questionnaire and in the interview presented here, it was found in this work, that the use of mediation as a method of dispute resolution presents a great social gain.

In addition to the speed and effectiveness of the method, the resolution given by the litigants themselves leads to the satisfaction of those involved, thus bringing the desired social pacification in a satisfactory, fast and effective way.

It can also be evidenced that the computerization of the processes and procedures authorized by Law 11.419 / 2006, in addition to speeding up the judicial provision by electronic means, also allowed, after the pandemic, the institution and regulation of mediation sessions through WhatsApp or Videoconference, making this model of dispute resolution to be presented as a tool for saving and protecting the environment, due to the non-use of paper and vehicles by users of virtual mediation.

From an economic point of view, as evidenced, the state court of justice has a great savings on energy, water and paper expenses with virtual mediation, since mediation sessions are held remotely, and users of this system do without to attend the forum.

Regarding the consumption of paper, in a specific way, its disuse when the solution of the conflict happens through electronic mediation, contributes in a very expressive way to the benefit of the environment. deforestation and, with that, makes it possible to maintain the trees that capture carbon dioxide in the atmosphere, reducing the exacerbated warming of the atmospheric temperature.

In this context, due to the results presented in this research regarding the use of paper, if the processes distributed in 2019, at the Rodolfo Aureliano Forum, were resolved through virtual mediation, the amount of carbon dioxide in the atmosphere, equivalent to approximately 150 (one hundred and fifty) tons, since approximately 1,665 (one thousand, six hundred and sixty-five) eucalyptus trees would be saved from deforestation.

Likewise, the non-use of vehicles by users of the remote dispute resolution method, mitigates the direct

emission of polluting gases, with motor vehicles being more responsible for air pollution than any other human activity, thus being great aggressive agents of the environment environment and public health, as expressed in the bibliography cited here.

The use of faster and more effective non-traditional methods of conflict resolution such as mediation, combined with virtual electronic media; according to the case study carried out at Cejusc / Recife, the object of this research, leads the Pernambuco Court of Justice to a win-win process, presenting greater satisfaction, speed and effectiveness in resolving the disputes resolved by the parties themselves and can be a model of sustainable practice to be copied by other courts in the country.

This model, according to the reasons set out here, contributes considerably to non-deforestation and the consequent increase in the uptake of carbon dioxide in the atmosphere by trees and a reduction in the emission of polluting gas by motor vehicles, contributing significantly to the mitigation of the effect stove.

Although the paradigm shift is not an easy task for the Court of Justice of Pernambuco, due to the habit rooted in the Brazilian legal culture regarding traditional procedures, this transformation will be essential in view of the pressing need for the judiciary to have a faster, more efficient judicial provision, satisfactory and protective of the environment.

ACKNOWLEDGEMENTS

To Technological Institute of Pernambuco.

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Regulatory Behavior Law and Prosumers

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Received: 03 Dec 2020;

Received in revised form:

05 Feb 2021;

Accepted: 19 Feb 2021;

Available online: 07 Mar 2021

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Keywords— Behavioral economics. Regulation. Nudges. Photovoltaics. Environmental sustainability.

Abstract— This paper aims to present the methods that can be used by the Public Administration to encourage the use of renewable energy sources by the market and by civil society, in order to implement the guidelines of the 2030 Agenda. The specific objective is to reach energy self-consumers. electricity - prosumers - through public policies that enable behavioral change. To this end, behavioral economics has influenced the development of public policies capable of encouraging consumers and the market to use renewable energy sources. The scope of the research is the use of new technologies applied to the production of renewable energies, with an emphasis on photovoltaic energies and the position of prosumers in this context. The methodology used is bibliographic research, use of data from official sources, in addition to the analysis of current public policies in Brazil on the subject.

I. INTRODUCTION

One of the main historical reports of the environmental impacts generated by the use of fossil fuels was the big smoke in England. It occurred in December 1952, when a fog, originated from the great burning of fossil fuels in the period of the Industrial Revolution, generated intense atmospheric pollution and covered the city of London.

Subsequently, several movements began in order to raise awareness among the world population about sustainability issues. This culminated in the current Agenda 2030, which

presents the 17 Sustainable Development Goals¹ - SDGs - to be followed by the member states that are part of the UN.

In the list of SDGs, the seventh objective² that specifically deals with renewable energies stands out, with an

¹ The Sustainable Development Goals are a collection of 17 global goals, established by the United Nations General Assembly, in order to eradicate poverty and promote dignified life for all, within the limits of the planet. These are clear objectives and targets for all countries to adopt according to their own priorities and to act in the spirit of a global partnership that guides the choices needed to improve people's lives, now and in the future.

indication of the need to guarantee universal, reliable, modern and affordable access to energy services.

This paper intends to address the use of the Behavioral Economy in order to stimulate the adhesion by the prosumers to sustainable energy generation methods, and for this to be made possible, the need to update the existing policies in accordance with market needs and respecting environmental issues. Such updates will be proposed through nudges of social and economic behavior necessary to achieve the objectives of Agenda 2030.

II. RENEWABLE ENERGIES AND NEW TECHNOLOGIES

Power generation has been a common theme since the advent of the Industrial Revolution. Appearing in England, it takes care of a moment that assumes a determining dimension in the economic competitiveness of countries and in the quality of life of its citizens (SILVA & CARMO, 2017).

As a starting point, the Industrial Revolution saw the need to increase production and, consequently, increase the use of fossil fuels. It was a milestone for the beginning of environmental awareness, since England was affected by a major environmental impact in 1952, known as big smoke (BBC, 2002).

With the Industrial Revolution of the 18th century, factories began to demand more natural resources to produce consumer goods and produce a significant increase in the burning of fossil fuel and coal (Paz, Boch, Ortega, & Campos, 2015).

Despite the positive aspects resulting from socioeconomic development, many negative environmental impacts marked the Industrial Revolution. As a result, several international movements and treaties have emerged that sought to protect the environment, including, for example, the Stockholm Convention³, Kyoto Protocol⁴, Agenda 21⁵, Rio +20⁶ and the Agenda 2030⁷.

These initiatives in favor of the environment demonstrate the worldwide concern for sustainable development, brought about by the Bruntland Report in 1987.

At the Brazilian level, it is important to point out that the ecologically balanced environment is a constitutional guarantee provided for in art.225 of the 1988 Constitution. This is an economic principle, the impact of which affects all areas (VASCONCELOS, 2020).

2.1- New technologies applied to the production of renewable energies

The progressive protection of the environment depends on the change of mentality and attitude towards the generation of energy, with primacy for its renewable sources.

Renewable energies, as the expression suggests, are the result of natural resources that are renewed, that is, that are inexhaustible, such as hydro, tidal, geothermal, solar, wind and biomass energy (Portal Solar, 2015).

According to Portal Solar (2015), hydropower uses water in motion to generate electrical energy, where the water pressure, which flows over the blades of a turbine, rotates on an axis and drives an electric generator, converting the movement in electric energy (Portal Solar, 2015).

Ocean energy, in turn, offers several forms of energy generation, with emphasis on wave energy, which is generated by capturing the movement of waves. The second way refers to tidal energy, which in turn involves the trapping of water during high tide and uses the flow during the period when the tide is going down to generate electricity. The third form is known as ocean thermal energy, which uses temperature differences between deep waters and the surface, in order to extract energy from the heat flow (Portal Solar, 2015).

Geothermal energy uses heat inside the earth by means of steam or hot water that can be used by energy generators to produce sustainable electrical energy.

On the other hand, solar energy is one of the most promising alternatives when it comes to renewable energy,

² SDG 07 - affordable and clean energy. Available at <https://brasil.un.org/pt-br/sdgs/7>

³ The Stockholm Convention, in addition to raising the status of the environment to the level of human rights, highlighted the need for protection and interaction between the artificial and natural environment, in order to guarantee a better quality of life.

⁴ The Kyoto Protocol was implemented in 2005, establishing mandatory targets for a total of 55 countries, in order to reduce the emission of polluting gases.

⁵ Agenda 21 took place in 1992, its main objective was to present proposals focused on sustainable development, which was recognized worldwide as a necessity.

⁶ Rio +20 was basically a renewal of the political commitment to sustainable development, with two main themes, green economy in the context of sustainable development and the institutional structure for sustainable development.

⁷ At the meeting that culminated in the Agenda 2030, all UN countries defined new sustainable development goals as part of a new sustainable development agenda that must be implemented by 2030.

since it is inexhaustible and can be used as a source of heat or as a source of light. This energy method is responsible for the origin of practically all other energy sources on the planet, since it contributes to the evaporation of water, originating the water cycle, allowing the damming and the consequent generation of energy through hydroelectric plants. Solar radiation also induces atmospheric circulation on a large scale, producing winds, providing opportunities for the generation of wind energy (PINHO & GALDINO, 2014).

According to the Special Report on Renewable Energy Sources and Climate Change Mitigation published by the IPCC (Intergovernmental Panel on Climate Change), it separated the production of direct solar energy into five blocks, namely: 1) passive solar, where bioclimatic architecture is inserted, 2) active solar, which includes solar heating and cooling, 3) solar photovoltaic, for the production of electrical energy, 4) generation of electrical energy from solar thermal concentrators for high temperatures and 5) process inspired by photosynthesis through from which, in a reactor powered by carbon dioxide (CO₂), water and metal or metal oxide, exposed to solar radiation, hydrogen, oxygen and carbon monoxide are produced. In this case, hydrogen would be the solar fuel to feed fuel cells, no longer produced from natural gas, but from breaking the water molecule through sunlight (PINHO & GALDINO, 2014).

As for wind energy, its generation results from wind turbines that convert the wind force into torque, propelling the electric generator to generate electricity.

Finally, there is biomass, which is used to burn organic materials such as agricultural and forest residues or even urban or industrial residues in cogeneration. (VASCONCELOS, P.E.A., 2019b, p. 75-79).

In this research, the outlined scope is the analysis of the prosumer in the generation of photovoltaic energy, since it has a low environmental impact and can be applied in the urban environment with ease.

2.2. The Brazilian reality and the adoption of photovoltaic plates

Brazil occupies the first position in the world ranking of renewable energy generation, holding 46% of the country's energy production through this method, far ahead of the world average, which is 14.2%, and of OECD countries (Organization for Cooperation and Economic Development). The latter - OECD - have only an average of 10.8%, as shown in the table 1, based on data from the Brazilian Energy Review (Ministerio de Minas e Energias, 2020)

Table 1: Internal Energy Supply in Brazil and in the World (% and toe)

Fonte	Brasil		OCDE		Others		World	
	1973	2019	1973	2019	1973	2019	1973	2019
Petroleum Derivates	45,6	34,4	52,6	35,3	29,9	25,4	46,1	31,5
Natural Gas	0,4	12,2	18,9	28,1	12,9	20,9	16	22,8
Mineral Coal	3,2	5,3	22,6	15,7	31,1	35,3	24,6	26,3
Uranium	0	1,4	1,3	9,6	0,2	2,3	0,9	5
Hydro	6,1	12,4	2,1	2,3	1,2	2,5	1,8	2,5
Other Non-Renewables	0	0,6	0	0,4	0	0,1	0	0,3
Other Renewables	44,8	33,8	2,5	8,5	24,7	13,5	10,6	11,6
Solid Biomass	44,3	24,1	2,4	4,6	24,7	11,7	10,5	8,9
Liquid Biomass	0,5	7,8	0	1,03	0	0,18	0	0,65
Wind	0	1,64	0	1,42	0	0,53	0	0,87
Solar	0	0,195	0	0,82	0	0,59	0	0,65
Geothermal	0	0	0,16	0,62	0	0,52	0,1	0,54
Total (%)	100	100	100	100	100	100	100	100
Of wich renewable	50,8	46,1	4,6	10,8	26	16	12,5	14,2
Total - Mtep	82,2	294	3.741	5.418	2.105	8.223	6.109	14.358
% world	1,3	2	61,2	37,7	34,5	57,3		

Due to the good climatic conditions and because it has several natural resources, Brazil has the possibility to implement any of the means of renewable energies, enabling the diversification of its energy matrix.

It is possible to identify the increase in investments in the country for the implementation of renewable energies, as shown in Tables 2 and 3. The increase, mainly, in the use of wind energy, which had an increase of 15.5%, and energy solar, which had an increase of 92.2% in generation compared to the previous year, as well as a reduction in energy generation through the burning of oil by 25.5% (Ministerio de Minas e Energias, 2020).

Table 2: Internal Energy Supply

Specification	mil toe		19/18 %	Structure %	
	2018	2019		2018	2019
Non-Renewable	157.972	158.395	0,3	54,5	53,9
Petroleum and Derivates	99.627	101.051	1,4	34,4	34,4
Natural Gas	35.905	35.909	0	12,4	12,2
Mineral Coal and Derivates	16.418	15.480	-5,7	5,7	5,3
Uranium (U308) and Derivates	4.174	4.174	0	1,4	1,4
Other Non-Renewable (a)	1.848	1.780	-3,7	0,6	0,6
RENEWABLE	131.898	135.642	2,8	45,5	46,1
Hydraulics and Electricity	36.460	36.364	-0,3	12,6	12,4
Firewood and Charcoal	25.511	25.725	0,8	8,8	8,7
Derivates of Sugar Cane	50.090	52.841	5,5	17,3	18
Other Renewables (b)	19.837	20.712	4,4	6,8	7
Total	289.870	294.036	1,4	100	100
dos quais fósseis	153.798	154.221	0,3	53,1	52,4

(a) Blast furnace, melt shop and sulfur gas; (b) bleach, biodiesel, wind, solar, rice husk, biogas, wood waste, charcoal gas and elephant grass.

Source: Resenha Energética Brasileira (2020)

Table 3: Internal Electricity Supply (IES)

Specification	GWh		19/18 %	Structure %	
	2018	2019		2018	2019
Hydraulic	388.971	397.877	2,3	61,1	61,1
Sugarcane Bagasse	35.435	36.827	3,9	5,6	5,7
Wind	48.475	55.986	15,5	7,6	8,6
Solar	3.461	6.655	92,2	0,54	1,02
Other Renewables (a)	18.947	18.094	-4,5	3	2,8
Oil	9.293	6.926	-25,5	1,5	1,1
Natural Gas	54.622	60.448	10,7	8,6	9,3
Coal	14.204	15.327	7,9	2,2	2,4
Nuclear	15.674	16.129	2,9	2,5	2,5
Other Non-Renewables (b)	12.314	12.060	-2,1	1,9	1,9
Import	34.979	24.957	-28,7	5,5	3,8
Total (c)	636.375	651.285	2,3	100	100
of which renewable	530.269	540.395	1,9	83,3	83

a) bleach, biodiesel, wind, solar, rice husk, biogas, wood waste, charcoal gas and elephant grass; (b) Blast furnace, melt shop and sulfur gas; (c) Includes captive self-producer, which does not use the basic network.

Source: Resenha Energética Brasileira (2020)

In view of the current world scenario in 2020, Brazil occupies a privileged position in terms of energy generation through renewable means, offering opportunities to stand out in a future global energy revolution.

It is important to mention, albeit succinctly, the paper Matriz Energética Brasileira (TOLMASQUIM, GUERREIRO, & GORINI, 2007), which, despite its elaboration in 2007, reflects the Brazilian energy reality until 2030. In this work, the authors point out that energy consumption will grow at rates higher than the last few decades and that the expansion of energy supply may exceed twice the current capacity.

It is noteworthy that concerns about the environment will also grow and economies that more efficiently implement the binomial energy resources of low cost and low environmental impact will obtain important advantages compared to countries that adopt non-renewable methods of energy. This is an issue that is likely to reveal an important challenge for Brazil, but also an opportunity to stand out on the international stage (TOLMASQUIM, GUERREIRO, & GORINI, 2007).

On the one hand, the challenge stems from economic and social development, which will demand a significant amount of energy and, with this, a high degree of security and energy sustainability. On the other hand, the opportunity opens up for Brazil, which has special conditions for renewable energy resources and technology to transform its natural wealth into energy and, thus, add value to its wealth production (TOLMASQUIM, GUERREIRO, & GORINI, 2007).

In the meantime, it is up to Brazil to adopt the necessary means to increase the diversification of its energy matrix in order to stand out, increasingly, in the international

scenario as a pioneer in the use of renewable means of energy generation.

In this context, solar energy from the sun and captured by photovoltaic plates stands out, transforming it into energy, which has been the predominant medium used by countries in the field of renewable energies, due to the minimal environmental impact and the possibility of its use by any citizen in their residence or in the buildings where they reside. It is possible to notice the growth in the use of solar energy in recent years, with the reduction of the respective generation costs, in comparison to other methods of energy generation (SILVA & CARMO, 2017).

It should be noted that, despite the 92% increase in Brazil, solar energy is the one that offers less energy in Brazil, contributing only 6,655 GWh, compared, for example, to wind energy, which contributes 55,986 GWh, and hydro, which generates 397,877 GWh, according to data presented in Table 3.

Brazil, in turn, has high levels of solar radiation, since it is located in an intertropical region and in a latitudinal range, with solar radiation higher than that seen in most parts of the world and, therefore, higher potential than European countries, in the form presented in the Brazilian Solar Energy Atlas, which states that in the least sunny region of the country it is possible to generate more energy than the sunniest place in Germany (PEREIRA et al, 2017)

From the averages presented by Atlas (2017), it is possible to see that the northeast is the region that has the greatest potential for generating solar energy, with generation potential of 5.39 to 5.59 KWh / m² in the annual average, using based on the average horizontal global solar radiation over a period of one year, since this is the standard used worldwide as an identification base for the energy potential. It was also identified that this area has the lowest annual irradiation variation, as well as demonstrating that there is uniformity in irradiation in Brazil, which allows the implementation of solar energy generation projects in any area of the country (PEREIRA & et al, 2017).

Having established these premises, it remains to discuss what are the incentives that Brazil has adopted to expand the generation of solar energy.

Brazil has at least three important projects to encourage renewable energy, namely: 1) Normative Resolution 482/2012 of the National Electric Energy Agency - ANEEL; 2) green IPTU⁸; and 3) exemption from ICMS

⁸ IPTU is a Brazilian tax on the property, called Urban Property Tax

for solar energy equipment and components in the state of São Paulo. (VASCONCELOS P.E.A, 2019a)

ANEEL Normative Resolution 482/2012 provides for the electric energy compensation system, allowing the interested party, who generates clean and sustainable energy, to exchange energy with the local distribution network. According to article 6, sole paragraph, of the aforementioned Resolution “will be granted as a free loan to the distributor, with the consumer unit now having a credit for the amount of active energy to be consumed for a period of 60 (sixty) months”⁹. That is to say: the consumer will not be entitled to any compensation in cash, but only in credit to be used with the distributor.

The green IPTU¹⁰, in turn, refers to the discount on the aforementioned municipal tax in the case of buildings that use sustainable solutions, whether in new or renovated buildings. However, as it is a municipal tax, it is up to the municipalities to institute laws with the provision of said tax benefit, with different discount rates and specific requirements for its implementation.

Regarding the exemption from ICMS, its effectiveness is based on Article 1, III, of Decree 63.095 / 2017 of the State of São Paulo.

In summary, it is possible to perceive that Brazil, although it is the winner among the countries in the quantitative aspect of energy generation, has enormous challenges in the technological aspect, since the largest quantity of renewable energy generation in the country comes from hydroelectric plants that have impacts environmental and social issues in the region where they are located (MORAN, LOPEZ, MOORE, MULLER, & HYNDMAN, 2018).

It should also be noted that Brazil is the most promising country in terms of energy generation through the use of photovoltaic plates, with the potential to supply all the country's demand.

⁹ ANEEL Normative Resolution 482/2012: “Art. 6th. The consumers responsible for the consumer unit may join the electric energy compensation system: I - with microgeneration or distributed mini-generation; II - member of an enterprise of multiple consumer units; III - characterized as shared generation; IV - characterized as remote self-consumption. ”

¹⁰ “Green” taxes are aimed at reducing carbon emissions in the atmosphere, with the aim of trying to curb global warming and can also help to reduce deforestation - by allocating part of the collection to funds for this purpose. This type of tax aims to tax those who contaminate the environment, in order to reduce the degradation of nature and curb climate change

III. NEED TO IMPLEMENT RENEWABLE ENERGIES TO IMPLEMENT THE 2030 AGENDA

The 2030 Agenda, signed in 2015, highlights in its preamble several objectives, such as, for example, eradicating poverty, promoting prosperity and well-being for all, protecting the environment and tackling climate change, with the presentation of 17 objectives and 169 goals to be achieved by 2030 (United Nations, 2015).

Here the objectives of Agenda 2030 will be highlighted, which have a close connection with the generation of clean energy, namely: a) SDG 7: deals with clean and accessible energies for the population; b) SDG 11: highlights the importance of sustainable cities and communities; and c) SDG 13: need for action against global climate change (United Nations, 2015).

SDG No. 07 indicates the need to ensure reliable, sustainable, modern and affordable access to energy for all by 2030. It also stresses that countries must substantially increase the share of renewable energy in the global energy matrix, as well as strengthening international cooperation, with the aim of facilitating access to clean energy research and technologies. (United Nations, 2015) (VASCONCELOS P. E., 2020c, p. 133)

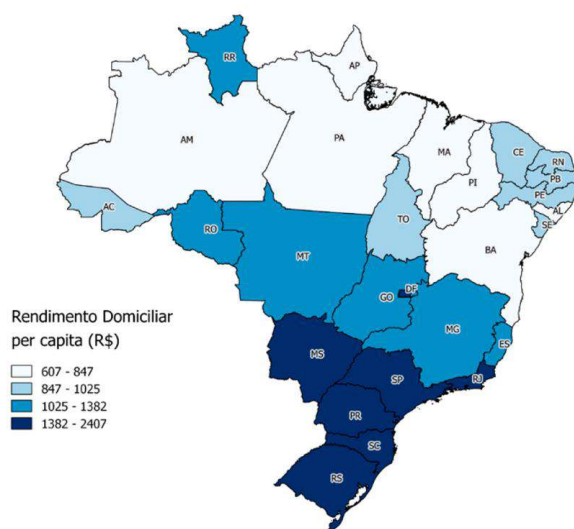
At this point, it is important to highlight that Agenda 2030 not only foresees the importance of implementing renewable energy, but also highlights that these energy sources are accessible to the population. Renewable energies can be supplied by the Government itself or by its concessionaires, as well as they can be exploited by individuals, individuals and legal entities, based on state incentives. In the latter case, the Government must encourage, through “regulatory pushes” (nudge), the use of sustainable energy in homes and commercial establishments.

As highlighted in the previous chapter, Brazil has several laws that aim to facilitate the acquisition of photovoltaic plates by the population, in order to make them self-producers or prosumers.

However, the rules in force do not prove capable of guaranteeing the democratization of the use of photovoltaic plates that currently have high prices in relation to the Brazilian socioeconomic reality. According to data from IBGE (Instituto Brasileiro de Geografia e Estatística, 2019), the per capita household income of the States range from R\$ 607 to R\$ 847 to R\$ 1382 to R\$ 2,407 (Figure 01), which makes implementation practically impossible of an autonomous photovoltaic system, even in the states with the highest per capita income in the country, since the average cost reaches

approximately R\$ 20,000.00, including the value of the material used and labor (Portal Solar, 2020).

Cartograma 1 - Rendimento mensal domiciliar *per capita* das pessoas residentes em domicílios particulares, segundo as Unidades da Federação - Brasil - 2018



SDG 11 provides that cities and human settlements must become inclusive, safe, resilient and sustainable. In the list of goals, SDG 11 provides for the reduction of the negative environmental impact per capita of cities, including paying attention to air quality, waste management, among others (United Nations, 2015).

It is important to highlight that the adoption of photovoltaic plates in buildings or houses is closely linked to the reduction of negative environmental impact. By not using non-renewable energy supplied by concessionaires, there will be less emission of polluting gases into the atmosphere. Likewise, the use of photovoltaic plates would bring benefits in relation to the energy generated by hydroelectric plants, as there would be no need to build new plants that naturally generate a high environmental impact in the area of operation.

Finally, SDG 13 indicates the need to adopt measures to combat climate change and its impacts, highlighting, in its second goal, the need to integrate climate change measures into national policies, strategies and plans (United Nations, 2015).

Incidentally, one of the main factors for climate change is the burning of fossil fuels, with the emission of greenhouse gases - GHG - into the atmosphere, generated by various means, including cars, industries or power plants that use energy generation methods through non-renewable sources.

Thus, it is inferred that the replacement of these factors by alternative energy methods would contribute to the fight against climate change.

The implementation of renewable energy sources and environmental sustainability depend on the efficient performance of the Government that can use the strategies presented by the Behavioral Economics studies to encourage the use of these energy sources, as will be demonstrated in the next chapter.

IV. REGULATORY LAW AND BEHAVIORAL ECONOMICS

In this topic, the forms of state regulation and the tools that have been intensified in recent years from the studies of Behavioral Economics and Economic Analysis of Law will be addressed.

As for Behavioral Economics, Thaler and Sunstein's (2008) theory of nudges will be presented, which represent small state "push" inducing social and economic behavior desired by the Public Power, which would act as an "architect of choices".

In the end, it is intended to demonstrate the importance of the Public Power in inducing behaviors necessary for environmental sustainability and the fulfillment of the objectives set out in Agenda 2030.

4.1. Concept and fundamentals of state regulation

State regulation represents a form of indirect State intervention in the economy that aims to discipline the exercise of economic activity through the establishment of legal rules, inspection, sanctions and conflict resolution.

At this point, Oliveira (2015) highlights that the term "regulation" is polysemic, admitting three different meanings, namely: a) broad sense: This sense provides that regulation is any form of state intervention, corresponding to the generic concept of intervention in the economy; b) intermediate sense: provides that state regulation is equivalent to conditioning, coordinating and disciplining private activity, excluding, therefore, the direct action of the State in the economy; and c) restricted sense: regulation would be only the conditioning of economic activity by law or normative act. In the present work, the term regulation will be used in its intermediate sense.

The regulatory role of the Brazilian State is based on art. 174 of the Brazilian Constitution¹¹, which provides that the State must act as a supervisory agent, regulator, encourager and planner of economic activity. Due to the principle of free initiative and the provisions of art. 173 of

¹¹ "Art. 174. As a normative agent and regulator of economic activity, the State will exercise, in accordance with the law, the functions of inspection, incentive and planning, which is decisive for the public sector and indicative for the private sector."

the Brazilian Constitution, the State can only exercise economic activity directly in cases of national security imperative or of relevant collective interest¹².

Regulation represents an indirect intervention by the State in the economic order that is not to be confused with the State's business activities (direct intervention). It is not, however, a simple adoption of a passive stance of police power or state ordering, but rather an active stance in the imposition of behaviors on the markets to be regulated (OLIVEIRA, 2015, p. 138)

It should also be noted that the regulation of the economic order can be carried out in four ways: a) state regulation: exercised by the Direct Public Administration or by entities of the Indirect Administration, usually through special autarchies (regulatory agencies); b) non-state public regulation: carried out by private initiative entities through state delegation or recognition of the legal order; c) self-regulation: implemented by private entities that concentrate the role of regulators and regulated, since they regulate the market in which they are inserted; d) deregulation: when there is no institutionalized regulation, public or private (OLIVEIRA, 2015, p. 138).

Regarding the fundamentals of state regulation, Oliveira (2015) mentions the two schools that seek to explain the reasons for regulatory intervention in the economic order: a) School of Public Interest: provides that regulation must be intensified and justified by the need to satisfy the public interest or the common good; and b) Chicago School: maintains that the regulation of ensuring the proper functioning of the market, correcting its flaws, among them: monopoly, externalities, collective goods and information asymmetries.

However, the author still highlights the two views, considered in isolation, are insufficient to justify regulation in the contemporary State, especially in the Brazilian context. The "strong" intervention of the State in the economic order, due to the asymmetry of information between the Public Power and the market, can generate the so-called government failures, causing the following problems: state paternalism (reduction in the autonomy of individuals), theory of capture (satisfaction of regulated interests to the detriment of consumers) and regulatory asphyxiation (unfeasibility of exercising economic activities due to the excess of state restrictions). On the other hand, "light" state intervention in the economy does not consider the distribution of wealth, which contributes

to the maintenance or increase of social and economic inequalities between individuals, thus making sustainable and egalitarian development unfeasible (OLIVEIRA, 2015).

In fact, the historical process is pendulous, and the profile of state regulation has always varied according to the reality of each country, with moments of greater economic freedom and others of greater state intervention in the economic order, especially, in this last case, in a period crisis, as happened with the 1929 crisis in the United States and in the moment after the two World Wars in Europe (OLIVEIRA, 2015, p. 140).

It turns out that the traditional debate centered on the intensity of state regulation has, to some extent, lost its role in coexisting with the debate on regulatory quality - Better Regulation - through the institutionalization of mechanisms capable of ensuring greater legitimacy, efficiency and control of regulatory policy (WEATHERILL, 2007, p. 1-17).

In this scenario, Baldwin (2010) highlights the guidelines of the Organization for Economic Cooperation and Development (OECD) for the implementation of better regulation: a) serving clearly identified political objectives and being able to achieve them; b) have a solid legal and empirical basis; c) produce benefits that justify costs considering the distribution of effects across society and taking into account economic, environmental and social effects; d) minimize costs and market distortions; promote innovation through market incentives and goal-based approaches; e) be simple and practical for users; f) be consistent with other regulations and policies; and g) be compatible, as far as possible, with competition, trade and the principles of investment facilitation at domestic and international levels.

Thus, highlights Baldwin (2010), that within the discussion that involves better regulation, the application of smart regulation, or smart regulation, should be valued, which aims to implement a mix of control methods that do not focus only on state agencies, but also by other regulatory actors such as associations, corporations, pressure groups and even individuals themselves. Intelligent regulation argues that whenever possible, low intervention methods should be used.

4.2. Regulation and behavioral economics: nudges

According to Richard Thaler (2008), Behavioral Economics, which can be used in the formulation of public policies, intends to include the human factor in economic models, replacing the fictitious beings used in traditional economic models, defined as "Econs", which they are flawed and affect several deviations when they disregard the reasons that drive the performance of ordinary people.

¹² Art. 173. Except for the cases provided for in this Constitution, the direct exploitation of economic activity by the State will only be allowed when necessary to the imperatives of national security or to the relevant collective interest, as defined by law.

According to the author, the central premise of economic theory is that people would always seek to optimize their choices, that is, of all the goods and services offered, one would opt for the best within their possibilities. There is a presumption that the beliefs that motivate “Econs” choices are impartial, based on what economists call “rational expectations” (THALER, *Misbehaving*, 2019, p. 19)

Thaler (2019) points out three criticisms of traditional economic models: a) the problems of optimizing the choices common people face are often too difficult to be rationally and ideally solved; b) the beliefs from which people make their choices are still biased, with several biases that have been documented by psychologists; and c) there are many factors that the optimization model leaves out.

The premises of the Behavioral Economy must be taken into account by the Public Power when regulating the economic order.

In this sense, Richard H. Thaler and Cass Sunstein (2008, p. 3) suggest that the State should function as a kind of “architect of choices” that organizes the context in which people decide in order to guide the decision, without replacing the choices of individuals.

According to the aforementioned authors, the push regulation can be inserted in the so-called “libertarian paternalism”. On the one hand, paternalism is characterized by the state's induction of choices and, on the other hand, the libertarian character is found in the very choice that will be made by the individual (THALER; SUNSTEIN, 2008, p. 4-6).

According to neuroscientists and psychologists, there are two systems of thinking in people: automatic system (fast and instinctive) and reflexive system (deliberative and conscious). Due to the scarcity of time and information asymmetry, it is impossible to demand that all individuals' choices are reflective and take into account all variables in the decision-making context.

Regulatory pushes are intended to facilitate the automatic choices people make on a daily basis.

In a study on the subject in the 70s, Israelis Amos Tversky and Daniel Kahneman, identified three heuristics or “golden rules” about the way of thinking (THALER; SUNSTEIN, 2008, p. 23-31): a) anchoring: people usually think and decide based on data and information that they have previously or that are placed in the questions (eg, people normally make larger donations when, in the question, higher value options are placed); b) availability: people usually analyze the risks involved in their choices based on experienced examples (eg someone who experienced an earthquake usually overestimates the risk

of its occurrence) or disclosed by the press (for example, when immediately after the occurrence of a terrorist attack, frightened people will overestimate the risks of a new attack occurring); and c) representativeness: thoughts and choices based on stereotypes (eg, the high number of cancer cases in a given neighborhood can lead to the false idea that there is a national epidemic).

In this context, the State should architect the choices of individuals through the presentation of information and possible alternatives, especially in cases where there is a time lapse between the costs and benefits of the decision (ex: promoting the diet to ensure better health in the future), decisions on infrequent or non-feedback issues and situations involving information asymmetry or lack of time to evaluate the options involved.

In its role as an architect of choices, the Public Authority takes into account the psychological principle of stimulus-response compatibility, exposed to Thaler and Sunstein as follows: “the signal you receive (stimulus) must be consistent with the desired action. When there are inconsistencies, there is a drop in performance, and as a result, people are wrong” (THALER & SUNSTEIN, 2008, p. 98).

Thaler and Sunstein (2008) present several basic principles of choice architecture, highlighting, in this study, the standard option principles (the path of least resistance) and feedback. The first principle highlights that people accept the option that requires the least effort or the path of least resistance. The second principle, on the other hand, reveals that feedback is the best way to help improve the performance of human beings, highlighting that an important type of feedback is the warning that there is a problem or that the problem is about to happen.

Furthermore, Thaler and Sunstein (2008) highlight the herd behavior that suggests that most people learn from others, regardless of the correctness of ideas. Social influences could be grouped into two basic categories: a) the first involves information, that is, if many people do or think something, their actions and thoughts convey information about what would be more convenient to do or think; and b) the second involves social pressure that refers to the importance that people attach to their image before others.

Regulation by pushing (OLIVEIRA, 2015, p. 197) or nudge represents an important instrument of satisfaction of the public interest, with the state induction of socially desirable behaviors, without withdrawing the decision of individuals. In relation to the environment, regulatory pushes can contribute intensively to increasing the use of renewable energy and the effectiveness of environmental sustainability, as will be highlighted in the next topic.

4.3. Behavioral regulatory law and environmental sustainability

Based on the premises previously established, it is intended to demonstrate how behavioral regulation can contribute to the realization of the objectives of Agenda 2030.

The environment, as taught by Jose Afonso da Silva (2002), is a system that provides balance for life in all its prisms, being formed by the conjunction of factors arising from nature, culture or even artificial factors that guide this trajectory of life.

The promotion of the defense of the environment represents an important challenge, due to the prevailing vision in the different countries towards the maximization of economic advantages, in what was called by Cardoso and Neto (2019) "economicocentrism", which recognizes a subsidiary role of nature that it would be a supplier of goods that can be turned into economic wealth or money. In this scenario, the environment would be seen as an instrument for generating profit and not as a need for humanity to survive.

Notwithstanding this reductionist view, it is necessary to strengthen the need for an ecologically balanced environment, which is a good of humanity inserted in the catalog of human rights by the United Nations, through the Stockholm Declaration. As a result, the environment requires global protection, since the risks go beyond state borders, and it is up to the states and the population to protect it.

Cardoso and Feitosa (2019) add that, in addition to the normative structure of Environmental Law, which covers constitutional norms and infraconstitutional legislation, there are other types of rules for the protection of rights, called soft law and originated within the scope of International Law. These rules, also used in economic regulation and public services, make rational choices in terms of cost and benefit feasible, presenting themselves in a more flexible way, with the relativization of legal commands.

However, the current scenario reveals that the standards under review were not sufficient for the effectiveness of sustainable measures by the general population, which is why the instruments provided by the Behavioral Economy and nudge regulation can induce members of society to do better choices on environmental issues

At this point, the research carried out by Evans et al. (2017) whose scope is the application of nudges to environmental issues, in what can be called green nudge.

In summary, the authors claim that environmental issues have certain characteristics that differentiate them from

other political-legal areas, which demonstrates the inefficiency of traditional regulatory models for preventing environmental damage. Environmental protection is a public good that must be protected by reducing social inequality, with social inclusion through economic and political participation (EVANS, et.al, 2017, op.cit Croson and Treich, 2014 p.336)

For this reason, green nudges expand the reach of public policies to deal with environmental issues and must be incorporated into the state regulation toolkit.

In order to exemplify nudges aimed at encouraging the reduction of energy consumption, Thaler and Sunstein (2008) mention a study on the power of social norms, carried out in San Marco, California, where all houses received information on the amount of energy consumed in previous weeks and information about the average energy consumption of the houses in the neighborhood. In the following weeks, it was found that those who were above average reduced their consumption and spending on energy, but those who were below average increased their consumption.

This latest discovery is called by Thaler and Sunstein (2008) as the "boomerang effect" and reveals a warning: if the intention is to guide people to present socially desirable behaviors, do not let them know that they are already behaving better than the norm. The way found to solve or minimize the problem, was to add visual feedback through happy or sad emoticons.

It is possible to imagine some green nudges that can be used in the field of state regulation, such as, for example, the permission to sell photovoltaic energy to the electric company, the exemption of interest on installments and the realization of advertisements encouraging the adoption of this model in together with environmental awareness.

As green nudge applied to the use of green energy, Pichert and Katsikopoulos (2007), bring up the following hypothesis: "Standard, it affects the choice for energy. Currently, the standard is polluting energy, so people use it because it is the standard. In this case, if the standard were clean energy, then people would use it".

For the hypothesis presented, Pichert and Katsikopoulos (2007) present two experiments, where it was possible to analyze the hypothesis where clean energies are the standard for use.

The first experiment was carried out in a small town called Shönau in Germany. The authors present initially, that such a city is not considered an environmental center, since the green party, had only 5% of votes of the population, in the period presented by the author. In the 1980s, an initiative by the citizens of the area was founded,

as a reaction to the Chernobyl disaster, aiming to rise up against nuclear energy.

In view of this scenario, proposals resulted in the adoption of sustainable means of energy generation and for that, the city created its own energy company, which buys energy generated through renewable sources and promotes the generation of solar energy (PICHERT & KATSIKOPOULOS, 2007).

The second scenario portrays the case of a German company, a supplier of electrical services that diversified its services, offering three new tariffs where previously there was only one. These tariffs were divided into a green tariff (used as a standard) an economic tariff (8% cheaper than the standard tariff but using polluting methods for power generation) and the premium green tariff (23% more expensive than the standard tariff but enables a greater share of electricity generated in new installations).

Because green energy is used as a standard, it would be up to consumers who wanted to change the tariff to one of the other two presented, to contact the company, requesting the exchange. In this scenario, 94% of consumers maintained the standard tariff method, as this is the “easiest” choice, being this one of the fundamentals of the choice architecture.

With the concomitant reading of both cases presented, it is possible to perceive that the fact of implementing a method of sustainable energy generation as a standard will make a large part of the population maintain it, this being a tested nudge that can be applied in other countries

V. CONCLUSION

The present study demonstrated the Brazilian challenge related to the low adherence to the energy generation system through solar energy through photovoltaic plates.

The adoption of this system would be enough to generate enough energy to sustain the entire country, in addition to the potential for sales to other countries, since the solar radiation index in Brazil is high when compared to other countries.

However, the current reality reveals that the installation of autonomous energy generation systems, through photovoltaic plates in homes and commercial establishments, involves high investments if we consider the per capita income of Brazilians.

The issue is not only economic, but also the necessary awareness of the population in general about the need to use renewable energies for the effectiveness of environmental sustainability. Along with the necessary tax incentives, it is necessary that the Public Power uses

instruments of regulation by pushing in the environmental area (green nudges), creating incentives for democratization and universalization of the generation of renewable energies, notably through photovoltaic plates in condominiums, in homes, in commercial establishments, industry and public buildings.

Through the presented study, it is demonstrated that the application of Behavioral Economics in environmental matters is not only correlated, but also essential for the implementation of the relevant rules. As a demonstration, experiments were carried out in Germany, which prove the efficiency in the use of green nudges in the electrical area. It is something essential to the Public Power in its decision making, in order to ensure that the Goals for Sustainable Development are fully fulfilled.

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The precariousness of women's work in the Petrolina/Juazeiro Pole, located in the northeastern semiarid and the need for public policies as a way to mitigate inequalities

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Received: 21 Nov 2020;

Received in revised form:

04 Feb 2021;

Accepted: 21 Feb 2021;

Available online: 11 Mar 2021

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Keywords— Polo Petrolina/Juazeiro, Irrigated fruit growing, Female labor, Precarization, Public politics Equality.

Abstract— The investigative process in this study refers to the relevance of implementing public policies aimed at reducing gender inequalities in the exercise of fruit farming activity in the São Francisco Submedium. In this region, agroindustry developed over the last 50 years, with irrigation technologies, with major transformations, mainly in the 1990s, both in the form of production and working conditions and in the economic and social repercussions and with this, there was an evolution in the hiring of female labor to exercise the activity of fruit growing. However, despite the participation of women in the viticulture of the Semiarid of São Francisco, the literature on the subject points out the precariousness of female work, as well as the inequality between the work of women and men, with a greater appreciation of their work. Therefore, the research aims to analyze public policies that can be implemented in the semiarid northeast, with the aim of ensuring equal treatment between workers and rural workers of fruit production in the Petrolina/Juazeiro pole. The methodological strategy used was a bibliographic research, of qualitative nature with descriptive objective. The study is justified to encourage the improvement of the quality of life of workers in the semiarid region of São Francisco, through the possibility of implementing public policies aimed at economic insertion, social, women in the region's agricultural activity ensuring real equality.

I. INTRODUCTION

The Petrolina/Juazeiro Pole, located in the northeastern semiarid region, is recognized worldwide for its economic dynamism in the production of irrigated fruit. In this region, agribusiness has developed over the last 50 years, with irrigation technologies, and has seen great transformations, especially in the 1990s, both in the form

of production and working conditions and in the economic and social repercussions [1].

With this, there was a strengthening of irrigated fruit cultivation with emphasis on vitiviniculture and mango cultivation [2], and expansion of formal employment. Currently, according to 2019 data from the Brazilian Agricultural Research Company [3], in the Agroindustrial

Pole of Petrolina/Juazeiro, there are the largest mango and grape producers in the country, which drives the economic and tourist development of the region.

Faced with the development of fruit farming in the São Francisco Submedium, formed by municipalities in the states of Bahia and Pernambuco, among them the municipality of Juazeiro (BA) and Petrolina (PE), with the predominant vegetation of caatinga, the female labor began to be absorbed, especially in the culture of table grapes [4]. This fact occurred mainly due to the recognition by the employers of the skills and qualification of women to exercise activities essential to viticulture, such as the selection of fruits.

However, businesses and farms in the region hire a greater number of temporary workers, keeping a small number of permanent worker [5]. Information ratified by the General Register of Employees and Unemployed - CAGED, in 2019 [6].

Thus, despite the participation of women in the viticulture of the semiarid region of São Francisco, the literature on the subject points to the precariousness of female work, as well as the inequality between women's and men's work, with a greater appreciation of their work [4].

In this perspective, it is noteworthy that, despite the women's organizations to gain visibility, the struggle of social entities and the Collective Labour Convention (CCT), over decades, have brought gains for women workers, wage differences between men and women, and the precariousness in hiring female service remain.

Given this, it is important to ask what is the reason for the devaluation of female labor and inequality in this activity, the search for implementation of public policies as a form of social and economic insertion of women and as a consequence of the mitigation of inequalities is relevant.

II. THEORETICAL REFERENCE

2.1 Female work in the Petrolina-PE/Juazeiro-BA Pole, in Northeast Brazil, inequalities and precariousness

The Brazilian semiarid is a region defined by Law 7,827 of September 27, 1989 and delimited by the defunct Ministry of National Integration (MI), replacing the drought polygon that was understood as the area of the Brazilian Northeast recognized by legislation as subject to repeated prolonged drought crises [7].

Currently, the Brazilian Semiarid, according to the new delimitation of the SUDENE - Superintendence of Development of the Northeast [8], consists of 1,262

municipalities in the states of Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia, Minas Gerais and Maranhão.

The criteria for delimitation of the semiarid approved by the Resolutions of the Sudene Deliberative Council nº 107, of July 27, 2017 and nº 115, of November 23, 2017, are the average annual rainfall of 800 mm or less; the Thornthwaite aridity index equal to or less than 0.50; and the daily percentage of water deficit equal to or greater than 60%, considering all days of the year [9] [10]. In addition, the region is marked by two distinct realities: the irrigated areas that stand out for their economic dynamism and agricultural production; and the non-irrigated areas that are characterized by low production, given their dependence on rainwater, resulting in high local poverty.

The Petrolina/Juazeiro Pole is formed by eight municipalities of the northeastern semiarid that are located in the area known as Submedium do Vale do São Francisco, on the banks of the São Francisco River. In the state of Pernambuco, the municipalities of Lagoa Grande, Orocó, Petrolina and Santa Maria da Boa Vista are part of the Pole, and, in the state of Bahia, the municipalities of Casa Nova, Curaçá, Juazeiro and Sobradinho.

It is important to note that the region has soils and climate suitable for growing fruit, with an average annual temperature of 26°C, with availability of water for irrigation from the São Francisco River [11].

Since the mid-nineteenth century, the micro-region polarized by the municipalities of Petrolina and Juazeiro, already played a prominent role in the commercial and service activity of a vast area of the northeastern backlands, despite the absence of a capital flow that would allow the expansion of production activity, in addition to the problems with transport infrastructure that would lead to the transfer of the surplus, therefore, the population survived basically from subsistence activity encountering several obstacles to development.

Until the middle of the last century, it was not possible to predict the development of the region as a major center of fruit production in Brazil, however, from the second half of the 1960s, the concentration of federal investments in the São Francisco River Valley, for the creation of irrigation infrastructure and electric power generation, provoked new investments aimed at strengthening socioeconomic infrastructure, positively impacting on social and economic areas, both in the agricultural area and in the urban environment [12].

With this it was possible to observe the increase in the generation of jobs and income in the region. Moreover, in the 1980s and 1990s, there was greater leadership in the private sector, through the organization of entrepreneurs

who started to pressure the government for the expansion of infrastructure, motivated by the need for competition in national and international markets. Thus, strengthened by a remarkable productive reconfiguration, the irrigated fruit farming was consolidated in the region of São Francisco Submedium, with emphasis on vitivincura and mango cultivation.

The region's most developed irrigation complex is located around the cities of Juazeiro (BA) and Petrolina (PE), where, according to data from the São Francisco Valley Development Company - CODEVASF, seven Public Irrigation Projects (PPI) are installed: two in Pernambuco: Senator Nilo Coelho and Bebedouro; and five in Bahia: Curaçá, Manicoba, Tourão, Mandacaru and Salitre.

Analysing public and private investments in the region [2], identified that these resulted in a strong expansion of formal wage-earning, involving one means hiring women.

However [4], despite the fact that practical skills acquired throughout life have been used, women are not recognised in terms of pay.

When it comes to discrimination against women at work, it is decomposed that this is a problem that devastates our society. It is known that the first division of labor was based on sex. Until the 1980s it was a humiliation for the husband to allow his wife to work. However, it is noteworthy that the obstacles encountered by women to be accepted in the labor market come not only from the family, but also from the market itself, and, in present times, still, there is the sexual division of labour favouring male labour to the detriment of female labour.

[13], found that in a recent research entitled *"Portrait of Gender and Race Inequalities"*, the Institute of Applied Economic Research - IPEA, concluded that if there is no acceleration of public policies to ward off gender inequality, It will take 87 years to match the salaries of men and women in Brazil. However, it is noteworthy that the differentiated treatment between men and women is not restricted to wage inequality, since there is also discrimination regarding the functions performed.

It cannot be omitted that women, however qualified they may be, are sometimes allocated to discredited activities, and the majority of them seek to reconcile paid activities with their domestic activities. In addition, female paid occupations have less prestige than male paid occupations, and the majority of women have a small number of functions [14], that is, women do not have as much opportunity as men.

[15], in the last decades of the 20th century, there was a significant change in the profile of Brazilian women's

access to education, schooling and paid work, with women now having more formal education time than men. Despite this, he concludes that the professionalization of these did not guarantee equal access to different occupations.

With regard to the precariousness of female labor in agricultural activity, in particular in the vitiviniculture of the São Francisco Submedium, in the Petrolina/Juazeiro Pole, the literature offers some works dealing with the valuation and hiring of female labor, focusing on inequalities and precariousness.

In the early 1990s, the effects of the globalization of food systems highlighted the sexual division of labor in the San Francisco Underground. There was a significant increase in the female labor force in the activities related to the cultivation of fine table grapes [15], with this, the recognition by employers of certain typical female skills for productive activities was verified. These skills and characteristics attributed to women have become required and "valued" in the new productive processes. Despite this, there was a discrepancy in the average level of pay and working conditions in favor of men.

[02], the sexual division in fruit production work for export in the semiarid Valley of Francisco, point out that the work is marked in all stages of production by associations and representation of "femininity" and "masculinity" referred to the type of work demanded at each stage of production. These authors mention that this demarcation leads to the hierarchical organizing principle, since men perform the activities that demand a higher incidence of equipment and technological resources, as a result, they are remunerated with higher wages than women's labor, there is also an additional salary, established through trade union negotiations.

Furthermore, gender stereotypes are employability criteria verified by both local employers and fruit farmers, with "light" work linked to women and the "heavy" to men, which contributes to the precarious position of women in the labour market [02].

In this way, it clearly shows that employers assign different activities to men and women and redefine women's qualified work as something inherent in their nature, and as a result, do not pay them fairly.

[16], the allocation of social roles, in which women are responsible for lighter or less specialized activities, often leads to the naturalization of socially constructed roles, thus hindering their contestation, which could lead to less rigidity in occupational mobility.

In vitiviniculture where there is a large hiring of women in the Petrolina/Juazeiro pole, most of the female labor is in the activity of thinning (with scissors) and the

pinicado (to remove certain parts of the plant) which are essential for the production of fine table grapes, therefore, female activity is of great importance, however, female qualification for work remains symbolically linked to the reproductive sphere, being, in this way, of less prestige and qualification status for the world of work. This established wage differences between men and women, as well as inequalities in employment, career and economic and political participation [02].

It is also noticed that because women accumulate double hours, being responsible for domestic activities, care with children, being more susceptible to events external to the sphere of work, employers despise the hand-female labor, thus having a greater absorption of male labor.

It should be noted that women are mostly employed for temporary work during the wine-growing season, which is ultimately profitable for employers and, although women earn an income from this work, it should not be forgotten that there is a precariousness of female work, because due to the dependence on employment and the need to renew the contract, women workers submit to informal work and suffer exorbitant charges, they are not guaranteed the same rights as are accorded to male workers who for the most part perform the function for an indefinite period.

Despite the difficulties encountered by the workers, it is notorious that the female work in the activity of irrigated fruit growing in the Petrolina/Juazeiro Pole brought significant changes in the social, family and economic life of the workers, generating personal autonomy and facilitating female inclusion for the exercise of social, political, economic rights, although legally foreseen, are not enjoyed in many regions of the country where women do not have their own income.

However, such changes cannot be used to justify gender inequalities in the exercise of work, thus requiring public policies with female participation to ensure isonomic treatment between workers and rural workers, and as a consequence, respect for the fundamental principle of equality.

2.2 Women's struggle for equality at work in rural areas

The Principle of Equality is one of the most important constitutional principles, being indispensable for the democratic rule of law, so that, without its impact on society, it would be impossible to implement the democratic model [17]. [18], the principle of equality informs of fundamental rights and of the whole constitutional order, being a vector of constitutional interpretation of democracy by virtue of its value.

[19], they call this dimension of the principle democratic and they preach it, prohibiting discrimination in the exercise of power and access to public office. The authors also mention the importance of another dimension of this principle, the liberal one, in which individuals are considered as beings to be treated equally (formal equality), regardless of their birth, status, before the law, general and abstract. In addition, they discuss the social dimension, which has as a consequence the search for measures to achieve equality, with the reduction of social and regional inequalities.

It follows that formal equality establishes the equal treatment of all, without any distinction, this aspect of the principle of equality has been treated in the modern age and consolidated with the French Revolution and the beginning of the contemporary age, in which, first, he thinks of the subject and then thinks of society, thus the individual has come to prevail over the social.

It is noteworthy that formal equality was not an obstacle to the accumulation of wealth by the bourgeois of liberal society. However, the liberalism that emerged in the eighteenth century became the monopoly capitalism of the following century that witnessed the concentration of capital for the few and the exploitation of man by man.

Thus, since the Industrial Revolution, equality before the law has become insufficient, given its impossibility of materialization and, from the 20th century, the State intervenes to effect equality. In this context, equality gains the traits of a material equality (real equality), which aims to ward off inequalities, treating the unequal in an unequal way, in the measure and proportion of their inequalities [14].

[17], teaches:

The principle of equality, after the Declaration of Human and Citizen Rights, has been used by various constitutions created in the Modern State, and with the passage from the Liberal State to the Social State it has been sought not only to give positive rights to written constitutions, but also to effect them, which led to several modifications and evolutions in the normative systems of the States, which had not only the formalization of the right to equality, but also the search for its materialization, when there is not only equal treatment for those who are in the same condition and an unequal treatment for people who are in different situations, but an analysis of the most diverse situations is

sought in a punctual way so that greater differences are not created [17].

[20], conceptualizing justice says that: "justice is treating the equal and the unequal alike". It is clear that human beings have characteristics that individualize them, such as race, sex, age, sexual choice, culture, religious belief, among others. Differences must coexist in society, and there must be respect for and guarantee of fundamental human rights. The principle of equality must not make everyone equal, by extinguishing differences, but must prevent unequal treatment from depriving the human being of the exercise of his or her fundamental rights.

In Brazil, the Constitutions, since the Empire, have treated the principle of equality, as equality before the law (formal isonomy), in the sense that the law and its application treat all equally, without distinction.

In the same sense, the Federal Constitution of 1988, at first, deals with formal equality, establishing in art. 5th, caput: *"that all are equal before the law, without distinction of any nature"* [21]. However, contrary to the previous Brazilian constitutions, it reinforces the principle by establishing norms on equality or seeking the equalization of unequal rights by granting substantial rights (material equality) [22].

In view of this, it is perceived that the original legislator, taking advantage of the advance in the international sphere, when promulgating the Federal Constitution of Brazil of 1988, unlike the previous Constitutions promulgated in Brazil, which dealt only with formal equality, brought, explicitly, the need to propose measures to mitigate social and economic inequalities, in order to rule out unequal and prejudiced treatment.

In this sense [17]:

The constitutional text should contain specific legal rules on the termination of treatment which have a prejudiced nature, as well as any action which would lead to an arbitrary and unjustified distinction, for people, which leads us to understand as pluralism the need to accept the heterogeneous factor as something natural to political coexistence, since we have a society formed by diverse beings, both in personal and social tendencies [17].

Thus, it appears that the Brazilian Constitution in force is not limited to bringing in its text only equality before the law, it also deals with material equality, prohibiting any distinction of origin, race, color, creed, sex (art. 3º, IV); prohibiting and distinguishing wages, of exercise of functions and criteria of admission by reason of

sex, age, colour or marital status (art. 7º, XXX); also establishing that men and women are equal before the law (art. 5º, I).

However, despite the positivity of the principle of material equality, inequalities persist in our society, so there is the need to seek ways to remove them.

From the 1980s, the struggle to combat gender inequality in the countryside, resurfaces, with the social movements of rural women. [23], when analysing these movements, they reported that after the military dictatorship these movements gained strength, having as main themes: the fight for recognition of the profession of farmer and for rights deriving from this recognition, social rights, the right to unionize, participation as members and leaders of these organizations.

In this period, in the Northeast, the movement of rural women grew, with this, they strengthened themselves and begin to produce their reaction processes to submission, as well as, to recognize that they have a certain specific capital sufficient to form a production group, have an income. After experiencing a profitable productive activity, they are not the same, they no longer feel as prisoners, they are more open to the multiplicities of the world, they dream of freedom and thus infect other women, affecting and being affected by these desires [24].

In view of this, we can see the female struggle against the setbacks in her achievements and, above all, for the right to be able to go out on the street, to walk on public transport without being harassed, be beaten or raped and so that no right won with so much struggle and resistance is withdrawn. Today, more than half a century after the *"First Feminist Wave"*, a period of feminist activity in the world, mainly in Canada, the United States and the United Kingdom, during the 19th and 20th centuries, which raised political rights, equality and freedoms, has amplified and divided into several others. His subject no longer boils down to the white woman, middle class, who fights for civil rights, is also black, mother, the periphery, the young, lesbian and transgender [25].

Thus, while significant wage inequalities between men and women in the same capacity remain, it is undeniable that feminist criticism of inequalities in the labour market played an important role in the intense occupational diversification, experienced by women in the last three decades [26].

The integration of women occurs almost exclusively by their own effort, due to the rapid change of mentality through which our society passes [13].

Also, it is worth noting that the women's movement in Brazil is one of the most respected in the world,

standing out for the decisive contributions in the process of democratization of the state producing, including, important innovations in the field of public policies [26].

Therefore, the struggle of women is extremely important in order to solve the gender inequalities that remain in our society and ensure the creation and implementation of public policies in favor of women.

2.3 Need for Public Policies as a way to mitigate inequalities

Public policies are activities developed by the State (at the federal, state, district or municipal level) directly or indirectly, aiming to use the means at their disposal to meet social needs and demands.

[27], public policies can be conceptualized as follows:

Public policy is a collective action whose function is to materialize social rights demanded by society and provided for in the laws, or, in other words, the rights declared and guaranteed in the laws are only applicable through corresponding public policies, which, in turn, operate through programs, projects and services [27].

Therefore, public policies are actions, instruments and norms of the state, in the economic, social, cultural sectors, among others, that regulate governmental actions to guarantee collective rights, being fundamental to experience a democratic environment.

[17], the Federal Constitution of 1988, presenting in its caput the expression "*fundamental objectives*", brings the definition of the goals to be achieved by the Brazilian State, through public policies for the promotion of constitutional social benefits in the exercise of the civil service, aiming at the effective promotion of development and the good of all. It highlights that for the construction of this end, it is important not only the creation, but also its implementation, thus ensuring the isolation of those involved.

Based on gender, public policies recognize the gender difference and, based on this recognition, implement differentiated actions aimed at women [28].

These activities when aimed at women in order to mitigate gender differences and ensure entitlement are of paramount importance for the improvement of the quality of life of these and decrease the inequalities existing both in the urban and rural areas of Brazil, thus guaranteeing rights achieved after the struggle of women against discriminatory treatment, however, this is an arduous task, which encounters personal, family and institutional obstacles.

When proposing "*gender*" public policies, it is necessary to establish the meaning of the changes that are intended, above all, to contemplate the emancipatory condition and the dimension of women's autonomy. In addition, in order for public policies aimed at women to be drawn up and implemented, a dialogue between the state and civil society should be sought, which should be achieved through women's struggle movements.

It is also relevant the institutionalization, in the states and municipalities, of governmental bodies such as secretariats, policy coordinations for women that can ensure the implementation of measures that can reduce inequalities between men and women.

In the Petrolina/Juazeiro Pole there are some public policies directed to rural workers, such as:

A) Women's Assistance Reference Center - CRAM, for protection against domestic violence;

B) National Rural Learning Service - SENAR, of Pernambuco, aiming to reduce the dropout of young people (men and women), from rural areas; and

C) Straw Hat Program for Rural Women (allowance in the off-season and course - crafts).

It cannot be doubted, that despite the existence of some public policies aimed at women in the region under study, the obstacles to the social, political and economic rise of women, gender inequality remains, which leads to the precariousness of female labor in fruit farming in the Petrolina/Juazeiro pole.

In this way, it is essential for the guarantee of social and gender equality and the economic growth of women to implement new public policies linked to promoting the increase of day care centers to ensure access to the labor market for working mothers, welfare, health assurance, education, professional qualification, culture, inclusion, empowerment, supervision to guarantee women's rights, as well as disclosure, compliance with and access to these policies, thereby promoting increased income, self-esteem, respect and empowerment of women in the San Francisco Valley and ensuring opportunities and security for rural fruit farmers.

Furthermore, it is equally important to promote women's social mobility and their participation in positions that, for the most part, are held by men, seeking both a factor that provokes change and

visibility for rural organisations, which can contribute to reducing the conditions that favour men over women in the fruit-growing activity of the semiarid and, therefore, to the guarantee, to respect the constitutional principle of isonomy.

III. METHODOLOGY

It is a bibliographic research, of qualitative nature, with descriptive objective. Initially, data collection was performed through bibliographic research in secondary sources, with document analysis. For the development, a data collection was performed at the Brazilian Institute of Geography and Statistics - IBGE, and CAGED.

As for the method, the methodological process was adopted through the systematic integration of quantitative approaches, aiming at broadening the understanding of the analyzed phenomenon, through the incorporation of the two forms of research, because it provides the researcher a greater field of apprehension of the problem addressed, as it is the most appropriate mixed method in dealing with complex issues [29].

In order to achieve the proposed objectives, the position of women at work in irrigated fruit growing in the Petrolina/Juazeiro pole was investigated.

The application of the method was performed in three stages, namely: Pre-analysis; Exploration of the Material; and Treatment of the Obtained Results and Interpretation [30].

IV. RESULTS AND DISCUSSIONS

With the realization of the present research, it is possible to observe an increase in the female participation in the activity of irrigated fruit growing in the Petrolina/Juazeiro pole, which occurs mainly in viticulture, bearing in mind that most cultural tracts and handling (grinding, pruning, harvesting, sorting) are manual and require more careful and delicate work to avoid waste and meet the requirements of the international market, and so there is a preference for hiring female labor for this activity.

According to the Agricultural Census 2017, prepared by the Brazilian Institute of Geography and Statistics - IBGE, the participation of women in the viticulture of the São Francisco Valley went from 42% in 2006 to 50% in 2017. However, it was observed that, despite performing important work in irrigated fruit growing in the Petrolina/Juazeiro pole, female tasks are still undervalued and the lack of opportunities in the semiarid region, the turnover of fruit production activity, the hiring of employees on a temporary basis, provide a scenario where

the workers of this activity, end up submitting to low wages, and may still be subject to violation of their rights.

There can be no doubt that the precariousness of those who depend on few job opportunities and the fruit companies to find their livelihood, generates a situation of dependence and instability for workers. Moreover, the study brought to light the evidence that although fruit farming is an employment-generating activity for the São Francisco Valley region, some of these jobs are occupied by women, mainly in grape and mango crops, given the specificities of the activities, requiring special handling care [31], the employment relationship is still precarious and unequal, as employers disregard the female workforce, and yet there is a greater absorption of male labour.

Thus, the difficulties and unequal treatment between men and women persist, with the need for public policies to solve problems such as functional machismo, low wages and double working hours linked to the lack of appreciation of them by companies, even though women are qualified. Furthermore, in order to reduce inequalities and contribute to social justice, it is essential for companies to assume their responsibilities and take steps to improve working conditions in their production chains, as well as to guarantee a decent wage, safety and equal treatment between workers and workers, good transport conditions, food, comfort in their work breaks among other practices and policies to ensure equality between men and women working in fruit farming.

V. CONCLUSIONS

The irrigated fruit growing in the Petrolina/Juazeiro pole in the northeastern semi-arid region is one of the main activities generating employment in the region, being largely occupied by women mainly in grape and mango crops as a result of the special handling care and post-harvest activities taking place at the *Packing House* [31].

However, the female qualification for work remains symbolically linked to the reproductive sphere, thus being of lower prestige and qualification status for the world of work. This established wage differences between men and women, as well as inequalities in employment, career and economic and political participation [2].

In addition, female hiring occurs mostly on a temporary basis and although the contracts are formal, guaranteeing the rights guaranteed by labor laws, there is no guarantee of the same rights of the contract for an indefinite period, in addition to the fact that there is a large number of small enterprises in the region where there is a higher incidence of informal female employment contract [31].

It is important to highlight that the workers spend part of the year without employment, leaving the option of looking for alternative occupations, such as single workers in fruit growing, domestic service provision, as well as resorting to social subsidy programs.

It remains clear, therefore, that despite the irrigated fruit growing in the Petrolina/Juazeiro pole has caused significant changes in the social, family and economic life of women, inserting workers in the labor market and guaranteeing income for them, gender inequality and consequently, the precariousness of women's work remains.

In this way, faced with the obstacles and unequal treatment that lead to the precarization of women's work, it is important to encourage the participation of women in the process of drafting laws and creating bodies that ensure the implementation of public policies (linked to education, well-being, health, professional qualification, among others), with a gender focus, with the aim of promoting equal treatment between men and women workers in irrigated fruit farming in the São Francisco Submedium, as well as female social mobility, equality in the occupation of posts and functions in this activity, thus ensuring respect for the constitutional principle of isonomy.

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The Impact of ICT on the Performance of Logistics Firms in Accra, Ghana

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Received: 19 Nov 2020;

Received in revised form:

08 Feb 2021;

Accepted: 20 Feb 2021;

Available online: 11 Mar 2021

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Keywords— ICT, Logistics firms,
Performance, Profitability.

Abstract— The study examines the impact of Information and communication technology (ICT) on the performance of logistics firms in Accra, Ghana. The main objective of the study was to gain a better insight into how the level and use of ICT in the firm's security and tracking, customer service delivery and also how the information integration of systems affects the firms' performance. Twenty-one (21) logistics firms in Accra consisted the research sample. The sample population included the managers, directors, supervisors and staff that are in direct contact with ICT usage. In order to achieve the objective, 147 questionnaires were distributed, and 129 questionnaires were filled and retrieved for analysis. This represented a response rate of 87.8% of the sampled population. The researcher analysed the data obtained using SPSS version 26. Descriptive statistics methods were employed to present and summarize the findings of the result. The researcher further analyzed the data using inferential statistics and multiple regression.

The study showed that ICT has an impact on the performance of the logistics firms in Accra, Ghana. The findings revealed that three out of the four ICT indicators used as the independent variables of the research were found to be statistically significant, which were enough to influence the performance of the logistics firms. The researcher recommends that management should continue to motivate and increase ICT usage within the firms and even to the sectorial level that are yet to be computerized to achieve a higher level of optimum operation and profitability.

I. INTRODUCTION

The world today is undergoing rapid changes due to the advancement in science and technology. It is becoming a challenge each day to do away with technology. Most individuals and corporations admire the many technological devices they use in their daily lives and businesses. A recent example of technological change dynamics and economic growth is the proliferation of new technologies of e-business and Information and Communication Technology (ICT) among companies (Koellinger, 2006). It is without a doubt that new ICT tools

are emerging each day, giving organisations that employ them to gain competitive advantage.

In May 2019, the launch of a new digital roadmap was announced by the government of Ghana. This is part of a wider strategy to develop the country as a leading ICT innovation center in sub-Saharan Africa. (Oxford Business Group, 2020). It confirms that Ghana is fast embracing these new emerging technologies into its various sectors of operations, of which the logistics sector is of no exception. In recent years, businesses active in the logistics and transport industries have made considerable improvement

in embracing modern technologies, especially those connected to the e-business sectors and the internet (Koellinger, 2006). ICT tools help to speed up the execution of activities, encourage automated decision-making procedures and processes, and allow distributive operations. (Huang & Nof, 1999).

In recent times, innovation is considered to be the key to business success (Analytics-Insight, 2019). As new technologies evolve, logistics firms tend to seek innovations that will help retain and expand their customer base. These new techs increase the efficiency and effectiveness of the firms to better serve their customers and also achieve a competitive edge over competitors. The introduction and use of ICT are helping logistic firms live a dream come true since it helps foster better customer relations and satisfaction, reduce cost, improves communication, reduce transactional time, provide security, and enhance their overall effectiveness and performance. A report on the logistic performance index (LPI) by the (World-Bank-Group, 2016), Ghana had an improvement in its logistics performance, recording an index of 2.66 instead of 2.63 in 2014 and this improvement was a result of the Ghana National Single Window (GNSW) programme. The Single Automated System model, an ICT tool for the integration of existing systems and the construction of new facilities where necessary, was adopted by this programme. However, in 2018 the report on LPI by the World Bank showed a decline in Ghana's logistics performance from an index of 2.66 in 2016 to 2.57 in 2018.

Despite ICT adoption in logistic sectors with its numerous benefits, studies have shown that users have not completely realized its benefits. It has been realised that some of several firms do not operate to the required standard bringing additional damage instead of good to investors, customers, and other users. Logistics firms do suffer from wrong technology choices, insecurity, inefficiency, and inadequate information sharing. For the functional areas of logistics firms to work effectively, the right technology and personnel must be selected to avoid inefficiencies. Logistic firms must use the right infrastructural facilities to smoothen the pace of operation. Adequate information sharing is of the essence to foster transparency and better customer relation between all the parties involved in a transaction.

Critically looking at the introduction of ICT owing to its objectives, there is no much focus on the worth of technology provided but how best it serves the needs of the potential users. This study, therefore, seeks to evaluate the impact ICT has on the performance of the logistics firms' in Accra, Ghana to realize its relevant

effect on their activities and operations to assure their potentiality of growth. The study seeks to find answers to the following questions: What impact do ICT usage levels have on the firm's performance? What impact does the usage of ICT insecurity and tracking system have on the firm's performance? What impact does the usage of ICT on the customer service delivery system have on the firm's performance? What impact does the information integration system have on the firm's performance? The findings of this research will be helpful to owners and managers of logistics firms since it gives better insight into the impact of ICT on logistics performance that will help them make a strategic business decision for business growth. It will also be an eye-opener for investors to start making investments into the logistics firms hence improve economic growth. The findings will also be helpful to the government as it will well inform them on the way forward in ICT services within the country.

II. LITERATURE REVIEW

2.1 Technology Acceptance Model

This Technology Acceptance Model is the theoretical starting point of this study (TAM) propounded by (Davis, Bagozzi, & Warshaw, 1989). TAM focus on the adoption and use of ICT, with two concepts of theory, thus Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) that affect the motive to use technology. It is aimed at predicting and clarifying ICT usage behavior and finding out why potential users or adopters do accept or reject the usage of information technology. In Ghana, Technology is still being phased in gradually. Manually, most processes, operations, and associated tasks are performed. This theory illustrates readiness within a user community to use ICT for the purposes that it is meant to serve. Several studies have used TAM as their theoretical background to explain the adoption and use of ICT. Most researchers have affirmed that PU's relationship with adoption intention is positive (Davis et al., 1989) and continuance intention (Ritu Agarwal & Karahanna, 2000; V. Venkatesh, 2000). In furtherance, post-adoption studies have realised that PU influences satisfaction (Bhattacharjee, 2001; Limayem, Hirt, & Cheung, 2007) and attitude toward technology (Bhattacharjee & Hikmet, 2008). PEOU was found to affect both PU and adoption intention (Davis et al., 1989). Also, PEOU was found to affect satisfaction (Thong, Hong, & Tam, 2011), continuance intention (V. Venkatesh & Davis, 1996; V. Venkatesh & Davis, 2000), and actual continuance usage (R. Agarwal, 2000; Lippert, 2007).

2.2 Innovation Diffusion Theory

Innovation Diffusion Theory (IDT) proposed by (Everett Rogers, 2003) has had much research that has used the IDT to be their theoretical framework or combined other theories with IDT and models to explain the adoption and use of ICT. The theory posits five main constructs that affect the diffusion of innovation, thus relative advantage (the level to which technology provides enhancements over the tools available presently), compatibility (its conformity with users social values, practices, and norms), complexity (its ease of usage or difficulty), trainability (a chance to try out innovation to enable committing or opposing to using it), and observability (the level to which the results of the technology and its benefits are evident). These constructs are capable of being determinants of the rate or degree of diffusion on their own but diffusion studies have shown that innovations producing merits, compatibility with current beliefs practices, and values, low level of complexity, possible trainability, and observability would be quickly diffused as compared to innovation with the opposite cluster features. (E. Rogers, 1995).

With this theory, the researcher gets to understand how ICT is been used at the various logistic firms to enhance operations thus if it adopted at all and its conformity with organizational norms and practices. It will also help answer research questions that seek to finds out the tangible impact ICT has on the performance of firms if they are adopted.

2.3 Unified Theory of Acceptance and Use of Technology (UTAUT)

This theory was propounded by (V. Venkatesh, Morris, Davis, & Davis, 2003). UTAUT offers a detailed description of how determinants of intention and behaviour change over time. The theory posits four concepts as important indicators of user acceptance and usage behaviour thus performance expectancy, social influence, effort expectancy, and facilitating conditions. These construct relationships are being moderated by age, gender, experience, and voluntariness of use (V. Venkatesh et al., 2003).

The theory provides a framework for managers, directors, supervisors to evaluate the probability of technology introductions being successful and to understand and consider acceptance drivers for implementing intervention strategies that involve training or marketing. UTAUT undergoing empirical testing proves that social influence, performance expectancy, and effort expectancy have a positive relationship with technology use intentions (V. Venkatesh et al., 2003). Perceived usefulness and perceived ease of use have been shown in

subsequent studies to be affected by social influence. (Hong & Tam, 2006; Lu, Yao, & Yu, 2005).

2.4 Empirical Study

(Maizs & Toroitich, 2016), researched "Effect of Information and Communication Technology on Organizational Performance in Unga Limited Eldoret, Kenya" to assess the effect ICT has on the company performance. Questionnaires were used as the guide to collect data from 65 staff including the management team, department heads, and employees of the company. Descriptive and quantitative methods and techniques were used to interpret the data after which the results were presented in tables. The study's findings showed that the use of ICT in the company promoted the quality-of-service delivery, enhanced the company's production efficiency, strengthened the organization's infrastructure, increased employee efficiency, and ensured that all systems were working effectively and efficiently. The research also found out that ICT was an essential aspect that enabled the company to enjoy a competitive advantage over other companies since it fastened the transfer of goods and hence improve the company's supply chain. The research concluded that ICT is a vital aspect of a company's performance.

(Choy et al., 2017), researched "Impact of information technology on the performance of the logistics industry: the case of Hong Kong and Pearl Delta region". They sought to evaluate the present state of IT use and its influence on logistics service performance. The study surveyed two-hundred and ten (210) logistics companies across Hong Kong and the Pearl Delta region. The study proposed a hypothetical model that used the resource-based and the market-based view theories to link the implication of IT abilities with logistics performance. The structural equation model was used in testing the hypothetical model. The research findings were that, (i) the implementation of IT directly improved the efficiency of service of the companies, (ii) the impact of the IT implementation also brought about competitiveness since the efficiency of service in the companies were improved.

(Gera & Gu, 2004) researched "The Effect of Organizational Innovation and Information and Communications Technology on Firm Performance" to determine whether ICT and organisational innovation are connected with higher performance in Canadian companies. The data used for the study was obtained from the 1999 workplace and employee survey (WES) which were analysed descriptively (mean, percentages) and inferentially (correlation, regression) statistics. The research findings showed that the correlation between ICT and firm performance was dependent upon the

circumstances in which the ICT's were been used. The result indicated that ICT use correlates with the skills of workers and suggest that human capital and ICT are complementary in the dynamic and distribution service industries hence companies that combine a higher level of ICT with a higher level of human capital tend to achieve a higher rate of innovation and product quality in the area. The research pointed out that ICT correlated with organisational innovation in efficient and production activities, HRM activities, and product quality-related activities which confirms that organisational innovation and ICT are compliments.

(Wilson, Iravo, Ondabu, & Ombui, 2015) researched "Effects of Information Technology on Performance of Logistics Firms in Nairobi County". Questionnaires were how data were collected from 10 Nairobi County logistics companies. The researchers developed and aggregated collective items based on the research model into four scales to measure IT use within the firms and three scales to measure the firm's performance. The data collected were subjected to an SPSS analysis and the findings were summarized in tables and charts. The ANOVA result showed a high significance level ($F = 2.729$ and $P = 0.000$) and this implies there was a strong relationship between the four variables and the firm performance of the logistics companies in Nairobi County.

2.5 Criticism of the theories relevant to this study

Theories over the decades have received much attention as well as critics, the theories used in this paper are of no exception. (Bagozzi, 2007) argues that the technology acceptance model has five shortcomings of which include the neglect of the collective, social, and cultural factors of decision making. It is considered to look out for the shared values of firms in determining their technology adaptability. It is easy for firms to adopt something when it is in line and appreciates the norms and values of what it stands for, moreover firm base decisions are more of collective intentions.

2.6 Research Gap

ICT is mostly seen as a force that drives superior performance of businesses; however, studies show that there have been very few studies done on the impact ICT has on the logistics firm's performance in Ghana. Most researchers do tend to examine the ICT impact on firm performance in general. This research study tends to examine the direct effect ICT has on firm performance in areas of security and tracking system, customer service delivery, information integration system, and their level of ICT usage.

III. METHODOLOGY

This research study involved the use of a descriptive research design. (Mugenda & Mugenda, 2003), posits that a descriptive research design allows a researcher to collect, summarize, present, and analyze information for clarification purposes. The researcher used both primary and secondary data for realizing the objective of the study. The secondary data was obtained from published articles, journals, reports, past research papers, as well as other relevant and credible sources. The primary data was obtained using a well-structured and developed questionnaire, a Likert scale starting from 1 to 5 was used as a measure of the questionnaire items, with 1 representing a strongly disagree, 2 - disagree 3 - uncertain, 4 - agree and 5 - strongly agree. Twenty-one (21) logistics firms in Accra, Ghana consisted of the research sample. The sample population included the managers, directors, supervisors, officers, and employees that are in direct contact with ICT usage of the freight forwarding or distribution logistics firms in Accra, Ghana. 147 questionnaires were distributed, this involved 21 companies however 129 questionnaires were filled and retrieved for analysis. This represented an 87.8% response rate of the sampled population. The Statistical Program for Social Sciences (SPSS) version 26 was adopted by the researcher for the analysis of the obtained data. Descriptive statistics methods thus percentages and frequencies were employed to present and summarize the findings of the result following the research objectives. The researcher further analysed the data using inferential statistics, specifically stepwise and multiple regression to find out the relationship between the ICT usage levels, security and tracking system, customer service delivery system, information integration system, and the performance of the firms.

3.1 Conceptual Framework

A conceptual framework is a written or visual product that explains the key items to be examined, concepts or variables, and the supposed relationship between them, either in narrative form or graphically (Miles M & A., 1994). This study, therefore, deemed it necessary to explain the various terms and concepts that form the foundation of the research work. A conceptual framework that illustrated the relationship between variables thus an independent and a dependent variable was adopted by this study. The dependent variable was the logistics firm's performance and the independent variables thus the ICT indicators were the level of ICT usage, security and tracking system, information integration system, and customer service delivery.

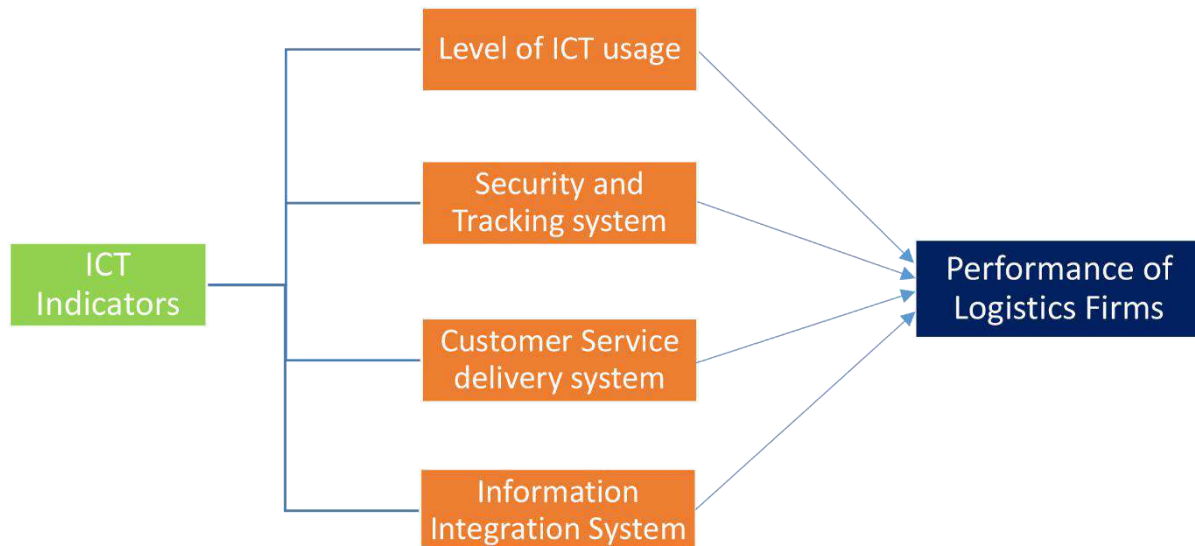


Fig. 1: Proposed Conceptual Framework of the Study

Source: [Modified (Wilson et al., 2015)]

3.2 Variables

3.2.2 Independent Variables

ICT Usage Level:

Over the past years, in some businesses and nations, ICT has always been a catalyst for transformation and innovation. Companies and firms that employ them are reaping from the various benefit it comes with. (Sanjeev, James, & Mona, 2019) posits that innovative companies are most likely to experience success and growth. The level of investment into ICT related infrastructure is also a determinant of the growth percentage experienced. The Organization for economic co-operation and development (OCED, 2004) data published indicated that countries that have increased their investment in ICT infrastructures experienced a growth in GDP and Labour productivity of which the United States, the Netherlands, Canada, and Australia enjoyed the largest boost.

Security and Tracking system:

How self-belief and confident it is for logistics service providers and customers to realize their goods in transit are safe and at the precise locations they ought to be. This has been made possible through the introduction of ICT tools like bar codes and Radiofrequency identification (RFID) devices which help you to identify, gain precise information and also track stocks in transit. The researcher tends to evaluate the impact this has on the logistics firm's performance.

Customer Service Delivering System:

Most businesses tend to thrive more based on their customer base as customers are the world's most important resource for any business category, it is, therefore, essential for every business to maintain their current customers as they attract new ones. Globalization today has brought about rapid changes in customers demand however customers continue to place more emphasis on low-cost goods, delivery date certainty, on-time delivery, or receiving a personalized product as posited by (Simchi-Levi, Kaminsky, & Simchi-Levi, 2003), it is with this that logistics firms have to add more value to their products and customers service delivery to achieve customer satisfaction and competitive advantage. Companies must therefore see innovation as part of business management, which will help implement new and creative processes, products, and services to quickly respond to the demands and requirements of customers. (Sullivan, 2005).

Information Integration System:

Information integration is a means by which data from diverse sources becomes unified and accessed by users for their various benefits. Information integration is key and essential for business growth as it encourages information sharing. Information sharing plays an important approach in an enterprise's survival and enables the integration of the supply chain (Lotfi, Mukhtar, Sahran, & Zadeh, 2013). Most businesses today are using information integration systems like Customer Relationship Management (CRM), Enterprise resource

planning (ERP), Electronic Data Interchange (EDI) to enhance cross-departmental, customer, and supplier collaborations to plan and make better business strategies and decisions to enhance overall operational efficiency. The researcher tends to evaluate the impact this has on the logistics firm's performance.

3.2.3 Dependent Variable

Logistics Performance:

Every business has the goal of performance growth been it financial or non-financial, the ICT impact on logistics performance has been a topic of research by a lot of researchers to find their relation. Some researchers do agree to a positive relationship between ICT and performance and some do object depending on how they were measured and analyzed. There is much evidence that

investment in ICT brings about innovation and innovative firms are most likely to experience growth. A positive influence of investment in information technology was found in one study on productivity, but there was no impact on profits (Brynjolfsson & Hitt, 1996). Another study found no positive influence of information technology capital on productivity while information technology labor contributed positively to profitability and output (Prasad & Harker, 1997). Ghana's Logistic Performance Index witnessed a decline from an index of 2.66 in 2016 to 2.57 in 2018 even though a Single Automated System model was implemented in 2016 to improve operational performance. These ambiguities are the cause of the researcher to make an inquiry and establish the relationship between ICT and Performance of the logistics firms in Accra, Ghana.

Table.1: Application of ICT in different sectors of logistics

Activities	ICT Application area	Merits
Warehouse Management	Management of warehouse to – <ul style="list-style-type: none"> • Receive goods • Identify goods received • Deploy goods for storage • Locate and pick goods • Deploy shipment 	<ul style="list-style-type: none"> • Paperwork is reduced • Real-time deployment • Time saved in inventory locating • Processing time is reduced • Goods safety and security increased • Human error is reduced • Consolidation of cargo
Transportation Management	<ul style="list-style-type: none"> • Fleet management and vehicle tracking • Fuel, safety, and health management of fleet • Vehicle speed management • Driver and route management 	<ul style="list-style-type: none"> • Increase in safety and security of personals • Helps recover stolen vehicles easily • Customer satisfaction is increased • Insurance cost is reduced • Help reduce overtime
Cargo and Security Management	<ul style="list-style-type: none"> • Cargo lease • Cargo safety and security • load and offload of cargo 	<ul style="list-style-type: none"> • Cargo safety and security is improved • Easy to track the location of cargo • Easy documentation of cargo
Customs Duty and Clearance	<ul style="list-style-type: none"> • Custom receipt and payment of duty • Documentations • Inspections 	<ul style="list-style-type: none"> • Fast receipt and payment of duties • Customer satisfaction is increased • Paperless transaction increase the speed of clearance • Reduction in administrative cost
Communication Management	Management of communication and information flow with <ul style="list-style-type: none"> • Customers • Suppliers • Manufacturers 	<ul style="list-style-type: none"> • Increased customer satisfaction • Transparency encouraged • Reliable to and fro of information • Increased on-time resolution

Source: [Modified (Bhandari, 2014; Wilson et al., 2015)]

The Table 1 above shows some of the activities engaged in by logistics firms, ICT application areas, and the merit of using ICT in the respective areas. The following ICT systems have been provided in the various aspects of logistics firms to aid their operation: GPS satellites, GSM/GPRS network, Web-Based Tracking, GIS and fuel management systems to help the ease of locating and managing fleets and cargos, the management of warehouses also involve the use systems such as the Information Directed System (IDS), Automated Inventory Tracking System (AITS), Automated Guided Vehicle System (AGVS) and Automatic Identification Technology like barcoding, Radio Frequency Identification (RFID) devices which helps in the easy identification and movement of goods. Information and communication systems like Enterprise Resource Planning (ERP) and Electronic Data Interchange (EDI) also help speedup transaction processes, information flow and documentation.

With the advancement in technology, these innovations have come to stay to help logistics firms that embrace them better and increase their efficiency of operation, satisfying customers' requirements, and also increasing profit. Logistics forwarding is currently gaining much attention and undergoing immense change due to the increase in multilateral trade between countries. Some logistics firms are fast embracing ICT in their various aspects of the operation, gaining a competitive edge over other firms, and reducing cost. (Sullivan, 2005) posits that as businesses immensely use information technology to explore competitive benefits and advantages, improve productivity and effectiveness to raise their profitability, market share, and customer loyalty, the emphasis on cost minimization will become severe. Logistics firms, managers, shareholders, and other parties should therefore realize the need to inculcate ICT in their operations and business strategies looking at its numerous benefits to boost work efficiency and effectiveness.

3.3 Reliability and Validity

The study's research instruments (questionnaire) was constructed carefully to ensure that it was reliable and valid in achieving the objectives of the study.

3.3.2 Validity

(Middleton, 2020) posits that validity is the accurateness of what a process measures and if the study has a validity that is high, it then means it produces results that correlate to real properties, characteristics, and variations in the physical or social environment. The research instrument was thoroughly checked by my supervisor to seek her opinion on the adequacy, representativeness, and accuracy, of the instrument to ensure that it covers all the measurable variables. A pilot study was also conducted using three supervisors from three different logistics firms, to determine the accuracy hence validity of the research instrument was the basic objective of the pilot test before adopted and applied in the actual study and this helped the researcher to modify the research instrument making it more transparent for understanding and removing ambiguous items hence enhancing the quality and validity of the instrument.

3.3.3 Reliability

(Crossman, 2020) defines reliability as the level of degree to which a measuring instrument produces consistent results every time it is used, with the assumption that it does not alter the underlying thing being measured. Cronbach's Alpha was used as the means to measure reliability and internal consistency. The testing was carried to validate the consistency in responses given by respondents. (Chelsea, 2015), Cronbach's alpha is determined by correlating the score with the total score for each observation for each scale item and then comparing it to the variance for all individual item scores. He further posits that the resulting reliability of the coefficient ranges from 0 to 1. However, a minimum coefficient of 0.7 to 0.8 (or higher) is suggested and adopted by many methodologists, and coefficients 0.5 or less is generally are unacceptable.

Table.2: Reliability Statistics

Variables	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Level of ICT Usage	.944	.945	5
Security and Tracking System	.949	.948	5
Customer Service Delivery	.965	.965	5
Information Integration System	.906	.903	5
Performance (Before the adoption of ICT)	.865	.870	6
Performance (After the adoption of ICT)	.969	.971	6

From Table 2 above, the reliability results shown in all variable items exceeded $\alpha=0.7$. This indicates that the questions used in each variable of the study were reliable hence consistency was proven in the responses of the respondents.

IV. RESULTS AND DISCUSSIONS

The descriptive statistics of the respondents in regards to the Impact of ICT on the performance of logistics firms in Accra, Ghana are presented below.

4.1 Respondent's profile

Response rate:

This study expected the distributed questionnaires to be filled by 147 respondents but 129 questionnaires were retrieved. This accounts for an 87.8% response rate and according to Field (2013) for a study to be statistically significant, it must have a response rate be at least 50%. The response rate can therefore be said to be excellent and statistically significant.

Gender:

The study's findings showed that 77.5% of the respondents were males and 22.5% were females. This indicates that males were the predominant workforce at the logistics firms.

Age:

The study revealed that most of the respondents were

between 31 - 40 years constituting 60.5% of the respondents, 25.6% were between 18 – 30 years, and 14% were between 41 – 50 years. These findings showed how youthful the workforce of the logistics firms was.

Level of Education:

Out of the 129 respondents in the research, 7% had a WASSCE/SSCE certificate, a majority of the respondents 62.8% had First Degrees, 22.5% had Masters Degrees and 7.8% had PhD.

Period of Work:

The findings of the research established that 5.4% of the respondents had worked for Less than a year, 17.1% had worked from 1-3 years, and 40.3% constituting the majority had worked from 3 - 5 years, 24% had worked for 5 - 10 years and lastly, 13.2% had worked for 10 years and above.

Job Role:

On the respondent's job roles, the findings of the study showed that 41.1% constituting the majority were in the Managerial roles of the logistics firms been the firm managers and officers of the various sectors of operations, 32.6% were in Supervisory roles and 26.4% were clerical staff with direct contact with ICT usage in the firm.

4.2 Level of ICT Usage

Finding out the level and extent of ICT usage in the logistics firms in Accra, Ghana was one of the objectives of the study. The results are tabulated below;

Table.3: Level of ICT Usage

	Strongly disagree Percentage (%)	Disagree Percentage (%)	Uncertain Percentage (%)	Agree Percentage (%)	Strongly agree Percentage (%)
The management motivates the use of ICT within the firm	13.2	19.4	1.6	38.0	27.9
The firm has a low-level ICT usage.	26.4	38.0	6.2	18.6	10.9
Employees oppose the use of ICT within the firm.	30.2	33.3	5.4	17.8	13.2
The ICT tools within the firm are defective	26.4	36.4	10.1	20.9	6.2
Most of the operations are computerized within the firm.	14.0	20.2	4.7	33.3	27.9

The findings from the Table 3 above shows that a greater percentage of the respondents representing 38.0% agreed to the fact that management motivates the use of ICT within the firm, 27.9% also strongly agreed to the same statement and 19.4% disagreed with it. With the level of ICT usage within the firms, 26.4% strongly disagreed and 38.0% disagreed with them having a low level of ICT use while 18.6% agreed. Employees within the firm also play a role in supporting ICT use within the firm, 30.2% strongly disagreed and 33.3% disagreed with employees opposing the use of ICT within the firm, however, only 17.8% agreed.

Moreover, how can ICT use be encouraged if the ICT tools within the firms are defective? Therefore 36.4%

and 26.4% of the respondents disagreed and strongly disagreed respectively with the statement that the ICT tools within the firms are defective. Finally, 27.9% strongly agreed and 33.3% also agreed with the statement that most of the operations within the firms are computerized but 20.2% disagreed and 14% strongly disagreed, and this confirms that as technology is still being phased in gradually in Ghana it is been rapidly adopted by these firms for their operational activities.

4.3 Security and Tracking System

The study pointed out in Table 4 below the level of agreement or disagreement of the respondents with the use of ICT in the security and tracking system of the firms.

Table.4: Security and Tracking System

	Strongly disagree Percentage (%)	Disagree Percentage (%)	Uncertain Percentage (%)	Agree Percentage (%)	Strongly agree Percentage (%)
The cost of digital monitoring and tracking cargo reduces the cost of security hence higher profit	12.4	18.6	6.2	27.1	35.7
The tracking system increases the customer's confidence and leads to increased sales.	7.8	16.3	9.3	31.8	34.9
Digital monitoring, tracking, and cargo management is safer than the manual management system	11.6	17.1	7.8	27.1	36.4
Computerized freight clearing and forwarding is faster and quicker than the manual system	1.6	20.9	10.9	29.5	37.2
The Digital monitoring and tracking system can be easily exploited as compared with the manual system	12.4	17.8	5.4	27.9	36.4

Using ICT in security and tracking by the firms had a remarkable positive response, a majority of 35.7% strongly agree and 27.1% agree with the statement that digital monitoring and tracking cost reduces the cost of security leading to higher profits. This throws light on the fact that ICT helps reduce the cost of operations within firms. A majority of the respondents also strongly agreed 34.9% and 31.8% agreed that the tracking system help

boosts customers' confidence which eventually leads to an increase in sales.

The respondents further strongly agreed 36.4% and agreed 27.1% that digital monitoring, tracking, and cargo management is safer than the manual management system. Also, the majority responded positively to the statement computerized freight clearing and forwarding is faster and quicker than the manual system with the

percentages of 37.2% for strongly agreed and 29.5% for agreed. This posits that automation of business processes makes work faster and simpler, however, 36.4% strongly agreed and 27.9% agreed that though digital monitoring and tracking help it can be easily exploited as compared to the manual system, and this confirms that at a point in time ICT tools may encounter technical challenges and

inefficiencies which may expose them to threats and become insecure.

4.4 Customer Service Delivery

The study sought to point out in Table 5 below the level of agreement or disagreement of the respondents to how ICT makes the serving of customers better.

Table.5: Customer Service Delivery

	Strongly disagree Percentage (%)	Disagree Percentage (%)	Uncertain Percentage (%)	Agree Percentage (%)	Strongly agree Percentage (%)
Through the integration of ICT systems, customers can initiate complaints and get services online	10.9	14.0	5.4	43.4	26.4
Through the integration of ICT systems, customer's complaints and grievances are resolved faster and quicker online.	10.1	14.7	4.7	41.9	28.7
Customers prefer to be served manually compared with online services.	28.7	36.4	5.4	20.2	9.3
Through the integration of ICT systems, the time required to serve a customer has reduced significantly	2.3	14.7	10.1	42.6	30.2
The cost of hiring customer service attendance while serving online has decreased.	8.5	22.5	6.2	34.9	27.9

The findings on using ICT to serve customers from Table 5 showed that a majority of the respondents agreed 43.4% and strongly agreed 26.4% that customers can initiate complaints and get services online and this possible because of the customer service integration systems by the firms. The respondents further agreed 41.9% and strongly agreed 28.7% that not only can customers initiate complaints online but their grievances are also attended to quickly and faster.

Responding to customers preference to be served manually as compared to the online service, 36.4% disagreed and 28.7% strongly disagreed however 20.2% agreed and 9.3% strongly agreed and this implies that as ICT is still been adopted not all customers are used to or conversant with this online services or technological changes going on in the firms as well as the nation. Moreover, a greater percentage of the respondent agreed 42.6% and strongly agreed 30.2% that through integration the time required to

serve a customer has reduced significantly. Finally, respondents also strongly agreed 34.9% and 27.9% agreed with the statement that the cost of hiring customer service attendance while serving online has decreased but 22.5% disagreed and 8.5% strongly disagreed and this can imply that although customers are served online, some firms still maintain their number of customer service attendees to double efficiency and is most common in larger firms

Table.6: Information Integration System

	Strongly disagree Percentage (%)	Disagree Percentage (%)	Uncertain Percentage (%)	Agree Percentage (%)	Strongly agree Percentage (%)
Integration ensures communication effectiveness, accuracy, and adequacy among customers, suppliers, and the firm	8.5	8.5	3.1	51.2	28.7
Integration allows easy to and fro payments among customers, suppliers, and the firm.	10.1	13.2	4.7	33.3	38.8
Integration improves and ensures an effective internal and external control system of the firm.	7.0	15.5	6.2	33.3	38.0
Serving integrated suppliers and customers become easier and simple.	0	14.7	9.3	38.8	37.2
Integration improves the quality and efficiency of customer service delivery.	10.9	13.2	4.7	29.5	41.9

From the findings of information integration systems, the majority of the respondents were in agreement with all the statements under the integration of systems thus integration plays an essential role in the operational efficiency of the firms. They strongly agreed 28.7% and agreed 51.2% that integration ensures communication effectiveness, accuracy, and adequacy among customers, suppliers, and the firms, communication is known to be key in the success of businesses. Respondents also agreed 33.3% and strongly agreed 38.8% that the to and fro payments among customers, suppliers, and the firms have been made easy because of integration.

Moreover, firms need to have absolute control over their systems to enhance maximum and efficient operation. It is

since customers are an important resource for businesses and need special attention.

4.5 Information Integration System

The study sought to point out in Table 6 below the level of agreement or disagreement of respondents on how information integration affects performance and efficiency within the firm.

with this that integration of systems sets in to improve and ensure an effective internal and external control system of a firm, majority of the respondents strongly agreed 38.0% and 33.3% agreed to this statement and function of an integrated system. Respondents also agreed that suppliers and customers that are already integrated into the firms' systems can easily be served and finally, integration was seen to improve the quality and efficiency of the customer service delivery by respondents, 41.9% strongly agreed and 29.5% agreed.

4.6 Performance (Before the adoption of ICT)

The study sought to point out in Table 7 below the level of agreement or disagreement of respondents with the performance of the firm before the adoption of ICT.

Table.7: Performance (Before the adoption of ICT)

	Strongly disagree Percentage (%)	Disagree Percentage (%)	Uncertain Percentage (%)	Agree Percentage (%)	Strongly agree Percentage (%)
Our company's reputation improved in the eyes of the Customers.	8.5	19.4	14.0	34.9	23.3
Employees' productivity was above the industry average.	10.9	17.1	16.3	33.3	22.5
Relations with suppliers and customers were stable and excellent.	30.2	33.3	16.3	10.9	9.3
Our company's return on assets (ROA, %) was above the industry average.	27.9	32.6	19.4	12.4	7.8
Sales growth in our company was at a faster rate.	24.8	38.0	19.4	14.0	3.9
Our Company's liquidity ratio was above the industry average.	27.1	37.2	20.2	10.1	5.4

From the findings, it was realized that the respondents strongly agreed 23.3%, and agreed 34.9% to the statement our company's reputation improved in the eyes of the customers but 19.4% disagreed and 14% were uncertain, this can imply that even before the adoption of ICT some among the firms undertook activities that helped them gain customers reputation. Also, the respondents strongly agreed 22.5%, and agreed 33.3% to the statement employees' productivity was above the industry average however 17.1% disagreed and this can be as a result that some firms even before the adoption of ICT engaged their employees in training and other activities that made them more productive.

Moreover, the respondents strongly disagreed 33.3% and disagreed 30.2% with the statement that relations with suppliers and customers was stable and excellent but 10.9% agreed and 16.3% were uncertain. Before ICT adoption, much work was done manually,

involved more paperwork, and communication devices were inadequate and this can result in an unstable relationship with suppliers and customers. 27.9% strongly disagreed, and 32.6% of the respondent disagreed with the assertion our company's return on assets (ROA, %) was above the industry average. Also, a significant number of the respondents strongly disagreed 27.1% and disagreed 37.2% that their companies' liquidity ratio was above the industry average but 20.2% were uncertain, 10.1% agreed and 5.4% strongly agreed. Finally, a greater number of the respondents disagreed 38.0% and strongly disagreed 24.8% with the assertion sales growth in our company was at a faster rate however 19.4% uncertain and 14% disagreed.

4.7 Performance (After the adoption of ICT)

The study sought to point out in Table 8 below the level of agreement or disagreement of respondents with the performance of the firm after the adoption of ICT.

Table.8: Performance (After the adoption of ICT)

	Strongly disagree Percentage (%)	Disagree Percentage (%)	Uncertain Percentage (%)	Agree Percentage (%)	Strongly agree Percentage (%)
Our company's reputation improved in the eyes of the Customers	8.5	9.3	0	44.2	38.0
Employees' productivity is above the industry average.	9.3	10.9	3.9	38.8	37.2
Relations with suppliers and customers is stable and excellent.	0	10.1	11.6	40.3	38.0
Our company's return on assets (ROA, %) is above the industry average.	8.5	10.1	4.7	40.3	36.4
Sales growth in our company is at a faster rate.	0	9.3	7.0	45.0	38.8
Our Company's liquidity ratio is above the industry average.	6.2	10.9	7.8	37.2	38.0

From the study, after the adoption of ICT by logistics firms in Accra, Ghana realized a significant positive response from the majority of the respondents. 38.0% strongly agreed and 44.2% agreed that their company's reputation improved in the eyes of their customers, as well as the statement that employees' productivity is above the industry average, also witnessed a significant response with 37.2% strongly agreeing and 38.8% agreeing. This stands to reason that although the respondents agreed to these statements before ICT adoption however the rate of agreement response after ICT adoption surpasses and this proves that the use of ICT does play a role in this achievement.

Moreover, the respondents, 38.0% strongly agreed and 40.3% agreed that relations with suppliers and customers after ICT adoption is stable and excellent, ICT today, have aided in providing technological gadgets that integrate suppliers and customers to the firms' systems and eased communication. Also, respondents, 36.4% strongly agreed and 40.3% agreed that their company's return on assets (ROA, %) is now above the industry average, as well, 38.0% strongly agreed and 37.2% agreed to the

assertion that their company's liquidity ratio is above the industry average. This implies that ICT does not only make operational activities quicker and faster but increases the financial performance of firms too.

Finally, the sales growth within the firms was 38.8% strongly agreed and 45.0% agreed to be at a faster rate by respondents after the adoption of ICT. It is with no doubt that the firms though witness somewhat growth in sales before ICT adoption however the aftermath is a boost.

V. REGRESSION ANALYSIS

The regression analysis was computed for further analyses into the impact of ICT on the performance of the firms. A stepwise and multiple linear regression methods of analysis was then performed on the dependent and independent variables. A p -value less than 0.05 of a regression analysis (≤ 0.05) is said to be statistically significant while a p -value greater or higher than 0.05 (> 0.05) is said not to be statistically significant (Grabowski, 2016). The findings are tabulated below

Table.9: Stepwise Regression Analysis Excluded Variables^a

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	LEVEL OF ICT USAGE	.108 ^b	1.090	.278	.097	.269
	INFORMATION INTEGRATION	.314 ^b	4.225	.000	.352	.425
	SECURITY AND TRACKING	.117 ^b	1.784	.077	.157	.614
2	LEVEL OF ICT USAGE	.205 ^c	2.173	.032	.191	.256
	SECURITY AND TRACKING	.039 ^c	.592	.555	.053	.554
3	SECURITY AND TRACKING	.054 ^d	.830	.408	.074	.548

a. Dependent Variable: PERFORMANCE (AFTER ADOPTION OF ICT)

b. Predictors in the Model: (Constant), CUSTOMER SERVICE DELIVERY

c. Predictors in the Model: (Constant), CUSTOMER SERVICE DELIVERY, INFORMATION INTEGRATION

d. Predictors in the Model: (Constant), CUSTOMER SERVICE DELIVERY, INFORMATION INTEGRATION, LEVEL OF ICT USAGE

From the stepwise regression analysis above, it was found that all the independent variables were able to meet the criteria of a *p*-value less than 0.05 and therefore included in each step of the analysis to determine their

significance level on the dependent variable except security and tracking which was excluded due to the fact that it did not meet the criteria hence not significant enough to predict the dependent variable.

Table.10: Multiple Regression Analysis Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	99.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.750	.202	3.716	.000	.222	1.278
	LEVEL OF ICT USAGE	.184	.082	.213	.027	-.030	.398
	CUSTOMER SERVICE DELIVERY	.310	.110	.347	.006	.023	.598
	INFORMATION INTEGRATION	.331	.078	.331	.000	.126	.536
	SECURITY AND TRACKING	.046	.056	.054	.830	-.099	.192

a. Dependent Variable: PERFORMANCE (AFTER ADOPTION OF ICT)

From Table 10 above, it was found out that the level of ICT usage on performance realized a ($\beta = .213$, $p = 0.027$). This implies that the level of ICT usage was statistically significant and can positively influence performance by 21.3% if improved. Also, the usage of ICT in serving customers was found to be statistically significant at $\beta = .347$ and $p = 0.006$ which means serving customers with

the aid of ICT tools has the potential of increasing performance by 34.7%. It was also realized that the information integration of systems by the firms had a ($\beta = .331$, $p = 0.000$) which was highly significant. The firms' ability to integrate their systems can influence performance positively by 33.1%. Lastly, the security and tracking system realized a ($\beta = .054$) which implies that a

marginal increase in the security and tracking system by the logistics firms can improve performance by 5.4% however this is statistically insignificant given a ($p = 0.408$).

The above results therefore indicate that the ICT indicators used as the independent variables of the research thus level of ICT usage, customer service delivery, information integration system except security and tracking system generated from this study had a significant part to play on the performance of the logistics firms in Accra, Ghana.

VI. LIMITATIONS AND AREAS FOR FURTHER STUDY

Given that the impact of ICT has always been a topic of research in diverse fields and still under study, the findings from this research confirms a positive impact on the performance of the logistics firms in Accra, Ghana. This study was limited only to the logistics firms in Accra, Ghana, however, some firms declined to participate in this research survey. Also, this study made use of only four ICT variables thus the level of ICT effectiveness, ICT usage in Security and Tracking System, Customer Service Delivery, and Information Integration System but there is a relatively long list of other variables that could have been used in this study.

It is with this that the researcher recommends the following fields for further study, first, an in-depth analysis of the effect of ICT on the transportation service of logistics firms. Secondly the impact of ICT on the warehouse management of logistics service providers and lastly, the adoption and impact of ICT on the performance of Small and Medium-scale enterprises (SME's) in Ghana. Notwithstanding the above limitations, the research is fit for academic and industrial purposes.

VII. CONCLUSION & RECOMMENDATION

The objective of this research was to analyze the impact of ICT on the performance of the logistics companies in Accra, Ghana. Our findings largely confirms previous academic literatures that ICT helps improve firm performance. Our findings showed a high relationship between ICT use within the firms and their performances. The firms had a high level of ICT usage because management motivated its use and ensured all tools are effective and in good condition hence increase performance. The use of ICT in the security and tracking system was found out to enhance security and also help the firm save cost and gain customers' confidence but was not statistically significant. Through the customer service

delivery system, customers and suppliers were been served easily thus increasing customer satisfaction as well as helping the firm save time and cost hence improve firm performance. Also, information exchange is key to the success of businesses and the information integration systems helped serve that purpose better by ensuring communication effectiveness, accuracy, and adequacy between the firms and their corresponding parties.

To conclude, three out of the four independent ICT variables generated from this research were found to be statistically significant to influence performance and that is sufficient enough to conclude that ICT does influence performance hence making work faster, effective, and efficient giving firms that employ them reap its numerous benefits over others.

On the basis of the results and findings the researcher recommends that management should continue to motivate and increase the level of ICT usage within the firms even to sectors that are yet to be computerized since the higher the level of usage the better it helps achieve a higher level of optimum operation. Also, management should be abreast with the rapid technological changes in order to keep an update on their ICT tools to enjoy better services and also avoid security breaches. The researcher also recommends that the firms should continue to use and expand their customer service delivery and information integration systems to keep serving their customers better and with ease hence increase customer satisfaction. Finally, the researcher recommends that for the logistics firms in Accra, Ghana to achieve success, they need to adopt ICT as part of a "system" or "cluster" of mutually reinforcing organisational approaches as posited by (Milgrom & Roberts, 1990).

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APPENDIX B

ENLISTED LOGISTICS FIRMS OF THE SURVEY

1. DHL GHANA (EXPRESS)
2. ARAMEX GHANA LTD.
3. IAS/FEDEX GHANA LTD.
4. ZERO TH LOGISTICS LIMITED.
5. OVERCOMERS TRADING (OVERCOMERS SHIPPING COMPANY)
6. IMPRESSIVE SOLUTIONS GHANA LIMITED
7. GBH LOGISTICS
8. TRIPSTAR SERVICES
9. LIKEL CLEARING AND FORWARDING AGENCY
10. HOLLY CARGO COMPANY
11. M&E LOGISTICS
12. CHRISATH LOGISTICS
13. AMOOKSCO VENTURES (AMOOKSCO LOGISTICS)
14. CANDOR GHANA LTD.
15. ZF1 GARDEN LOGISTICS
16. LOGICAL MARITIME SERVICE
17. XLM SHIPPING COMPANY
18. AKT SHIPMENT AND LOGISTICS LTD
19. PLG LOGISTICS
20. MODERN WORLD LOGISTICS LTD
21. ALS GLOBAL LOGISTIC AND SHIPPING

Practices and Costumes of Ribeirin Mothers in the Care of the Newborn

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Received: 30 Nov 2020;

Received in revised form:

28 Jan 2021;

Accepted: 16 Feb 2021;

Available online: 11 Mar 2021

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Keywords— *riverside mothers,
PNSIPCEA, FHS, Newborn.*

Abstract— *Objective: To analyze the practices and customs of riverside mothers in the care of their newborn children in the municipality of Barcarena, state of Pará, northern Brazil. Method: descriptive research, with a qualitative approach, carried out with eight mothers of children under five years old in a Family Health Strategy in the municipality of Barcarena-PA. The content analysis proposed by Bardin was used for the treatment of the data. Result: The popular care practices used by mothers are based on customs acquired and passed on from generation to generation, such as teas, home remedies, blessings and baths, which despite the influence of the urban way of life being gradually inserted into the community, we observed that this cultural trait was not lost and allowed us to value cultural similarities and differences, accepting and valuing their cultures. Conclusion: We hope that the results obtained in this research can be used in the training of future nurses who want to work with riverside populations and that serve as a subsidy in promoting culturally appropriate assistance respecting the mothers' local knowledge in the care of their children.*

I. INTRODUCTION

Brazil is known for being one of the countries with the greatest biodiversity, with emphasis on the Amazon rainforest. In addition to its recognized natural wealth, the Amazon is home to an expressive set of traditional populations, who learned over time to live with different environments¹. From this, in the country, the National Policy for Comprehensive Health of the Populations of the Countryside, the Forest and the Waters (PNSIPCFA) emerges, with the objective of promoting access to health services, reducing risks and injuries and improving your indicators and quality of life. These populations are characterized by their ways of life, production and social reproduction, mainly in relation to the land. The rural population is identified as one that depends on traditional knowledge and on the relationship with nature to support itself².

Amazonian riverside dwellers are considered traditional peoples of the forest and have a vast knowledge of the nature in which they live. Therefore, this condition is transmitted by vertical transmission, useful to build, over the generations, a set of knowledge and practices about the natural world and biodiversity, essential for its survival in the forest and on the banks of rivers and lakes³.

Popular practices used in riverside communities are supported by symbolic constructions that reflect the unique way in which riverine subjects conceive and deal with the health-disease-care process. In this way, they differ from other social groups in the way of classifying, naming and solving health problems⁴.

The relationship between mother and child begins in pregnancy, and the influence of culture is perceived from that moment. The riverside culture directly influences the care that is inserted in the mother's daily life. Newborns are vulnerable to customs, as this is the period when they are totally dependent on maternal care, and it is common for prayers to seek the cure of the evil eye, the use of a red ribbon on the forehead to end the hiccup, put castor oil in the umbilical stump or do not bathe the newborn in the first days, as they believe that the baby may die⁵.

Traditional knowledge takes root in the community, usually transmitted orally over generations, making riverside mothers use traditional care more often. The proximity to biodiversity means that several natural resources are used for their survival and care for the child, such as the use of teas to cure diseases⁶.

The importance of popular practices and customs of riverside mothers demonstrating how care is offered to newborns, however, in these communities the population has a cultural and social identity, that is, it is necessary to know their relationship and their main forms of disease

prevention and care. Thus, the following guiding question arose: What are the practices and customs that riverside mothers use to care for their newborn child? In this context, this research aims to analyze the practices and customs of riverside mothers in the care of their newborn children in the municipality of Barcarena, state of Pará, northern Brazil.

II. METHOD

Descriptive, exploratory study with a qualitative approach developed in a Family Health Strategy (FHS), located on Ilha das Onças, municipality of Barcarena, state of Pará, northern Brazil.

Eight mothers of children under five participated in the survey. Participants lived on Ilha das Onças, were registered with the ESF and were 18 years old or older. As for the exclusion criteria, they were mothers not registered in the FHS, who were not 18 years old or more and mothers of children older than five years.

Data collection was carried out in three moments: In the first, the survey of the family register was carried out, identifying the number of mothers who met the inclusion criteria. In the second, we carried out the home visit at the mothers' residence together with the Community Health Agents of each micro area, where we explained to them the purpose of this research, we set the date and time of the interview.

In the third and last moment, we conducted the interviews at the participants' homes, containing guiding questions with open questions, leaving the interviewees free to discuss them. To maintain the anonymity of the participants, we used, for identification, tea names from the Amazon region such as capim-santo, chamomile, boldo, fennel, among others. The interviews were recorded on a device with an audio recorder and later transcribed. All of them signed the Free and Informed Consent Form.

For data analysis, we opted to use the content analysis technique, to find the thematic ideas of the guiding questions and expand the knowledge on the theme, articulating it with the context. In view of this diversification and terminological approximation, we list the stages of the technique according to Bardin⁷, which organizes them in three stages: In the first stage of the pro-analysis, we make an identification and evaluation reading of the acquired material, according to connection between the content of the discussions and the objectives of the study.

In the second stage "exploration of the material", we carry out four phases to gradually convey the essence of the messages. The phases were as follows: decomposition

and standardization of the text, organization of the main thematic ideas and exploration of the material. In turn, in the last stage, the results obtained and the interpretation of the data evaluated the content through the testimonies, using indicators in the form of record units.

This research followed Resolution No. 466/2012 of the National Health Council, which deals with regulatory standards on research with human beings. This work was approved by the Ethics and Research Committee on Human Beings of the Centro Universitário Metropolitano da Amazônia, under the number 3,277,431 and under the CAAE number: 09265119.1.0000.5701.

III. RESULTS

The research was carried out with eight women, aged between 19 and 35 years, with several children between one and five children. As for the level of education, three participants had completed high school, an incomplete high school and four, complete elementary school. As for marital status, one was married, four lived in a stable relationship and three were single mothers. Regarding family income, none had their own income, all worked in family agriculture and received government assistance.

The collected data were submitted to the content analysis technique. Thus, the analysis of the data allowed the construction of four thematic categories that cover the experiences of riverside mothers in the care of their newborn child.

Reasons for the illness of your newborn children

In this category, we seek information about the reasons for the illness of the participants' newborns. In this case, it was observed that the newborns became ill, mainly due to allergies, diarrhea, skin changes and flu, a situation evidenced by the following reports:

"It was more skin allergy, skin infection, I almost had no flu, but I also had diarrhea" (Capim-santo)

"[...] it's more of the nose, throat, sometimes colic" (Chamomile)

"More than viruses, flu and cough, the virus never left her" (Boldo)

"[...] then, with the flu, he was admitted with bronchitis" (Fennel)

Popular care and the perception of improvement

As for this category, we seek to identify the main popular care performed by the participants and their perceptions of improvement. Furthermore, since popular care is a striking feature in riverside communities, we

show that popular care is performed by all participants, especially baths, teas and blessings, as reported below:

"I used home remedy, right? Boiling garlic with andiroba and honey [...] from these fragrant woods, and I took it to bless when I cried a lot" (Mint)

"I made tea, tried to use the resources I had at home, the little plants, lemongrass tea, guava for diarrhea, Dutch tallow [...] I only blessed because my mother insisted, and it was difficult to get to the city" (Capim-santo)

"Then we would make a bath of lemon leaves, a little bit of mint to put on our heads at dawn, right?! [...] here when the child is crying a lot, with weakness, we say that there is a spell, then we take it out to bless" (Fennel)

"[...] he lived in papaya flower tea and guava eyes, he drank rosemary tea to clean his belly, fennel to relieve the gas and when he had a lot of headaches, we took him to bless, then it gets better." (Cinnamon)

Given the above, when interviewed about the perception of improvement with popular care, we identified that everyone perceives improvement with such practices, especially prayers and teas, as reported by the mothers below:

"Yes [...] There are situations that are always resolved, and there is no need to take them to the doctor, because it only works with home remedies. [...] When I realized that there was no way, I took it to the doctor" (Capim-santo)

"Yes [...] when he had a fever, he was already weak, I took him to bless him and he got better right away" (Cinnamon)

"Yes [...] in the case of the virus, the teas work and the evil eye left the day he was blessed, we have faith, right?!" (Fennel)

Acquisition of popular service

In this category, the acquisition of popular care was analyzed. From this, the participants reported that they acquired popular practices and customs with their mothers and grandparents, showing that the family is the main source and disseminator of popular practices, according to the following reports:

"[...] Yes, with my grandfather, he taught my mother who passed it on to me and my sisters, everyone at home bless when the child is very weak" (Chamomile)

"[...] this already comes from my mother's family who learned from her father, right? Whenever he cried a lot and choked, she blessed him. In order not to be enchanted, it was good to put a red ribbon with a talisman or male garlic on the child's arm" (Mint)

"[...] I always saw my grandmother doing this, right?! My mother learned from my grandmother, so I always resorted to natural teas, that's how I learned" (Capim-santo)

"[...] with my grandmother, the one who taught my mother, we saw her blessing when we were children" (Fennel)

"[...] it was passed down for generations because my grandmother was a healer and a midwife" (Cinnamon)

Popular care for umbilical stump, hiccup, abdominal colic, fever and flu

In turn, in this category, popular care was observed with the umbilical stump, hiccups, abdominal cramps, fever and flu. From this, we observe a mixture between the care permeated between the popular and the scientific saber, evidenced by the following statements:

"At home there was a tree, the taperebazeiro (laughs) when I didn't want to heal, my mother took the bark and mixed it with breast milk, then put it in a cloth and tied it to the baby's navel" (Capim-santo)

"[...] we bought alcohol that they send and tie a cloth, right, put the cloth every other day, so as not to stuff the navel" (Mint)

"[...] at the health center, they said to pass that alcohol, 70% alcohol. Every morning I washed well and my mother used to pass andiroba to avoid insects" (Chamomile)

Regarding the hiccup, it was evidenced in the statements that all mothers care for the newborn based on popular knowledge, with the use of a red ribbon on the forehead or a cotton pad soaked in breast milk, according to the statements a follow:

"I would take a piece of cotton and pass it milk and put it on my forehead, or else a red cloth, which would solve it" (Capim-santo)

"It gave breast, (laughs), but my mother immediately put cotton with breast milk" (Cinnamon)

"Just suckled and passed, when not, put red hair on the forehead." (Boldo)

"Usually, I put a cotton pad with breast milk on my forehead, so the hiccup goes away" (Rosemary)

About care for abdominal cramps, fever and flu, mothers reported the use of allopathic medicines with herbal teas and dressings, showing that folk medicine is still very present in our society.

The testimonies reflect forms of child care that are passed on through generations that share beliefs, values and customs, thus constituting popular care that is

influenced by the diversity of cultural values, as shown in the following reports:

"[...] when my baby had colic, i made fennel tea to relieve the gas and gave a few drops of simethicone that passed quickly" (Cinnamon)

"[...] I gave rosemary and mint tea; it is good for belly pain and put a drop of simethicone. When it did not pass, mom took the opportunity to bless, passed quickly" (Lemon grass)

"Mom immediately gave me lemon and mint tea with three drops of paracetamol, because the medicine alone does not solve it" (Fennel)

IV. DISCUSSION

Regarding the reasons for the illness of the participants' newborn children, the results showed that the children became ill from various conditions, the flu was the most cited, that is, the epidemiological situation of the community directly affects the newborn.

Care is possible due to the existence of human frailty, which allows every individual to receive and care, however, a newborn need much more care than an adult, as it is more vulnerable to health in the first days of life⁸.

Newborn care is a priority for public health services due to the priority in reducing infant morbidity and mortality rates, which are still high in many Brazilian municipalities. Care for the newborn is important in preventing diseases, due to the immaturity of its protective cells and due to its condition of defenseless and vulnerable as environmental conditions⁹.

It was found that popular care is still a striking feature in riverside communities, as the use of teas, baths and home remedies was cited as an important custom used by mothers who reveal their perceptions on the subject, even though they are the main protagonists in the home care provided to children.

"Daily care" is perceived as a set of actions aimed at promotion, prevention, diagnosis, treatment, cure and rehabilitation, developed by communities in search of quality of life or better health conditions, having as reference the house where they live and the place where they live¹⁰. Therefore, in riverside communities, this daily care is rich in popular practices that value local knowledge and allow the resolution of health problems.

A striking feature in relation to popular practices used by mothers in caring for their children were medicinal plants and blessing. Medicinal plants and blessings are among the main practices used in traditional communities,

as a form of intermediate care between the human and the sacred, to ward off the evil that afflicts the child¹¹.

The blessing is practiced by elderly women, called healers. There is a relationship established with the sacred, built by religious concepts guided by the Catholic Church and indigenous traditions¹². In addition, the knowledge built by healers, over centuries of religious practices, reveals the experiences of the place.

Religion is one of the aspects that influences the ways of caring since religious plurality integrates the disease in an expanded and diversified sociocultural context¹³.

The Theory of Diversity and Universality of cultural care grounds that nursing practices must be based on the culture of each individual, respecting their beliefs, values, practices, habits and customs. This proposal has as main objective to know different cultures and, thus, provide culturally sufficient and holistic nursing care¹⁴.

Cross-cultural nursing directs nurses to a holistic view of care, and it is essential to know the growing cultural diversity as a wealth that brings challenges to the provision of care. It is necessary to consider the cultural and subcultural elements of families, to respond to their needs and humanize care¹⁵.

Therefore, the application of the theory of transcultural care proposed by Leininger allows nurses to make decisions, plan behaviors to promote humanized and quality care so that they can intervene and care for the communities in which they are inserted¹⁶.

Thus, when interviewed about the perception of improvement with popular practices, we show that even with the availability of allopathic medicines at health centers, riverside residents prefer to use the resources that are within their reach, such as herbs for teas and baths, to solve health problems, based on mysticism and popular knowledge.

In addition, medicinal plants are part of popular medicine practices, composed of a set of knowledge between different users and practitioners, who have a lower income, and that their use comes from popular knowledge, which even with the evolution of scientific knowledge, the use of herbs is still quite common, due to the need to cure some primary diseases¹⁷.

During the speeches, we observed that the popular care was acquired by the female figure, in which the popular care within the family was apprehended, shared and transmitted, since the woman is usually the holder of the knowledge transmitted between the generations. In the family context, the woman, the mother and the grandmothers are the main caregivers and those who most

commonly participate in the responsibility of caring for the newborn¹⁸.

The riverside culture is expressed in the orality of the elderly, who use community and religious spaces to transmit knowledge, values and social tradition to local populations, configuring a practice in which culture is fundamental in the social formation process of these communities¹⁰.

Regarding the care with the umbilical stump, we show that the mothers interviewed mentioned this care permeated between popular and scientific knowledge. In addition, the most current guidelines of the Ministry of Health regarding care for cleaning the umbilical stump are the use of 70% alcohol or 0.5% alcoholic chlorhexidine after bathing and changing diapers, to promote the acceleration of the process dehydration and antisepsis¹⁹.

The umbilical stump is a favorable location for the colonization of bacteria, which can lead to infections with high risk of life for the newborn. There is a great diversity of popular practices in the care of the umbilical stump and that generate doubts about which is the best and most efficient practice to be adopted. Although some mothers reported using 70% alcohol, other mothers cited the use of bark from *Spondias mombin* and *Psidium guajava*, andiroba oil and occlusion of the umbilical stump²⁰.

However, no studies have been found that relate the use of tree bark to heal the umbilical stump in newborns. However, andiroba is scientifically proven to have anti-inflammatory and insect repellent action²¹. Another care not recommended with the umbilical stump is occlusion of the stump. However, covering the umbilical stump with bands or bandages can cause serious infections, by keeping the area occluded, favoring the proliferation of microorganisms⁵.

In these cases, care without scientific evidence that can harm the newborn's health must be readapted. In continuity, in the Sunrise model proposed by Leininger, it is suggested that, after analyzing the dimensions of the individual's cultural and social structure, the nurse should follow the care actions and decisions, including the readaptation or standardization of cultural care¹⁵.

Thus, the use of tree bark and occlusion should be readjusted and clarified by health professionals to the riverside population, that the use of tree bark can cause infections by dirt and umbilical hernia happens for other reasons, which will not be avoided with compression place. Beliefs with the use of tissue in the abdominal region are used to avoid accentuated hernia of the umbilicus, however, this can predispose to infection of the umbilical stump²².

In the case of hiccups in the newborn, we observed that all mothers performed care based on popular knowledge, such as red ribbon on the forehead or cotton soaked in breast milk. However, some mothers reported that they were breastfeeding the baby to stop the hiccups. Hiccup is characterized by a violent inspiratory act, occurring due to a sudden involuntary (spasmodic) contraction producing a hoarse noise, being treated when it is of the benign type by interrupting the breathing cycle that is done by holding your breath for a few seconds or swallowing water, sneezing or breathing repeatedly in a bag, justifying the cessation of hiccups with breastfeeding²³.

Regarding abdominal pain, fever and flu, it was found that even with the insertion of scientific knowledge in the way of life of these traditional communities, such as the use of medicines, the custom of taking the child to bless, giving teas and baths with leaves of herbs, is not replaced due to the beliefs and mysticism that persist in the imagination of riverside communities.

The cultural influence is perceived in the care with the changes presented in the first years of the children's lives, situations in which women seek popular practices and medicalization, confirming the interface between formal and popular knowledge, evidenced using allopathic medicines, and the practice of popular care such as dressings, teas and baths²⁴.

Therefore, in the case of riverside communities, there is a peculiar way of life and an intimate relationship with the environment. In addition, popular practices of care for the newborn are built in the daily lives of communities, and respect for cultural habits and values are acquired by the family, mothers, fathers, grandparents. These life practices need to be inherent in the practice of nursing and, mainly, with regard to child care in the family context⁸.

V. CONCLUSION

The realization of this research facilitated the testimony of the reality of riverside mothers in their care, practices with their newborn children, as well as the maternal cultural values that can influence the care provided to the newborn. Therefore, it was possible to identify that the popular care practices used by mothers are based on customs acquired and passed on from generation to generation, such as teas, home remedies, blessings and baths, which despite the influence of the urban way of life being gradually inserted in the community, we observed that this cultural trait was not lost and allowed us to value cultural similarities and differences, accepting and valuing their cultures.

The importance of the health professional as a community caregiver and mediator of care practices was verified through the knowledge of the cultural values of the area. The health professional needs to understand the woman and her context to assist her in the care directed to the child, in this case, the nurse cannot disregard the mother's cultural care and her past experiences. In addition, this professional should not consider himself as having technical-scientific knowledge, but rather articulate these aspects to make the care of the newborn beneficial.

Finally, we hope that the results obtained in this research can be used in the training of future nurses who want to work with riverside populations and that serve as a subsidy in promoting culturally appropriate assistance, respecting the mothers' local knowledge in caring for their children. In addition, we hope to contribute so that nurses can develop care according to each culture, as proposed by the cross-cultural theory, to promote well-being and health, knowing the cultural context of each community, such as beliefs and values, since this culture should be prioritized in the nurse's vision and care.

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Nursing care for patients in cardiorespiratory arrest: Nurses' knowledge and practice

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Received: 09 Sept 2020; Received in revised form: 15 Nov 2020; Accepted: 22 Nov 2020; Available online: 03 Dec 2020 ©2020 The Author(s). Published by AI Publications. This is an open access article under the CC BY license (<https://creativecommons.org/licenses/by/4.0/>)

Received: 23 Nov 2020;

Received in revised form:

20 Jan 2021;

Accepted: 22 Feb 2021;

Available online: 11 Mar 2021

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Keywords— Cardiac arrest. Nursing care. Cardiopulmonary Resuscitation.

Abstract— Objective: to analyze nurses' knowledge and practices regarding the care provided to patients in cardiopulmonary arrest in the emergency room of a medium and high complexity public hospital in Belém, State of Pará, Brazil. Method: this descriptive, exploratory, qualitative study included ten nurses, who work in the urgency and emergency service. Data collection took place from February to March 2019 through semi-structured interviews. Thematic content analysis proposed by Bardin was used to construct the data. Results: the studied population has deficient and sometimes insufficient knowledge, mostly marked by mistaken speeches and uncertainties, revealing gaps in knowledge and divergences in relation to the resuscitation science consensus necessary to perform adequate care during a cardiorespiratory arrest, and may compromise the effectiveness of cardiopulmonary resuscitation, causing damage to resuscitation and, consequently, contribute to the emergence and / or aggravation of sequelae, which can impact on increased morbidity and mortality. Conclusion: knowledge deficiency is multifactorial, which may be related to the lack of continuous and permanent education, and the lack of personal motivation for the constant search for knowledge, in addition to the lack of incentive to update proposed by the head of the service in the studied scenario.

I. INTRODUCTION

Cardiorespiratory arrest (CRP) remains a worldwide public health problem. Although there have been many advances related to its prevention and treatment, the rate of mortality is still worrying. In Brazil, about 200,000 CRPs are estimated a year, half of the cases that occur in a hospital environment (Intra Hospital Cardiorespiratory Arrest) and the other half in environments such as homes, shopping malls, airports, stadiums and other spaces (Extra Hospital Cardiorespiratory Arrest)¹.

In 2020, until the month of May, it is estimated that more than 170 thousand people died of cardiovascular diseases, according to the "cardiometer" of the Brazilian Society of Cardiology. Despite not being the state with the highest mortality rates from acute myocardial infarction, the state of Pará in Brazil had a variation in the mortality rate from 2003 to 2012, a rate from 40.4% to 53.6%; values that show a clear growth trend².

Cardiorespiratory arrest is defined as abrupt interruption of heartbeat, respiratory movements and loss of consciousness, resulting in irreversible brain damage and death if cardiopulmonary resuscitation (CPR) maneuvers are not performed effectively and in a timely manner¹.

It is the situation considered as the greatest emergency attended in the hospital and pre-hospital environment, where in the latter, approximately 95% of patients die before arriving at the hospital³. The respiratory cardiac paradigm can be classified into four distinct rhythms, namely: Ventricular Fibrillation (FV), Ventricular Tachycardia Without Pulse (TVSP), Electrical Activity Without Pulse (AESP) and Asystole. When any of these modalities are found, CPR maneuvers must be promptly initiated, based on the premise that the brain does not support hypoxia for more than 5 minutes, which leads these individuals to suffer irreversible neurological injuries⁴.

CPR maneuvers aim to maintain the flow of oxygenated blood to the brain and other vital organs until the return of spontaneous circulation and the restoration of homeostasis occurs. These well-executed maneuvers can double and even triple the patient's chance of surviving, constituting the best chance of recovery of neurologically intact cardiopulmonary and brain function¹⁻³. Time is a crucial factor in this situation, it is estimated that for every minute that the patient remains in CRP without high quality CPR maneuvers, there is a reduction of approximately 7 to 10% in their chance of survival, leading to higher mortality in an extrahospital environment without intervention by health teams. Therefore, the Basic Life Support (BLS) and Advanced Life Support

maneuvers are essential to prevent the deterioration of the patient's clinical condition, enabling the maintenance of brain and coronary perfusion, and consequently increased survival with a lower degree of sequelae⁵.

Since CRP is a sudden event, it requires the health professional to quickly recognize and immediately start high-quality CPR maneuvers. For the assistance provided to have an effective result, it is essential that professionals are aware of their role in patient care and that they act quickly and efficiently, with the necessary technical skills and competences to perform this action, in order to reduce the possible complications of CRP, thus reducing morbidity and mortality⁶.

The nursing team plays an important role in care during the CRP, as they are often the first to encounter the situation and initiate resuscitation maneuvers. For this reason, they must be technically prepared to act, knowing how to recognize the CRP and providing the necessary assistance adequately, considering that the patient's prognosis is directly associated with the speed and effectiveness of these actions. However, what has been reported in the literature is that the conduct performed by nurses during a CRP is still unsatisfactory, although they recognize the importance of the theme¹. On October 21, 2020, the new recommendations of the American Heart Association (AHA) Guidelines for CPR and Emergency Cardiovascular Care were published⁷.

In view of the constant updates that are made in the guidelines, it is necessary to train and constantly update the multidisciplinary teams so that they can provide adequate assistance to patients in the light of consensus. In this way, the importance of scientific knowledge marked out for the care of CRP is emphasized, with a quick and correct diagnosis to guarantee success in CPR regardless of the professional's specialty. In the meantime, then this study is justified, denoting the knowledge and practice of nurses working in urgent and emergency services, aiming to contribute to improving the quality of care for patients suffering from CPR, considering that nurses coordinate the teams that pass by longer time with patients and it is usually professionals who initiate CPR maneuvers. Thus, the following question emerged: what is the nurses' knowledge and attitudes about the care provided to patients in CPR?

In this sense, the study aimed to analyze the knowledge and practices of nurses about the care provided to patients in cardiorespiratory arrest in the emergency room of a public hospital of medium and high complexity in Belém, State of Pará, Brazil.

II. METHOD

Descriptive, exploratory research with a qualitative approach, carried out with 10 nurses who work in the urgency and emergency of a public hospital of medium and high complexity in Belém, State of Pará, Brazil, from February to March 2019. Participants were identified through alpha numeric codes, with the following denomination: “E1, E2, E3, respectively, in which the “ P ” means participant and the number the order in which they were addressed in the interview.

Nurses working in the urgency and emergency service of the institution where the study was located were invited to participate. The following inclusion criteria were used: i) Be nurse; ii) Have at least one year of experience in the emergency department; iii) Belong to the age group of 18 to 75 years; iv) Show interest and willingness to participate in the study. The following were excluded: i) The other professionals of the nursing team and the multidisciplinary team; ii) Those employees who were not part of the effective staff of professionals working in the emergency room; iii) Those who had less than one year of experience in the service; and iv) Those who reported unavailability at the time of data collection for reasons of sick leave, maternity leave, vacation, breaks, among other leave.

An interview script was used as an instrument for data collection, and the semi-structured interview was used as a technique. The interviewees' statements were recorded for transcription, analysis and interpretation. Sampling was carried out for convenience, through the snowball process, in which the service professionals indicated other individuals to participate in the research.

The sample closure was due to saturation around two thematic axes. Minayo (2017) describes that in this type of research, 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. The interview script contained items related to the participants' socio-demographic characterization and knowledge about CRP and CPR, such as: 1) What is a CRP ?; 2) What are the signs and symptoms of a CRP ?; 3) Describe how you develop your care for patients with CRP; 4) When faced with a CRP, what are the first procedures to be adopted?; 5) what is the frequency of compression and ventilation recommended by the current CPR guidelines?; 6) What are the cardiac rhythms that the defibrillator needs during a CRP and what loads should be used?; 7) What is the indication, route of administration and care with the drugs used during CRP? After reading and signing the informed

consent form, data were collected, on days and times scheduled according to the availability of the participants.

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 linguistic vices that have meaning in the context of speech.

From the collection of information, it proceeded to the construction of the data, from the methodological framework of thematic content analysis proposed by Bardin⁸. The study corpus made it possible to organize the content into empirical categories, grouped according to the theme extracted from the responses. The results allowed the construction of five empirical categories, namely: 1) Infrastructure and permanent education; 2) Identification of the clinical signs of CRP; 3) Nursing care in CRP; 4) Nursing care in CRP, chest compression and ventilation techniques; 5) Shockable rhythms, defibrillation and knowledge of the pharmacology used during attempts at CPR.

This research was submitted to the Research Ethics Committee of the Nursing undergraduate course at the University of the State of Pará, with Certificate of Presentation for Ethical Appreciation n°: 50869415.8.0000.5170, opinion number: 1,346,432, date of ethical approval CEP / CONEP: 12/02/2015. All participants signed the Free and Informed Consent Term and Authorization Term for Voice Recording before participating in the study. The research was carried out following the norms that regulate research involving human beings contained in resolution n. 510/169 of the National Health Council / National Research Ethics Commission.

III. RESULTS AND DISCUSSION

Among the ten participants, nine were female and one male. Age ranged from 33 to 51 years, mean of 44.6, median of 46 years, with standard deviation of 6.5 and coefficient of variation of 14.65%. The training time ranged from eight to 35 years, average of 19.8, median of 20, with standard deviation of 8.7 and coefficient of variation of 46.95%. Among the ten participants, 90% have a lato sensu post-graduation (specialization) in the areas of Health Services Management, Primary Health Care, Adult and Neonatal Intensive Care, Hospital Infection Control, Occupational Health, Obstetrics and Family Health (Table 1).

Table 1 – Characterization of research participants regarding age group, gender, time since graduation, updating in CRP / CPR and specialization (n.10), Belém, Pará, Brazil, 2019.

CODE	AGE	GENDER	TIME SINCE GRADUATION	UPDATING IN CRP / CPR	SPECIALIZATION
E1	50	F	27 years	PALS - Advanced Pediatric Life Support.	Health Service Management; Epidemiology; Primary Care for Family Health.
E2	33	M	8 years	Pré-Hospital Trauma Life Support – PHTLS; Advanced Cardiac Life Support – ACLS.	Adult Intensive Care and Neonatal Intensive Care.
E3	51	F	26 years	There is no information	Family Health; Health Service Management.
E4	51	F	25 years	-	-
E5	43	F	9 years	-	Public health;
E6	44	F	16 years	Polytrauma rescue in the pre-hospital and hospital – 2013;	Hospital Infection Control; Worker's health; Public health.
E7	36	F	12 years	Advanced Cardiac Life Support – ACLS – 2012	Nephrology.
E8	50	F	19 years	There is no information– 2013.	Nursing work; Obstetrics; Family Health.
E9	48	F	25 years	There is no information– 2012.	Public health; Worker's health.
E10	40	F	21 years	There is no information– 2014.	Family Health.

Source: field research, 2019.

Infrastructure and permanent education

In this category, the professionals discussed issues related to physical structure, human and material resources, which they believe reflect directly on the quality of care provided to patients in CRP. Thus, 70% of the interviewees mentioned that the place has technological support apparatus and an adequate multidisciplinary team for assistance, as observed in the following statements:

E2: “We have the basics to assist a patient in PCR, material, equipment, medication, which may be missing is still better team training, better team training”.

E4: “Here we have all the devices, we need a little more professional qualification, but we have the devices, medication if necessary”.

E6: “Yes, we have the stretcher, the bed, the appropriate bed, the board for cardiac massage, the monitors, the necessary drugs, the necessary staff, doctor, nurse, nursing technicians”.

E7: “There are all the resources besides the material, medicine, the monitoring devices and the complete team, in addition to the respirators, have all the support for cardiorespiratory arrest”.

The lack of training reported by the interviewees is a serious problem for patient care, since the nursing professional must have scientific knowledge and practical experience to act in urgent and emergency situations, as they are usually responsible for initiating the BLS and as they are close to the patients for 24 hours, they are therefore responsible for identifying signs of cardiopulmonary breathing or any other worsening of the patient's clinical condition and initiating CPR maneuvers

when indicated. In addition to CPR procedures, nurses must coordinate an emergency care team, planning the necessary care, requiring continuous professional training from this professional, so that in this way they can develop critical and reflective reasoning, with quick decision making¹¹.

Studies show that nursing professionals generally have insufficient theoretical and practical knowledge, whom they consider to be ideal for performing high quality CPR based on consensus, and this deficit is associated with the absence or training with ineffective methods^{12,13,14}. In this study, this aspect was evident in the statements of the participants:

E2: "What we observe, a negative point that interferes with assistance is the lack of training of the team, especially the technical nursing team".

E4: "I see as a point that needs improvement, the training of the team. We are placed in a sector and do not have the training, we are learning".

E3: "First, the lack of an update course to assist patients in cardiac arrest, according to the physical structure that is not adequate to provide this type of care".

On this subject, the lack of training, motivation for the opportunity of the first job and the need to work, ends up allowing the performance of individuals with little experience in these services, which leads professionals to learn to work in this sector with routine, being sometimes "Trained" by colleagues themselves. In view of this problem, permanent education in this context is essential, aiming at training professionals in the sector; fundamental strategy so that there is a revision in the way of working, of the educational precepts, in order to make possible a qualification to the professionals, and to obtain as a result improvement of the services provided¹¹.

A study carried out at the Cardiology Units of a Hospital at the Federal University of Paraná, Brazil, showed an increase of 29.7% of correct answers in questions about cardiorespiratory arrest and CPR, when applying the same questionnaire before and after an action of Health education. In the same study, indexes higher than the initial one were obtained when the questionnaire was applied three and six months after training, corroborating with the premise that it is important to carry out continuous training, with intervals not exceeding three and six months, aiming to improve the retention of knowledge¹⁴.

Health care requires a structure and processes that, when integrated, produce a system that optimizes outcomes. An effective care system comprises all these

structural elements, processes, systems and patient outcomes, in a structure of continuous quality improvement⁷. The data show a lack of investment in training and qualification for emergency professionals, which could be the differential when carrying out actions related to CPR, which could, in conjunction with other factors, reduce the sequelae rates and increase survival neurologically intact in patients suffering from cardiorespiratory arrest.

Identification of clinical signs of cardiac arrest

In this category, statements related to knowledge about the identification of clinical signs of CRP were grouped. According to the new recommendations of the AHA Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care, the clinical signs of cardiorespiratory arrest are unconsciousness (unresponsiveness), absent breathing (apnea) or gasping (agonized breathing present in 40% to 60% cardiorespiratory arrest) and absence of central pulse (carotid or femoral). Early recognition of these signs allows for faster intervention with the immediate start of resuscitation maneuvers, which provides greater survival for individuals affected by cardiorespiratory arrest.

Searching for success in emergency care in CPR, the AHA presented, based on a wide literature review carried out by peers, the new guidelines, in which it is recommended that care should be quick, effective and in a timely manner, with an emphasis on chest compression high-quality, high-quality external ventilation, artificial ventilation and early defibrillation when indicated, using the algorithm to meet quality requirements (CAB, in which: C - means "Compression, A - Opening of the airways and B - Good ventilation")⁷.

Among the 10 nurses interviewed, 6 presented speeches with statements that meet the recommendations of the literature and consensus of the science of resuscitation. It was evidenced in the speeches that, although they mention the clinical findings of cardiorespiratory arrest, there seems to be conceptual confusion about such signs, in addition to presenting outdated knowledge about current consensus, which can compromise care in this context, as can be seen in the following statements:

E1: "That's when we see the answers using A, B, C, D. The patient who does not respond, we evaluate skin tone, the upper airways, the degree of consciousness, in this sense checking whether it is a stop or not".

E2: "There is no pulse, no breathing, bradycardia, sweating, decreased level of consciousness".

E5: *"Breath below 18, SPO2 less than 85%, blood pressure = 80x50mmHg, loss of consciousness, heart rate less than 50bpm".*

E7: *"It is when the patient arrives without any respiratory function and sometimes with no heartbeat. There was a respiratory arrest but there is a heartbeat or sometimes he arrives without both".*

There were many conceptual misunderstandings in the nurses' statements, in addition to being outdated. Regarding the "ABCD" mnemonic mentioned by participant E1, AHA updated it in its 2010 consensus for CAB, as already mentioned. It should be noted that individuals in bradycardia are not in cardiorespiratory arrest, as well as hypotensive individuals; these findings, when present, represent hemodynamic instability, which if not managed early and clinically stabilized can lead to cardiac arrest. Respiratory function may or may not be preserved, considering its function in its widest dimension (uptake, diffusion and use of oxygen by the cells) even in apnea, however with a decrease in the level of consciousness there is a deficit in the stimulus of the respiratory center in the central nervous system; there may be airway obstruction due to tongue fall, among other factors that are associated with impaired ventilatory/respiratory functions, but its function can still be preserved in another dimension.

When analyzing the nurse's statement E5, it is possible to notice the total ignorance and disagreement of the clinical signs of cardiorespiratory arrest mentioned, with the consensus of the science of resuscitation. In the response of nurse E1, it was noticed the disagreement and the lack of updates about the recommendations. Thus, it appears that this professional is unaware of the consensus and updates of AHA7. It is observed that the interviewee prioritizes the evaluation of skin color and upper airways before the evaluation of other parameters of greater relevance, which bring clear and greater benefits for the survival of patients victims of cardiorespiratory arrest recommended by peers in the guidelines.

It can be seen that the E7 professional believes that cardiopulmonary breathing is the absence of respiratory function and "sometimes the absence of heartbeat". It is worth mentioning that the absence of cardiac movements is one of the clinical manifestations of the respiratory cardiac paradigm. That is, there will always be an interruption of the heartbeat, otherwise it cannot be considered as cardiorespiratory arrest. Furthermore, professional E2 mentioned bradycardia as clinical evidence of cardiopulmonary arrest, however it does not fit as evidence of cardiac arrest reported in the consensus, since in cardiac arrest there is a decrease in heart rate and

no absence of mechanical activity, which characterizes cardiac arrest¹.

In this study, the question with the highest rate of correct answers was about the recognition of cardiorespiratory arrest, as it diverges from another study, which revealed that only 33.3% of nurses and 68.9% of nursing technicians have clear concepts and detected the cardiorespiratory arrest correctly¹⁵.

Nursing care in cardiorespiratory arrest

In this category, the statements related to the nurse's actions in front of an adult victim in cardiorespiratory arrest were grouped. With regard to the initial actions of the nurse towards the individual in intra-hospital cardiorespiratory arrest, it is evident that the individuals interviewed here have basic knowledge, and prioritize the fundamental actions recommended by the current consensus, however there are still deficits of knowledge and conceptual non-conformities, as can be seen in the following statements:

E1: *"First procedure is massage and intubation".*

E3: *"We start to massage the patient and do the ventilation process with AMBU".*

E9: *"We provide cardiac massage at the same time doing ventilation and intubation, another professional does the medication part".*

It should be noted here that the most appropriate and accepted term in the scientific world for "cardiac massage" is "external chest compression". Professionals E1 and E9 refer to intubation, making it clear that this procedure is performed in this context as a nurse's action, however it is worth mentioning that it is assigned to the medical professional to perform a definitive advanced airway, orotracheal intubation, according to the Exercise of Medicine Law (Law No. 12,842 / 2013)¹⁶. When a cardiorespiratory arrest occurs, nursing should assist in the procedures of intubation, drug administration, monitoring, and other actions applicable to each member of the nursing team in accordance with current legislation¹⁷.

In this context, the main aspects of Advanced Life Support in adult cardiology are: emphasis on performing high quality CPR maneuvers; early administration of vasopressor (administration of adrenaline during shockable and non-shockable rhythms is associated with increased rates of hospital survival); early administration of antiarrhythmic drugs in rhythms refractory to defibrillation, early defibrillation when indicated, recognition of reversible causes of cardiorespiratory arrest, installation of advanced airways, quality ventilation avoiding hyperventilation, in addition to

maintaining critical points of the BLS, such as: chest compressions in the frequency minimum of 100 not exceeding 120 compressions per minute, allow the full return of the chest to each compression, change the massagers every 2 minutes to avoid exhaustion and minimally interrupt CPR maneuvers. In addition, the use of hemodynamic monitoring, with waveform capnography can optimize the quality of CPR and serves as an indicator of Spontaneous Circulation Return and is an indicator for the cessation of attempts in CPR maneuvers^{7,18}.

Regarding the aspects related to the nurses' practice that refer to Advanced Life Support, the following statements stand out:

E5: "We administer medication prescribed by the doctor, check vital signs, administer oxygen".

E8: "We check for breath, check for airway obstruction, keep the airway clear so that medications can be administered".

The testimony of participant E5 relates to checking vital signs when assisting cardiorespiratory arrest. However, classic vital signs are more present in evaluations of patients in post-paradigm-respiratory care. The nurse must constantly evaluate and monitor the patient, but in addition to paying attention to the classic vital signs (blood pressure, heart rate, respiratory rate, temperature and pain), he must expand this monitoring with saturimetry/pulse oximetry, waveform capnography, cardioscopy, capillary glycemia, Noninvasive or invasive blood pressure (NIBP), blood gas when available, among other parameters of clinical and laboratory importance, in order to identify any sign of return of spontaneous circulation, complication and thus prevent damage and sequelae, increasing this forms the neurologically intact survival among these patients¹⁹.

It should be noted that participant E8 refers to the maintenance of permeable routes for drug administration, although it sounds strange, this is a method that can be used as an alternative in CPR procedures, in the event of the impossibility of IV or IO access. Although many drugs can be absorbed by the lung, the endotracheal route is not recommended as preferred. Studies report that drugs such as lidocaine, adrenaline, atropine, naloxone and vasopressin can be effectively absorbed via the endotracheal route. It is described that the administration of these drugs through the endotracheal route, during CPR, results in lower plasma concentrations when compared to the same doses administered intravenously (IV).

Animal studies suggest that low plasma concentrations of adrenaline, after endotracheal administration, may

produce beta-adrenergic effects, resulting in vasodilation. If intravenous IV and intraosseous (IO) access are not possible to be established, adrenaline, lidocaine and vasopressin can be used by the endotracheal route, paying attention to the change in dose from 2 to 2,5 times higher than the doses administered by route intravenous, and dilution in 5 to 10 ml of saline or sterile water²⁰.

Chest compression and ventilation techniques

When asked about the techniques of external chest compressions and ventilation, the following speeches emerged:

E2: "The ratio is 30 massages for 2 breaths in patients not intubated. The technique is one hand extended over the other at the level of the sternum, so you can make the thoracic comprehensions".

E10: "30 compressions for 2 breaths. Hands splayed fingers interlaced and positioned in the region of the sternum, lightly presses the left hand with a depth of 5 cm allowing time for the return with a rhythm of about 80 - 100 movements per minute".

We can see that the statements of the professionals analyzed here correctly describe the relationship between external chest compression and ventilation recommended by the current guidelines, 30 compressions for 02 ventilations. However, when referring to the technique used in CPR, the interviewees took the placing of hands on the sternum bone as an anatomical reference, however without defining the exact location of the hand, to be positioned on which sternal follow-up. What is believed to be an action that can compromise the quality of CPR^{4,7}. In addition, participant E10 mentions that the frequency to be used is "more or less 80 - 100 movements per minute", again denoting outdated and ignorance about the technique recommended by the consensus, both with regard to the frequency of compressions, the appropriate depth and laterality of the hands.

Regarding the actions after the recognition of cardiorespiratory arrest, according to the AHA, external chest compressions should be performed at a frequency of 100 to 120 / min, compressing to a depth of at least 2 inches (5cm), not exceeding (2,4 inch) 6 cm, allow the full return of the chest to each compression and minimize interruptions; the professional must take care not to perform the compressions more or less than the recommended frequency, as well as not to compress more than 2.4 inches (6 cm) or lean on the patient's chest in the interval between compressions. This priority focuses on changing the pattern from ABC to CAB, increasing the emphasis on prioritizing compression over airway opening and ventilation⁷.

The main aspects to be observed in CPR are frequency, depth, return of the chest to each compression and minimal interruption. For adequate tissue oxygenation, it is essential to minimize interruptions in chest compressions and maximize the amount of time chest compressions generate blood flow¹⁸.

Regarding the technique and anatomical points that should be used as a reference for performing external chest compressions, only the tenar and hypotenar region of a hand (randomized clinical trials describe that the dominant hand had better CPR quality and better outcomes) should be positioned on the lower half of the victim's sternum bone, and the other hand overlapping the first, interlacing the fingers, with the hand that first touches the flat chest, without the rest of the rescuer's hand touching the victim's chest. Furthermore, it is recommended to extend the arms and keep them at a 90° angle, perpendicular to the victim's body^{7,18-21}.

Shockable rhythms, defibrillation and knowledge of the pharmacology used during attempts at Cardiopulmonary Resuscitation

In this category, it was found that there is a lack of knowledge related to the identification of cardiac arrest rhythms that require defibrillation, as well as the loads used in the defibrillator during cardiorespiratory arrest. No professional knew how to answer the rhythms that require defibrillation, and only one professional mentioned the load used in the defibrillator during cardiorespiratory arrest, however, his response was not adequate when compared to current consensus. The data found here converge with the study carried out in Pernambuco, Brazil, in which most nurses and nursing technicians did not know how to recognize the rhythms of cardiorespiratory arrest, scientifically described in the literature, namely: TVSP, FV, AESP and asystole¹.

Regarding the knowledge of cardiac arrest rhythms, a survey conducted with nursing professionals who work in the Intensive Care Unit, revealed that these professionals considered only asystole as a cardiorespiratory arrest modality, not pointing out the other modalities (FV, TVSP and AESP), in addition to not understanding which rhythms require defibrillation and in which there is no shock recommendation¹⁵.

Cardiopulmonary arrest occurs in 3 phases, namely: electrical phase, in which there is a cardiac collapse; circulatory or hemodynamic phase, characterized by deprivation of substrates necessary for metabolism; and metabolic phase, with acidosis and cellular dysfunction. Cardiopulmonary arrest can be caused by four rhythms or modalities: FV, TVSP, AESP and asystole. The victim's survival depends on the integration of the BLS, the

Advanced Life Support in Cardiology, and post-resuscitation care, in addition to the care in the recovery phase recommended in the current CPR guidelines of 2020. For victims of cardiopulmonary in the FV modalities and TVSP, performing CPR and early defibrillation has shown a significant increase in survival^{7,18-22}. However, there are no recommendations on shock delivery in cardiopulmonary arrest due to asystole and AESP⁷. Despite the clear recommendation in consensus and guidelines, some studies have pointed out that health professionals often recognize asystole and AESP as shockable cardiac rhythms^{1,7}, as can be seen in the statements:

E2: "Atrial fibrillation, ventricular tachycardia, using 260J of load. Using 1 or 2 mg of adrenaline".

E6: "Asystole and atrial fibrillation, starting with 50J, according to patient assessment and medical advice".

When comparing the findings of this study with the guidelines and consensus on the topic, we show that the professionals evaluated here lack knowledge about the subject, as it was evident in the statements, that they do not know which rhythms need defibrillation, as well as which loads are used in the defibrillator. It is described that when performing the monitoring, and the revealed pace is either FV or TVSP, there is a clear recommendation to defibrillate, considering that the studies describe better survival rates in this group of patients. In the biphasic defibrillator, the shock energy must be between 120 and 200J, according to the manufacturer's guidelines. In the single-phase defibrillator, the recommended load is 360J^{7,23}.

Regarding the use of vasopressors, represented here by the adrenaline reported by the professional E2, we observed convergence with the current guidelines with regard to the drug of first choice. However, the nurse ponders about the dose to be administered in the wrong way, considering 1 to 2 mg. In a study conducted in a public university hospital in the interior of Paraná, Brazil, it was identified that there was a significant difference in the number of correct answers regarding issues related to the route of administration, drug used and mechanism of action, when performing analysis pre and post educational action, demonstrating that nursing professionals are unaware of the characteristics and indications of the drugs used during CPR. Given this, the importance of continuing education in the hospital environment is emphasized once again, especially in emergency services²⁴.

It is a consensus that after the first shock, CPR is performed for 2 minutes, followed by a rhythm check on the monitor. If FV or TVSP rhythms persist, a new high energy shock is performed, followed by CPR for 2 minutes. The timing for administering the vasopressor has not been established, and its onset should be considered after establishing an intravenous or intraosseous approach. Early administration of vasopressors has the ability to optimize myocardial blood flow before the next shock. At any pace of cardiorespiratory arrest, the first vasopressor drug of choice should be adrenaline. Although the level of evidence is limited, administration of adrenaline is recommended at a dose of 1 mg every 3 to 5 minutes via IV or IO^{7,18}.

Participant E6 states that Asystole and atrial fibrillation (AF) are the stopping rhythms that require defibrillation, and that the load to be used is 50J, however Assistolia is a pace in which defibrillation is not indicated because it does not present benefits in clinical trials. In this modality, it is necessary, then, to promote high quality CPR, administration of vasopressor drugs, in addition to recognizing and treating the reversible causes of cardiorespiratory arrest (5H and 5T). Atrial fibrillation, mentioned by these participants, is not recognized as a rhythm of CRP, and despite being a potentially fatal arrhythmia, it is not characterized as cardiac arrest because there is electrical, mechanical and metabolic activity^{7,25}.

IV. CONCLUSION

The objective of analyzing nurses' knowledge and practices regarding the care provided to patients in cardiorespiratory arrest in the emergency department of a public hospital of medium and high complexity in Belém, State of Pará, Brazil was achieved as demonstrated in the results.

It was evident that the studied population has deficient and sometimes insufficient knowledge, mostly marked by mistaken speeches and uncertainties, revealing gaps in knowledge and divergences in relation to the resuscitation science consensus necessary to perform adequate care during a cardiac arrest. Knowledge deficiency is multifactorial, and may be related to the lack of continuous and permanent education in the service analyzed, and the lack of personal motivation for the constant search for knowledge, in addition to the lack of incentive for updating proposed by the management in the studied scenario.

It is understood that cardiorespiratory arrest is a sudden event that demands from nurses the scientific knowledge, technical skill and critical reasoning, as these

professionals are most often the first to identify and initiate CPR maneuvers. In this sense, inadequate knowledge about cardiorespiratory arrest and CPR can contribute to the worsening and / or the appearance of permanent sequelae, thus increasing the morbidity and mortality of assisted patients.

The significant number of incorrect answers in this research evidenced the need to update all nurses who work in the studied scenario, with the realization of theoretical and practical training in a continuous and periodic way about the actions performed in the face of a cardiorespiratory arrest, in order to enable that professionals provide fast, safe and effective assistance within what is recommended in the international consensus of the AHA Cardiopulmonary Resuscitation science, maintaining the uniformity of the conducts between the teams and thus improving the care provided to the patient, and consequently the neurologically intact survival.

Thus, it is conjectured that some of these professionals may be encouraged to perform the service motivated by the fulfillment of actions associated with solidarity, without, often, having knowledge based on the theme.

The limitations of the study were to carry out only the theoretical knowledge approach and not have evaluated the practical skills, in addition to a small sample of the participants, which does not allow for more comprehensive results and generalizations. Additionally, the study was carried out in a specific region of Brazil, which makes it difficult to generalize the results obtained for a national and international scenario.

It is understood that the institution of training and their evaluation is fundamental, in a theoretical and practical way, as a way to optimize and consolidate knowledge continuously, in periods not exceeding three to six months, which may be the subject of other studies.

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Sustainable Motor Oil Recycling Process using Banana Peel (*Musa Paradisiaca*) for Fe ion Adsorption

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Received: 11 Dec 2020;

Received in revised form:

24 Jan 2021;

Accepted: 20 Feb 2021;

Available online: 14 Mar 2021

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Keywords— Potentially toxic elements, banana
peel, *musa paradisiaca*, Adsorption.

Abstract— Due to the inadequate disposal of materials containing potentially toxic elements, the concern with the preservation of the environment has increased. Biosolvent materials have been used as an alternative material to treat waste. The objective of this paper was to test the efficiency of banana peel (*musa paradisiaca*) for the adsorption of Fe ions present in spent motor oils. The banana peels were dried, crushed and sieved (16 mesh). The oil used was collected from the disposal tanks in gas stations in the city of Uberaba, Minas Gerais State, Brazil. The analyses were carried out in batch mode, under agitation, to guarantee contact between the adsorbent and the oil. After contact, oil and adsorbent were separated by centrifugation or by vacuum filtered. The process of liquid-solid separation by centrifugation influenced the results due to the action of the centripetal force causing the separation of the ions by drag but resulted in a removal efficiency of 33.43 to 94.53% of Fe iron removal from the oil, depending on the treatment time. Using vacuum filtration, the process had an efficiency of 38.58%.

I. INTRODUCTION

According to the annual report by the National Association of the Automobile Vehicles Manufacturers (Associação Nacional dos Fabricantes de Veículos Automotores - ANFAVEA), 91 million vehicles were produced worldwide in 2019 (ANFAVEA, 2020) and it is estimated that there are 1.4 billion vehicles in use. Lubricating oil is an essential for the operation of these motor vehicles, as it plays a role in reducing friction, heat transfer and corrosion resistance (Li et al., 2020) and approximately 40 million tonnes of lubricating oil are required annually to service the world fleet (Lam et al., 2016). Lubricating oils are complex and contain various additives, such as antioxidants, defoamers, anti-wear, thickeners, corrosion protection, detergents, dispersants,

pour point depressants and extreme pressure additives (Yash et al., 2015).

According to the Brazilian technical standard, NBR 10.004 (ABNT, 2004b), lubricating oil is classified after use as a dangerous waste, due to its characteristics of flammability, corrosivity and reactivity. After use, lubricating oils contain degraded additives and undesired substances that can cause adverse effects that also justify the classification as dangerous waste (Lam et al., 2016).

It is a fact that a large part of these lubricants in the post-use phase are discarded and cause pollution of the environment, contaminating soils and groundwater reaching food, harming public health. In Ordinance No. 685, of August 27, 1998, ANVISA establishes maximum levels of contaminants (mycotoxins, inorganic

contaminants, pesticide residues, veterinary drugs and migrants from packaging and equipment in contact with food) in foods that pose risks to human health (ANVISA., 1998).

With the proposal of contributing to the reduction of the inappropriate disposal of industrial contaminants, this work was developed with the purpose of treating automotive oils in a sustainable manner. Treatment of used oils is a subject of few studies; however, it covers a wide area of research.

As a concept of sustainability, the practices of 6R (recover, remanufacture and redesign, recycle, reduce and reuse) promote actions that reduce the impacts generated by the incorrect disposal of this waste (Jawahir and Bradley, 2016). In the context of the remanufacturing of lubricating oil, the 6R concepts contribute to the mitigation of the environmental impact caused by this dangerous waste, which can contain soot, polycyclic aromatic hydrocarbons and metal ions present in oil additives (Peng et al., 2018).

In addition to mitigating the impacts caused by the disposal of this waste, it is worth mentioning that there are economic advantages in the practices of the 6R concept, as explained by Jawahir and Bradley (2016). These purification practices can be conducted by many techniques, such as adsorption (Miyagi et al., 2003),

Table 1. Main elements and contaminants in lubricating oils (Concawe, 1996)

Elements	Origen	Limits (ppm)
Ba	Detergent additives	<100
Ca	Detergent additives	1000 - 3000
Mg	Detergent additives	100 - 500
Zn	Anti-wear additives	500 - 1000
Fe	Engine degradation	100 - 500
Cr e Ni	Engine degradation	Traces
Al, Cu e Sn	Bearing	Traces
Si	Additives/water	50 - 100
S	Base oil / combustion products	0.2 – 1%
Light hydrocarbons	Fuel	5 – 10%
Poly aromatic hydrocarbons (PAH)	Incomplete combustion	<1000

The adsorption process involves fixation of soluble liquids and/or gases on the surface of a solid (Fiyadh et al., 2019). The adsorption operation exploits the ability of given

extraction (Mohammed et al., 2013), hydrotreating (Ramasamy et al., 2007), coagulation, oxidation and vacuum distillation (Shri et al., 2014).

In the context presented, this study aims to test the efficiency of the *Musa Paradisiacal* banana peel in adsorbing Fe ions present in used automotive oils, by employing an adsorption process. For this purpose, this article will be structured as follows: In section 2, a literature review on the concept of Adsorption that will serve as a methodological basis for the study proposed in this article. Section 3 presents the methodology for the present study and the results are presented in section 4. Contributions and conclusions are discussed in section 5.

II. LITERATURE REVIEW

In addition to the basic oil degradation products, the original additives are also present in the used oil and have not yet been consumed (Li et al., 2020), as well as metals from engine and machine wear, such as lead, chromium, barium and cadmium (Peng et al., 2018). Various contaminants, such as water, unburned fuel, dust, and other impurities are also encountered (Pinheiro et al., 2017). Table 1 indicates the main contaminating elements found in lubricating oil and the concentration ranges encountered.

solids to concentrate certain substances present in liquid or gaseous solutions at their surface, allowing them to be

separated from the other components present in these solutions (McCabe, 1986).

These substances are called adsorbates (Yang et al., 2015). There are two main types of adsorption: physisorption and chemisorption (Nascimento et al., 2014). Physisorption occurs when the adsorbent and adsorbate are joined by Van Der Waals forces and chemisorption occurs when the adsorbate molecules are bonded to the surface of the adsorbent by chemical bonds (Fiyadh et al., 2019). McCabe (1986) complements that these processes can also be defined as physical adsorption or chemical adsorption and explains that physical adsorption occurs only by adsorption of the component (solute) of interest in the pores of the adsorbent, whereas in chemical adsorption there is a reaction between the adsorbent and the adsorbate.

There are several methods for removing metal ions, including ion exchange, solvent extraction, reverse osmosis, precipitation, coprecipitation and adsorption. Activated carbon and other carbon-based adsorbents are widely used because they are efficient in removing (via adsorption) metal ions. Due to the high cost of synthesis and regeneration of activated carbon, there is a continuous search for low-cost adsorbents, which demonstrate efficiency in the adsorption process (Ferreira, et al., 2015).

In the relevant literature, several different types of adsorbent have been used for the removal of heavy metals. These are separated as adsorbents of non-organic or organic origin. For the first group, modified chitosans, manganese oxides and extracellular polymeric substances (Yang et al., 2015), activated sodium titanate nanofibers (Sountharajah et al., 2015b), among others, can be exemplified. For the organic group, peanut shells (Brown et al., 2000), peat and sewage sludge ash (Ho and McKay, 1999), granular biomass (Hawari and Mulligan, 2006), fly ash (Weng and Huang, 2004), landfill clay (Ghorbel-Abid and Trabelsi Ayadi, 2015), activated carbon (Sountharajah et al., 2015a), and sugarcane bagasse (Ferreira, 2015), can be mentioned.

It is a fact that all these adsorbents suffer from some limitations, such as low adsorption capacity and low levels of effectiveness and efficiency in removing heavy metals, and have their efficiency measured by adsorbed components that are concentrated on the outer surface of the solid. Therefore, the larger the surface area available, the more favorable it will be for the adsorption process. The particles that act as the adsorbent, present between 5 to 30% of adsorbed area, reaching 50% in exceptional cases (McCabe, 1986).

Yang et al. (2015) explains that the quality of this process depends on the adsorption capacity, which in turn

depends on the characteristics of the adsorbent surface and how it interacts with specific pollutants. For example, surface load, surface area and functional groups can produce different levels of activity for different pollutants.

When considering adsorption processes and adsorbents of organic origin, three important studies can be cited:

- a) Brown et al., (2000) evaluated the potential of peanut shell pellets to capture metal ions from wastewater and compared their performance to that of raw peanut shells and a commercial quality ion exchange resin. The 90% removal of Cu^{2+} , Cd^{2+} , Zn^{2+} and Pb^{2+} was verified.
- b) Ferreira (2015) described the efficiency of Cu^{2+} and Cr^{3+} adsorption from liquid effluents, using the sugarcane bagasse ash. The results indicated an average removal efficiency of 97.3% for Cr^{3+} and 96.4% for Cu^{2+} , and this material can be applied as an adsorbent in industrial effluents.
- c) Abdel-Jabbar et al., (2010) investigates the recovery of automotive lubricating oil used by different adsorbent materials, such as shale egg powder, date palm almond powder, and acid activated palm kernel powder by adsorption processes and obtained results in the extraction of asphaltenic contaminants and metallic oil residues.

III. METHODOLOGY

3.1. Infrared Spectroscopy (FTIR)

As presented by Concawe (1996) in used automotive oils it is possible to verify a concentration of 100 to 500 ppm of Fe ions. With the objective of verifying whether the samples collected for this study contained Fe ions or other elements resulting from their decomposition in the used automotive oil, the methodology of Infrared Spectroscopy (FTIR) was used to identify traces of Fe or derived by-products of Fe.

3.2. Banana peel treatment

As a starting point to carry out the tests to determine Fe in the samples, according to the methodology of Skoog et al. (2013) and Nascimento et al. (2014), the banana peels, raw material for the adsorbent in this study, were placed in an oven at a temperature of 60° C for a period of 48 hours and, subsequently, crushed in the knife mill. The crushed material was passed through a granulometric sieve, selecting the particles of interest with 16 mesh.

3.3. Calibration curve for concentration calculations

Then, as initial tests, using the dilutions made from the standard $\text{Fe}(\text{NO}_3)_3$ (1000 mg/L), it was possible

to plot the calibration curve (Figure 1), which made it possible to obtain the iron concentrations in the samples under study.

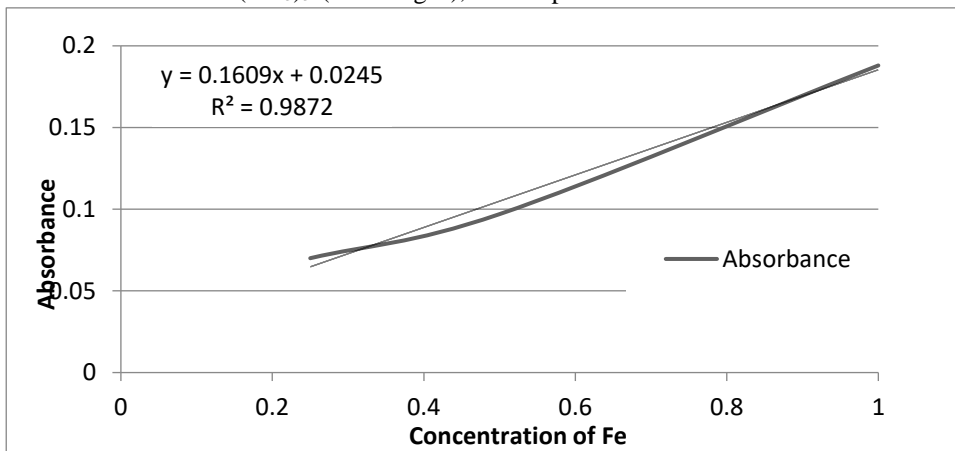


Fig.1: Calibration curve for concentration calculations

According to the methodology of Skoog et al. (2013) for Fe determination in samples, the calibration curve was generated from the standard iron (III) solution (1000mg / L) diluting to the concentrations (mL/L) of 0.80, 1.60, 2.40, 3.00, 20.00 and 4.00, following reading spectrometer. All samples were treated at room 25°C.

3.4. Motor oil treatment

The used oils studied here were collected from gas stations in the city of Uberaba-MG. After collection of all material, the oil samples were homogenized.

Before starting the adsorption tests using the peel and used oil, the base level of Fe ions in unused oil was determined by adding 7.2×10^{-3} g of iron (III) nitrate ($\text{Fe}(\text{NO}_3)_3$) per gram of unused automotive oil. The dilution of $\text{Fe}(\text{NO}_3)_3$ is very slow, and the mixture was stirred for 24 hours to ensure the homogeneity of the mixture. These initial tests were important to determine the ideal contact times between the adsorbent and the oil for the adsorption process to occur.

3.5. Variation parameters

Treatment of the used oil was performed by varying parameters such as adsorbent mass, oil mass and the contact time, with the objective of increasing the

efficiency of adsorption of the iron, present in the oil, using the peel.

The banana peel and the oil were homogenized by magnetic stirring for determined contact times, defined as homogenization time (T_h). Subsequently, the separation step was performed by vacuum filtration (filter paper diameter of 15 μ m). For the purpose of comparison, the separation was also performed using a centrifuge for 5 mins at 2000 rpm.

After treatment, the banana peel (2 g) and oil (2 g) from each sample were calcined in a muffle furnace and, subsequently, the quantification of iron present was performed.

IV. RESULTS AND DISCUSSION

4.1. FTIR analysis of oil samples

With the results obtained using FTIR, it was possible to obtain the spectrum given in Figure 2. The bands corresponding (1) to 487 cm^{-1} and (2) to 644 cm^{-1} can be associated with literature values (Namduri and Nasrazadani, 2008), proving the presence of Fe by-products, originating from engine wear.

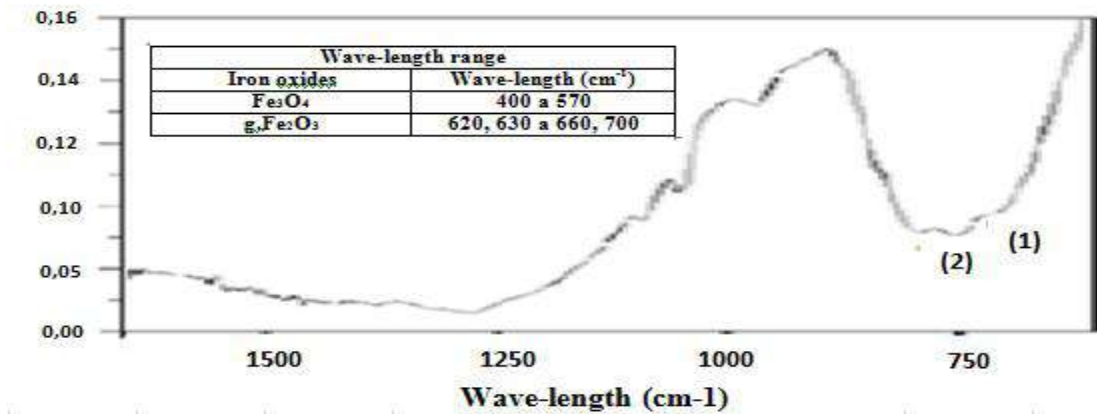
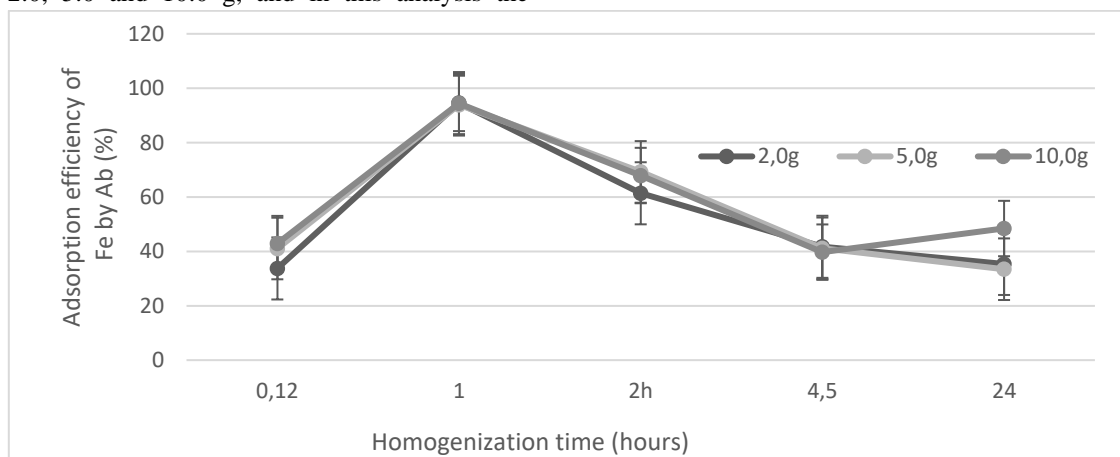


Fig.2: FTIR analysis of oil samples

4.2. Fe absorption efficiency by A_d

To analyze the effect of homogenization time (T_h) on the absorption efficiency of Fe by the adsorbent (A_d), centrifugation tests were performed on oil samples (40 g), with a centrifugation time of 20 min, in which the T_h was varied by 0.12, 1.0, 2.0, 4.5 and 24.0 hours and the weight of A_d at 2.0, 5.0 and 10.0 g, and in this analysis the

centrifugation time was fixed at 20 min. In these tested conditions, the concentrations of Fe in the oil samples, the Absorbances and the % of Fe in the oil samples were obtained and are shown in Figure 3. Each analysis was performed in triplicate, and the results are given in Table 2.

Fig.3: Variation of Fe adsorption efficiency as a function of T_h of A_d mass.

The values obtained in the tests were based on concepts of analysis of variance and hypothesis testing for an analysis of equality of means for a significance level of 5%. In this case, when the statistical significance (p) is greater than 0.05, the variables are considered statistically equal; when

it is less, they are considered statistically distinct. For these calculations, Analysis of Variance (ANOVA), and Student's t test were employed. The significance level of the averages was 0.0089, being characterized as statistically distinct, with 95% reliability.

Table 2. Residual iron concentration in samples varying T_h and A_d mass

Treatment data		[Fe] (mg Fe/Kg of oil)*	% Fe
A_d (g)	T_h (h)		
0.0	-	75.11	100.00
2.0	0.12	49.78	66.28
2.0	1.00	4.10	5.47

2.0	2.00	29.02	38.64
2.0	4.50	43.80	58.32
2.0	24.00	48.53	64.62
5.0	0.12	44.27	58.95
5.0	1.00	4.57	6.09
5.0	2.00	23.09	30.78
5.0	4.50	44.22	58.88
5.0	24.00	49.99	66.56
10.0	0.12	42.91	57.14
10.0	1.00	4.19	5.59
10.0	2.00	24.11	32.11
10.0	4.50	45.27	60.28
10.0	24.00	38.75	51.60

As the objective of analyzing the interference of Th in Fe absorption efficiency by Ad in percentage and this is shown in Figure 3. Note that Th was efficient for values close to 1h, and the values for 2.0, 4.5 and 24 h the values obtained were unsatisfactory. This fact is explained by McCABE (1986) in which the desorption process, which is the passage of the solute particles to the liquid phase, that is, the inverse adsorption process can occur. For the value of 0.12 hours the result was also unsatisfactory, and this fact can be explained by the low time given for the adsorption process to occur.

4.3. Influence of Ad on Fe adsorption

It can also be noted in Figure 4 that when the Ad mass was varied, the results obtained are very similar, showing a significant difference for the treatment with 2.0 g of peel. The fact that there is little significant difference in the residual amount of iron, suggests a more detailed analysis of the contribution of Ad mass to the absorption efficiency of Fe by A_d .

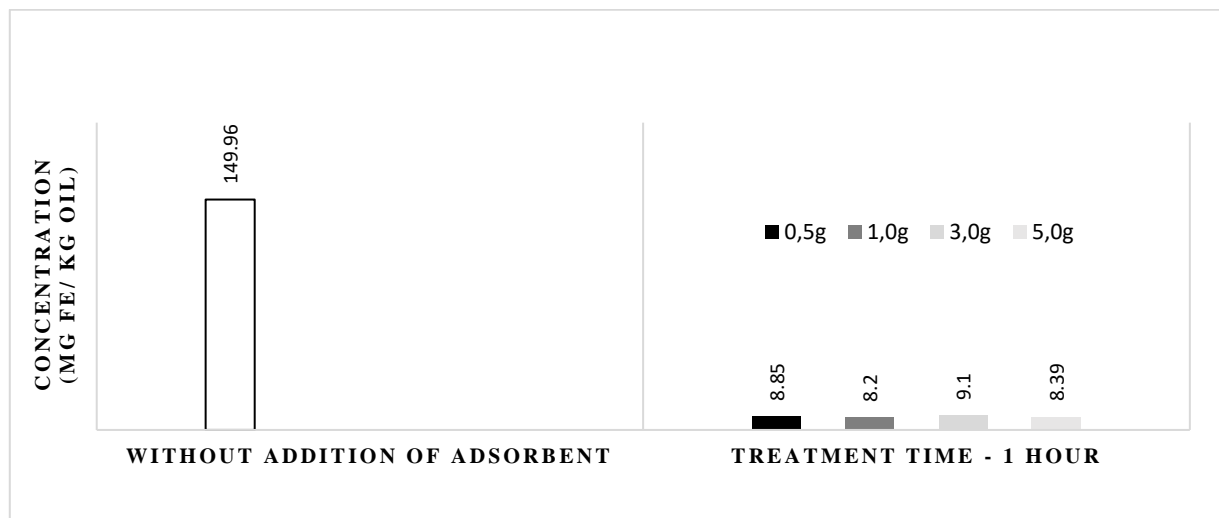


Fig.4: Residual iron concentration after centrifugation, varying the A_d mass.

To prove that the amounts of Ad would not influence the adsorption process, another test was carried out on samples of 40 g oil, varying the amount of peel by 0.5, 1.0, 3.0 and 5.0 g and setting T_h to 1 h and the centrifugation time at 20

min. These results are presented in Table 3 and in Figure 5, confirming that, as observed in Figure 4, there is significant effect of A_d mass on the adsorption process.

Table 3. Residual Fe concentration varying the A_d mass and fixing T_h at 1 h.

A_d (g)	[Fe] (mg Fe/Kg of oil)	Absorbance	% Fe
-	149.96	1.231	100
0.5	8.82	0.096	5.88
1.0	8.20	0.090	5.47
3.0	9.136	0.098	6.092
5.0	8.390	0.092	5.595

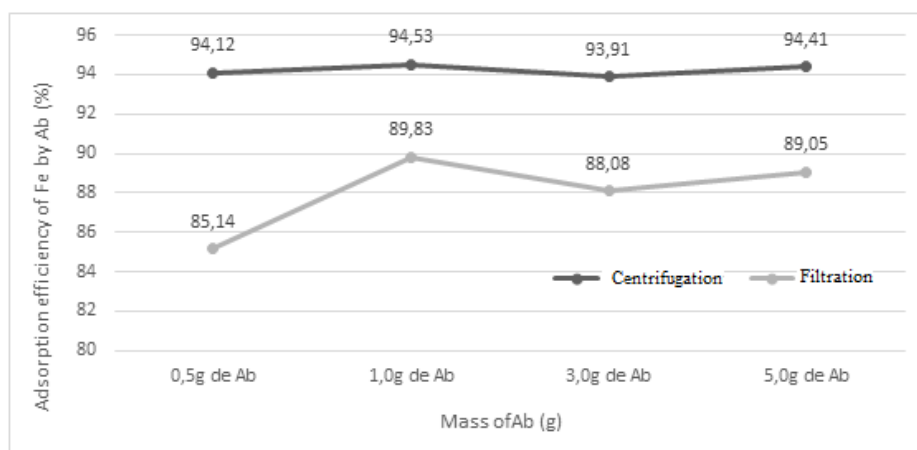


Fig.5. Comparison of absorption efficiency between centrifugation and filtration.

4.4. Residual iron concentration in relation to the centrifugation time

Subsequently, now with the objective of analyzing the results in which the T_h values close to 0.12 h and with variations in A_d mass, tests were performed in which samples of oil (40 g), varying the amount peel in 0.5; 1.0; 3.0 and 5.0 g and setting the T_h at 0.12 h and the

centrifugation time at 20 min. These results are shown in Table 4. Note that the results were similar, which indicates that low T_h does not contribute to the absorption process, even at low A_d mass values, such as 0.5 or 1.0 g. Facts explained by the low contact time between the adsorbent and the adsorbent.

Table 4. Residual iron concentration varying the A_d mass and fixing T_h at 0.12 h.

A_d (g)	[Fe] (mg Fe/Kg of oil)	Absorbance	% Fe
-	30.88	0.273	100
0.5	18.21	0.171	58.95
1.0	17.94	0.168	58.01
3.0	18.00	0.168	58.29
5.0	17.65	0.166	57.14

After analyzing the data, where it was noted that the ideal times for the adsorption process are values close to T_h of 1 hour, as shown in Table 3. For the subsequent analyses, this value will be fixed, and the A_d masses varied at 0.5,

1.0, 3.0 and 5.0 g. To optimize time and verify the influence of the centrifugation time on the results, the centrifugation time was set at 2 min and 20 min. The results are shown in Table 5. The difference in the

percentage of iron adsorption between treatments was very small, but with a noticeable emphasis on the longer centrifugation time. This fact points to the need for further

analysis to verify the contribution of the centrifugation time to the adsorption process.

Table 5. Residual iron concentration varying centrifugation time

A _d (g)	Centrifuge time (min)	[Fe] (mg Fe/Kg of oil)	Absorbance	% Fe
-	-	30.88	0.273	100
1.0	2	6.84	0.030	4.82
1.0	20	8.20	0.090	5.47
5.0	2	6.20	0.025	4.39
5.0	20	8.39	0.092	5.59

From Table 5, it cannot be said that centrifugation time was the main parameter to influence the results. However, with these results, some questions arose about the methodology used for separating the Ad and about the solubility of iron nitrate III in oil.

4.5. Comparison absorption efficiency between centrifugation and filtration

According to Green and Perry (2019), the centrifugation process occurs due to the centripetal force that arises through the rotation of the material around a central point. The content of the flask exerts an equal and opposite force on the walls of the container. As a result, all material is subject to two forces: gravity (downward) and centrifugal (horizontal).

Considering the theory of Green and Perry (2019), it was suspected that when the samples were

centrifuged, the entire peel (along with the Fe ions) was dragged to the bottom of the Falcon tube. Thus, as the oil collected for calcination was at the top, consequently, it would be exempt or with a small concentration of iron.

Bearing in mind that the solubility of iron nitrate II in oil is low, even maintaining the agitation for 24 hours, no analysis was carried out to ascertain this homogenization (Figure 5). However, tests were carried out directly with burnt oil, and for comparison criteria treatments were performed with centrifugation and vacuum filtration.

In a new research strategy for this study, it was decided to compare the results obtained by centrifugation and vacuum filtration. Thus, oil (40 g), Th of 1 h with separation by vacuum filtration or by centrifugation for 20 min was performed, varying A_d (Table 6).

Table 6. Fe concentrations, by filtration and centrifugation, varying the Ad mass.

A _d (g)	Separation	[Fe] (mg Fe/Kg of oil)	Absorbance	% Fe
--	--	149.96	1.231	100
0.5	Centrifugation	8.82	0.096	5.88
1.0	Centrifugation	8.20	0.090	5.47
3.0	Centrifugation	9.136	0.098	6.09
5.0	Centrifugation	8.390	0.092	5.59
0.5	Filtration	22.28	0.244	14.86
1.0	Filtration	15.25	0.167	10.17
3.0	Filtration	17.87	0.195	11.92
5.0	Filtration	16.42	0.180	10.95

In Figure 5 can be seen that the centrifugation process proved to be able to remove more Fe ions compared to vacuum the filtration process. Note the differences in efficiencies between filtration and centrifugation are constant for 1.0, 3.0 and 5.0 g, however for the 0.5 g mass there is an increase in this difference, possibly caused by the small amount of Ad.

4.6. Contribution of the centrifugation

In a new analysis strategy for this study, now with the objective of determining the contribution of the centrifugation time to the adsorption process, the amount of iron present in the oil and in the peel after centrifugation was determined. For this analysis the mass of Ad was fixed at 10 g, the Th was 1 h and centrifugation time was 2 min.

The results are given in Table 7. Three types of sample were studied, the first being 40 g of oil without added adsorbent (Ad = 0). For the 2nd sample, oil (40 g) with 10 g of adsorbent was vacuum filtered and after this procedure, a solid mass (solid material from filtration) and a liquid mass (liquid material from filtration) were obtained, and from these two by-products the values of Fe concentrations were measured. For the 3rd sample of oil (40 g), 10 of adsorbent was added and centrifuged for 2

min and a solid mass (solid centrifugation material) and a liquid mass (liquid centrifugation material) was obtained, and the Fe concentration determined.

4.7. Comparison of residual iron concentrations obtained by centrifugation and filtration

Analyzing the treatment carried out by vacuum filtration and centrifugation, it was possible to observe that the iron concentration in the oil decreased and the peel increased. This result appears to be coherent, and it is possible to conclude that a small interval of time is sufficient for peel-oil separation.

Analyzing the oils, it is noted that the iron concentration when it is separated by centrifugation (0.06 mgFe / kg oil) is much lower than the oil concentration by filtration (6.89 mgFe / kg oil), being able to conclude that the centrifuge process works as described by Green and Perry (2019).

The theory of Green and Perry (2019) applies to the results obtained with the adsorbents, because in the treatment by centrifugation, the iron ions were dragged to the bottom of the Falcon tube by the centripetal force or by the drag caused by the movement of the peel. Ad from filtration showed a higher percentage of iron than those resulting from the centrifugation process.

Table 7. Residual iron concentration in oil and peel samples treated for 5 min with separation performed by vacuum filtration and centrifugation for 2 min.

Tratamento	[Fe] (mg Fe/Kg of oil)	Absorbance	% Fe
Ad = 0	14.170	0.138	100.000
Liquid material from filtration	0.684	0.030	4.823
Liquid material from filtration	13.275	0.131	93.686
Liquid material from filtration	0.062	0.025	0.439
Liquid material from filtration	8.788	0.095	62.019

This result can show that the shells analyzed after the centrifugation process were influenced by the centrifugal and gravitational forces. On the other hand, the results obtained from the shells separated by filtration showed the

concentration of iron that was adsorbed, showing the efficiency of the process and reaching the objective of the work (Figure 6).

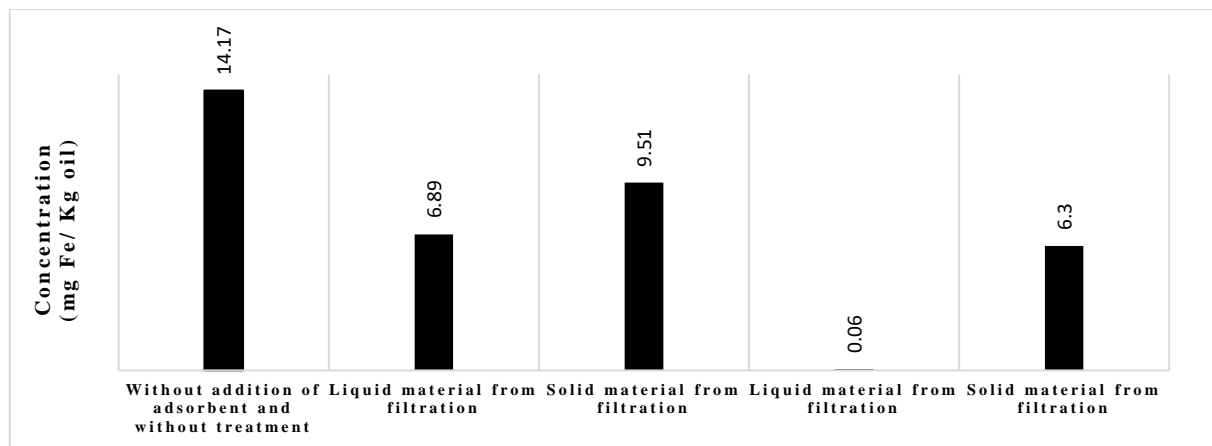


Fig.6: Residual iron concentration in samples separated by vacuum filtration and centrifugation.

4.8. Efficient parameters for Fe adsorption

Finally, to determine up to which moment the adsorption process is efficient, new treatments were performed using Ad equal to 0.5 and 10 g, in oil samples

(40 g), treated by vacuum filtration. The values were 5, 30 and 60 min. These results are shown in Table 8, and it is possible to observe the adsorption kinetics.

Table 8. Residual concentration in mg Fe / Kg oil varying Th and Ad, separated by vacuum filtration.

Tratamento com filtração	Concentração	Absorbância	% Fe
Sem tratamento	44,189	0,380	100,000
Th 5 min e massa de Ad de 0,5g	27,533	0,246	62,301
Th 30 min e massa de Ad de 0,5g	35,861	0,313	81,153
Th 60 min e massa de Ad de 0,5g	37,477	0,326	84,810
Th 5 min e massa de Ad de 10,0g	43,008	0,3705	100,000
Th 30 min e massa de Ad de 10,0g	26,414	0,237	61,416
Th 60 min e massa de Ad de 10,0g	26,787	0,24	62,283
Th 5 min e massa de Ad de 10,0g	27,657	0,247	64,306

With the data obtained (Table 8) it was possible to observe that the adsorption process using 0.5 and 10 g is efficient up to approximately 5 min of contact (Figure 7). After 5 min, the treatment with a mass equal to 10 g tends to

remain constant, while the concentration in the sample carried out with the treatment containing mass equal to 0.5 g, after 5 min, increases again.

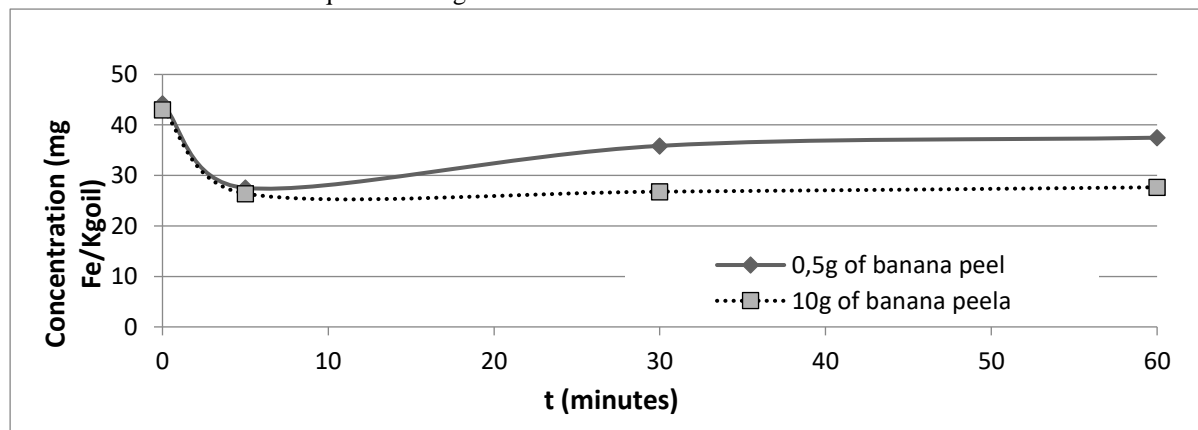


Fig.7: Residual concentration in mg Fe / Kg oil over time for a sample with 0.5g and 10g of husk, separated by vacuum filtration.

V. CONCLUSION

As stated by Jawahir and Bradley, 2016 the practices of the 6R concept contribute to reducing the impacts generated by the incorrect disposal of this waste. The use of organic adsorbents is one of the tools to achieve this goal.

The separation processes by vacuum filtration and centrifugation were efficient in all tests, managing to separate the iron ions from the oil by chemical adsorption and by the action of the centrifugal force, respectively.

The results obtained by the solid-fluid separation process by centrifugation were influenced by the centripetal force caused by the separation of the ions by dragging, but the process had an efficiency between 33.43 to 94.53% of removal of iron ions from the oil depending on the treatment time. .

The use of Musa paradisiacal banana peels for the Fe ions adsorption, using 10 g of Ad and separation performed by vacuum filtration obtained an efficiency of 38.584% during the first 5 mins of contact between the materials.

Due to the adsorption kinetics, the oil treatment using 0.5 g of peel was efficient in the first 5 min, after that time, the Fe concentration remained constant.

ACKNOWLEDGEMENTS

This work was supported by Instituto CEFORES and ICTE from the Federal University of Triangulo Mineiro.

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Sustainability Reporting in Higher Education Institutions: a systematic approach using VOSViewer and Iramuteq softwares

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Received: 07 Dec 2020;

Received in revised form:

29 Jan 2021;

Accepted: 27 Feb 2021;

Available online: 14 Mar 2021

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Keywords— Correspondence Factor
Analysis (CFA), Descending Hierarchical
Classification (DHC), Lexicographic
analysis, Sustainability Disclosure.

Abstract— There is a lack on the research of sustainability reporting by the higher education institutions, being in its early stages. The paper aims to add to the discussion on sustainability reporting in higher education institutions by identifying which themes are prioritized by authors in this field. The authors conducted systematic review to investigate abstracts using VOSViewer to generate co-authorship networks maps and Iramuteq software to generate Lexicographic analysis, Descending Hierarchical Classification and Correspondence Factor Analysis. Then we analysis the results identifying the main themes addressed by the articles. In this study we covered 50 abstracts from 2016 to 2020 about sustainability reporting in higher education institutions from SCOPUS and Web of Science platforms. The research is limited by the number of publications analyzed, and time frame. In this research, we find that the disclosure of sustainability reporting by HEIs is in its initial stage and diverges in a considerable way from each other. The results may be used by researchers, on account of the key themes presented and by the university's administrative bodies, in order to support the credibility of the sustainability reports published.

I. INTRODUCTION

Higher Education Institutions (HEIs) are prominent in technological development and can assist in building a sustainable and just society. Environmental management in universities must include, among others, the evaluation of consistent environmental indicators [1]. In order to meet human needs, without compromising the resources of the next generations, innovation and sustainability must transform the university [2].

Sustainability assessment tools play an important role in contributing to the development and improvement of sustainable actions in Higher Education Institutions and can disclose the local situation contributing to the

advancement of sustainability in the institution. There is still much to be studied and developed in this area [3].

Sustainability reports are not widely used by higher education institutions and are at an early stage when compared to those used by companies. They can be improved and used to assess the social, environmental, economic, and educational dimensions of HEIs, in addition to being used as communication tools with stakeholders [4,5].

In this context, the research questions were outlined: (Q1) How are recent publications on sustainability reporting in higher education institutions? (Q2) Which journals and authors are the most prominent in the field? (Q3) Which themes are prioritized by authors in the field?

Thus, this paper aims to: O1) identify how are recent publications on sustainability reporting in higher education institutions, O2.1) identify which journals and (O2.2) which authors are the most prominent in the field and O3) identify which themes are prioritized by authors in the field.

The results of this investigation showed that the issue of sustainability reporting in HEIs, is a theme that is still in its initial stage and is increasingly relevant, due to universities commitment through the sustainability and society increasing interest. Thus, this research evidenced some key themes prioritized by authors from this field.

II. METHODOLOGY

We performed a search in title, abstract and key words using the directories "sustainability report*" AND ("universit*" OR "higher education institut*") in the Scopus and Web of Science platforms for articles and reviews published between 2016 and 2020. The articles were selected according to the following exclusion criteria: (a) absence of abstract available; (b) addressed to another type of institution that was not a HEI or (c) not about sustainability reporting.

To facilitate the management of the information of the articles and to exclude duplicates, we used Mendeley software. We also used Excel software to generate tables and figures. For co-authorship networks we used VOSviewer software, a freeware for constructing and viewing bibliometrics maps [6].

For textual content analysis [7], we used the software Iramuteq 0.7 Alpha 2 (Interface de R pour l'Analyse Multidimensionnelle de Textes et de Questionnaires). Iramuteq is a textual analysis software based on statistics (interface with R statistical software), which is useful to generate different analyses, such as: Specificities, Correspondence Factor Analysis (CFA), Reinert's Method or Descending Hierarchical Classification (DHC), Similitude Analysis and Word Cloud [8]. This software has been used in several studies [e.g.: 9, 10, 11].

First, we grouped the abstracts in a single textual corpus, then we prepared the text and imported to Iramuteq [8]. Next, we generated the statistics, the DHC and AFC graphs and analyzed then.

III. RESULTS AND DISCUSSION

The search for articles that were involved in research about sustainability reporting in universities resulted in a total of 97 articles in Scopus platform and 52 in Web of Science platform published between 2016 and 2020. Then,

we imported the occurrences to a reference manager (Mendeley software), grouped the 149 articles and removed duplicates, 107 articles remained. From this total, 57 articles were excluded from subsequent analysis, where 56 of them were not about higher education institutions and 13 of were not about sustainability reporting, 12 were excluded by both criteria totaling 50 articles remaining for review of abstracts. The survey was carried out between 21 and 22 of November 2020.

In the next topic, we analyzed the publications per year.

3.1 Publication per year

The survey identified 50 articles on sustainability reporting in higher education institutions between 2016 and 2020. We found 134 authors and 27 journals.

As seen in Fig. 1, although the number of publications had an increase from 2017 to 2018 (3.8 times greater), in 2020, the number of publications within the scope of this research was 2.1 times lower than in 2019.

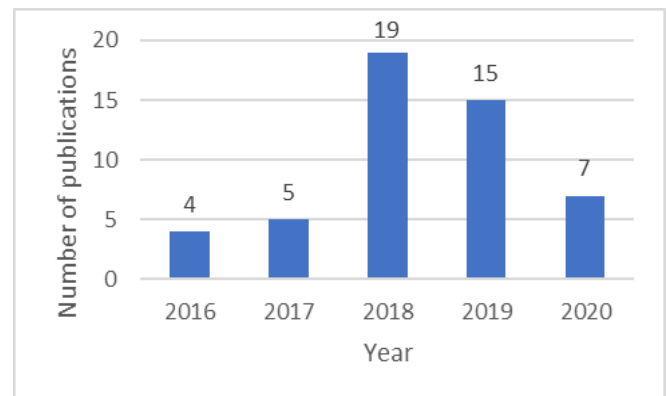


Fig. 1 - Number of publications per year from 2016 to 2020.

In the next topic, we analyze the co-authorship networks.

3.2 Co-authorship networks

From the 43 clusters generated by VOSviewer software, 4 of them has 6 authors in collaboration, 3 has 5 authors in collaboration, 8 has 4 authors in collaboration, 11 has 3 authors in collaboration, 13 has 2 authors in collaboration and 4 were standalone authors.

Considering the most collaborative networks, four of them deserves to be highlighted (Fig. 2) due to the number of publications: red (4 articles), yellow (3 articles), blue (2 articles) and purple (2 articles).

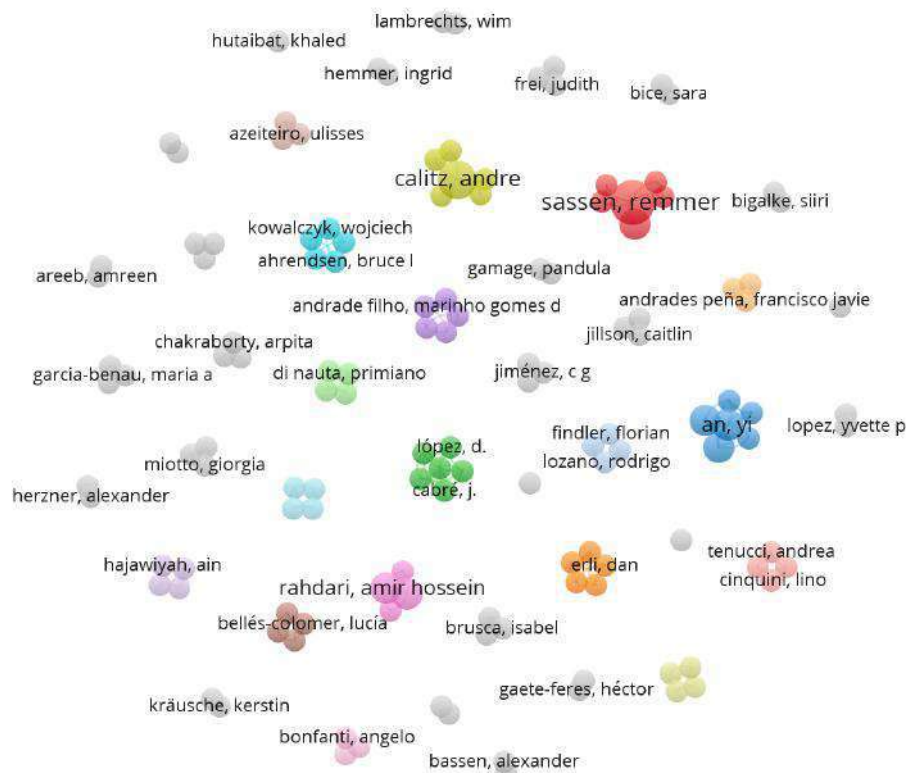


Fig. 2 - Co-authorship networks, generated in VOSviewer software.

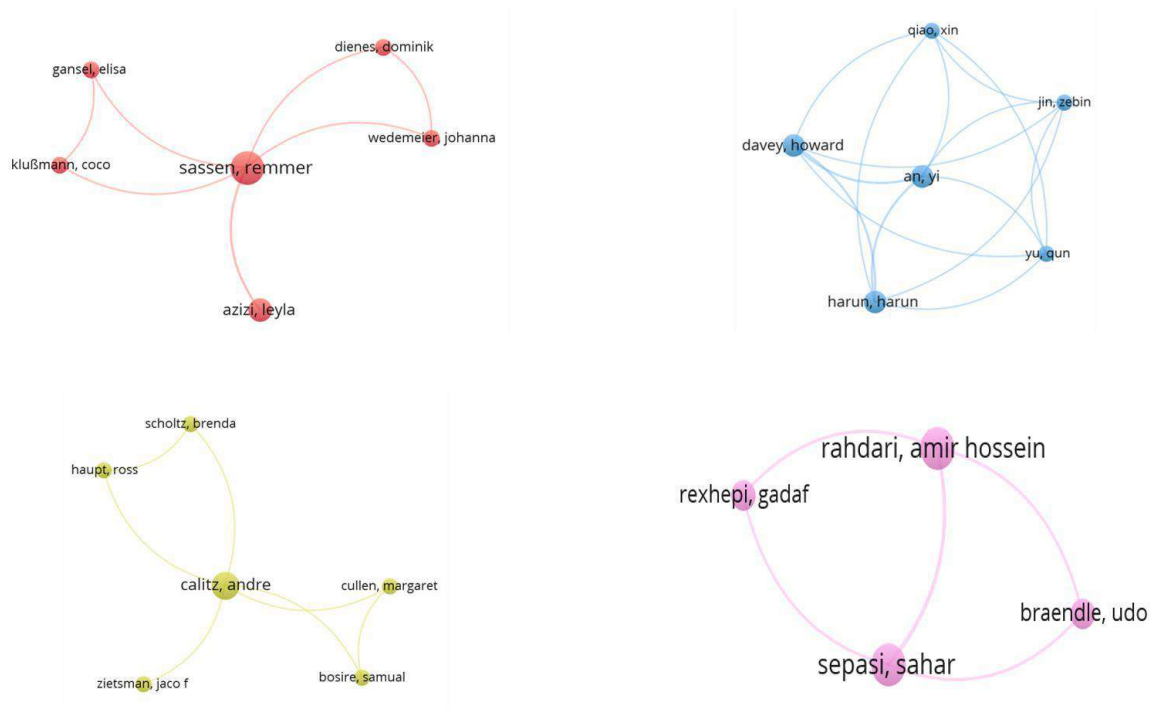


Fig. 3 - Main clusters from authorship networks.

In the red cluster, the two most cited articles: “Assessing sustainability reports of US universities” (26 citations) and “Voluntary disclosure of sustainability

reports by Canadian universities” (24 citations) evaluated sustainability reports from universities by conducting a content analysis [12, 13].

In the blue cluster, the article: “Online sustainability reporting at universities: the case of Hong Kong” (1 citation) examines the state of online sustainability of Hong Kong HEI sector by a multiple case study and the article “Sustainability reporting at a New Zealand public university: A longitudinal analysis” (23 citations) evaluated sustainability reports from a New Zealand public university by conducting a content analysis [14, 15].

In the yellow cluster, the two most cited articles were “A business intelligence framework for sustainability information management in higher education” (20 citations) and “The role of business intelligence in sustainability reporting for South African higher education institutions” (10 citations). The first article proposes a business intelligence framework for strategic sustainability information management addressed for HEIs, used a case study in a South African HEI [16]. The second article applied questionnaires at 21 South African and selected international HEIs aiming to show that business intelligence is important to sustainability reporting framework [17].

In the purple cluster, the article “Developing a sustainability reporting assessment tool for higher education institutions: The University of California” (12 citations) aimed to develop a sustainability reporting assessment tool for evaluating sustainability reporting in HEIs, the authors applied the framework named Environmental, Social, Educational, and Governance (ESEG) University Sustainability Reporting Assessment Tool in a case study in the University of California [18]. The article “Comprehensive sustainability reporting in higher education institutions” (13 citations) aimed to evaluate the comprehensiveness of sustainability reporting in HEIs by using a sustainability rating framework [19].

In the next topic, we analysis the journals that published the articles.

3.3 Journals analysis

A total of 27 journals were identified among 50 articles. As seen in Table 1, the International Journal of Sustainability in Higher Education has 13 articles published (26%), Sustainability has 9 articles (18%), Journal of Cleaner Production has 3 articles (6%), Account Forum has 2 articles (4%) and the others one each one.

The first three journals have together 63% of the citations. The most cited article “True green and sustainable university campuses? Toward a clusters approach”, with 74 citations, was published by one of those journals: Sustainability, the authors made a review of the most common Campus Sustainability Assessments, compared two case studies (The Politecnico di Torino, in Italy and the Hokkaido University, in Japan) and then propose a new Campus Sustainability Assessment that

encompasses clusters of homogeneous campus typologies for meaningful comparisons and university rankings [20].

Table 1 - Relevance of journals according to the number of articles on the topic of the research.

n	Journal	Number of articles	Total of citations	Average number of citations
1	International Journal of Sustainability in Higher Education	13	144	11,08
2	Sustainability	9	134	14,89
3	Journal of Cleaner Production	3	88	29,33
4	Accounting Forum	2	8	4
5	Accounting, Auditing & Accountability Journal	1	18	18
6	African Journal of Information Systems	1	3	3
7	Australian Journal of Public Administration	1	40	40
8	Business and Society Review	1	10	10
9	CIRIEC-Espana Revista de Economia Publica, Social y Cooperativa	1	1	1
10	Engenharia Sanitaria e Ambiental	1	0	0
11	Independent Journal of Teaching and Learning	1	0	0
12	International Journal of Innovation, Creativity and	1	0	0
13	International Journal of Sustainable Development	1	0	0
14	Journal of Business Economics	1	24	24
15	Journal of Environmental Planning and Management	1	17	17
16	Journal of Environmental Studies and Sciences	1	3	3
17	Journal of International Education in Business	1	0	0
18	Journal of Public Budgeting, Accounting & Financial Management	1	1	1
19	Revista de Docencia Universitaria	1	0	0
20	Revista Digital de Investigación en Docencia	1	0	0
21	Revista Iberoamericana de Educación Superior	1	16	16
22	Social Responsibility Journal	1	13	13
23	Sustainability Accounting, Management and Policy	1	1	1
24	Sustainable Development	1	12	12
25	Sustentabilidade em Debate	1	0	0
26	Tertiary Education and Management	1	40	40
27	The International Journal of Management Education	1	2	2

The second most cited article “The challenge of sustainability and integrated reporting at universities: A case study”, with 58 citations, was published by Journal of Cleaner Production, the authors analyses the process or implementing new models of reporting focusing on an innovative Spanish university and contributed, contributes by showing the challenges and main issues of the process of implementation [4].

In the next three topics, we performed the analyses using Iramuteq: Lexicographic analyzes, Descending Hierarchical Classification (DHC) and Correspondence Factor Analysis (CFA).

3.4 Lexicographic analysis

To perform the analyses using Iramuteq software we grouped the 50 abstracts in a single textual corpus, prepared the text and imported to Iramuteq. The lexicographic analysis of the textual corpus constituted by the 50 articles abstracts revealed a total of 10,323 occurrences; 1562 after de lemmatization of segments of the text by the software, where 1288 were active forms (82.4%) and 274 (17.5%) were supplementary forms. The corpus of analysis was made up 284 segments of the text, with 199 (70.07%) retention of the text segments in lexicographical analysis. We consider this analysis robust

because it has a retention greater than 70%, as in other studies [21, 10].

In the next topic, we analyze the Descending Hierarchical Classification.

3.5 Descending Hierarchical Classification (DHC)

From the DHC analysis was generated a dendrogram (a tree diagram), to produce this graph the software performs chi-square tests (χ^2), characterizing the bonding strength between form and class [22, 23].

The dendrogram presented in Fig. 4, has 5 classes of words, each class has the terms with the highest occurrence. With these classes it is possible to check the distance between the words from the branches present. In the present case, it is possible to notice that class 5 represents a branch, while classes 1, 2, 3 and 4 are part of another branch, divided into two groups: one containing class 4 and another containing classes 1, 2 and 3. The second group is divided in others two groups, one with class 3 and other with class 1 and 2. So, classes 1 and 2 have more similarities with each other than with class 5, and class 3 have more similarities with classes 1 and 2 than with class 5.

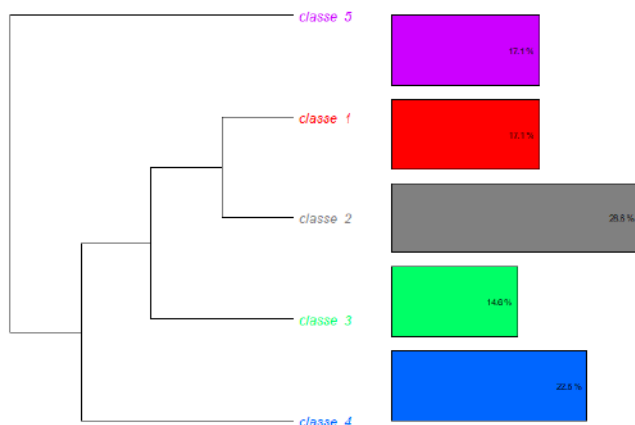


Fig. 4 - Dendrogram from Descending Hierarchical Classification (DHC).

In the class 1 the first forms are: “dimension”, “characteristic”, “show”, “finding”, “result” and “canadian”. In the class 2 the first forms are: “sustainability reporting”, “content analysis”, “university”, “purpose”, “sample” and “future”. In the class 3 the first forms are: “present”, “criterion”, “material”, “implementation”, “sustainable reports”, “discussion”, “engagement”, “define”, “aspect” and “quality”. In the class 4 the first forms are: “management”, “business intelligence”, “information”, “strategic”, “relate”, “plan”, “sustainable” and “assist”. In the class 5 the first forms are: “student”, “project”, “learn”, “write”, “part”, “prepare” and “create”. The level of statistical significance

(p) associated with the χ^2 of the forms presented here is $p < 0.0001$.

In the next topic, we analysis the Correspondence Factor Analysis.

3.6 Correspondence Factor Analysis (CFA)

At the cartesian level with CFA, it is possible to verify the distance from one class to another in a more intuitive way, as seen in Fig. 5. The classes are equally divided as in DHC, thus, Class 1: red; Class 2: grey; Class 3: green; Class 4: blue and Class 5: purple.

We can see that classes 1, 2 and 3 are interconnected, forming a single group (which has some forms highlighted: “sustainability reporting”, “university”, “study” and “paper”. In the class 4 the forms: “higher education institution”, “management” and framework are highlighted, while in class 5 the forms highlighted are: “sustainability report”, “student” and “project”.

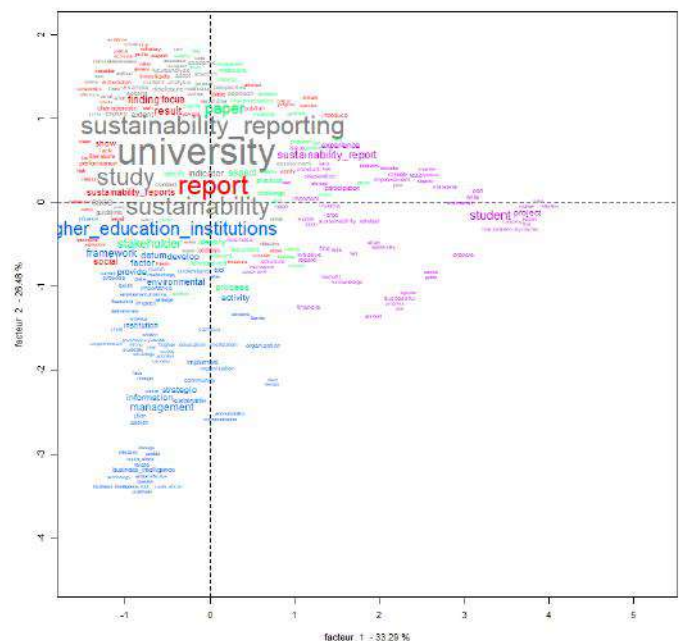


Fig. 5 - Correspondence Factor Analysis (CFA)- the most frequent active words in each of the lexical classes obtained in the DHC. Colors correspond to the lexical classes (Class 1: red; Class 2: grey; Class 3: green; Class 4: blue; Class 5: purple).

3.7 Main themes addressed by the articles

To facilitate interpretation of the results we named the classes subjectively considering top cited words of each class and their respective abstracts. Thus, the main themes prioritized by the authors in this field were obtained.

In the group of classes, composed by class 1, 2 and 3, the themes are interrelated.

Class 1 – “Sustainability Dimensions”:

As results of the research of [13], they find that there is a focus on the disclosure of the environmental dimension

of sustainability and a lack of coverage in social dimension in the Canadian universities, probably as result of their participation in the Sustainability Tracking, Assessment and Rating System (STARS) program. These authors concluded that for future studies would be interesting to investigate the voluntary behavior of universities' sustainability reports, in addition to conducting a mixed method survey and focusing on the complete portfolio of reports from these institutions, including annual and human resources reports [13].

Yalin et al. [24] addressed some characteristics of their findings in the study of sustainability reporting by China's HEIs. Among them, that economic dimension was not disclosed and the disclosure of the environmental, social and educational dimension were poor. The sustainability reporting by China's HEI is in the initial stage.

Class 2 – “Contents of the sustainability reports”:

Some research focus on evaluate the content of the sustainability reports (e.g. [19, 25, 26]).

The disclosure of sustainability reports in Turkey is still in its infancy, probably by some factors as: lack of motivations and low funding. The findings offer suggestions for developing extra sustainability indicators [25].

In the research of Zorio-Grima et al. [26] the results shows new characteristics of sustainable development strategies by Spanish public universities, such as devoting a specific sustainability reporting section in their websites, creating a sustainability body or submitting the sustainability report to external assurance. They also concluded that there are already pioneer universities in Spain with high levels of application and disclosure of sustainability reports using the sustainability indicators by the Global Initiative Report (GRI).

Class 3 – “Evaluation of sustainability reporting”:

In the study of Lubinger et al. [27], they aimed to investigate if the sustainability reporting practical of universities which had adopted the GRI guidelines really uses the materiality as a content-selection principle. They found that adoption of that principle by the universities is superficial.

Class 4 – “Sustainability reports as management tools”:

The sustainability reporting in a Spanish school of engineering has contributed among others to "develop a more comprehensive and strategic vision of the institution, which is now shared among key positions" helping the governing bodies and supporting strategic plans [28].

The authors proposed a business intelligence tool, that integrates data of multiple areas of sustainability and provides information to stakeholders, that helps to the improvement of the sustainability reporting in HEIs [16].

Class 5 – “Students involvement”:

By examining the participation of students in the writing of the sustainability report of a German university, they conclude that “students have to be aware of what they can expect from being a part of it – and what they cannot”, the students suggest to introduce of “special classes aiming at dealing with and writing the university's report on sustainability” [29].

In order to illustrate an introductory project in an accounting course, the authors demonstrated that some students considered the project on financial / managerial accounting and sustainability reporting to be somewhat beneficial and others prefer to maintain the financial focus of the discipline [30].

IV. CONCLUSION

Based on this study, the following conclusions were obtained according to the research objectives:

- O1 - The recent publications in sustainability reporting demonstrates that the field of research is advancing, although there is much more to be researched.
- O2.1 – The top three most prominent journals in the field are: “International Journal of Sustainability in Higher Education”, “Sustainability” and Journal of Cleaner Production.
- O2.2 - The most prominent first authors in the field are: Remmer Sassen, Yi An, Brenda Scholtz, Andre Calitz and Sahar Sepasi.
- O3 – The key themes addressed by the authors in the field are: “Sustainability dimensions”, “Contents of the sustainability reports”, “Evaluation of sustainability reporting”, “Sustainability reports as management tools” and “Students involvement”.

Therefore, this article contributes on advancing of the research on sustainability reporting on HEIs and could be used by body of administration of HEIs, supporting the credibility of the sustainability reports released and by researchers on this field by addressing key themes.

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Analysis of the benefits of the addition of granite residues in the production of ecological brick

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Received: 15 Dec 2020;

Received in revised form:

03 Feb 2021;

Accepted: 28 Feb 2021;

Available online: 15 Mar 2021

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Keywords— Ecological Brick; Granite; Waste.

Abstract— *The activities of the ornamental rock sector generate huge amounts of solid waste, which can cause negative consequences to the environment. Given the need for environmental preservation and a greater concern with the concepts of sustainability, we have been seeking to use natural resources intelligently, thus aiming at a better future of the planet, the ecological brick presents itself as a possible alternative to reuse these granite residues presenting an alternative destination for ornamental rock tailings. This work seeks through a brief bibliographic survey to evaluate the potential of the insertion of waste from granite in the production of ecological bricks.*

I. INTRODUCTION

According to [1, 2] it is estimated that the construction sector consumes around 9.4 ton./hab. year of building materials. The discussion around the challenges found to reinsert these materials used in civil construction back into the production chain, the way these resources will be generated in the reuse processes and how this alternative contributes to sustainability [3].

[4] emphasize that, for Civil Engineering, the concept of sustainable development involves the use and production of high-performance materials at reasonable costs, with the least possible environmental impact. The principle of sustainable development is a better distribution of humanity's economic resources, with a concern for the preservation of nature. Production processes must save energy and not generate dangerous by-products, which endanger nature and human beings [5].

The civil construction market presents itself as one of the most effective alternatives to consume recycled materials, since the construction activity is carried out in any region, with the ever increasing expansion of the built

environment, which will reduce transport costs. In addition, most of the components necessary for the production of buildings can be produced without great technical sophistication [6].

The processing activities of ornamental rocks generate a significant amount of residues, part of these residues have forms of rock flakes such as casqueiros, broken plates and other residues as a form of residual powder (mud), usually composed of water, rock powder and some type of abrasive [7]. Taking into account the large amount of waste generated and trying to contribute to sustainable development, the use of granite cut waste in civil construction, some researchers have been studying the production of mortar [8], ceramic bricks [9] and ceramic pieces [10].

Over the years, laws to encourage sustainable development have become stricter, causing the productive sectors that generate pollutants and waste to minimize their impacts. In Brazil, in 2010, the National Solid Waste Policy (PNRS) was sanctioned, with the purpose of not generating waste or reducing its potential risk to the

environment and human health through the perspective of recycling, reuse and environmentally appropriate disposal of tailings [11].



Fig.1: Priority of waste generation

Fonte: PNUMA (2015).

The inverted pyramid model, shown in Figure 1, is applied to PNRS from the perspective of two perspectives that bring production closer to sustainable consumption: shared responsibility and reverse logistics [11].

One of the materials already disseminated that concerns the concern with environmental issues and sustainable development is the soil-cement brick. With soil-cement bricks, production is clean and with less waste and debris, since the perfect fit structure facilitates calculations, reduces the amount of cuts, eliminates the need for nails, wires and holes in the finished wall [12; 13]. Ecological bricks are so named due to their manufacturing process, which does not make it necessary to go through the firing process as in the conventional, avoiding a reduction in the cutting of trees as well as reducing the gases released into the atmosphere [14].

This article is a bibliographic review on the application of granite dust residues in the production of ecological bricks. This review was carried out from the history of publications until the year 2020 and aims to raise the main information on the quality of the products produced in order to show the effectiveness of adding granite powder to ecological brick through mechanical characterization, according to the rules in order to encourage new research.

II. THEORETICAL REFERENCE

2.1 Ecologic Brick

Ecological brick is a brick model (table 1) that promotes positive environmental impact, reducing the consumption

of different materials in the construction area and applying concepts of sustainability in its manufacture and during the execution of the work, produced from waste generated by construction, allowing the reuse of most of these materials being manufactured with manual or hydraulic presses, resulting from the homogeneous, compacted and cured mixture of soil, cement and water in appropriate proportions resulting in a material with good mechanical resistance, water absorption index, small retraction volumetric and satisfactory durability compatible with the recommendations of technical standards [15].

Table 1: Dimensions of bricks sold in Brazil.

	Dimensions	Characteristics
Common massif	5 x 10 x 20 cm 5 x 10 x 21 cm	Settlement with consumption mortar similar to that of ordinary solid bricks
Solid with fittings	5 x 10 x 21 cm 5 x 12,5 x 25 cm 5 x 11 x 23 cm	Fitting with low mortar consumption
½ plug-in brick	5 x 10 x 10 cm 5 x 10 x 11,5 cm	Element produced so that there are no breaks in the formation of devices with mismatched joints
Bricks with two holes and fitting	5 x 12,5 x 25 cm 5 x 12,5 x 12,5 cm 7,5 x 15 x 30 cm	Dry laying with white glue or very plastic mortar. Pipes pass through vertical holes
½ bricks with holes and fitting	5 x 10 x 10 cm 5 x 12,5 x 12,5 cm 7,5 x 15 x 15cm	Element produced to seat the devices, without the need for breakage.

Fonte: (Instituto de tecnologia e pesquisa de São Paulo 18/06/2012).

According to [16], several physico-chemical factors such as solids, water and air that make up the soil can influence the characteristics of the final product of the soil-cement, among them the cement dosage, nature of the soil, moisture content and compaction or pressing [17]. The cohesion of the cement soil is determined by the

constitution of the cement, its fineness, amount of water and the ambient temperature.

As for the constructive aspect, the two holes in the ecological brick provide thermal, acoustic insulation and protection against humidity, as they form air chambers [18]. Ecological bricks, when overlapped in the settlement, form ducts through which the wires and pipes are passed, avoiding tears in the walls and ensuring greater savings in materials and labor. Its installation is carried out through successive male and female fittings with simple leveling and alignment, being recommended for the union of the construction elements, mortar for laying floors and PVA glue, in the respective proportion of 20/1 and can be used as apparent masonry, receiving only a waterproofing paint, or to be coated with plaster and textures [19].

2.2 Ornamental Stone Waste

The world production of ornamental stones is approximately 68 million tons / year, of which 59.2% are related to carbonate rocks (marble), 35.8% to silicate rocks (granite) and 5% to slate. other rocks. In the ornamental stone beneficiation industry, the various stages of production generate large losses, with a very significant waste volume, it is estimated that the amount of waste generated is 40% of the volume of the processed block. This figure can reach 41%, so it is estimated that 3.26 million tons of processing waste were generated in Brazil in 2018, with 2.12mt of fine waste (rock dust) and 1, 14m tonnes of coarse waste (shells and shavings) [20]. Since the 1990s, the ornamental stone sector has grown at a rate of approximately 4.5% a.a., and in the last 5 years, between 2013 and 2017, 4% a.a. [21].

Brazil is one of the countries that stands out most in the world in the production and commercialization of ornamental stones. According to data from the Brazilian Association of the Ornamental Stones Industry [22], the country is the seventh largest world exporter of rocks in physical volume, behind only China, India, Turkey, Italy, Iran and Spain. The Brazilian extraction of rocks totals 5.2 million tons / year, with the states of Espírito Santo, Minas Gerais and Bahia responsible for 80% of this production. Among these states, Espírito Santo stands out as the main producer, with 47% of the Brazilian total [22].

The high national production generates a strong industrial activity of extraction and processing of ornamental rocks, such as granite, marble, gneiss, slate, among others. This activity has made a great contribution to the national economy, generating wealth and social development. It is noteworthy that Brazil is the center of production of ornamental rocks richest in granites [23].

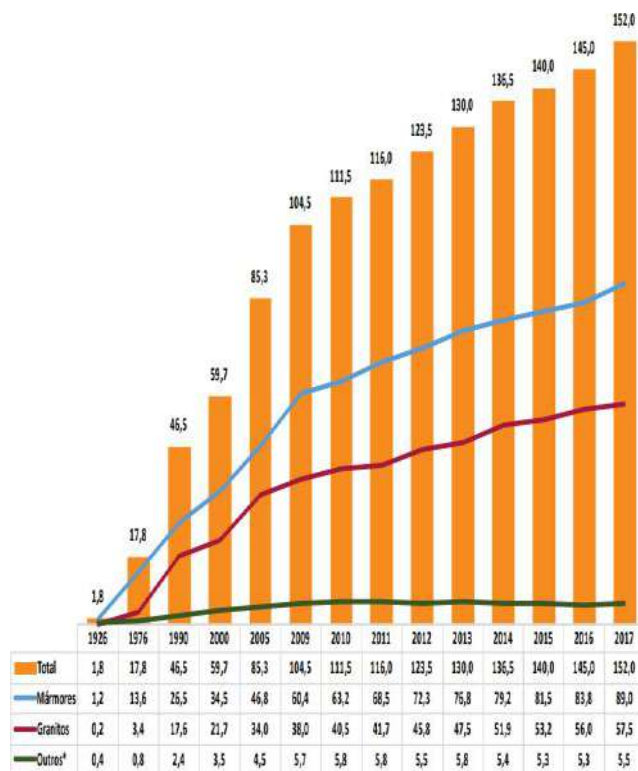


Fig.2: Evolution of world ornamental stone production (millions of tons / year)

Fonte: Bezerra (2018).

According to [24], granite is a type of ornamental rock with great applicability in the area of civil construction, it is an igneous rock (plutonic magmatic), the result of the solidification of magma at great depths.

As explained by [25], among the phases of the rock production process there are extraction, unfolding, polishing and finishing. During the extraction, the mining residue is generated, consisting of pieces of unused rock and cracked rocks. At sawmills, blocks are transformed into slabs. When sawing blocks, cutting is carried out with looms because it combines factors such as: greater flexibility, high productivity, relatively low costs, in addition to a good cost / benefit ratio for the initial investment. In this process, a slurry in the form of an abrasive pulp is generated, basically consisting of water, shot (used as an abrasive that facilitates sawing), lime (used to lubricate and cool the sawdust blades, in addition to cleaning the channels between the sheets) and ground rock. The last phase is the cutting and polishing process that transforms the granite sheet into mosaics. In this step, the surface is smoothed, polished, polished, cut and finished in order to comply with the specifications that the final product requires. It is at this stage that a small amount of waste is generated, the so-called shavings. After finishing, the rock is ready for commercialization. Figure 3

shows the phases of the granite beneficiation process and the residues obtained in each step.

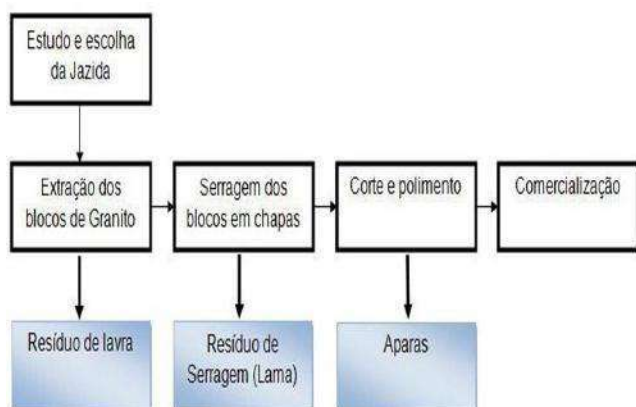


Fig.3 :Flowchart of the granite beneficiation steps.

Fonte: Lima (2010).

According to [26], in the granite beneficiation process, about 30% of the material turns into waste, which is usually disposed of directly from the soil and without any cover. Despite the fact that granite mud is considered inert and non-toxic, its indiscriminate generation and inadequate disposal generate discomfort and expense for companies, in addition to numerous impacts on the environment, such as: alteration of soil drainage conditions, air pollution, visual pollution, modification and destruction of the natural landscape and damage to human health, where when it dries, the mud forms a powder that can cause silicosis, if inhaled.

2.3 Granite residues added to ecological brick: Main benefits

According to [27], the use of granite residues in the manufacture of soil-cement bricks can be configured in an ecologically correct practice as it contributes towards reducing the volume of material discarded in nature and the exploitation of natural resources, preserving the environment. In addition, its specific characteristics show potentialities for its use as an additive material for the manufacture of ceramics, such as the modular brick of cement soil.

Studies show that granite sawdust residues (RSG) and marble and granite sawdust residues (RSMG) have great potential for use as cladding mortars, compacted landfills and precast floor tiles [28].

According to [29], the use of marble and granite powder in bricks reduces the cost, since its use reduces the consumption of cement or sand, in addition to minimizing the environmental impacts due to these materials being extracted from nature, contributing to sustainable development, reducing the emission and transmission of

pollutants, reducing costs and the use of non-renewable raw materials, in addition to improving living conditions and nature.

III. METHOD

The methodology adopted is a bibliographic survey carried out on the academic google and CAPES journals portal, admitting publications until 2019, on the application of granite powder in the manufacture of ecological bricks, aiming to show its sustainable, economical points and its main characteristics. According to the theme of the work and the doubts on this topic, we sought to analyze the reading of the titles and abstracts in order to verify the choice of the article.

IV. RESULTS AND DISCUSSIONS

As raised in the literature researched for this work, several authors carried out works with the incorporation of residues from different sources and compositions to obtain a mixture that contributes to the improvement of the ceramic mass for the production of bricks, among them the rubber of tires [30], demolition residues [31], banana peel residues [32], rice husk ash [33], marble and granite sludge [34], sludge from the treatment plant [35] and ornamental rocks from the diamond wire loom, among other researches [36; 37].

[32], used granite powder residues as part of the raw material for the manufacture of soil-cement bricks in order to reuse part of this residue from the unfolding of ornamental rocks for the manufacture of ecological bricks in proportions that the quality and the good performance of the material are not damaged. The ecological brick is composed of portland cement, soil, waste and water; the residue in this research work will replace part of the sand used in the production of the soil-cement brick. The research had as tests the substitution procedure of the aggregates for the mud coming from the cutting and polishing of the granite, the manufacture of specimens with the traces 1/7 (cement and soil) was made, incorporating residues percentages of 60% , 45% and 30% in soil replacement. For each composition obtained in Factorial Planning, there was a variation in the water / cement ratio of 3, 2 and 2.5 and the percentage of residue. Seven types were obtained and a total of 28 specimens were made. The compaction test was conducted according to the NBR ABNT 12023/90 standard.

[32], evaluated the tests of resistance to simple compression, through the rupture of the specimens in a specific press for this test. The results of determining the

simple compressive strength of specimens manufactured with different combinations of granite powder as a percentage of this residue, at 28 days, are shown in Table 1. For each type, four values were obtained, which were discarded the value that least came close to the other points

of the test, being, therefore, represented by three values. These data underwent statistical treatment, in which it obtained significant results.

Table 1: Data from the studied specimens

Tipo	% Resíduo	Fator água/ cimento	Tem-po (dia)	Códi- go	Valor obtido no ensaio	Resistên-cia (Mpa)
A	60	3	28	A1	110	1,476
				A2	110	1,476
				A3	102	1,275
B	30	3	28	B1	105	1,409
				B2	103	1,383
				B3	117	1,570
C	60	2	28	C1	147	1,973
				C2	179	2,403
				C3	180	2,416
D	30	2	28	D1	178	2,389
				D2	189	2,537
				D3	189	2,537
E	45	2,5	28	E1	155	2,080
				E2	156	2,094
				E3	165	2,215
F	45	2,5	28	F1	155	2,080
				F2	155	2,080
				F3	150	2,013
G	45	2,5	28	G1	165	2,215
				G2	177	2,376
				G3	180	2,148

Fonte: Silva et al. (2016).

Following the studies by [32], table 2 presents a descriptive summary for the values of resistance to simple compression of the mortar of the soil-cement

bricks. There is an average resistance of 1.97 MPa and a coefficient of variation of 21.83%, which shows an average dispersion of the data.

Table 2: Descriptive Values of Simple Compression Strength

Valores Descritivos da Resistência a Compressão Simples				
Média (MPa)	Desvio Padrão (MPa)	Coeficiente de Variação (%)	Máximo (MPa)	Mínimo (MPa)
1,97	0,43	21,83	2,53	1,39

Fonte: Silva et al. (2016).

After performing the simple compression resistance tests [32], he observed that the independent variable water-cement factor is the most influential factor in the process, because with the increase in this factor, a reduction in resistance is observed (Figure 1). The pareto graph (figure 4) for resistance and compression allowed an easy visualization and identification of the most important causes or problems, allowing the concentration of efforts on them. In addition, the Pareto diagram for the two response variables (Resistance to Simple Compression and Water Absorption) allows to determine which coefficients of the models really have statistical influence at the 5% significance level.

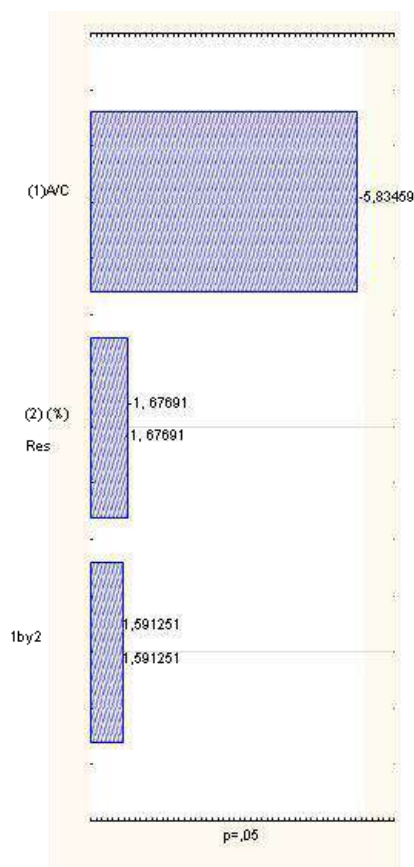


Fig.4: Pareto chart for compressive strength

Fonte: Silva et al. (2016).

The response surface has a higher resistance to a water-cement factor and a percentage of residue around 2 and 30%, respectively. Figure 5 shows the response surface of Factorial Planning.

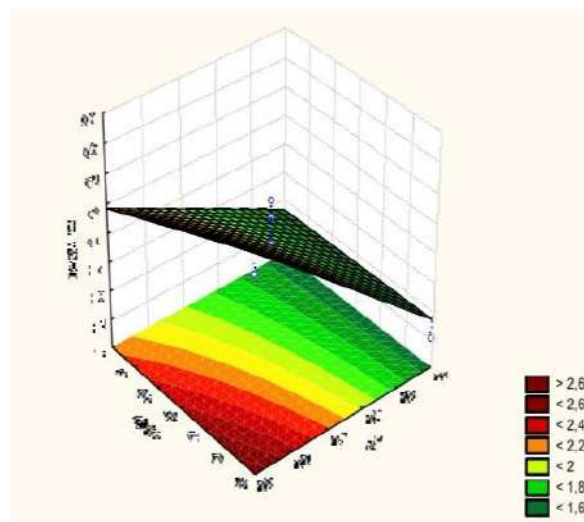


Fig.5: Response surface of Factorial Planning

Fonte: Silva et al. (2016).

The work carried out by [38], aimed to develop in the teaching of chemistry the recycling of granite waste, in the manufacture of ecological bricks of soil-cement, working in the classroom the relationship of chemical knowledge in teaching with this technology aiming mainly the reduction of the environmental impact. This work aims to develop Environmental Issues in the teaching of Chemistry, using as its theme the recycling of abrasive sludge for the manufacture of ecological soil-cement bricks, thus preserving an age-old culture aimed at combating the housing deficit. The type of soil used was the scaffolding, which meets the standards ABNT NBR 10832 and NBR 10833, the cement CPII-F-32 was used, which has compatible characteristics for the elaboration of modular soil-cement bricks. Abrasive sludge consists of water, lime, shot and granite powder, the abrasive sludge comes from the sawdust of the rock blocks, where it is usually thrown to the decantation tanks in the companies' yard. The abrasive sludge was processed through ABNT No. 80 dry sieves.

In the manufacture of ecological bricks, 4 features were adopted: 1: 7: 2; 1: 6: 3; 1: 5: 4 and 1: 4,5: 4,5 (Cement, soil and granitic residue respectively). The soil-cement bricks under study have dimensions of 25 cm in length, 6.5 in height and 12.5 in width. The variation in the water / cement ratio adopted was based on data from Oliveira (2004), where the relationships adopted are within these ranges. For each line, the study was carried out with three water / cement factors 1; 0.86 and 0.72. The tests of the water absorption content are directly linked to the degree of porosity of the material. The determination of water absorption was made according to NBR 10836/94, the samples were placed for 24 hours in an oven at 110°C and

weighed, then they were immersed for 24 hours in water and weighed again. Resistance to simple compression is one of the most important parameters of soil-cement. Current regulations state that the average resistance of cement-bricks should be equal to or greater than 2.0 Mpa after 7 days of curing [38].

According to studies by [38], in addition to the seven days, tests were also performed at 28 and 60 days with the respective factors a/c 1, 0.86 and 0.72 - T1, T2 and T3 respectively, thus verifying their resistance of the test groups for the ages such molding ages, for the wet curing process. It can be seen, according to Figure 3, that the greatest resistance to simple compression occurred with the water / cement ratio 0.86 (T2); The tests show that the ecological brick has an increase in its resistance with time, mainly with 40% of addition of residue (trace 1: 5: 4) of ornamental rock, where the value was 7.6 Mpa for a 60-day cure. It is also seen that practically all the strokes presented results that met the requirements of NBR 10836 of minimum resistance of 2Mpa at 28 days. The greatest resistance to simple compression, happened for the trace 1: 5: 4 because, the individual values are in accordance with the NBR 10836, where it is observed (figure 6) that this trace has a larger amount of residue than the 1: 7: 2 trace; the values of resistance to simple compression, increase with the decrease of the amount of soil and the increase of the granite residue content, both for the 7 days of curing, as well as for the 28 days of curing and 6th days of curing; Therefore, it is observed in the 1: 5: 4 line that it obtained less absorption, so this also explains the good resistance that this line was for the manufacture of soil-cement bricks.

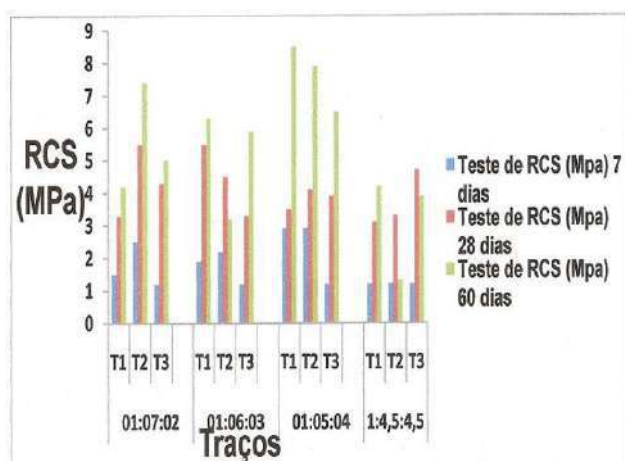


Fig.6: Traces used in the manufacture of soil-cement bricks and the results of simple compressive strength tests

Fonte: Silva et al. (2016).

Another example of studies on the application of residues generated in the processing of ornamental rocks applied to soil-cement bricks is mentioned by [27], as his research attempted to find the ideal water / cement factor for the manufacture of ecological soil bricks- cement incorporated with granite residue from the unfolding of ornamental stone blocks for the construction of popular housing, preserving the environment contributing to sustainable development and trying to economically mitigate the costs of popular buildings through ecologically correct solutions. This research aimed to evaluate the water / cement factor of bricks manufactured with solid waste generated in the processing of ornamental rocks. For the determination of the ideal water / cement ratio of each composition (with respective contents of residues), tests were carried out by varying the a/c ratio (three for each line) where, according to the tests, the greatest resistance to simple compression occurred with the water / cement ratio 0.86.

In determining the ideal water / cement ratio of each composition (with respective levels of granite residue), tests were carried out by varying the a/c ratio. This ratio is given by dividing the amount of water (g) by the amount of cement (g), this value being dimensionless. For each a/c ratio, 3 (three) bricks were molded, and their respective masses and resistance to simple compression (RCS). The hand test criterion was also observed - which consists of forming a "cake" with the hands that would keep its shape unchanged when opening the hand (Figures 7, 8 and 9) and the presence of water veins in the bricks right away. after molding [27].

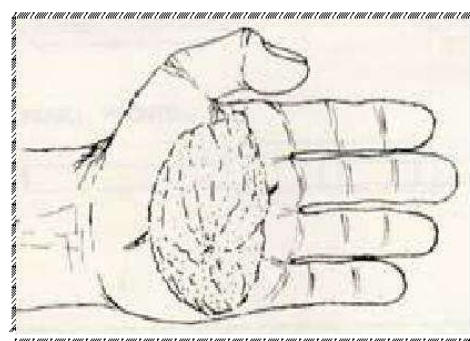


Fig.7: Hand with the mixture

Fonte: Cartilha 1999. Santiago et al.(2012).

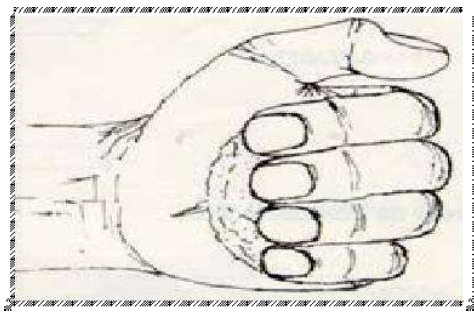


Fig.8: Hand with cake

Fonte: Cartilha 1999. Santiago et al.(2012).

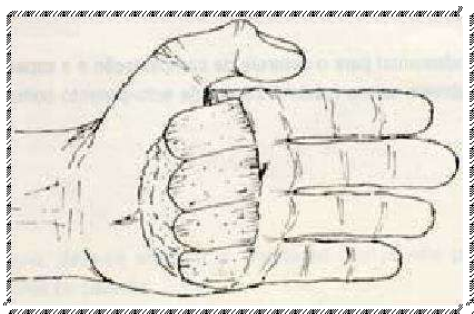


Fig.9: Open hand with cake

Fonte: Cartilha 1999. Santiago et al.(2012).

The variation of the water / cement ratio initially adopted was based on data from the literature, mainly in studies by [39], where the adopted relationships are within these ranges of variation, for the same traits studied. For each line, the study was carried out with three water / cement factors. Four traits were adopted: 1: 7: 2, 1: 6: 3, 1: 5: 4 and 1: 4,5: 4,5 (Cement, soil and granitic residue respectively). For each composition, 18 bricks were made, which served as the basis for technological tests in accordance with all technical standards.

According to [27], the resistance to simple compression was determined according to the standard ABNT NBR 10836/94 - "Hollow block of soil-cement without structural function - Determination of Resistance to Compression and Water Absorption". The current standard determines that the average resistance of the cement soil bricks must be equal to or greater than 2.0 MPa at seven days of age, with individual values greater than 1.7MPa. To analyze the RCS, the ABNT NBR 10836 standard was followed. / 94. Where it managed to obtain better water / cement factors in relation to strength as shown in Table 3.

Table 3 - RCS test and water / cement factor ratio.

		Período de Cura (dias)		
Traço	(a/c)	7	28	60
	1,00	1,5	3,3	4,2
1:7:2	0,86	2,5	5,5	7,4
	0,72	1,2	4,3	5,0
	1,00	1,9	5,5	6,3
1:6:3	0,86	2,2	4,5	3,2
	0,72	1,2	3,3	5,9
	1,00	2,9	3,5	8,5
1:5:4	0,86	2,9	4,1	7,9
	0,72	1,2	3,9	6,5
	1,00	1,2	3,1	4,2
1:4,5:4,5	0,86	1,2	3,3	1,3
	0,72	1,2	4,7	3,9

Fonte: Santiago et al.(2012).

After the results [27], they observed according to Table 3 that the tests used to obtain a better water / cement factor in relation to the resistance were performed with the following values 1.00, 0.86 and 0.72 where According to the tests, the greatest resistance to simple compression occurred with the water / cement ratio 0.86. The tests show that the ecological brick has an increase in its resistance with time, mainly with 40% of addition of residue (trace 1: 5: 4) of ornamental rock, where the value was 7.9 MPa for a curing of 60 days. It is also seen that practically all the lines presented results that met the requirements of NBR 10836 for minimum resistance of 2 MPa at 28 days.

V. CONCLUSION

It can be seen from this literature that there are several studies aimed at the use of waste for materials in the civil construction chain. Based on the results obtained in the research, it is concluded that: For the sectors of ornamental stones and civil construction to act in a sustainable partnership, the addition of granite residues for the manufacture of ecological bricks is, therefore, a excellent alternative for the use of these residues, being a new proposal to combat the housing deficit, configuring an ecologically correct practice, since it can contribute to reduce the volume of material discarded in nature, reduce the exploitation of natural resources, and thus contributing to preserving the environment. As a suggestion for future work may be the reduction of cement consumption in soil-cement mixtures, as well as the feasibility of economic and

environmental analysis between ceramic bricks and soil-cement bricks.

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The development of an experimental aerodynamics research center in Brazil

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Received: 11 Dec 2020;

Received in revised form:

06 Feb 2021;

Accepted: 21 Feb 2021;

Available online: 15 Mar 2021

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Keywords— Aeroacoustics, Aerodynamics,
Experimental, Wind energy, Wind tunnel.

Abstract— The present work describes the recent activities of the Experimental Aerodynamics Research Center (CPAERO) concerning all the efforts devoted to develop capacities on both experimental and numerical aerodynamic and aeroacoustic techniques applied for solving fundamental and industrial flows. Despite the low investment of resources by the Brazilian government and ruptures in institutional policies in the last decade, over the past 05 years it has been possible to build a medium-size low-speed subsonic wind tunnel and acquire, as well as design and build, various apparatus for laboratory and open field studies. The main activities are developed in the sectors of aeronautical, automobile and alternative energy sources such as wind energy. However, other applications are under development in fields such as fluid-structure interaction, drone noise and calibration of wind tunnels and anemometric sensors. To support the experimental studies, special attention was given to computational aerodynamics through the use of open source codes for the design of airfoils, wings and more complex flow-body simulations in computational fluid dynamics (CFD). Growing interface with local and national companies is taking place, as well as research partners with other universities and research centers. Some results are presented for unconventional aircraft analyses, commercial vehicles such as sedan and pick-up's aerodynamics, flow over cylinders with different aspect ratios as well as experimental and numerical data for finite-height surface-mounted cylinders. Recent and new approaches are provided for designing biomimetic blades for small-scale horizontal axis wind turbine (HAWT). Aeroacoustics numerical data is also compared with experimental data for subsonic jets at free-stream and cross-flow conditions showing the flexibility of tools and capabilities at CPAERO.

I. INTRODUCTION

Experimental aerodynamics is a key area for the development of new technologies and products. In fact, most of the advances seen in the aeronautical, automobile, civil construction and many other application fronts come from results obtained in large and small, high and low speed (transonic and subsonic) experimental facilities

spread around the world in different countries. Wind tunnels (WT) and their experimental apparatus, for several decades, formed the technological and scientific basis for the advancement of several applications.

However, there has been a progressive advance of numerical methods through CFD (Computational Fluid Dynamics) in the last 4 decades, which has changed the

way of solving new and old aerodynamic problems. Today it is possible to find CFD applications in almost all current industrial problems, as well as studies of concepts and new products never physically tested. This advance is undoubtedly well received by universities, research centers and the industrial sector. However, it can be said that such techniques are additional tools to deal with practical engineering problems. And, as tools, they need verification and validation before being used in scientific or even industrial processes.

As discussed by [1], the future progress in aeronautics, as well as in other areas, the coupling of advanced tools with new understandings of fluid mechanics is leading to new interdisciplinary ways of tackling aerodynamics problems. Computational tools and new experimental capabilities will play increasingly important roles in aeronautical technology progress. These new methods will profoundly affect the cost and speed of design processes as well as the efficiency and utility of future aircrafts.

In this context, it is understood that all the advances experienced in the aeronautical sector can be extrapolated to other areas of knowledge and, in fact, many methodologies and studies are shared with the automotive industry, power generation, civil construction, high performance sports, fluid-structure interaction among many other areas.

Recent works that are multidisciplinary, involving computational and experimental tools are progressively increasing. One of these works is presented by [2] which presented results obtained from wind tunnel testing and numerical analysis of a highly detailed nose landing gear. The results from this approach were quite consistent and allowed the authors to assess the contribution of the wheel bay cavity noise to the overall noise, indicating that the numerical methods could be used at the preliminary design stage of wheel bay's. The works of [3] and [4] illustrates the aerodynamic study of small car's model by employing both numerical and experimental techniques with very good agreement allowing a sensible aerodynamic drag evaluation that could help for future car development.

The main objective of this article is to demonstrate the recent development of experimental and numerical techniques underway in the Experimental Aerodynamics Research Center (CPAERO) from the Federal University of Uberlândia - Brazil. This effort is a major part of a strategic development program, which will support sectors of the industry that need aerodynamic analysis. Despite the low investment of resources by the Brazilian government and ruptures in institutional policies in the last decade, it was possible to join efforts to build a medium-size low speed subsonic wind tunnel (WT), as well as to buy and design

several apparatuses for the aerodynamic laboratories. The work carried out was focused on the bias of joining multidisciplinary, numerical and experimental tools, in order to expand the research center's capacities to deal with different problems at the same time that a deeper understanding of knowledge is built.

The work is structured as follows: Sec. II provides an overview for the test-facilities. The methodology for doing different physical measurements and numerical simulations is also presented. Sec. 3 presents some results obtained from studies in aeronautics and automobiles. Section 4 is devoted to present some data from fundamental studies such as flow over cylinders. Sec. 5 illustrates some original work performed in the area of wind turbines by using biomimetic approach for designing blades. Sec. 6 illustrates aeroacoustics numerical analyses for subsonic jets. Sec 7 provides general discussions and technical highlights are commented, gathering the most important conclusions.

II. MATERIAL AND METHODS

The Experimental Aerodynamics Research Center (CPAERO) is actually being consolidated at moment having 2 (two) wind tunnels at disposal for both academic and applied research purposes. The small wind tunnel, named TV-60-Zephyr is located in the Experimental Aerodynamics Laboratory (LAEX) from Federal University of Uberlândia, Brazil. In this closed working section and open-circuit WT, flow momentum is created by a rotor of 12 blades driven by a 25 Hp electrical engine. The maximum air speed in the tunnel test section ($0.6 \text{ m} \times 0.6 \text{ m} \times 1.0 \text{ m}$) is approximately 30 m/s with minimal blockage. An improvement has been applied to this wind tunnel with inclusion of four wire-mesh screens and guide vanes after the fan to straight the flow inside the channel. These modifications had helped to decrease the turbulence intensity for levels around 0.5 – 0.8% inside the test section, providing a good flow quality with minimum distortion provided by the fan blades – Fig. 1.



Fig. 1: TV-60 with pressure module apparatus.

With easy access to the working section, this WT is also equipped with a three component dynamic force/moment balance, interchangeable and multi-port simultaneous pressure scanning system with 2 Pitot-tubes and vertical and transversal home-built rakes for speed and pressure measurements. Boundary layer (BL) profiles are gathered with home-built BL mouse. Very low speed flows (low Reynolds numbers) are tested in this WT encountering applications such as low speed foils, flow over simplified vehicles and bodies, as well as fundamental fluid dynamics research[5], [6], [7] and [8].

The new WT from CPAERO is the TV-170-Hurricane, which is still a low speed (\sim Mach 0.26), medium-size wind tunnel for applied research – Fig. 2. It is a closed-circuit/closed-test-section with passive flow control (corner-vanes and stabilization chamber). The design criteria have been set to enable accurate measurements of steady or unsteady flow with low turbulence intensity to facilitate the study of the physical phenomena of interest. Moreover, provisions were considered in the wind tunnel design for further boundary-layer transitions experiments and aeroacoustics analysis. According to these requirements, the main characteristics of the wind tunnel were defined as shown:

- Working test-section with $1.7 \text{ m} \times 1.5 \text{ m} \times 3.0 \text{ m}$
- The maximum air speed at test chamber designed to reach 90 m/s with a prescribed turbulence level around 0.2% - 0.5%
- Minimum flow velocity: 5 m/s
- Drive System: electrical engine three-phase with 8 poles, 380 V and 350 Hp equipped with an air cooling system, and fairing integrated in order to reduce flow disturbance and heating

- The drive system is completely structural isolated from other sections of the wind tunnel, in order to avoid vibration
- Access to test-chamber through large automatized acrylic doors for easy assemblage of large models
- $5 \text{ m} \times 5 \text{ m}$ settling chamber fully assembled with hexagonal aluminum honeycomb and screens



(a) Outside view



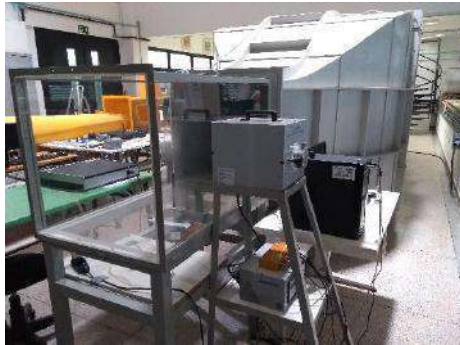
(b) Inside test-section

Fig. 2: TV-170 Hurricane - general overview.

Both wind tunnels are supported by complementary accessories for velocity, pressure and flow visualization as well as for building scaled-models. A six-component dynamic force/moment balance is available for bigger models while a 3-component aerodynamic balance (AA-TVAB1[®]) is at disposal for small models tests. Multi-port simultaneous pressure scanning system (AA-TVCR2[®]) with 64 channels together with pressure module for a multi-hole Pitot system (Aeroprobe[®]) are at disposal. Six channel hot wire anemometer (DANTEC[®]) with probe calibrator and multiples 1D, 2D and 3D probes are also available for more detailed analyses – Fig. 3. Multiple and single smoke filaments is achieved by a fog-machine (AA-TVEG[®]) while parietal and wake-flow visualization is done with oil/china clay techniques and wool-tufts respectively.



(a) Six-channel Hot-wire anemometer



(b) 3-component Aerodynamic balance

Fig. 3: Complementary apparatuses – LAEX/CPAERO.

Scaled-models are built by modelling through a semi-professional 3D-printer with chamber dimension of 45 cm × 30 cm × 30 cm. A small workshop provides support for finishing the models to be used in wind tunnels – Fig. 4.



Fig. 4: Example of printed scaled-models.

In terms of computational aerodynamics, CPAERO has the capacity to perform small and medium performance simulations with the availability of 2 workstations with 12 processors each, with 48 and 64 Gbytes of RAM, respectively. All aerodynamic analyzes are performed using open source software's developed in-house or publicly available such as OpenFOAM, Xfoil and Qblade, among others – Fig. 5.



Fig. 5: Computational resources room – LAEX/CPAERO.

A summary of the methods used at CPAERO as well as their applications can be listed below:

1. Evaluation of aerodynamic coefficients (drag, lift and pitch moment)
2. Determination of pressure distribution in blunt or aerodynamic bodies
3. Evaluation of velocity profiles in flows
4. Flow visualization and characterization of laminar, transitional and turbulent flows
5. Determination of loads in structures
6. Computational analysis (2D and 3D) of academic and industrial aerodynamic problems
7. Design and construction of blades for fans and other pumping systems
8. Velocity and pressure measurements in the field (industrial environments)
9. Prototyping of models with maximum dimensions of 90 cm × 60 cm × 60 cm
10. Wind tunnel characterization for calibration of anemometric probes

Now in consolidation, CPAERO will provide the training of teachers and the training of students from scientific initiation to postgraduate studies in several academic units at UFU in the field of Experimental Aerodynamics. Depending on the country's development, CPAERO also aims to meet the demand for RD&I (industrial research and development) and provide services to public and private companies, as well as the execution of academic and extension research projects within UFU and partner universities. Fig. 6 illustrates some of the areas in which CPAERO could collaborate for development, with extensive support for academic and industrial researches.



Fig. 6: CPAERO's areas of expertise.

III. AERONAUTICS AND AUTOMOBILES

Some studies in the aeronautical and automobile sectors have been conducted by CPAERO in the last 5 years, including fundamental and applied research in the scope of master's dissertations and doctoral theses, as well as scientific initiation and service (consultancy) work for some regional companies. Research and work partnerships were also instrumental in establishing a good portfolio of subjects and studies, such as the partnership with ISVR (Institute of Sound and Vibration Research, UK) and the EESC-USP (School of Engineering at University of São Carlos, Brazil).

Different studies in the aeronautical field go through aerodynamic and aeroacoustics analysis of subsonic jets through experimental tests and numerical simulations [9], [10] and [11], comparative studies for the design of propellers [12], characterization of the flow in NACAS and SCOOPS in unconventional aircraft [13] and [14]. These last works developed by CPAERO was in partnership with the aircraft manufacturer FABE Ltda, through the development of a methodology for the design, verification and validation of air intakes for a canard type aircraft (unconventional), as described by [15].

The case study is a canard-type aircraft named Bumerangue EX-27 Cross-country in the general aviation category (experimental aircraft). This is a four-place aircraft, monoplane, single engine installed in the pusher configuration, with retractable landing gear. The powerplant system is composed by a Continental TSIO 360 EB Turbo – air refrigerated developing 210 HP at 2700 rpm and equipped with a MT propeller with stainless steel protection and fiberglass. Due to its geometric configuration, this type of aircraft has a piston engine mounted in a pusher configuration in the rear part, behind the cabin, which needs cooling during flight. Fig. 7 illustrates one of the flight tests where wool tufts were

applied to visualize the flow in region of the air admission for the engine.

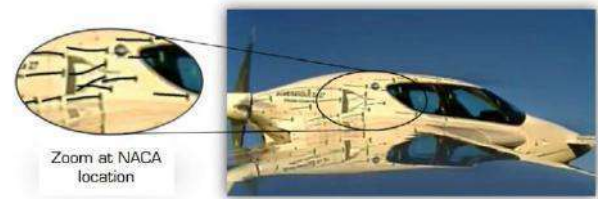


Fig. 7: Wool tufts visualization – flight-test at 3,000 ft with 120 knots. Source: [15].

A complete numerical assessment was carried out having as reference data experimental measurements (most pressure) and flow visualization from flight, as seen in Fig. 7. The mesh used was an unstructured tetrahedral with prisms surrounding the fuselage, aiming at a good characterization of the boundary layer. Using AnsysIcemCFD® software, the mesh was generated and had approximately 9 million elements for all geometries proposed. A prism layer covers all the walls assuring a y^+ value of 30. A mesh illustration is presented in Fig. 8.

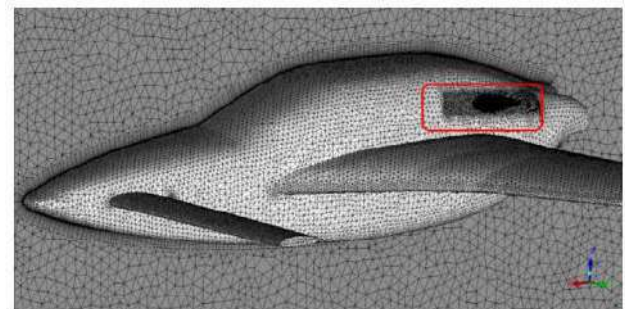


Fig. 8: Mesh view, highlighting portion with the air-intake geometry. Source: [15].

A close look at Fig. 9 shows the velocity streamlines that entry each of the intake geometries proposed for AOA 2° .

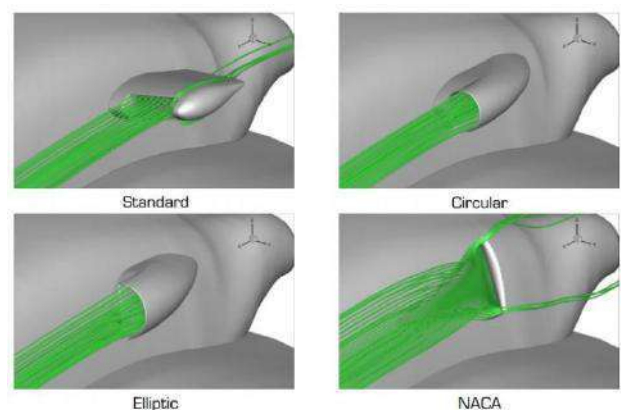


Fig. 9: Streamlines for $\alpha = 2^\circ$ entering the different air intake geometries. Source: [15].

Fig. 10 illustrates the comparison of the air-intake efficiency for each configuration tested by considering both AOA ($\alpha = 2^\circ$, cruise condition and $\alpha = 15^\circ$, takeoff). Both elliptic and circular air intakes have shown efficiencies over 80% and are quite desirable for engine cooling, albeit additional evaluation for the drag penalty must be considered.

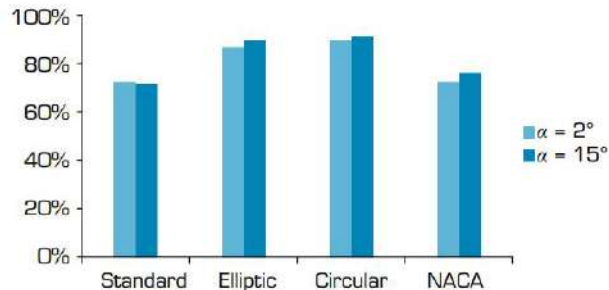


Fig. 10: Efficiency comparison of air intake. Source:[15].

Flow characterization and aeroacoustics analysis of simple and complex nose landing gear is being developed through partnership with LAE-1 (Laboratory of Aerodynamics) from EESC-USP – Fig. 11.



Fig. 11: Flow visualization from China clay technique – Lagoon model.

Activities in the construction of new and detailed models of cars such as pickups and sedans, with reference to the automobile market in Brazil, as well as physical and numerical tests have been conducted recently. Although the tests are conducted at relatively low Reynolds numbers of 5×10^5 (compared to the real scale), these tests serve to verify construction techniques, speed and pressure measurement approaches, as well as to establish methodological analysis criteria for tests on larger models. In addition, it is possible to establish correlations between the results obtained in low Reynolds with the numerical results collected in simulations with higher Reynolds numbers (simulating the real case). One of the first works was the analysis of the flow around pickup trucks[5], depicted by Fig. 12.

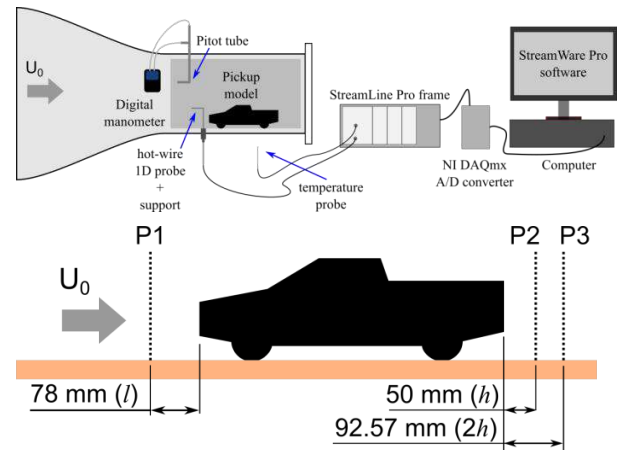


Fig. 12: Hot-wire anemometry system and acquisition points. Source: [5].

Flow analysis was carried out by hot-wire anemometry by measuring velocity profiles in front and behind the pickup. Later, aerodynamic drag evaluation was performed by using the 3-component aerodynamic balance. Flow visualization was performed through tufts and parietal techniques such as china clay. All experimental results served as verification and validation of the CFD solutions – Fig. 13.

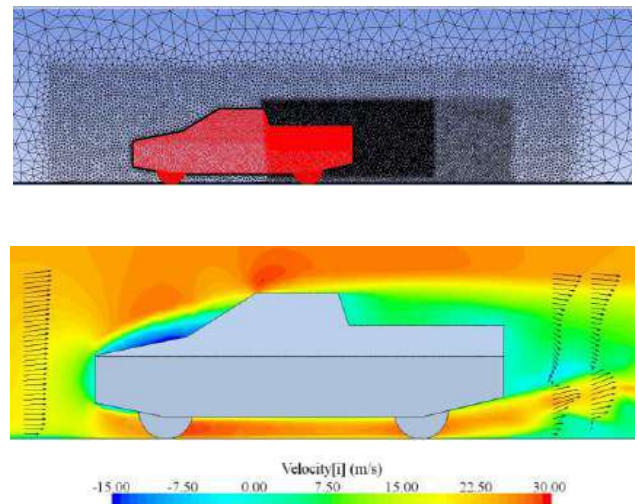


Fig. 13: Numerical surface mesh on symmetry plane pickup – Baseline mesh). Source: [5].

The reverse flow was completely captured by the CFD simulation, showing the interaction of this flow with the tailgate. Structures that are observed on overall model are illustrated in Fig. 14. Important features are highlighted and labeled sequentially.

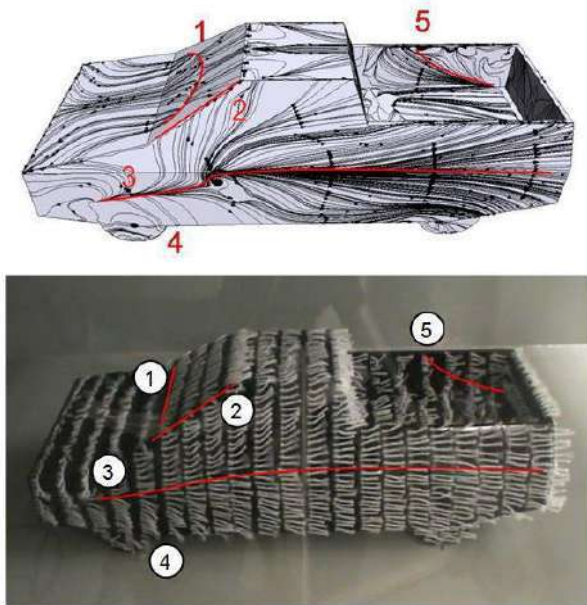


Fig. 14: Numerical shear streamlines and wall tufts ($U_0 = 25 \text{ m/s}$).Source: [5].

Additional and similar studies have been conducted by using sedan vehicles – Fig. 15.

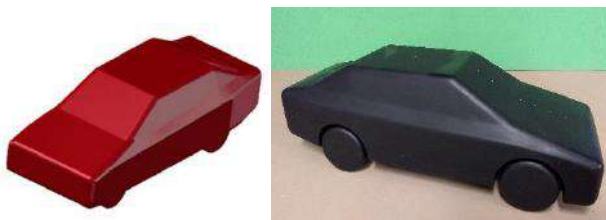


Fig. 15:3D-CAD model and printed model at scale 1:11.

Both numerical and experimental data was gathered in order to compare flow visualization, drag coefficient, pressure coefficient distribution over the model.

The numerical resolution of the flow was made based on the Navier-Stokes equations weighted by the Reynolds means (RANS), in steady state, formulation of absolute speed and the system of equations based on the formulation of pressure (pressure-based). To close the equations in the RANS methodology, two turbulence models known in the industry: $k-\epsilon$ Realizable (with Enhanced Wall Treatment) and $k-\omega$ SST were used – Fig. 16 and Fig. 17.

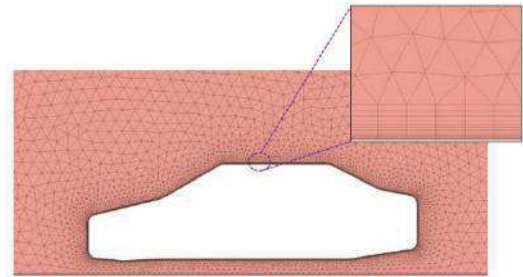


Fig. 16: Mesh detail in the prism layer region.

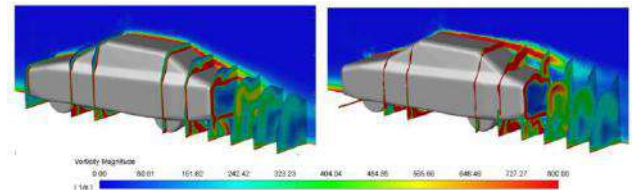


Fig. 17: Contours of vorticity: (a) $k-\epsilon$ Realizable - $V = 16 \text{ m/s}$; (b) $k-\omega$ SST - $V = 16 \text{ m/s}$;

Pressure distribution and drag coefficient were consistent and satisfactory during the measurements and numerical simulations leading to errors between 5 up to 10% in respect to the flow velocity studied – Fig. 18. Additional data and analyses are being processed at the time and future publications on this topic are expected soon.

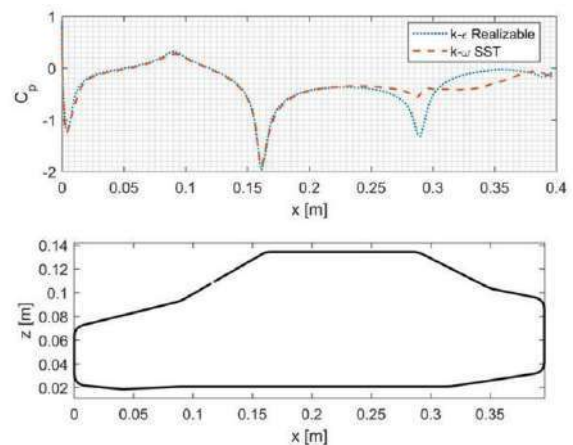


Fig. 18: Numerical comparison for pressure distribution with $k-\epsilon$ Realizable and $k-\omega$ SST.

IV. FUNDAMENTAL TESTS

Flow over rectangular cylinders with different aspect ratio (AR), circular and semi-circular cylinders, as well as bodies derived from these two last geometries is a front of study and fundamental research in CPAERO. Many engineering problems find application for this type of geometry in different areas of knowledge, from civil engineering (buildings) to compact heat exchangers.

Most of the characterization of the flow is performed with multi-hole Pitot tubes and hot-wire anemometers by means of measuring the velocity profiles and pressure distribution over the different bodies as illustrated by Fig. 19. Drag coefficient is also gathered under specific configurations since it depends on the way the cylinder is mounted in the aerodynamic balance.

Also, due to the unsteady nature of such flows over cylindrical bodies (blunt bodies), special attention is given to the numerical modeling. Sometimes, at low speed flow, it is possible to perform some steady state simulations to evaluate the data.



Fig. 19: Flow over different cylindrical shapes (blunt bodies).

A complete experimental analysis of the flow around square-base cylinders with different aspect ratio (AR) and surface-mounted was carried out (unpublished results). Fig. 20 illustrates the 4 cylinders used in these experiments covering aspect ratios from 1 up 4.

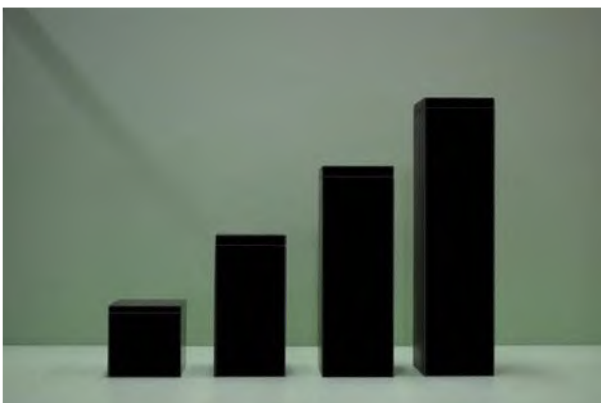


Fig. 20: Flow over different surface-mounted square-base cylinders.

Pressure distribution (C_p coefficient) over the faces, aerodynamic drag coefficient, velocity profiles and flow

visualization have been extensively gathered during the tests.

Fig. 21 shows the hot-wire measurements of transversally u -velocity profiles behind the cylinders (1D) at 16 m/s. It is possible to observe a well-distributed wake flow behind the cylinders with different mixing flow according to the AR.

Fig. 22 compares the C_p distribution of the horizontal points on the right-side for all cylinders (with different aspect ratios).

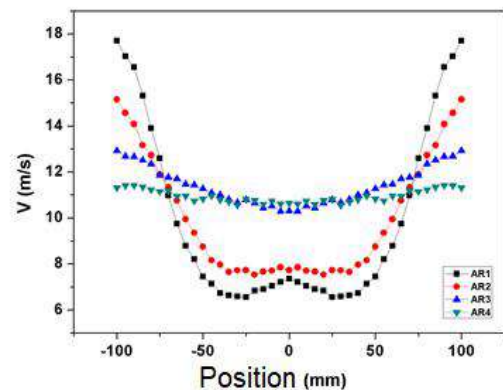


Fig. 21: u -velocity profiles behind (1D) the cylinders.

The flow when encountering the corners of the front face, tends to increase its speed, detaching from the wall, creating on the side face of the cylinder a region of low pressure of unknown thickness (further investigation), causing the C_p on the side faces of the cylinders to become negative.

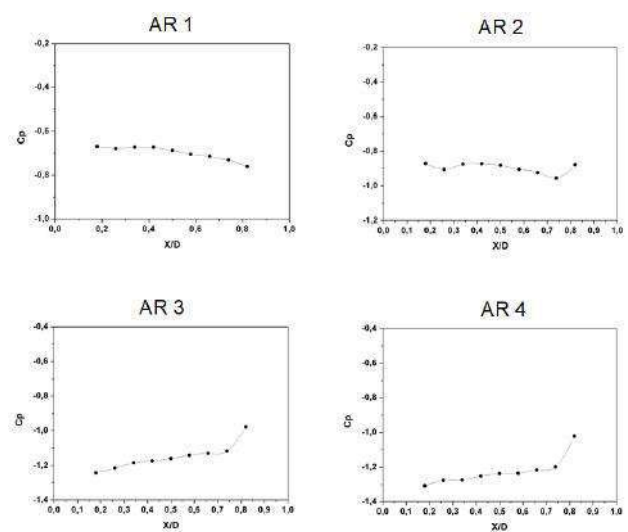


Fig. 22: C_p distribution over the lateral face of the cylinders.

Flow visualization through smoke and china clay techniques allowed to identify some characteristics of the flow over the cylinders. Fig. 23 summarizes some of these investigations, providing details about the flow being developed both at the top and side-faces from a cylinder with $AR = 1$.

This work is an ongoing research being developed at CPAERO at the moment. The next steps are towards the comparison with unsteady CFD analyses in order to enhance the knowledge about the flow structures present in this peculiar fluid-structure interaction problem.



Fig. 23: Visualization of the flow over a square cylinder surface mounted.

Another approach deals with the flow over a cantilever finite-height semi-circular cylinder with aspect ratio of 2.0, as depicted by [16]. Numerical and experimental data allowed to characterize the flow over such geometry in terms of drag coefficient, pressure distribution and flow visualization.

The perspective-view of the path lines by CFD confirms the complex flow behind the semi-cylinder, it was possible to identify the recirculation and massive separations formed in the wake region behind the semi-circular cylinder – Fig. 24.

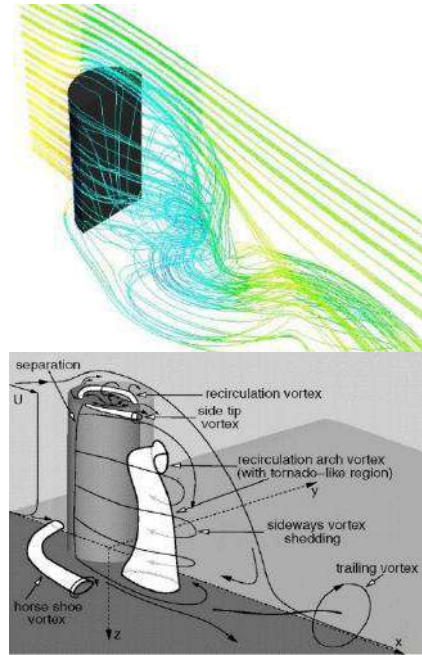


Fig. 24: Comparison of the flow field – semi-circular and circular cylinder. Source: [17].

Likewise, the work of [17], who also proposed a model based on numerical simulations of the flow around a finite cylinder of $AR = 2$ and Reynolds number of 2×10^5 , similar characteristics of the flow behavior were obtained on the semi-cylinder at CPAERO – Fig. 25. In both models were able to see side-tip vortices generated from the sides of the free-end surface, recirculation arch vortex with a tornado like region behind the semi-cylinder and horse-shoe vortex.

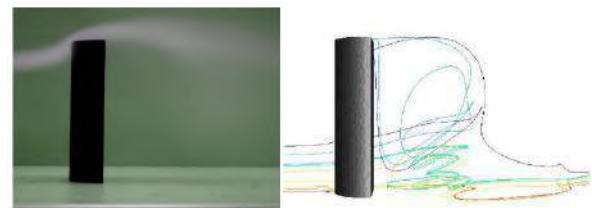


Fig. 25: Path lines from the flow field around the semi-circular cylinder.

Table 1 presents the drag coefficient obtained in this work by considering experimental and numerical measurements. The drag coefficient in this study ($C_D = 0.838$) was a little bit higher than the results obtained in the literature data as pointed in the work of [18] for full-circular cylinders, where drag coefficient was 0.78. Nevertheless, it is worth noting the good approximation between the numerical and experimental results in the present work.

Table 1. Drag coefficient evaluation.

Experimental	Numerical
0.838	0.824

V. WIND TURBINE

Recently, in Brazil, the demand for knowledge in the field of alternative energy sources, mainly wind energy, has been growing. With the increase in wind farms on the Brazilian coast and the demand for off-grid installations along the country, the number of studies and works in this area has substantially increased. As such, CPAERO has developed training and new design studies for small and medium-sized wind generators.

The work of [7] illustrates the construction and test of a Lenz-type VAWT (vertical axis wind turbine). Fig. 26 illustrates the final prototype CAD's design and photo of the Lenz-type VAWT, which was fully-tested (including the electrical core of the generator) in the LAEX/CPAERO Laboratories. The entire cost of fabrication for the prototype of this small-size wind turbine was around \$90,00 (ninety American dollars) and took not more than a week for being completely assembled.



Fig. 26: 3D-drawing and photo of the Lenz-type VAWT.

Wind tunnel power-up conditions were set for velocities of 5, 6, 7, 8, 9, 10, 10.8 and 11.7 m/s with different resistive loads (R_c) applied in the electrical system as 14.7, 12, 9, 6 and 3 Ω (ohms), making the total test matrix with 40 points.

To evaluate the shaft mechanical power, it was necessary to use a DC generator and a resistive load, as sketched on Fig. 27. The DC generator was energized, and the resistive loads were applied in the circuit as seen below:

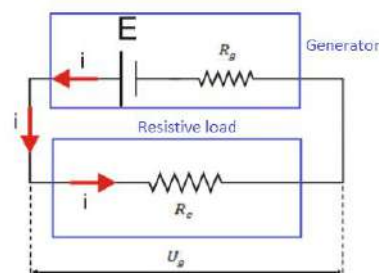


Fig. 27: VAWT's electrical circuit sketch.

Fig. 28 presents the variation of mechanical power as a function of the shaft rotation for different wind speeds tested in the wind tunnel. The results were consistent with the theory as the power is proportional to the cube of wind speed.

Laboratorial tests, by using a wind tunnel, have shown important results for the mechanical power and power coefficient for the wind turbine. The mechanical power with a resistive load of 3 Ω reached around 73 Watts and the functioning of the wind turbine was quite safe up to wind velocities around 11 m/s. Despite some losses in the bearings and in the electrical generator, the Lenz-type wind turbine showed potential for use in areas with low winds in countryside of Brazil, such as farms or even in small urban centers.

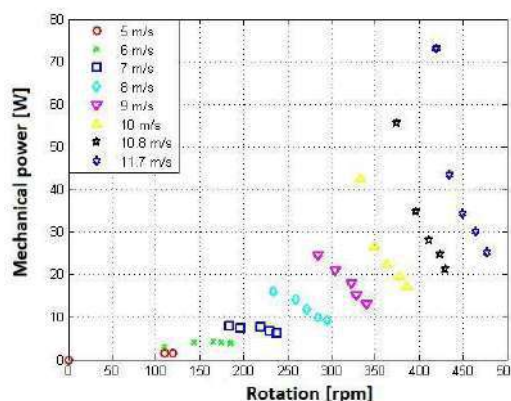


Fig. 28: Mechanical power as a function revolution per minute at different wind speeds.

A more recent study aims to develop the bio-inspired design (biomimetics) of the blade of a horizontal axis wind generator (HAWT) based on seeds from the Brazilian savannah (*cerrado* - vegetation that covers part of the center-southeast region of the country). For this research, seeds with autogiro morphology were chosen, as shown in Fig. 29. These are characterized by being winged seeds on one side only, which provides the means for dynamic

propulsion: it rotates firmly around the seed at the end of the diaspore [19].

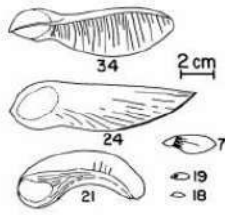


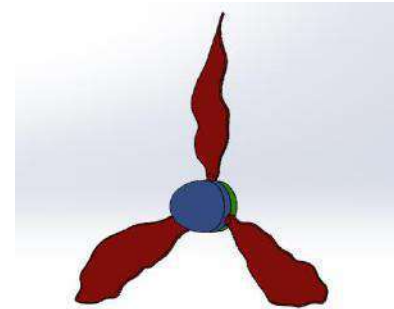
Fig. 29: Examples of self-tapping seeds. Source: [19].

Seeds of *Q. Multiflora* from the *cerrado* biome were collected to generate the geometric profiles of the biomimetic blade. An average of the contour points of a seed was used to generate a profile at different angles of vision using the *SolidWorks*® and *Catia*® software, giving the leading edge, curvature and trailing edge of the proposed blade – Fig. 30.

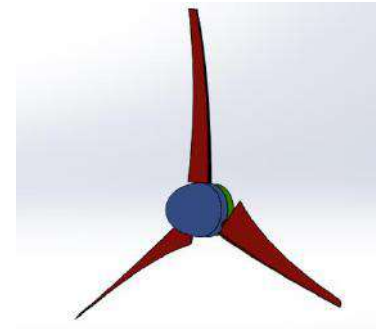


Fig. 30: *Q. Multiflora* seed and the 3D-scaled model for the HAWT blade.

To evaluate and to compare the HAWT blade performance, a reference (baseline) of a blade model attached to a three-blade wind turbine with a rotor diameter of 0.45 m was primarily used to test the concept, as seen in Fig. 31. The biomimetic design did not have any optimizations in the analysis during the accomplishment of this work, being the first analyzes in this type of configuration. A thickness of 5 mm was imposed for the blade. For application purposes, the root region of the blade has been strengthened so as not to break due to the properties of the sheet.



(a) Biomimetic design



(b) conventional design (baseline)

Fig. 31: Scaled model prototypes – CAD 3D drawing.

The mechanical power generated by the blade is directly proportional to the torque and angular velocity of the blade. To determine both the torque and angular velocity of the blade, a torque transducer was used. The Magtrol® TM-307/011 was utilized, which is primarily designed for measuring the static, dynamic torque and the rotational speed, as seen in the workbench exclusively prepared for the tests – Fig. 32.



Fig. 32: Torque transducer and brake system to the turbine shaft – WT setup.

The results obtained points towards a good relationship between angular velocity and torque for the *Multiflora*-based design. Once the rpm and torque are

higher for the biomimetic design, as seen in Fig. 33, it is hoped that there is margin for improvement in the current design, as for instance the optimization of the blade position. Also, the good capacity of auto-starting at low wind speeds is a good advantage when compared to conventional design's. All these advantages are leading to improved future works to demonstrate its performance in tests with larger wind turbine, which is being built at the moment.

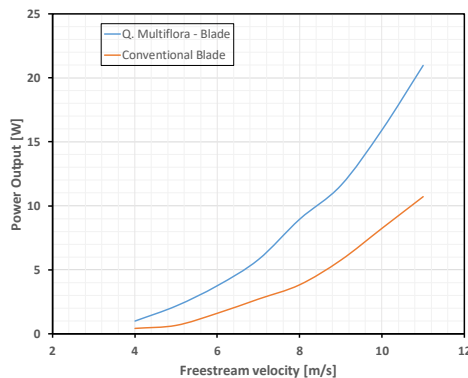


Fig. 33: Power Output comparison between bio-inspired blade and conventional design for HAWT.

VI. AEROACOUSTICS

Currently, the development of capabilities and tools in the field of aeroacoustics has been done on two main fronts, numerical and experimental, as usual. The numerical part is devoted to acoustic analogies and data correlation with experimental data – empirical tools. Applications are seen in field of subsonic jets. For instance, the sound field of subsonic jet in crossflow (JICF) was investigated by [11]. Some of the results were very promising and are illustrated in Fig. 34.

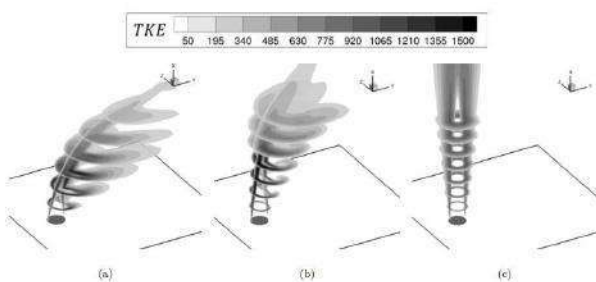


Fig. 34 :TKE distribution along X-axis and symmetry plane for (a) $V_c = 4$, (b) $V_c = 8$ and (c) free jet. Source: [11].

It is important to show first the sound field prediction for the free jet, i.e. without the crossflow. Experimental data are available for six angles at the farfield plotted against the LRT (Lighthill Ray-Tracing) results in a polar plot shown in Fig. 35. A very good agreement is achieved

by the acoustic model. The symmetry in the plot is clearly seen, as the microphone position is set at $Y = 0$ or $Z = 0$.

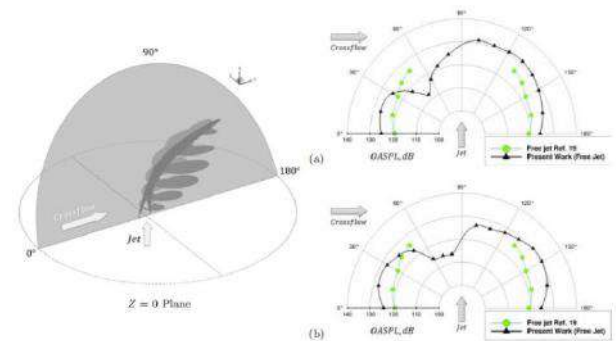


Fig. 35: OASPL results for $Z = 0$ at (a) $V_c = 4$ and (b) $V_c = 8$. Source: [11].

Although it was a purely numerical work, it shows the applicability of tools and some approaches developed in the Laboratory to face more complex problems.

Another numerical study used experimental data to validate a methodology for aeroacoustics of coaxial jets. This work was part of a major investigation for coaxial jet noise prediction and refers to a study of geometrical and velocity parameters and their influence on the noise generated by coaxial nozzles. The Reynolds Averaged Navier-Stokes (RANS) approach coupled with a fluctuation synthetization model and the integral formulation of Curle's Acoustic Analogy were employed to calculate the noise spectrum and compare it to experimental data from JEAN EU project.

The nozzle geometry used in this study is shown in Fig. 36. The coplanar nozzle has been used in the EU JEAN project and in a research collaboration program between ISVR (Institute of Sound and Vibration) and Federal University of Uberlandia following previous works [20] and [21]. For this coplanar nozzle, only acoustic experimental data was available for different area ratio ($AR = A_s/A_p$): $A = 0.87$; 2 and 4; different velocity ratio ($VR = V_s/V_p$): $VR = 0.63$; 0.79 and 1.0.

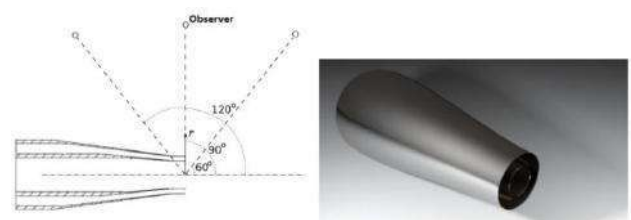


Fig. 36. Description of observer locations and shape of coplanar nozzle. Source: [11].

The steady-state flow field has been achieved by employing a RANS (Reynolds Averaged Navier-Stokes equations) approach to solve the three-dimensional (3D) problem of the flow from a subsonic dual-stream jet discharging by a coplanar nozzle with different area and velocity ratios. What is referred to hybrid approach is the fact that the aeroacoustics of the problem is evaluated in two steps: a) Characterization of an averaged flow field by depicting the flow and turbulent variables (source calculation); b) Use of a method or technique to generate the unsteadiness related to the problem (fluctuation of the field); c) Propagation of the noise generated by this field to the location of the observer through an integral propagation solution [21]. Fig. 37 illustrates some of the results for 1/3 octave-band for sound pressure levels (SPL):

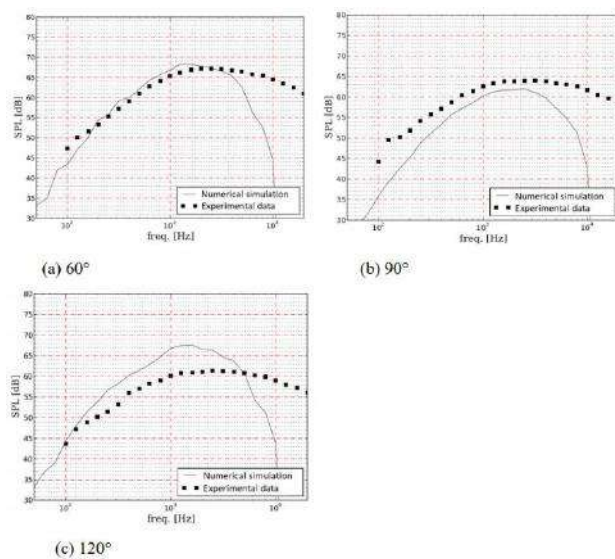


Fig. 37: Sound pressure level (1/3 octave-band) for configuration A2V6 at (a) 60°; (b) 90° and (c) 120°.

Source: [11].

Based on the results, it was possible to state that there was no linear proportionality between the velocity ratio and the levels of turbulent intensity. For all area ratio investigated, there was no pattern for the variation in the velocity ratio, as the intermediary values of VR have presented lower levels of turbulent intensity in the central region of the jet. More detailed experimental data including more variations of VR could help to explain such kind of confirmation.

Additionally, experimental work on aeroacoustics is being developed in two ways: a) development of a single-frame setup for doing tests (microphone measurements) of blade-rotor/structure interaction in drone configurations. Such single-frame setup would work both in lab and outfield. This is an ongoing research recently started at LAEX/CPAERO facilities with in-house funding

resources; b) development in collaboration with EESC-USP for measurements with noise mapping antenna (beamforming) for more complex tests such as high-lift devices and landing gears. This is also an ongoing research and completely dependent on external funding resources.

VII. CONCLUSION

The present work provided an overview on the recent activities of the Experimental Aerodynamics Research Center (CPAERO) concerning all the efforts devoted to develop capacities on both experimental and numerical aerodynamic and aeroacoustics techniques applied for solving fundamental and industrial flows in Brazil.

Most of the work done was completed in the last 5 years, having found several applications in academic studies as well as in the industrial environment. Moreover, it should be emphasized the importance of training future engineers and professionals (masters and Ph.D.'s) for the university environment. Despite various restrictions on resources and investments by the federal government in Brazil, it can be said that the great contribution of CPAERO is, at first, in the training of personnel and, subsequently, in the solution of possible industrial problems by providing specialized skills and understanding of different flows phenomena.

The present work was intended to demonstrate these capabilities and, at the same time, to expose in a concentrated manner the actions carried out at CPAERO in Brazil. One of the objectives is to exchange experiences with other universities and research centers, as well as to demonstrate the possibilities of development in studies for the industrial sector. Therefore, it seeks to expand knowledge and offer opportunities not directly envisioned by the CPAERO team to date.

All results presented herein are qualified and most of them published, showing a satisfactory range of techniques and methods now under development at CPAERO. All of this capacity translates into an expansion of knowledge and the possibility of partnerships and actions in the solution of different flows, both with academic and industrial bias. Therefore, with the advent of new investments and the emergence of new projects, it is intended to leverage future developments on new fronts such as PIV, unsteady-aerodynamics and flow control techniques (active methods).

ACKNOWLEDGEMENTS

The author would like to recognize the funding resource from FINEP (Financiadora de Estudos e Projetos) through grant 01.12.0068.00-Reference 0378/11. Also, it is

important to mention all the support given by the administration of the Federal University of Uberlândia during the implementation of CPAERO. External recognition also applies for Prof. Fernando Martini Catalano from School of Engineering at São Carlos University (EESC-USP) and Prof. Rodney Harold Self from Institute of Sound and Vibration Research (ISVR), UK.

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Performance of Sustainable Building Fabric to Replace the Traditional Cavity Wall Technique for New Housing Sector in the UK

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Received: 16 Dec 2020;

Received in revised form:

02 Feb 2021;

Accepted: 22 Feb 2021;

Available online: 15 Mar 2021

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Keywords— Sustainable Building, Housing
Sector, construction industry, Greenhouse
gas emissions.

Abstract— UK Government confirms the important binding targets to promote low carbon construction industry such as enhancing reduction 34% by 2020 and 80% by 2050. This reduction can be adopted by different way for instance mitigating the energy use in houses. Huge numbers of houses were annually built-in construction industry, In England and Wales more than 160,000 houses are built in 2017 therefore, Promoting the improvement through airtight and insulated in building envelope can lead to high energy consumption reduction. Reducing greenhouse gas emissions is considered a significant part that related to the energy consumption requirements in terms of the operational energy of houses in United Kingdom. Reducing the energy demands can be achieved through using building materials and operational energy. Construction methods of construction can also provide impacts on the energy demands of building in terms of the materials that used during construction. Five methods of construction were selected to examine their performance in terms of the thermal resistance and factors that could affect acceptability in construction industry. The methodology was identified the behaviour of thermal performance for each method of construction through using cases study methods of previous cavity walls manufacturer. The acceptability of construction methods was carried out by collecting data of community. The main objective was to find out the optimal system of construction methods that could minimise the operational energy whilst providing comfortable houses energy.

I. INTRODUCTION

Greenhouse gas emissions have harmful impact on environment. These emissions are leading to climate change across the world. The net effect of climate change results as an outcome of global warming. Consequently, surface temperature would significantly increase. The three significant binding targets have been set to mitigate greenhouse gas emissions in the United Kingdom. The ongoing target was set to reach a 34% cut by 2020, which

was triggered as officially binding in 2009. The third target; to reduce about 80% of carbon emissions by 2050 [1].

In England and Wales, more than 160,000 houses were built in [1], considerably more than what was built in previous years. These dwellings are controlled by number of organisations that set many building regulations. However, there is slightly differences in these regulations between England and Wales, Scotland and Northern

Ireland. Nonetheless, they all cover the main aspects similarly. Controlling energy costs in properties could annually generate significant savings. Performance of building envelopes plays key role in preserving energy. Improving the envelop by using airtight thermal insulation could highly reduce energy consumption. The major issue with the currently used building envelopes is preserving the energy needed for the heating and cooling processes. Most of the procedures of energy savings are regulated by the Code for Sustainable Homes, which requires stakeholders to meet the standards by using adequate materials and efficient technologies.

Insulating concrete formwork (ICF) was initially appeared in UK in the early 1970s. ICF system uses cast in-situ concrete between two layers of insulation. However, the acceptance of this method was highly slow because brick and timber methods were considered similarly durable, as well as, they were already available [2]. Homebuilding and Renovating [3] [4] gave details for utilising the structural insulated panels system which recently accounted for about 8% of the UK house building. Throughout sustainable projects, a big challenge is the selection of best construction method. It is considered as a main factor that affects productivity and efficiency of projects [5]. There are two main techniques used in assessing environmental impacts and building design in the United Kingdom, namely; life cycle assessment (LCA) and code for sustainable homes. The code for sustainable homes is a national standard used in construction and verifies the sustainable performance of new houses by Applying building regulations. The implementation would be conducted considering many categories such as energy and carbon dioxide emissions, materials and pollution. Each category identifies the environmental impacts which could be mitigated by following certain measures.

II. LITERATURE REVIEW

Construction of new houses is considered traditional in England and Wales. Elements of housing designs and layouts are replicated over large areas. It could be due to the fact that most houses are constructed in large developments by building companies. An adequate housing design would provide efficient life for. Therefore, design and layout value of houses play very significant role by attracting and providing commercial motive for house builders, in order to adopt more innovative designs [1]. Effect of alternative construction methods on projects' execution is considered as an essential approach associated with an appropriate selection. The impact could extend to reach productivity, quality, and cost. It is highly possible to increase costumers' satisfaction when adopting efficient

construction techniques. At the same time, house builders will, with no doubt, gain commercial rewarding when providing more innovative and attractive designs. Either householders or users of dwellings are taking an account of the value of innovative designs, because innovative layout would help them acquire modern houses.

In the United Kingdom, different methods of construction and materials was used in previous years. Timber- frame construction represented 40% of the homes built in Scotland in 1995, with only 3% built in England and Wales in the same year [6]. Between 2003 and 2010, the majority of UK's homes were built using masonry cavity walls that typically consist of brick outer skin and a blockwork inner skin. Moreover, all construction works in England and Wales were administrated by Building regulations that imposed rules for new buildings to ensure that structures were safe. To comply with building regulations, it was obligatory to carry out works with adequate materials, efficient construction technique and workmanlike manner. Tricker and Samantha [7] indicated that existing or new construction materials would be checked by considering its adequacy requirements in terms of weather resistance, thermal resistance, weight and structural stability and fire protection. Due to the fact that construction materials demand extensive energy to produce, selection of building materials need huge awareness. There are several advantages and disadvantages to the construction techniques used for any specific project. In 2007 about 166.000 new building homes were constructed in the UK, around 92 percent of which were built using brick and block and timber frame methods. There are plenty of alternative methods of construction that can become a preferred option for either, the house building companies or the self-builders. These alternative building systems are will become more frequently used and architects must be well-skilled when utilising them. Therefore, choosing the best system for housing requires concessions over different aspects.

Construction methods have been adopted in the UK from global experiences that integrated various building materials such as insulated concrete formwork (ICF), structural insulated panels and thin joint blockwork. ICF system is considered as an innovative modern method, due to its association with the essential strength of concrete and the outstanding thermal insulation assets of polystyrene which provide cost saving and strong structures. Standing concrete formwork would be produced using polystyrene material. Concrete offers excellent sound insulation, fire resistance and thermal insulation. This construction method was first developed in Europe during the WWII as a strong technique to reconstruct destroyed houses [2]. Nevertheless, there are

some problems that could occurred during ICF construction. For instance, during construction, the procedures of pouring walls with concrete could sometimes be problematic. When concrete is placed at fast range, it might break through the polystyrene sheets, which can cause building delays. A skilled house builder must be aware of the adequate numbers of feet that can be placed without causing damages. Moreover, regular ICF panels are considered vulnerable to groundwater intrusion. Architect and designers should take into account the use of drainage sheeting to minimise the effect of moisture [8].

Structural insulated panels are considered as light weight, off-site, manufactured objects. The panels are typically orientated stand boards (OSB), which is composed of two skins of wood based panels and made by sandwiching a low density, cellular core rigid insulation. Using SIPs technique can provide high performance building, through enhancing the durable bond between core insulation and the skins of OSB. High level of airtightness in SIPs can be achieved by collecting all structure components in a tightly-fitted medium [9]. On the other hand, some drawbacks to the use of SIPs is that it requires very well skilled workforce during construction. The reason behind that is the fact that the orientated stand boards are considered as vulnerable to water, leak problems and moisture. Furthermore, SIPs has specific features as it is considered as lightweight construction technique. That would increase the risk of high temperatures in houses, particularly during summer. Consequently, overheating could affect the comfort and health of residents.

Thin joint blockwork technique is also considered as modern method of construction. The UK construction industry is increasing demands to utilise this method, due to its high performance. The layer of mortar that is used for blockwork is pre-blended cement that demands only further water to make it ready. That make blockwork easy to build, in stable conditions, and reduces the amount of mortar, compared to another technique. High levels of productivity could be promoted throughout building autoclaved aerated block walls, with a thin layer mortar that allows construction in less time. Using mortar joints during construction would reduce the thermal bridging and provides more preferable U-value. Combination of efficiency for thermal mass and low conductivity in blockwork is identified as significant aspect in reducing energy consumption in houses, which can be improved when using thin joint technology. That way, it would increase the whole execution of the cavity wall, considering the amounts of heat loss [10].

Most of construction issues are related with design, manufacturing and assembly. Which, ultimately, relates to

the capability to make decision within the available time frame. Some clients require specific data that could affect the phases, performance and amount of time allocated for projects. Selection of adequate materials would be relatively complex due to the difficulty in meeting the specific purposes of householders, house builders and architects. Any stakeholder must take into consideration the determination of priorities regarding the construction products. Designers also would reassess the materials related to building envelopes. Choosing the correct solution for a specific situation could give benefits for householders, as well as, for house builders. It is very important to take into account the comprehensive process of greenhouse gases reduction, through operations and during the assessment of the implications of design decisions on construction. Architects, developers and house builders need to raise awareness regarding the materials that would be used from different sources, to eliminate any possible issue [11].

III. METHODOLOGY

In this research, questionnaire was used to be spread for housebuilders among UK districts. The main objective is to find out the significant factors that could affect decision making process when selecting the most suitable construction method. Moreover, to measure the acceptability of construction techniques for housebuilders in construction industry it terms of thermal performance. Furthermore, cases study of u-values will be conducting in project to find out the more about heat lose and gain for each method construction. Construction techniques in this project have been selected according to their appropriateness by comparing them with the past and the already applied construction methods. Suggesting unfamiliar techniques of the modern methods of construction and other construction methods and evaluating the feasibility of using them during the upcoming 50 years in the UK. In this research, the qualitative methods would be used to clarify of the acceptability of construction methods that used in housing construction by using questionnaire, online survey was selected to identify the statics of the factors that could affect of design-making for the house building materials. The cases study was also carried out to illustrate the thermal performance for each construction method through manufacturers in UK and to measure the U-value for construction techniques.

The satisfaction with using a certain construction method by the public is considered a critical matter. The reason is that, raising awareness and the ability to make a proper decision is the responsibility of construction

professionals. Therefore, the acceptability of construction methods would be carried out by construction industry over the reviews of house builders. This consideration should be undertaken during the planning phase. Therefore, information about existing projects in the UK was collected from industry professionals. The online survey was used to identify the factors that affect the decision-making process when selecting the most suitable construction method and to measure public's satisfaction. Kothari [12] indicates that primary data can be obtained through various ways such as observation and direct communication. This work was carried out by using questionnaire for its high advantages. Some of these advantages are; respondents would have appropriate time to give precise answers, respondents' opinion can be easily obtained, large numbers of respondents can get involved and its low cost. Other key advantage of using questionnaires is the ability to collect adequate data by covering various districts within the UK. In spite of that, Kothari [12] gave some disadvantages to the use of questionnaires. He argued that questionnaires can be used merely in one case; when contributors are participative and educative. He continues and indicates that, loss of control can occur when surveys are sent online. Moreover, he added that there is difficulty when modifying the aspects once surveys has been referred.

The practical approach of questionnaires' design is considered critical because it might work either correct or wrong. Gillham [13] suggested that, adopting modern software could make the process easier and could help presenting questionnaires in a more attractive and professional way. Nevertheless, it is important to provide plenty of space for the questions. Moreover, it is necessary to make sure that every question has adequate area. Prior to starting the designing stage on computer, specific considerations are needed for ensuring the highest quality. For example, questions' list and pilot must be made in order to reach final decision about the presented questions and its contents. Also, applying the rewarding stage through promoting the first draft of questionnaire. That would enable the operator to make some changes for defects by proof reading. The main objectives of distributing questionnaires to house builders are to specify the key factors that would affect materials' choice of the cavity wall method, measuring the number of the used construction methods in previous projects and to identify specific properties of construction methods, to support house builders when making decision. In order to collect precise information and obtain the highest possible number of respondents, the questionnaire was written in simple language. Acceptability measure was applied by employing the yes or no answers. Respondents showed

their degree of satisfaction by answering 'yes' or 'no'. For instance, one of the questions was; "do you agree that following factors can support timber frame with brick cladding method to use in housings?". Moreover, the technical information of layers used in construction methods was briefly mentioned at the beginning of questions. The reason behind that is to ensure that respondents have clear idea about the subject matter and provide precise answers. Factors' selection was also identified, based on previous studies with similar construction methods. For instance, house builders were asked "do you agree that following factors can help brick and thin joint blockwork method to use in housings?". The purpose here was to locate significant factors that might measure respondents' satisfaction with the used construction techniques through giving the required answers in the form of 'yes' or 'no'. The online survey was built and distributed using Bristol Online Survey, which is well-known for facilitating the design process and obtaining more precise responses Gillham [13]. Different UK companies, in different areas, have participated in the online survey. The responses were chosen based on their experience. Moreover, in order to guarantee high accuracy and efficient response, about 30 samples were collected. The distribution process was conducted by sending links via email, with summarised explanation about the project. Surveys' link was also posted using social media such as Twitter, for obtaining higher number of responses. Seven charts were created for classification through statistically analysing the significant factors of the construction methods. The analysis was presented as percentages of the most to the least significant method for house builders. The performance of construction methods was demonstrated based on key factors such as airtightness, thermal efficiency, energy consumption.

Construction methods were assessed by their construction performances, in terms of their U value and air tightness. Choices would be made in accordance to the factors that could enhance the selection process for house and public builders. U value is considered an effective way to assess heat lose and gain. It is also effective tool used in measuring the insulating properties of buildings' structure. British standards [14] identifying U values as the thermal resistances of the elements. Kingspan [15] [16] indicates that Determination of U values is dependent on the R value or the resistivity of the materials. U-Value (of building element) = $1 / (R_{so} + R_{si} + R_1 + R_2 \dots)$. where: the R_{so} is the fixed external resistance. R_{si} is the fixed internal resistance and R_1 , R_2 , etc. are the resistivity of all elements within the application including that of the cavities within the construction. R values are considered the material's capability to resist heat transfer at specific

thickness of insulation materials, which is calculated as $R = L/\lambda$ where L = the thickness of the material in metres and λ is the thermal conductivity of the material in $W/m^2.K$. The thermal conductivity of most materials used in the construction methods were established from British, accordance to the British Standards Institution [14].

IV. RESULTS AND DISCUSSION

Most of questionnaire respondents were house-building companies in the UK with large different districts. The aim was to cover large areas with diverse views and different stages of work. Such stages included: design, planning and construction. Moreover, about 24 responses were received from these companies.

Materials' characteristics was one of the most factors in making decision to choose the construction method used and its relevant materials. There are many options of building materials available in the industry. Therefore, it would be difficult to know the best choice for houses construction. During the questionnaire, an important question was asked about the range of significant factors when choosing building materials. The factors that could affect the decision included: cost, construction speed, health and safety requirements, waste material disposal, durability and environmental impact. Moreover, the type of answers was in the form of yes or no. Percentage scores for each factor are shown in Fig. 1.

Cost had the highest level of importance, having that it could affect materials' selection. Regarding that, 100% of the participants responded 'yes'. The second highest aspect concerned house-builders was construction speed, which accounted for 91.7% with a 'yes' response. Regarding health and safety, building materials could cause leak of chemicals that can be harmful to residents' health. Therefore, during the online survey, health and safety had good level of consideration, scoring 79% of participants' concern. Cost, construction speed and health and safety requirements had high scores by the house-builders. Therefore, they need to be considered when making decision.

House-builders were asked 'has your company ever used this following methods of construction'. The answering choices were 'yes, no or maybe'. The aim of this question was to measure the acceptability of construction industry and to specify previous practices of alternative methods of construction. The results are shown in Fig. 2.

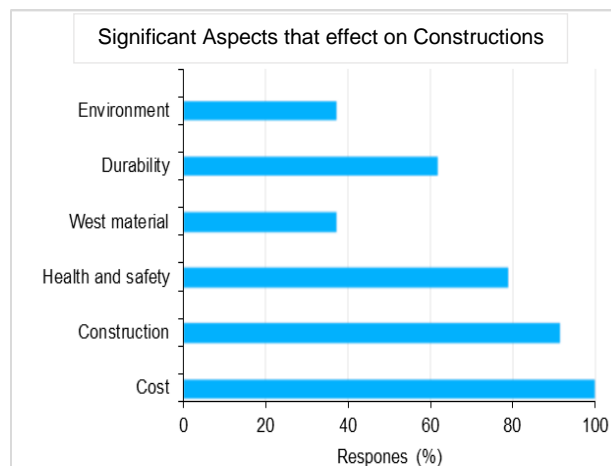


Fig. 1. Agreement Percentage of the importance of factors

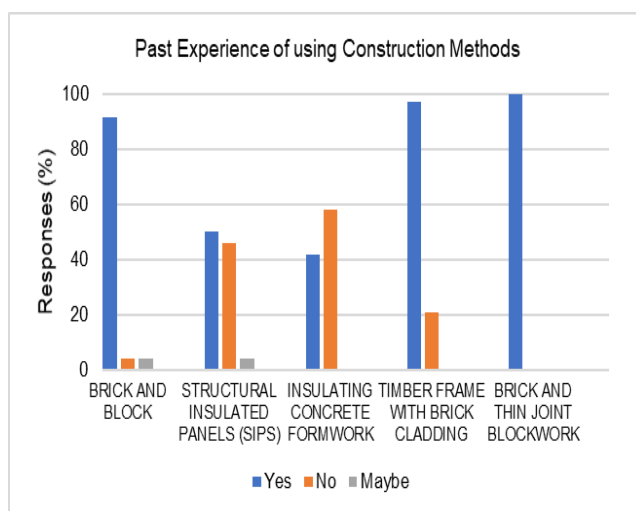


Fig. 2. Experience of using Construction Methods

The results showed that brick and thin joint block work had the maximum use, accounting for 100% of the companies that participated in the online survey. Brick and block was recognised as the second most used construction techniques for house building in the UK, with 91.70% answered 'yes' and only 4.20% responding with 'no'. These percentages were expected, due to the last figures shown in previous years. Another technique was timber frame with brick cladding, which was considered as the oldest method used in housing construction.

The method achieved high level of recognition, accounting for 79.20% of the responses. That may indicate that some house-building companies are still using timber frame, since it is faster, less expensive and lighter. Structural insulated panels and insulating concrete formwork method scored the lowest level of use in the UK, as indicated in previous studies. The figures showed us that there is acceptability, as well as awareness of utilising the most suitable construction method in housing.

Bricks and blocks are considered strong materials, formed into individual units. The walls have inner and outer skins, with a cavity in-between. The masonry was dominantly considered as the main construction material used in cavity walls for dwellings after 1990, accounting for about 88%. Brickwork and blockwork cavity wall are built by using external brickwork and internal fabric of blockwork, which are separately constructed with mortar. Air gap is used as insulation and ties for connection. Internal layers are finished by plasterboard and plaster skim layers. Calculating U-values was adopted, considering key aspects such as; thickness, thermal conductivity and resistant. The results were adopted from British Standards Institution [14] and manufacturers. Additionally, a $0.257\text{W/m}^2\cdot\text{K}$ U-value was calculated from Table 2.

Table.1: Brick and Block Materials Specifications

Material	Specification
Mortared brick	clay red brick and cement sand mix
Cavity	25mm width
Wall ties	Stainless steel
Insulation	Mineral wool
Block	8MPa compressive strength,
Plasterboard	12.5mm thickness
Plaster skim	6mm skim

Table.2: R values for brick and block method materials

Material	L (m)	λ (W/mK)	R ($\text{m}^2\cdot\text{K/W}$)
Brickwork	0.1025	0.84	0.12
Cavity	0.025	0.18	0.14
Insulation	0.1	0.038	2.63
Blockwork	0.1	0.18	0.56
Plasterboard	0.0125	0.16	0.08
Plaster coat	0.006	0.57	0.01

Table.3: R values for brick and block method materials

Material	L (m)	λ (W/mK)	R ($\text{m}^2\cdot\text{K/W}$)
Brickwork	0.1025	0.84	0.12
Cavity	0.025	0.18	0.14
Insulation	0.1	0.038	2.63
Blockwork	0.1	0.18	0.56
Plasterboard	0.0125	0.16	0.08
Plaster coat	0.006	0.57	0.01

Calculating U-values was adopted, considering key aspects such as: thickness, thermal conductivity and resistances. The results were adopted from British Standards Institution [14] and manufacturers. Additionally, a $0.257\text{W/m}^2\cdot\text{K}$ U-value was calculated from Table 3.

Structural insulated panels (SIPs) is considered as light weight and off-site manufactured method. The method is constructed as an essential loadbearing element. Doan [9] indicated that, Structural Insulated Panels are built by sandwiching a low density, cellular core rigid insulation, between two sheets of wood that are placed together through orientated process, named as orientated strand boards (OSB). Efficient materials were used in the layers as insulation, for providing high performance. These materials include: Extended Polystyrene (EPS), Polyurethane (PU), Extruded Polystyrene (XPS) and Polysio-cyanurate. Construction process can be simple when using SIP as it requires less skilled workers on site and adapts to high design requirements, especially for house building. The KINGSPAN TEK building system specifies [15] [16] that the breather membrane is fixed on the external panels, in order to increase weather protection, which, in turn, contributes to the overall U-value of cavity walls. Wall ties are used to connect the external brickwork to buildings' structure, while keeping cavity for insulation. Internally, walls are finished with plasterboard and plaster skim layers [3] [4]. Construction details of SIPs are included in Table 4, according to KINGSPAN's specifications.

Table.4: SIPs materials specifications

Components	Specification
Brick	102 mm brick external leaf
Mortar	cement sand mix
Wall ties	Stainless steel wall ties
cavity	50 mm residual cavity
Breather membrane	Kingspan nilvent breather membrane fixing using steel staples
SIP panel	142mm Kingspan TEK building system panel (2x15mm OSB sheets, 112mm urethane foam)
Plasterboard	2 x 12.5mm thickness
Plaster coat	6mm skim

Structural insulating panels provide high performance in terms of resisting thermal bridges. Kingspan [15] [16] indicated that, in the worst circumstance, full cavity wall can achieve a U-value of $0.20\text{W/m}^2\cdot\text{K}$, with no insulation foam. Department for Communities and Local

Government [17] argued that, most newly-built developments should have external walls with U-values targeted between 0.17 W/m².K and 0.18 W/m².K. For calculating U-values most details were provided from manufacturers and building regulations of British standards, such as [14] [15] [16]. The U-value calculated from Table 4 was 0.16 W/m².K.

Table.5: R values for SIPs materials

Components	L (m)	λ (W/mK)	R (m ² .K/W)
brickwork	0.1025	0.84	0.12
Cavity	0.050	0.18	0.28
OSB	0.015	0.06	0.50
Foam	0.112	0.023	4.87
Plasterboard	0.026	0.15	0.15
Plaster skim	0.0061	0.58	0.02

On the other hand, ICF is a block technique made from two sheets of foam, expanded polystyrene (EPS) or extruded polystyrene (XPS), connected by metal or plastic ties. Wall thickness typically differs according to buildings' type, use and anticipated performance. ICF has excellent properties as its thermal mass is achieved by a concrete core and two layers of insulation. Davies [18] suggests that, structural design will determine concrete's width, limited between 100mm and 350mm. In some cases, ICF formwork may be thicker for external walls, to give additional insulation. Rebar is used for structural requirements. Generally, cavity walls are erected to a first floor level, before pouring concrete, followed by curing. Formwork would remain in place to guarantee a durable layer of thermal insulation and appropriate wall shape.

Table.6: ICF materials specifications Materials

Type	Specifications
Brickwork	clay red brick, 102.5 x 65 x 215mm
Wall ties	Stainless steel,
Mortar	cement sand mix, 10mm joints
Concrete	RC 25 concrete, 10mm aggregate
ICF	Beco Wallform manufacturer
Plasterboard	12.5mm thickness
Plaster coat	6mm plaster

The Concrete Centre [2] indicated that, providing durable cladding in ICF is significant for providing protection from environmental damages. Moreover, it is important for providing efficient materials used for cladding such as brickworks, particularly in housing

construction. Connection between bricks and ICF's member is achieved through using wall ties. Needless to mention, placing the foam insulation into the air space cavity. Walls element are usually finished by using coats of plaster skim or plasterboard.

ICF is well-known for its energy. The Concrete Centre [2], ICF technique uses EPS/XPS thermal insulation, which provides about level 5 and level 6 in codes for sustainable homes. Moreover, it is a durable building technique that provides U-values of 0.10 – 0.30 W/m².K. Evans [19] argued that, when ICF system is used with insulation, external brick, foam leaves, plastic strip ties and cavity walls, U-values could be dropped to 0.13 W/m².K. The U-value calculated from information given by the [14] and [2] was about 0.204 W/m².K.

Table.7: R values for ICF materials

Material	L(m)	λ (W/mK)	R (m ² .K/W)
bricks	0.1025	0.840	0.123
Cavity	0.0151	0.180	0.083
ICF	0.313	0.0658	4.764
plasterboard	0.0126	0.160	0.078
Plaster coat	0.0061	0.570	0.011

Table.8: Thin joint blockwork materials specifications

Material	Specification
Mortar brickwork	clay red brick
Wall ties	Stainless steel
Thin joint mortar	cement sand mix
Thin joint blocks	Durox top blockwork
Plasterboard	12.5mm thickness
Plaster skim	6mm skim
Insulation	mineral wool

Table. 9: R values for thin joint blockwork materials

Material	L(m)	λ (W/mK)	R (m ² .K/W)
Brickwork	0.103	0.84	0.12
with mortar			
Cavity	0.025	0.17	0.15
Insulation (wool)	0.2	0.037	2.64
Blockwork	0.1	0.16	0.64
plasterboard	0.012	0.16	0.09
Plaster skim	0.005	0.58	0.02

Timber frame cavity walls are involve using various internal layers. These layers include; plasterboard, vapour control layer, air filled cavity, waterproof membrane and insulation. The system is suitable for most external cladding options, including brick for appropriate appearance. To ensure that building envelopes have durable finish, plaster skim is used National Building Technologies [14].

Table.10: Timber frame with brick cladding specifications

Materials	Specifications
Mortared brick	clay red brick with cement sand mix
Wall ties	Stainless steel
waterproof membrane	Glidevale Protect TF200 Breather Membrane
Insulation	Mineral wool
Plasterboard	25mm thickness
Plaster skim	6mm coat

The timber frame design includes insulation within composite structure. Efficient level of insulation is adopted, preventing air leakage that affects amounts of heat loss from buildings. many clients selected this method for its high performing score. Another reason was it blocks moisture and the air passing through the internal structure. Timber frame wall construction can provide high thermal performance by using durable layers, which reduces U-value to $0.24 \text{ W/m}^2 \text{ K}$ [20]. Moreover, the U-value, calculated from Table 11 was around $0.249 \text{ W/m}^2 \text{ K}$ [14].

Table.11: R values for timber frame with brick cladding materials

Materials	L(m)	$\lambda \text{ (W/mK)}$	R ($\text{m}^2 \cdot \text{K/W}$)
Brickwork	0.1025	0.84	0.12
Cavity	0.060	0.18	0.14
Wood sheet	0.009	0.03	0.30
Insulation	0.120	0.038	3.16
Plasterboard	0.025	0.16	0.08
Plaster coat	0.006	0.57	0.01

According to the online survey, most of construction techniques for cavity walls have been used in the United Kingdom. The methods of construction for housing building that were selected in this study included: brick and block, structural insulated panels (SIPs), insulating

concrete formwork (ICF), thin joint blockwork and timber frame with brick cladding. Methods' properties were examined during this project, in terms of their thermal resistance and U-values. The U-values are listed in Table 12 below.

Table.12: The methods of construction

Construction method	U value $\text{W/m}^2 \text{ K}$
Brick and block	0.257
SIP	0.16
ICF	0.13
Thin joint block work	0.18
Timber frame with brick cladding	0.249

V. CONCLUSION AND DISCUSSION

Five methods of construction of cavity wall were investigated in terms of sustainable building fabric, to mitigate energy demands in housing. The baseline method was brick and block, which is considered the most frequently used in the UK. Alternative methods of construction were applied in construction industry. Therefore, there is possibility to reach the code of sustainable homes evaluation and score accep Table levels. U-values of construction methods were examined to clarify thier thermal resistance.

The methods of construction were selected in terms of both; appropriateness and modern methods of construction, which were recently used in the industry. Therefore, the acceptability of public is considered significant to determining the best choice that could help house-builders in decision making. According to the questionnaire of the past experience of house-builders, the scale of acceptability is wide across the used techniques. Structural insulating panels and insulating concrete formwork methods represented the least methods used in housing construction. Therefore, they need to be developed. Brick and block and thin joint blockwork methods showed the highest acceptability. The differences in public acceptability were realised in results, perhaps due to studying different locations across the United Kingdom. The factors that concern house-builders and the public when selecting building materials were categorised as cost, construction speed, health and safety requirements, waste material disposal, durability and environmental impact. The factor that scored the highest was cost, which is considered the most important aspect affects method selection. Low costs of construction methods can increase acceptability for house-builders and the public, since

costing could reduce prices of building materials and energy demand.

The main aim behind using case studies was to determine the most adequate method of construction used in an envelope, in terms of its thermal resistance, heat loss minimisation and energy requirement. The differences in the scale of thermal resistance can allow using various construction methods, particularly the cavity wall. The results indicated that thermal transmittance of SIPs was most favourable when compared with other methods, as it scored the lowest U-value (0.16 W/m^2). Therefore, SIPs can be considered as the most appropriate option for achieving lower operational energy for industry's requirements. Although brick and block method scored the highest rate of acceptability in online survey, considered as the most frequently used in the industry, the method showed inefficient U-value. Hence, it needs to be developed in terms of its thermal areas. From the conducted study, it is clear that energy consumption and acceptability are important for achieving a successful housing construction.

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Perception of Master's Course Students on the Legislation that Governs Post-Graduation

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Received: 21 Dec 2020;

Received in revised form:

17 Feb 2021;

Accepted: 28 Feb 2021;

Available online: 16 Mar 2021

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Keywords— LDBEN, Master's degree, *Stricto sensu*.

Abstract— Since LDBEN 9394/96 was stipulated, in recent years it was possible to perceive a great growth in Brazilian postgraduate courses, including an increase in the offer of postgraduate *Stricto sensu* including in private Higher Education Institutions. In view of this scenario, the present study aims to verify the knowledge of the student, who seeks a *stricto sensu* postgraduate course, about the legislation of MEC LDBEN law 9394/96 in articles referring to graduate studies. In addition, the study also aims to identify the student's profile and motivation for taking the course. As for the methodological procedures, it is a descriptive, exploratory and field research, with a quantitative approach, where a closed questionnaire was applied to the Master's students in Public Health of the first module and their data were tabulated. In the results, regarding the profile, it was observed that most of the participating students were women with an average age of 36,8 years, with varying degrees, however the majority are graduated in nursing with training time varying from 4 to 28 years. As for the knowledge of LDBEN, the majority stated that they had heard of it, but demonstrated that they did not know the content and all were unanimous in stating that it is important to know the content intended for graduate studies as it can be beneficial for the course.

I. INTRODUCTION

The Brazilian educational system has undergone some changes throughout the governments, and it is currently governed by the Law of Guidelines and Bases of National Education - LDBEN 9394/96, which was instituted on December 20, 1996 establishing the guidelines and bases of national education. In this LDBEN there is a whole chapter dedicated to higher education, where in art. 43 the purpose of higher education is determined and in art. 44 courses and programs covered by higher education have been stipulated, including *stricto sensu* graduate courses.

In 40 years occurred a great increased in Brazilian postgraduate courses, which went from 699 courses in 1976, to about 6131 in 2016, with a growth of more than

800%. In the 2010 Census, a number of 516,983 masters were registered, there was also an increase in the offer of master's courses by Universities, giving greater emphasis to the growth of the post-graduate courses offers in private higher education institutions.

This research aims to verify the student knowledge, who crave a *stricto sensu* postgraduate course, on the legislation of MEC LDBEN law 9394/96 in articles referring to graduate studies. In addition, the study also aims to identify the student's profile and motivation for taking the course.

In order to achieve the objectives, a questionnaire was applied to 12 students in the class of the first master's module in Public Health at Instituto Ideia in partnership with Columbia University by email.

As a *stricto sensu* teacher, I could realize a lack of knowledge by the student about what a master's degree should contain, its functionality and objectives. This reality piqued my curiosity to understand the phenomenon. The study is relevant, because from the best knowledge about the objectives and functionality of the *stricto sensu* course, the student will be more focused and prepared to complete his research in favor of science and society.

1.1 BRIEF HISTORY OF POSTGRADUATION

In 1931, the Statute of Brazilian Universities - the university system was structured - giving rise to the first didactic organization that promoted the tutoring relationship between teacher and student that culminated in the graduate course. At that time, the university had a large number of foreign professors, coming from academic missions or asylums in Europe (NOBRE and FREITAS, 2017).

Between 1930 and 1960, there was an expansion of public universities, such as the University of São Paulo, in 1934, and the University of Brasília, in 1961. These were focused on research and this contributes to the emergence of *stricto sensu* courses (master's and doctorate) (NOBRE and FREITAS, 2017).

The period of military government, a period resulting from the movement of conservative forces, National Forces, Church and bourgeoisie, was a period of demonstration of the authoritarian action of the Brazilian State, which resulted in the (re) organization of movements against the authoritarianism in force and the moment when civil society gains vitality (ALVES and OLIVEIRA, 2014).

However, it was during this period of the Military Government that there was a set of reforms in education, where education assumes an instrumental function. The military regime promoted the reform of higher education (University Reform) in addition to the teaching of 1st and 2nd degrees, where according to the Report (1969, p. 210) the argument was to renew "the faith of the immense student population in the intentions and purposes of the Government and breaking obstacles that hinder the functioning of the Brazilian educational machine". The scenario in which these reforms took place was one of political and ideological control over education, few resources for public education, repression of opponents of the state for both teachers and students. And in higher education there was an intense educational upheaval, as the military regime promoted invasion, intervention in universities, removed deans, dismissed or retired teachers and arrested students (ALVES and OLIVEIRA, 2014).

During this period, it was also observed the case of "candidates without a vacancy", as the student passed

the entrance exam, but could not get a vacancy to enter higher education, which led to the mobilization of society. One of the alternatives of the military government to meet these demands was to promote reforms, in order to adapt higher education to the new reality. To meet these demands and remove the focus of resistance to the university regime, reforms in higher education were implemented through decrees, such as Decrees of n. 53 of 1966 and n. 252 of 1967, which served as the basis for the University Reform of 1968. And it was from this reform and Opinion n° 977 CES / CFE, of December 3, 1965, (Newton Sucupira Opinion) that the Postgraduate Program was intensely structured in Brazil.

O propósito era implantar e desenvolver o regime de cursos de pós-graduação no âmbito do ensino superior, uma vez que havia o entendimento de que faltava maior precisão no tocante à natureza dos cursos de pós-graduação então existentes no país. É, pois, neste contexto do Regime Militar, que a pós-graduação vivenciou um movimento de estruturação, normatização e institucionalização, bem como de ampliação do fomento, da expansão e da adoção de sistemática de avaliação, cujas diretrizes e bases permanecem ainda hoje (ALVES e OLIVEIRA, 2014, p. 352).

The Newton Sucupira Opinion generated a model similar to that of the United States (USA) that created two levels of training, the master's and the doctorate, with continuity between the two, as Brazilian laws did not require a master's degree to enter the doctorate (NOBRE and FREITAS, 2017).

Despite the creation of Coordination for the Improvement of Higher Education Personnel (Capes) in 1951, by Decree 29.741, it was only in 1981 that it started to be recognized as the body responsible for the elaboration of the National Plan for Post-Graduation *Stricto sensu*, through Decree of 86.791, with the function of elaboration, evaluation, monitoring and coordination of activities related to higher education (NOBRE and FREITAS, 2017).

1.2. THE LEGISLATION OF HIGHER EDUCATION

The Brazilian Education Guidelines and Bases Law regulates the entire educational system in Brazil, whether public or private, from basic education to higher education. And in 1996 it was the second time that Brazil started to have a new LDBEN.

Higher Education has its purpose described in the Law of Guidelines and Bases of National Education - LDBEN (Law 9394/96). Its exposition begins in art. 43 that explains its purposes:

Art. 43. A educação superior tem por finalidade:

I - estimular a criação cultural e o desenvolvimento do espírito científico e do pensamento reflexivo;

II - formar diplomados nas diferentes áreas de conhecimento, aptos para a inserção em setores profissionais e para a participação no desenvolvimento da sociedade brasileira, e colaborar na sua formação contínua;

III - incentivar o trabalho de pesquisa e investigação científica, visando o desenvolvimento da ciência e da tecnologia e da criação e difusão da cultura, e, desse modo, desenvolver o entendimento do homem e do meio em que vive;

IV - promover a divulgação de conhecimentos culturais, científicos e técnicos que constituem patrimônio da humanidade e comunicar o saber através do ensino, de publicações ou de outras formas de comunicação;

V - suscitar o desejo permanente de aperfeiçoamento cultural e profissional e possibilitar a correspondente concretização, integrando os conhecimentos que vão sendo adquiridos numa estrutura intelectual

sistematizadora do conhecimento de cada geração;

VI - estimular o conhecimento dos problemas do mundo presente, em particular os nacionais e regionais, prestar serviços especializados à comunidade e estabelecer com esta uma relação de reciprocidade;

VII - promover a extensão, aberta à participação da população, visando à difusão das conquistas e benefícios resultantes da criação cultural e da pesquisa científica e tecnológica geradas na instituição.

VIII - atuar em favor da universalização e do aprimoramento da educação básica, mediante a formação e a capacitação de profissionais, a realização de pesquisas pedagógicas e o desenvolvimento de atividades de extensão que aproximem os dois níveis escolares. (Incluído pela Lei nº 13.174, de 2015)

The university is a teaching place with a social function of producing knowledge, cultural development, science, technology and man himself as a participant in a society (SEVERINO, 2017).

In the academic environment, research is an essential act, which acts as an educational and scientific process that consists of an investigation process, exercising creative and critical activities and that must be focused on the problems and difficulties of society (LIBÂNEO, 2017).

With that, it can be said that the University is a means responsible for the production of scientific knowledge and technological advancement of society.

Leal (2008) highlights higher education, given the transformations of the contemporary world, should encourage individuals to be more autonomous and proactive by promoting a link between knowledge and life, thus becoming a critical, creative, participative and responsible individual.

In higher education, it is no longer accepted tacit students, nor teachers who use only expository classes,

teaching everyone as if they teaching only one. Critical thinking should be encouraged, preparing the student for the development of research. (RYSOVAS, 2016).

LDBEN 9394/96 in art. 44 also details which courses are included in Higher Education.

Art. 44. A educação superior abrangerá os seguintes cursos e programas: (Regulamento)

I - cursos sequenciais por campo de saber, de diferentes níveis de abrangência, abertos a candidatos que atendam aos requisitos estabelecidos pelas instituições de ensino;

I - cursos sequenciais por campo de saber, de diferentes níveis de abrangência, abertos a candidatos que atendam aos requisitos estabelecidos pelas instituições de ensino, desde que tenham concluído o ensino médio ou equivalente; (Redação dada pela Lei nº 11.632, de 2007).

II - de graduação, abertos a candidatos que tenham concluído o ensino médio ou equivalente e tenham sido classificados em processo seletivo;

III - de pós-graduação, compreendendo programas de mestrado e doutorado, cursos de especialização, aperfeiçoamento e outros, abertos a candidatos diplomados em cursos de graduação e que atendam às exigências das instituições de ensino;

IV - de extensão, abertos a candidatos que atendam aos requisitos estabelecidos em cada caso pelas instituições de ensino.

Parágrafo único. Os resultados do processo seletivo referido no inciso II do caput deste artigo serão tornados públicos pelas

instituições de ensino superior, sendo obrigatória a divulgação da relação nominal dos classificados, a respectiva ordem de classificação, bem como do cronograma das chamadas para matrícula, de acordo com os critérios para preenchimento das vagas constantes do respectivo edital. (Incluído pela Lei nº 11.331, de 2006)

§ 1º. Os resultados do processo seletivo referido no inciso II do caput deste artigo serão tornados públicos pelas instituições de ensino superior, sendo obrigatória a divulgação da relação nominal dos classificados, a respectiva ordem de classificação, bem como do cronograma das chamadas para matrícula, de acordo com os critérios para preenchimento das vagas constantes do respectivo edital. (Incluído pela Lei nº 11.331, de 2006) (Renumerado do parágrafo único para § 1º pela Lei nº 13.184, de 2015)

§ 2º No caso de empate no processo seletivo, as instituições públicas de ensino superior darão prioridade de matrícula ao candidato que comprove ter renda familiar inferior a dez salários mínimos, ou ao de menor renda familiar, quando mais de um candidato preencher o critério inicial. (Incluído pela Lei nº 13.184, de 2015)

§ 3º O processo seletivo referido no inciso II do caput considerará exclusivamente as competências, as habilidades e as expectativas de aprendizagem das áreas de conhecimento definidas na Base Nacional Comum

Curricular, observado o disposto nos incisos I a IV do caput do art. 36. (Incluído pela Medida Provisória nº 746, de 2016)

§ 3º O processo seletivo referido no inciso II considerará as competências e as habilidades definidas na Base Nacional Comum Curricular. (Incluído pela lei nº 13.415, de 2017)

In item III, we see the inclusion of the postgraduate course, such as master's and doctorate, considered *stricto sensu* courses, which is the universe of the present study.

II. METHOD

In order to contemplate the objective of the research, in addition to the bibliographic research, a field research was performed, in which a structured questionnaire was applied, with ten closed questions addressing the legislation that governs the graduate programs, with students of the master's course that is offered by an Instituto Ideia located in Rio de Janeiro in partnership with Columbia University. Instituto Ideia has been in the market for 10 years and offers partnerships with some Universities offering master's, doctoral and post-doctoral courses serving students from all over Brazil.

The sample included twelve students from the master's class in public health, participating in the first module of the course. Those who chose not to participate in the research or did not deliver the questionnaire in a timely manner were excluded. The application of the questionnaire was conducted from May 5 to 12, 2019, through the internet, through electronic mail, where along with the email followed the questionnaire and the Informed Consent Form - TCLE, where each student can respond individually to each item. The collected data were tabulated for better representation. The research followed the Ethical criteria of resolution 510/2016 of the CNS and its complementaries and was approved by the Research Ethics Committee of the UCDB on May 2, 2019 under opinion 3,299,343 and CAAE 11967319.3.0000.5162.

The questionnaire was divided into two parts, the first with the identification of the participant, where the variables sex, age, graduation area, graduation time were used. The second part consisted of questions such as: if you intend to work in the area of the course, what is the

motivation to attend the master's degree and knowledge about art. 43 of LDBEN 9394/96.

III. RESULTS

3.1. STUDENT PROFILE

Regarding the student's profile, the results obtained were categorized in table 1 below.

Table 1 - Profile of students of the Master's course in Public Health, 2019.

Profile	Participants
Age	29 to 60 years 36,8 average
Sex	8 female 4 male
University graduate	5 nursing 2 psychology 2 dentistry 1 medicine 1 pharmacy 1 technologist in aesthetics
Grad year	From 1991 to 2015

Source: Author data.

As for the profile of the participants, we can observed that most of the master's students are female, with an average age of 36,8 years, the majority with a degree in nursing and with graduation time ranging from 4 to 28 years.

This result corroborates the research by Abramowics, Bittar and Rodrigues (2009) on graduates of the master's course at the Federal University of São Carlos, that could be identified that majority of the participants were women. The same occurred with the study performed by Mendes *et al.* (2010) on the profile of master's students in health area at the Federal University of Piauí, which also identified a greater number of female students.

Guedes (2008, p. 118) states that women have been able to reverse a situation of inequality, consolidating a new reality. Reality in which they are more educated than the male contingent.

O recorte da população de nível universitário reflete o quanto a mudança foi rápida e marcante. Nessa perspectiva, a análise geracional e o olhar

específico para a entrada feminina em cada curso universitário revelam diferenciações históricas fundamentais nos tipos de inserção social das mulheres no contexto brasileiro.

In the case of age, an age variation between 29 and 60 years was observed, with an average age of 36,8 years.

Abramowics, Bittar and Rodrigues (2009) considered the average age of the students to be high, in relation to other studies, since the average age found was 43 years. However, Mendes *et al.* (2010) observed in his study a greater number of students aged 25 to 30 years. And Felli *et al.* (2011) in their study on the profile of graduates from the *stricto sensu* course in nursing management found a higher occurrence in the age group of 31 to 40 years.

Regarding graduation, there can be a variation in the area of training, with nursing being the most cited training. Mendes *et al.* (2010) also identified a

multidisciplinarity in his study where in the Master's course in Science and Health, graduates in medicine, dentistry, nutrition, nursing, psychology and physiotherapy were identified.

Still in the profile of the students, it was possible to observe a great variation in the graduation time, which shows that it does not depend on the time of formation to study. Ferreira *et al.* (2016) also found a variety in training time, with 64% with training in the last 5 years, 21% with training in the last 10 years and 15% with training after 10 years.

Scientific knowledge has been produced rapidly in the health field, and this knowledge is often made available in techniques and inputs in practice, thus requiring greater skills for professional health practice, placing these professionals in constant search of updating (VIANA *et al.*, 2015).

3.2 - LDBEN KNOWLEDGE

Regarding the questions in the questionnaire focused on the motivation and knowledge of LDBEN 9394/96, the answers were tabulated according to table 2.

Table 2 - Regarding the motivation and knowledge of LDBEN 9394/96 of students in the Master's course in Public Health, 2019.

Quiz	Participants
After completing the master's course, do you intend to work in the training area?	10 Yes 1 No 1 Maybe
What motivated you to pursue a master's degree in public health?	8 functional progression 1 improvement 1 improvement and progression 1 others 1 n /a
Do you know the legislation on higher education LDBEN 9394/96 art. 43?	5 have heard 4 Yes 3 Don't know
At any point during the course, was this legislation introduced to you?	6 do not remember 4 No 2 Yes
If so, in which discipline?	Bioethics
Do you believe that knowledge of this legislation will influence your master's course?	8 Yes 3 Maybe
Did you have any knowledge that the legislation provides for the "incentive to research and scientific investigation work, aiming at the	6 Yes

development of science and technology and the creation and diffusion of culture, and, thus, develop the understanding of man and the environment in which he works? lives ”;	6 No
Did you have any knowledge that the legislation provides for the "promotion of the dissemination of cultural, scientific and technical knowledge that constitute the heritage of humanity"	5 Yes 7 No
Did you have any knowledge that the legislation provides for "stimulating the knowledge of the problems of the present world, in particular national and regional ones, providing specialized services to the community and establishing a reciprocal relationship with it"	5 Yes 7 No
Now, after knowing these items of Law 9394/96, do you believe that this information will be beneficial for the progress of your course?	12 Yes

Source: Author data.

In the first question of the questionnaire, we were able to verify that most of the master's students stated that they wanted to work in the area in which they are studying for a master's degree. However, when asked what motivated them to attend the Master's in Public Health, it was found that the majority claimed to be studying to achieve functional progression, a benefit given to civil servants who, upon the acquisition of a title, may request the passage or “progression to the immediately higher standard within the current class or category of your Functional Career”, consequently increasing their salary (FIOCRUZ, 2017).

Cunha, Junior, and Martins, (2010) affirm that according to the student's investment in their training, it represents an enormous value and reflects on the community and the market that rewards them with higher remuneration, differentiation, status, prestige, recognition, respectability, professional stability, among others.

Giuliani (2010) in his research on master's in the area of administration found that the most cited motivation among the participants was the most qualified training to be able to work with teaching and research.

Ferreira *et al.* (2016, p. 81) adds by stating that students' motivation is generally associated with “the search for new knowledge and qualification to improve performance both in healthcare practice and in health teaching”. And he continues to affirm that when there is an early incentive to graduate in relation to academic activities, it generates greater motivation for the student to attend a master's degree.

When asking about the knowledge of LDBEN 9394/96, most claimed that they had heard of it. Even so, he was asked if this legislation had been presented to him in the master's course and it was observed that the majority did not remember and only 2 students said yes, they were

presented to him. With that, it was asked in which discipline, and the 2 students claimed to be in the discipline of Bioethics. Continuing with the interview, it was asked whether knowledge of the legislation could influence the master's course and the majority responded affirmatively. When asked if they were aware that such legislation provided incentives for research work, we observed that half claimed to know and the other half did not. When asked if they were aware that the legislation provided for the promotion of the dissemination of cultural, scientific and technical knowledge that constitute the heritage of humanity, most responded that they did not know. And being asked if they were aware that the legislation provided for stimulating the knowledge of the problems of the present world, in particular the national and regional ones, providing specialized services to the community and establishing a reciprocal relationship with them, the majority responded that they did not know. Finally, it was questioned whether after knowing these items of law 9394/96, if he believed that the information would be beneficial for the progress of his course, the answer was unanimous and everyone said yes. Knowledge of higher education legislation is of great importance since:

[.....]seu discurso “se concentra na formação de cidadãos conscientes e críticos, no entanto muitas vezes ela se atém apenas a treinar pessoas preparadas para atenderem às necessidades do mercado capitalista. Assim, pensar uma prática educativa emancipadora, é possibilitar que a educação seja veículo de

mudança em todo e qualquer local no qual o sujeito se insere, ou seja, para além da sala de aula (LIMA e LOPES, 2017, p.2).

Higher education should promote and stimulate knowledge in a critical and reflective way, not only focused on the professional area, but also on the social context (LIMA and LOPES, 2017).

Regarding the incentive to research Nervo and Ferreira (2015, p. 32) highlighted that

A pesquisa se torna peça chave da formação dos indivíduos, os preparando para a 'guerra' diária que requer um olhar científico e indagador, e a experiência com a pesquisa científica traz à tona todo esse potencial humano, pois o processo de aprendizagem é de extrema complexidade.

Nervo and Ferreira (2015) also state that research should be stimulated throughout the educational process and not only in postgraduate courses. They also highlighted that it is at that moment that the difficulties of reading, writing and interpreting are revealed.

The same authors also complement:

O educar pela pesquisa, é estimular o aluno à curiosidade pelo desconhecido, instigá-lo a procurar respostas, ter iniciativa, compreender e dar início a elaboração de seus próprios conceitos, e é também um desafio ao professor para transformar suas táticas didáticas (NERVO e FERREIRA, 2015, p. 35).

In the case of "Promoting the dissemination of cultural, scientific and technical knowledge that constitute humanity's heritage and communicating knowledge through teaching, publications or other forms of communication" by Ribeiro (2013) this process is a way of transcending the knowledge, mainly in preparing people with technical capacity to find themselves in a political process with wisdom and intelligence.

However, Pereira and Koshyama (2017) highlight the social-political responsibility that researchers and

institutions have to disclose their scientific research to the population since "society has the right to participate in the debates and decisions that will affect it in the future".

For Roncaglio (2004), he asserts that both higher education institutions and social institutions have responsibility in the formation of the subject, not only for teaching, research and extension, but also for cultural transmission, which meets the purpose of higher education expressed in Law of Directives and Bases of Education, especially in its Art. 43.

In relation to stimulating the knowledge of the problems of the present world, in particular the national and regional ones, providing specialized services to the community and establishing a relationship of reciprocity with it, Mitre et al., (2008) states that:

Tais prerrogativas foram reafirmadas pelas Diretrizes Curriculares, para a maioria dos cursos da área de saúde, acolhendo a importância do atendimento às demandas sociais com destaque para o Sistema Único de Saúde - SUS^{16,17}. Neste momento, as instituições formadoras são convidadas a mudarem suas práticas pedagógicas, numa tentativa de se aproximarem da realidade social e de motivarem seus corpos docente e discente a tecerem novas redes de conhecimentos (MITRE et al., 2008, p. 2135).

It is worth remembering that higher education is the continuation of school education, justifying its well-directed goals and aimed at a culture of transformation, in an advanced way to work knowledge, attitudes, values. An education aimed to improve skills focused on the labor market, in addition to the research perspective (FIRMINO E LIMA, 2016).

Regardless of the importance of the items in the articles and their knowledge, we must highlight that the results found in this research are worrying. It should be noted that the researcher in this study is the one who teaches the discipline of Bioethics and before entering the programmatic content of the discipline, she presents the items of article 43 of Law 9394/96. In view of the results presented, we can see the need to promote greater prominence in the presentation of legislation in the classroom.

IV. CONCLUSION

In the present research, through the results obtained in the field research, we can conclude that most of the participating students, belonging to the master's class in public health of the first module, in relation to the profile most participants were female, with an average age of 36,8 years, with multidisciplinary training and time of formation of the graduation very long, between 4 to 28 years.

Regarding the knowledge of LDBEN, it was possible to verify that the majority have heard of it, but do not know the content related to the legislation that governs higher education, including the course they are taking. However, we give greater emphasis to the fact that the legislation was presented to them during the course in the discipline of Bioethics, which was remembered by only two students.

We recommend that LDBEN Legislation art. 43 is presented more prominently in the Master's course in Public Health, so that the student starts the course having the necessary knowledge of the course purposes.

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Infrastructure and Health: An analysis of Atlas data in the city of Petrolina-PE

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Received: 17 Dec 2020;

Received in revised form:

07 Feb 2021;

Accepted: 19 Feb 2021;

Available online: 16 Mar 2021

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Keywords—Development, Environment,
Social Vulnerability, System R.

Abstract— Analyzing the conditions of infrastructure, health and social vulnerability of a municipality allows to know its weaknesses and enhance decision-making by managers and civil society. Given the above, this article aimed to analyze the conditions of infrastructure and health and their correlations with social vulnerability in the city of Petrolina-PE, in 2010. To this end, the study used quantitative analysis as a methodology through the graphical interface of the Statistical Program R, with data on infrastructure and health from the Atlas of Social Vulnerability being collected. The municipality of Petrolina-PE, currently with 350 thousand inhabitants, is located in the Sertão de Pernambuco, Northeast region of Brazil and is part of the Integrated Administrative Development Region (RIDE) of the Petrolina and Juazeiro Complex. After analyzing the Municipal Human Development Index; per capita income; the percentage of people in households with inadequate water supply and sanitation; mortality up to 5 years of age; the population that lives in urban households without the garbage collection service; and the vulnerability index of urban infrastructure and human capital, the research findings indicated, in general, that the housing units in Petrolina have a low correlation between the population of each unit and the infrastructure index, thus, it was noted that the management model needs improvement to promote development and reduce inequalities.

I. INTRODUCTION

The Integrated Administrative Development Region (RIDE) Juazeiro - Petrolina has undergone profound changes in its economic and social structure, being responsible for providing a significant financial contribution to the country, however, the RIDE's appear as a mechanism for integration and regional development in the search for the promotion of projects that aim at the

economic dynamization of low development territories (BRASIL, 2014).

Thus, strategies can be adopted to promote dialogue with the RIDE communities, with the urban space, issues such as poverty, the implementation of public policies, the participation of civil society in public decisions, the creation of instances of dialogues between society, and the

private sector and the state, in order to provide a basis for this population.

To make community improvement strategies feasible, tools for data collection and analysis can be used, such as the Atlas of Social Vulnerability platform (infrastructure / health) and the R Statistical Program, respectively.

According to the Institute of Applied Economic Research (IPEA), Atlas is a platform for consulting the Social Vulnerability Index and aims to offer instruments that allow the analysis and understanding of social issues related to the development processes of metropolitan regions and Brazilian municipalities.

According to Hornik (2016) the statistical program R is free software for data analysis and was developed in the 1990s by Ross Ihaka and Robert Gentleman, from the University of Auckland who created a new computational language under the influence of pre-existing programming languages.

Thus, the objective of this work was to analyze the conditions of infrastructure and health and their correlations with social vulnerability, delimiting for Polo Petrolina-PE, in 2010.

The choice of the topic is justified due to the need to know information about the city and its population, providing dialogue and the promotion of strategies around possible improvements in infrastructure and health, in order to promote the social inequalities present in the population.

II. DESCRIPTION OF DATA

The present study allows periodic reviews to be carried out, being able to evaluate the evolution of health conditions according to the works carried out. For the development of this work, the study area is the city of Petrolina located in the region of Vale do São Francisco, between the state of Pernambuco and the state of Bahia.

The city is in an accelerated transformation process driven by the dynamics of the irrigation process. The complementary law of RIDE includes in the state of Pernambuco the municipality of Petrolina, Lagoa Grande, Santa Maria da Boa Vista and Orocó (PE) and in Bahia it includes the municipalities of Juazeiro, Curaçá, Sobradinho and Casa Nova (BA), thus constituting, an experience of horizontal cooperation, both at the intercity and interstate levels; as well as vertical, between subnational entities and the federal government (OLIVEIRA, 2015).

The guarantee of the right to sustainable cities, understood as the right to housing, sanitation, among others, must also be expressed in the municipal Master Plans, according to the order provided for in the City Statute (BRASIL, 2008).

Adequate basic sanitation directly contributes to the improvement of the population's health (understood as access to sanitary sewage, storm drainage, garbage collection and water supply through the general network), also serving as an indicator of social inclusion. Methodological approach: adaptations and contextualization of the environmental health indicator. Environmental health is fundamental, being understood "as a right for everyone, it is an indispensable condition for health security and for improving the quality of life" (BRASIL, 2008).

Studies carried out at RIDE have shown where there were possibilities for development capable of reducing the weight of large cities, with regard to the concentration of economic activities and progress, the number of inhabitants and meeting their needs (OLIVEIRA, 2015).

Still according to Oliveira (2015) it is important to consider that the initiative to establish a RIDE in the Brazilian semiarid region was very plausible, considering not only the identification of a region with recognized economic potential for growth and development, but also an environment with serious social and economic benefits, which would benefit greatly from the results that RIDE could achieve.

Thus, the evolution of population growth, ended up also being a chain effect in order to diverge with everything that was planned. The evolution of cities occurs through qualitative and quantitative changes in urban activities, transforming the infrastructure of the spaces necessary for these activities (ZMITROWICZ, 1997).

Located in the Semi-Arid Northeast, RIDE Juazeiro - Petrolina is composed of 4 municipalities in the state of Bahia and 4 municipalities in the state of Pernambuco. Its total area is 34 thousand km² and its population is approximately 690 thousand inhabitants (IBGE-Census, 2010), it is totally inserted in the hydrographic basin of the São Francisco River, a Brazilian semiarid region, the Basin is divided into 04 sections: Alto São Francisco, São Francisco, the Submédio São Francisco, where the main reservoirs of the Basin are located and RIDE Juazeiro - Petrolina and Baixo São Francisco. RIDE, at the initiative of Federal Deputy Clementino Coelho (PSB / PE), was created by Complementary Law (LC) 113, of September 19, 2001, and regulated by Decree 4,366, of September 9, 2002.

RIDE Petrolina-Juazeiro is an instrument of planning and public management that makes it possible to identify priority actions in relation to sanitation services, thus guiding the actions of public managers and civil society in decision-making to achieve a better quality of life for the community. population and the environment.

Thus, analyzing the conditions of infrastructure and health and their correlations with social vulnerability, delimited to the Petrolina-PE Pole, in 2010, becomes relevant to know the weaknesses of the municipality and enhance decision-making on the part of managers and civil society.

The study was delimited to the municipality of Petrolina-PE due to its growth in recent years, especially with the strength of irrigated fruit and the provision of courses in the health area through Higher Education

Institutions, public and private in the health area, being, therefore, relevant to analyze from the perspective of the infrastructure and health variables.

As a strategy for pointing out alternatives for improvement, for the study area and chosen theme, the data included in this study are presented in TABLE 1.

Table 1. Description of the data to be analyzed

VARIABLE	BACKGROUND	JUSTIFICATION
Index of Municipal Human Development (MHDI)	According to the United Nations Development Program –PNUD (2020), this index presents a measure composed of indicators of three dimensions of human development: longevity, education and income. The index ranges from 0 to 1. The closer to 1, the greater the human development.	The choice of this variable results from the importance of its pillars (longevity, education and income) that makes it possible to identify some type of deficit / disability and from these establish strategies, actions, plans and public policies that mitigate or remedy the problems found.
Income per capita	It is an indicator of development of a country. Per capita income measures the income of each individual within a determined population, calculating an overall average of that value. It is therefore possible to measure your income in relation to your country, your state and your city (MERELES, 2017).	The use of this variable makes it possible to know the socioeconomic conditions of the population and how it is distributed in the perspective of paying attention to regional development in line with the HDI.
Percentage of people in households with inadequate water supply and sanitation	According to the Brazilian Institute of Geography and Statistics – IBGE(2010), in Brazil, one in ten households has inadequate sewage disposal, causing waste to be dumped into nature, whether in ditches dug in the ground, ditches, rivers or in sea.	The services associated with basic sanitation are the subject of several discussions in view of the Brazilian deficit in this regard. There are several waterborne diseases due to lack of access to drinking water, as well as open sewers, which puts this variable as a social problem of the order public health.
Mortality up to 5 years of age	In compliance with the provisions of Article 2 of Decree No. 3,266, of November 29, 1999, IBGE annually discloses, until the first of December of each year, the Complete Mortality Table for the total Brazilian population, referring to the last year.	This variable allows the identification of mortality factors that may result from sanitary conditions in the place where the pregnant woman lives, or the child herself who has repercussions on her physical health, child malnutrition due to lack of financial conditions to purchase food and even violence domestic.
Population	According to the Aurélio Dictionary, it is the group of inhabitants of a specific place, region, country. In the case studied, the population of Petrolina with about 210 thousand inhabitants (IBGE, 2010).	The chosen variable is the starting point for this study, considering that all variables constitute around the socioeconomic and environmental demands that must attend society.

Population living in urban households without garbage collection service	The National Household Sample Survey (PNAD) is a survey conducted by the Brazilian Institute of Geography and Statistics (IBGE). The survey is carried out annually and points out Characteristics of Households and Residents in a given region.	The issue of waste production is one of the major problems facing the society that integrates the economy, the environment and society. Urban waste management also integrates basic sanitation services and creates several problems when absent or deficient. The accumulation of waste that constitutes dumps has consequences such as: release of gases, pollution of ground and surface water (rivers), the concentration of waste in cities causes proliferation of insects, transmission of diseases, visual pollution, clogging of manholes, among others.
Index of Vulnerability in Urban Infrastructure	Urban infrastructure is the set of works that serve as a basis for the functioning of cities, formed by the basic distribution and driving networks. This index seeks to signal the access, the absence or the insufficiency of "Assets" that should be available available to every citizen, for force of State action (IPEA, 2020).	The variable constitutes a fundamental basis for this study, considering that the demands for health, education, employment and income, security, food, permeate the infrastructure present in cities and directly imply the quality of life for their population.
Human capital	For Viana and Lima (2010), in the socioeconomic context, capital human, dimensioned by the level education and knowledge population, is a variable important as an alternative to reducing social disparities and economic.	This index adds to the study as point of understanding possible factors that lead to inequalities in time that makes it possible to know how society appropriates and validates this knowledge in the direction of strategies for reducing socioeconomic differences existing.

In this way, the complex of socio-demographic data demonstrated so far explains the vulnerability of the area in both directions. These local characteristics are an important point to be taken into account in studies on the area

III. RESULTS AND ANALYSIS

For data analysis, the UDH- Housing Unit worksheet was used, in which cities are subdivided into housing units, which function as microregions.

The data was imported through the R graphical interface, and then some filters were made to select only the information relevant to the study, which were: The HDUs only in the cities of Petrolina, year 2010, for this purpose, the package was installed. Dplyr and the filter command is used.

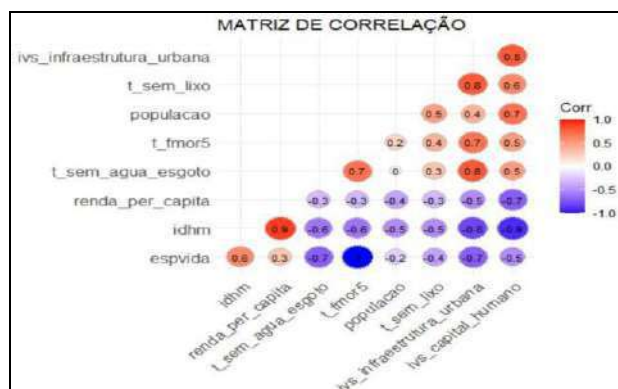
The data analysis was based on a correlation matrix between the variables, mentioned in topic 2 (Data description). Correlation is an interrelation between variables, that is, in a context of two variables x and y, it

is possible to state that there is a correlation between x and y when there is a variation in the variable x and a variation in the variable y, in close or equal proportions.

In the types of correlation we have: Weak and strong, what will dictate whether it will be strong or weak is the proportion that this variation occurs. That is, if the proportion that occurs in the variation of variable y is the same as the proportion of variable x we will have a perfect correlation, when this variation is quite different we will have a weak correlation.

As for the sign, the correlation can be positive (direct correlation) or negative (inverse correlation). Correlation coefficient: it is a number that measures the degree of correlation between two variables. This coefficient normally only assumes values between -1 and 1. In this study, Pearson's coefficient was used.

In the process of elaborating the correlation matrix, the color function was used to generate the correlation matrix, followed by the command GGCORPLOT to plot the correlation matrix, obtaining the following result.



Graph 1: correlation matrix of the selected variables.

Source: Study data.2020

In this correlation matrix the values in blue represent a negative correlation, the values in red represent a positive correlation. In order to achieve the objective proposed in this study, strong correlations (positive and negative) and a weak correlation to complement the results were analyzed, thus the following correlations were analyzed: *ivs_infraestrutura* and *ivs_capitalhumano* with 0.8 correlation; *ivs_infraestrutura_urbana* and *idhm* with -0.8 correlation, lastly *ivs_infraestrutura_urbana* and *populacao* with correlation 0.4.

For a better understanding of the *ivs_infraestrutura* and *ivs_capitalhumano* correlation, it is necessary to understand the composition of these indices. It is important to note that the descriptions of the indexes reported here were obtained from the dictionary in the RIDE data sheet. The *ivs_infraestrutura* is an index that in its composition considers the following aspects: Percentage of the population that lives in urban households without the garbage collection service; Percentage of people in households with inadequate water supply and sanitation; Percentage of people in households vulnerable to poverty and who spend more than one hour to work in the total number of employed, vulnerable people who return daily from work.

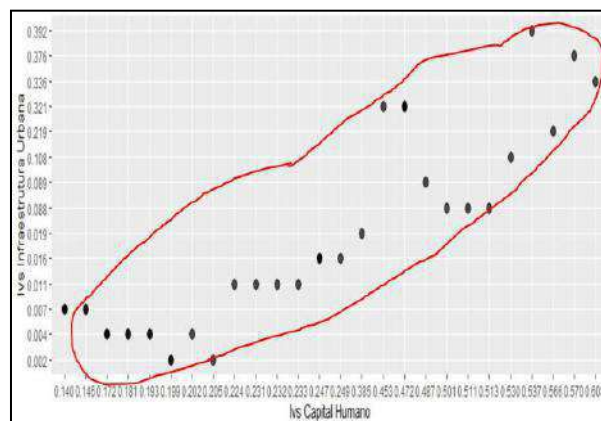
Thus, we can conclude that a growth in this index signals that less infrastructure has the housing unit. For example: We highlight two housing units in the city of Petrolina, the Areia Branca unit and the Cosme Damião / João de Deus unit, the first is a more centralized region, while the second is a more peripheral region, according to the UDH worksheet. *ivs_infraestrutura* of Areia Branca is 0.004 while Cosme Damião / João de Deus is 0.219.

The second index, *ivs_capital humano*, in its composition considers the following aspects: Mortality up to one year of age; Percentage of children from 0 to 5 years old who do not attend school; Percentage of children aged 6 to 14 who do not attend school; Percentage of women aged 10 to 17 years who had

children; Percentage of mothers who are heads of household, without complete elementary school and with at least one child under 15 years of age, in the total of mothers who are heads of household; Illiteracy rate of the population aged 15 or over; Percentage of children living in households where none of the residents have completed elementary school; Percentage of people aged 15 to 24 who do not study, do not work and are vulnerable to poverty, in the total population of this age group. So, The growth of this index signals a bad condition for the development of the HDU. For example:

We highlight two housing units in the city of Petrolina, the Areia Branca unit and the Cosme Damião / João de Deus unit, as mentioned above, which is a more centralized and a more peripheral region, which have the following *ivs_capitalhumano*: 0.172 e 0.566, respectively.

In order to complement the analysis of this correlation, a scatter plot between these two variables will be presented below:



Graph 2: dispersion graph that relates urban infrastructure indexes and human capital.

Source: Study data.2020

When analyzing the matrix and the dispersion graph, it is observed that the urban infrastructure index has a very strong positive correlation with the human capital index. Considering that the infrastructure is the set of works that serves as a basis for the functioning of cities, formed by the basic distribution and driving networks. This index seeks to signal the access, the absence or the insufficiency of “assets” that should be available to the citizen due to the State’s action (IPEA, 2020).

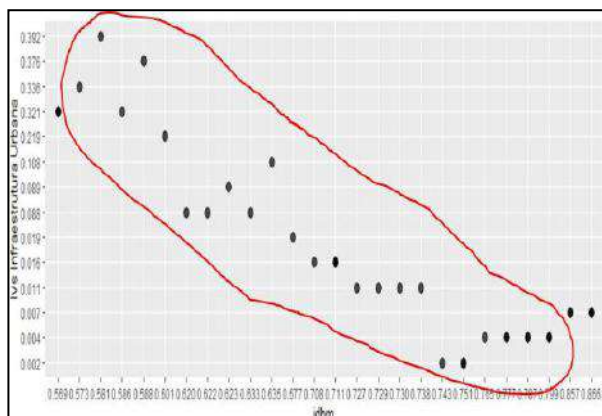
For Cruz et al. (2017), the expansion of infrastructure and human capital can contribute to better socioeconomic opportunities for the population, with a fairer distribution of income, with an increase in the returns on the generated capital and labor inputs, and further states that the expansion and appreciation of human capital is a “determining factor for technological progress”, given that

it is assumed that with greater education, more opportunities and possibilities of choices are realized in the individual's life.

In theory, a good human capital ratio provides greater awareness and demand for citizens' rights. In the perspective of Viana and Lima (2010) "education makes people more productive, increases their wages and influences economic progress", however the quality and quantity in which education is offered may establish an antagonism, considering that "even with a possible continuous increase in education, it may not reflect a qualitative level sufficient to boost productivity and the economic and social progress of the population" which implies a possible insufficiency in this regard and should also exercise its citizenship in charging public managers for the appropriate conditions on this issue.

This reflection demonstrates that investments in human capital and infrastructure must be continuously evaluated in order to improve the services provided, investments with optimization of public resources, with reflections on the quality of life of the population.

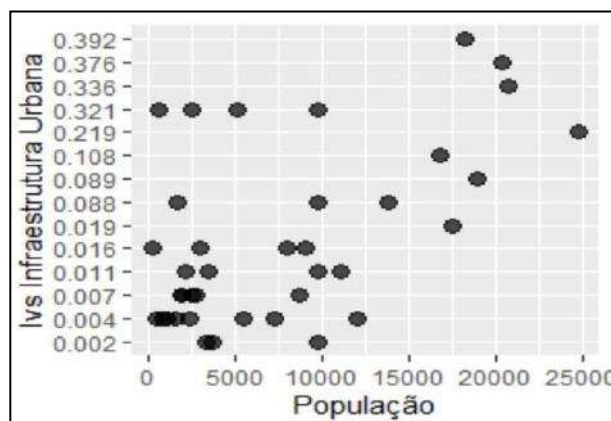
The next correlation that will be analyzed refers to *ivs_infraestrutura_urbana* and IDHM, for a better understanding it is important to understand that the IDHM index considers in its composition the following aspects: Income, education and longevity. Thus, we conclude that an increase in this index signals a good development of the housing unit. As highlighted in Graph 3, we conclude that a good municipal human development index (IDHM) leads to a good urban infrastructure index.



Graph 3: dispersion graph that relates the urban infrastructure and human development indexes municipal

Source: Study data.2020

The next correlation analyzed deals with the relationship between the Urban Infrastructure index and the Population, in this sense we identified a weak correlation of 0.4 highlighted in the correlation matrix, it is also observed, in graph 4, that there is no linear trend between the points shown in the graph .



Graph 4: Dispersion graph that lists the urban infrastructure indexes and the population of housing units.

Source: Study data.2020

According to IBGE (2020), the population topic comprises information on size and structure (by age and sex), color or race, population distribution, density and urbanization, information on fertility levels and characteristics, migration and mortality of the population, as well as births and deaths. According to the Aurélio Dictionary (2002), population is the group of inhabitants of a specific place, region, country. The city of Petrolina has approximately 210 thousand inhabitants (IBGE, 2010) and this variable was chosen as a starting point for this study, considering that all variables are based on the socioeconomic and environmental demands that must meet society.

The housing units in Petrolina have a low correlation between the population of each unit and the infrastructure index, so it was noted that the management model needs improvements to promote development and reduce inequalities. There are densely populated neighborhoods in Petrolina, such as João de Deus and Areia Branca, but with different infrastructure rates. The former has more deficient conditions such as open sewage, residents with low per capita income and the latter with a more organized structure.

According to Malpas (2004 apud ZOGHBI et al, 2007), housing is one of the five fundamental public services for the population, followed by education, health, social security and personal social services and is related to the state of social well-being. The deficit of infrastructure in housing units can generate precarious situations for the population, implying poverty, irregular land occupation (invasions, slums), informal economic activities, environmental problems, which reinforces the importance of the existence of adequate conditions for collective well-being.

For Monteiro and Veras (2017) conditions that imply “human development must include policies consistent with sustainable economic growth, such as a more equitable distribution of resources, linked to interventions that improve the essential conditions of the population” regarding the infrastructure-population correlation in Petrolina, becomes worrying, given that for human development, there are fundamental elements that come together in a fundamental way directly dependent on the conditions of the inhabited environment that reflect on the health of the population, considering, according to the World Health Organization, as a state of complete physical, mental and social well-being, and not just as the absence of illness or infirmity.

Glimpses the perspective of quality of life as a result of the condition of the state of integral well-being of the population, demands from public management attention to the demands that are not being met, as well as the monitoring of existing ones to promote and consolidate local development regional.

IV. CONCLUSIONS AND SUGGESTIONS FOR FUTURE WORKS

The Juazeiro - Petrolina Integrated Development Region (RIDE) was implemented by Complementary Law No. 113, of September 19, 2001, and regulated by Decree No. 4,366, of September 9, 2002, with the main objective of reducing existing inequalities between different Brazilian regions and develop local economic and social potential.

Through the R Statistical Program, the data collected through the information obtained from the spreadsheet RIDE_Petrolina_Juazeiro, from the Atlas report, were processed. A correlation matrix was established with the MHDI variables; Renda_per_capita; T_sem_agua_esgoto; T_fmor5; Population; T_without garbage; Ivs_infraestrutura urbana and Ivs_capital humano.

In graph 1, it was noted that the red color, the stronger, the more the variable has a correlation (statistically significant). Take as an example the variables IVS_infraestrutura urbana which has a high correlation with ivs_capital humano, it means that when you have human capital you tend to have greater urban infrastructure. In theory, a good human capital ratio provides greater awareness and demand for citizens' rights.

On the other hand, it is noted that human capital had a low correlation with life expectancy, that is, there is no statistically significant relationship. The data showed that life expectancy has a high relationship with MHDI, in

general, the higher the Municipal Human Development Index has a level considered, the better the life expectancy of the individual.

The housing units in Petrolina have a low correlation between the population of each unit and the infrastructure index, so it was noted that the management model needs improvement to promote development and reduce inequalities.

As suggestions for future work, it is recommended that a comparative analysis be carried out with the other municipalities that make up the RIDE, in order to contribute to the development of each city that makes up the hub, thus contributing to the discussion and improving the measures that are positive in one municipality to another, in addition to minimizing their possible weaknesses.

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Intecfatec: Innovative Entrepreneurship Focused on Surveying, Rescuing and Maintaining Actions Involving Companies and People Participating in Projects of This Nature

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Received: 11 Dec 2020;

Received in revised form:

03 Feb 2021;

Accepted: 21 Feb 2021;

Available online: 19 Mar 2021

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Keywords— *Ecosystem, Entrepreneurship, Innovation, INTECFATEC, Projects.*

Abstract— *Small businesses account for more than a quarter of Brazil's Gross Domestic Product, and together, the more than 10 million micro and small enterprises in the country account for 30% of this GDP, and by 2022, Brazil will have about 17.7 million small businesses. In partnership with universities, companies and public authorities, people present ideas that will guarantee them the first steps towards entrepreneurship and innovation, providing an experience that, given talent, effort and even "luck", will bring success to realize your dream business. The Paula Souza Center in its ETECs and FATECs, holds every six months several of these projects, initiatives or ideas, whose purpose is to encourage entrepreneurship and innovation for small businesses. Lots of projects are selected and remain within a support structure, however, some are not chosen for "training", others are neglected by the authors who give up undertaking and others persist until the end, but faced with other priorities, simply end. Thus, using exploratory, bibliographic, documentary and field research (survey) were adopted to understand, rescue, and encourage projects, establishing a "support" to the student, former student or member of the community who has, had, or wants to have a project of an entrepreneurial nature. The authors sought to study and partially map an ecosystem of innovation and entrepreneurship between FATECs and ETECs located in the Paraíba Valley, verifying incentive programs to generate feedback for those involved and interested.*

I. INTRODUCTION

Small businesses account for more than a quarter of Brazil's Gross Domestic Product, and together, the more than 10 million micro and small enterprises in the country account for approximately 30% of that GDP for the Brazilian Micro and Small Business Support Service (SEBRAE, 2019) and by 2022, Brazil will have about 17.7 million small businesses, that is, more than one million new ventures per year, according to SEBRAE, estimates. This number is 43% higher than the current one, which is 12.4 million Individual Microentrepreneurs and micro and small opting companies of Simples Nacional, a system that reduces the tax burden and bureaucracy. However, several studies point out the difficulties of people when starting their activities as a company, practicing entrepreneurship, and exploring the market with the shield of innovation. Many projects in partnership with universities, companies and public authorities propose the study, analysis, training and give individuals or already micro/small regular companies the first steps directing them to entrepreneurship and innovation, providing an experience in which, given talent, effort and even "luck", are classified as the next steps for the success or failure of the interested party to carry out his business (Santos and Pinho, 2010).

The Paula Souza Center or CPS in São Paulo (Brazil), more precisely in the ETECs (technical schools - vocational technical courses) and FATECs (technology colleges - higher education courses), have several of these projects and initiatives whose purpose is to encourage entrepreneurship and innovation for small businesses, several of them, implemented very successfully, in several units, which aim to provide the necessary and/ or basic tooling for the entrepreneurial training of students, former students and, people in the community, facilitating and better developing their socio-economic environment (CPS, 2020). Many projects are selected, targeted, and remain for months within a solid support structure. However, some projects are not chosen for "training", others are neglected by the authors themselves who give up attending "school". Others persist until the end, but months later they are no longer a priority of their creators and simply end up.

Thus, the idea of this article was to study and partially map the ecosystem of innovation and entrepreneurship of FATEC Guaratinguetá, a technological higher education institution of the CPS and FATECs and ETECs located in the Paraíba Valley region, to verify some programs of the same center and, thus, to promote partnerships, list initiatives or research on the subject that occurred in the units and to *generate feedback* for those involved. At first and mainly, establish focus on projects that are already active or closed, starting from exploratory

bibliographic, documentary and survey, for the people/companies involved.

This project is justified because it proposes issues relevant and necessary to institutions where innovation is the subject of debate and actions. Several institutions already in contact and studied previously ensure the lack of a reintegration, rescue, or maintenance approach to "old" or "discontinued" projects focused on entrepreneurship and innovation, which creates a "gap" in the ecosystem of innovation and entrepreneurship. Recent searches on the *Web of Science* or WOS portal (2015-2020) still show that the theme "entrepreneurship and innovation" is still quite incipient and has gaps within this knowledge base and can be very much addressed by several aspects.

Thus, the proposal became possible due to the structural ease of support and access of the authors with INTECFATEC, Laboratory of Innovation and Entrepreneurship of FATEC Guaratinguetá (SP) and the other regional units of the CPS, where they are collaborators, present their works and research results. In these technology centers considered a reference in the state and in the country, locally there are facilitators, researchers and entrepreneurs interested in the subject focus of this article.

Finally, using an exploratory bibliographic and documentary research methodology, the objective was to elaborate a conceptual update and based on this, go to the field, understand the situation of projects related to innovation and entrepreneurship in FATEC Guaratinguetá and in its surroundings covered by the CPS, rescuing old or encouraging new projects, establishing a "support platform" to the student, former student, or member of the community that has, had or wants to have a project of an entrepreneurial nature.

II. THEORETICAL FRAMEWORK.

In this section are presented some of the important and recent concepts on the main themes of this article such as innovation, entrepreneurship, its fragment for innovative projects, cite the importance of partnerships between university, companies, community, and *feedback* for projects, INTECFATEC and innovation ecosystems.

2.1 Innovation

According to Aveni (2014), the economist Jean-Baptiste Say was the first exponent to deal with innovation, in the work *A treatise on political economy: or the production, distribution and consumption of wealth*, edited in 1803 (French) and, again in 1821 (English), even not using exactly this term, because at the time, was considered entrepreneur or innovator the merchant or

people who made products circulate, especially by exchanges. But in a current concept, Trott (2012) defines innovation as the management of all activities that cover a process of idea design, development and improvement of technologies, manufacturing and marketing of a new product or a manufacturing process or equipment, a fundamental factor for economic growth.

Thus, innovation can be better explained as an action of transformation of classical methods of processes, knowledge, or even culture in favor of consequences for the construction of the new or renewed method (Gale, 2014), since, in recent years, much attention is considered for these methods in industrial and business contexts.

The act of innovating also represents the need to create strategies, and with them, success, and development, since the success of this rapid and intense development of innovation and entrepreneurship ecosystems enables countries to more capable of solving economic problems, promoting job creation, and leveraging socioeconomic advancement (Kon, 2016). This path to development is based on the deliberate action of public and private agents involved in this context, particularly through the perception of the need to promote, motivate and divide support activities and other stimuli, as the CPS does direct its INOVA Agency, which also relies on the efforts of ETECs and FATECs.

2.2 Entrepreneurship.

According to Degen (2009), the word entrepreneurship derives from the English term *entrepreneur*, which also derives from the French Latin word *entreprendre*, which brings together the words between, derived from *Latininter* or *reciprocity* and *preneur*, derived from the Latin *prehendere* or *buyer* and, in the combination of the two words, has an intermediate meaning, that is, one of the basic functions of "modern entrepreneurship".

Already to Hisrich, Peters and Shepherd (2014), it is a technique to generate something new, with value for the application of period and effort required, recognizing your risk in the organization resulting in financial support and personal recognition, so entrepreneurship happens when people make things happen, create business through the opportunities that arise providing value to society.

Thus, the entrepreneur or entrepreneur shipper can be the one who changes an existing economic order with the introduction of new products and services, by creating new forms of organization or by exploring new resources and materials (Dornelas, 2016).

2.3 Innovative Projects.

For Judgev and Müller (2005), the evolution of success in projects in the last 50 years is rewritten in the face of new conditions for this success. Critical factors, new scenarios, and, respectively, the vision of this success change constantly over time, from definitions limited to the implementation phase to definitions that reflect the evaluation of the entire life cycle of projects, products, or services. Concordant, Rabechini Jr and Carvalho (2009), add by stating that the intensification of "innovative" and "non-routine" activities in organizations has stimulated the search for the factors that influence the success of a project, however, the premise that a set of factors can be applicable to all types of projects has been strongly questioned, given the fundamental differences between them.

Thus, in the face of explicit changes, the literature points to a real need to investigate "innovative" projects, not only on which management variables contribute most to the success of these projects, but also, the establishment of "contingency" relationships between these variables and the types of projects, since previous research between the type and management variables that led to a significant success of the projects may have been responsible for the non-conclusive outcomes of some of these studies on the determinants of the success of a project (Rabechini Jr and Carvalho, 2009).

2.4 Importance of Partnership University, Companies and Community.

Seraphim (2015) reported in his work that in the last three decades there has been a growing global effort to formulate public policies, regulatory frameworks, initiatives and plans that seek to stimulate public-private partnerships to enhance economic and social development from the intensive use of knowledge, science, and technology. In fact, universities and colleges are part of this "task force", increasingly perceiving its mission as more comprehensive than the production and dissemination of knowledge. They start to play a more proactive role in innovation systems, seeking forms of relationship with the productive and service sectors, so, promoting technological development with companies, without compromising academic values.

Naturally, the interaction between educational institutions and companies occurs from formal or formal personal relationships, by formal agreements and the creation of structures suitable for interaction, and such initiatives may have their objectives defined according to the research to be contracted, or, when in the development prototyping, tests, cooperative research projects, training,

or joint research programs (Khorsheed and Al-Fawzan, 2015).

Corroborating the theme, Cherubini Neto (2006) states that, elaborating and motivating projects, universities and other educational institutions become potential contributors and with a fundamental role in R&D and, mainly, in Brazil, influence the entrepreneurship and innovation practiced in some companies (which, without them they would not do so) and, therefore, resources for R&D are gradually expanded for these, as well as increasing the participation of universities as major providers of knowledge and local and regional economic development.

For Lahorgue (2004), based on the recognition that development depends on the innovation capacity of a society, two other findings appear: a) the growth processes are rooted in the territory and are endowed with history, that is, the innovative environment will interact in the local environment of a culture and actors who are there and, b) the capacity for innovation is linked to actors such as government and institutions that provide scientific and technological knowledge such as universities and universities and Colleges.

Thus, as Rolim and Serra (2009) explain in their work, many institutions that provide technological and scientific knowledge (such as universities and colleges) have aroused interest and have begun to guide work aimed at entrepreneurship and innovation, thus receiving attention in Brazil, and are now considered as a "key element" in the development process between regions, supported by studies of the National Information System for Regional Development, the SNIDR.

2.5 Feed Back as A Learning Tool.

According to Flores (2009), one of the main components of formative *evaluation is feedback*, an action that can regulate a teaching-learning process, continuously providing information so that the teacher perceives how far, or near, he is from the desired objectives. Because it is continuous, feedback *allows adjustments* needed for the best quality of learning to be made early and not only when the student fails the tests or final assessments, that is, in the summative assessment.

And for Zeferino *et al.* (2007), if on *the one hand feedback is essential*, it also does not guarantee learning without adequate stimulation of the cognitive and metacognitive processes of teaching, which should be the center of the teaching-learning process, which means that teaching should be encouraged to develop self-assessment and self-regulation of their learning. Complementing, Flores (2009) still alerts those interested about the main objective of feedback, which is to provide tools to improve

the performance of teaching, identifying their weaknesses and helping him to create alternatives to overcome them and, to have quality, the feedback does not need to be long, but needs to be clear, objective, and transferred in the most appropriate way possible, awakening the reflection of the teaching, because only in this way, can change some behavior.

Finally, according Zeferino *et al.* (2007), it is important to point out that the lack of feedback distances the teaching from the primary objectives of his training, often leading him to a misinterpretation of his behavior, which can generate two extreme consequences, the development of a "false trust" or "insecurity" in decision making, or abandonment of the project, because there are many studies that show that the use of feedback can "yes" improve the performance of teaching in the execution of various tasks, projects and development of skills in general.

2.6 Innovation Ecosystem.

According to Kon's research (2016), competition and collaboration between individual firms in the search for a share in the market gained new interpretation with Moore's 1993 article, that understood companies not as units of a single industry, but as a part of a *business ecosystem* that involved a number of industries and, in this ecosystem, companies evolve together around innovation, producing competitively, but also cooperatively, with the aim of developing new products that satisfy the consumer in the market.

According to Audy (2017), the most recent concept of Innovation Ecosystems, as equivalent to Areas of *Innovation*, aiming to establish a parallel or metaphor with biology and natural ecosystems, that is, where life is created, adapted and evolves, with intense interaction, synergy and, regardless of the model of innovation environment adopted, whether in a region or in a city, the development of an area of innovation will require a series of factors to succeed in the process of economic, social and urban transformation involved.

In short, Rossi *et al.* (2014) explain that an *Innovation Ecosystem* models the economy, and its functionality is to enable technological development and innovation. In this context, the actors would be material resources (such as funds, equipment and facilities) and human capital (students, professors, support, researchers and industry representatives) that shape the institutions participating in the ecosystem and, these institutions, in competitive countries, are universities, research institutes, hybrid university-company arrangements, federal or industrial centers of excellence, schools and business es, venture capital companies, organizations supporting

economic development and state or local business, development agencies, policy formulators, among others.

2.7 Intecfatec

The Innovation and Entrepreneurship Laboratory of the Faculty of Technology of Guaratinguetá, called INTECFATEC, is an initiative responsible for local and regional programs to encourage the culture of innovation and entrepreneurship. Its objectives permeate local and regional economic and social development with training activities, complement of curricular activities and other activities that develop skills and skills of innovation and entrepreneurship, promoting the culture of innovation and entrepreneurship, promoting the dissemination of new technologies and their uses, expansion and dissemination of work opportunities and personal development.

Thus, INTECFATEC is an environment that stimulates the creation and development of projects and ideas for new businesses that, from an idea identified as a solution for the market. Whether as an individual microentrepreneur, micro and small business, the laboratory offers technical support and complementary training to the entrepreneur, whether he/she is a student, former student, or member of the community.

In addition to mentoring and consulting, INTECFATEC collaborates with the Innovation *Ecosystem*, local and regional entrepreneurship with initiatives such as *Hackathon*, *Startup Weekend*, *School of Innovators*, *Training for the Canvas Business Model* and *Technical Visits*. Its structure is composed of a manager and a technical team of teachers who, together with students and former collaborating students, realize innovation and entrepreneurship.

III. METHOD

Exploratory *research*, the basic method of the elaborated work, according to Gil (2019), is a format of scientific research and constitutes the production of studies that allow the researcher to familiarize with the object being investigated and, its application should generate greater proximity between the researcher and the universe of the object of study, offering information and guidance in the construction and formulation of the research

hypotheses. Through it, they identify new possibilities, formulate new ideas and build hypotheses.

Also as a method, a comparison of material already acquired and the addition of updated material was developed, that is, a comparison of accumulated knowledge that, as far as its nature is, is classified as *applied research* (Marconi and Lakatos, 2010), a method assisted by investigation of a problem related to the applicability of scientific knowledge and, which will still be based on a *bibliographical research* (Gil, 2019), material that, although partially developed recently, will still be complemented and added to other knowledge bases that will still be raised. Basilar as a methodology, we also adopted *documentary research*, a procedure for materials that have not yet underwent analysis or that can be reelaborated according to the objectives of the research, which is supported by materials that have not yet received any in-depth analysis and aims to select, treat and interpret the information, seeking to extract some meaning from it and introduce some value with the main purpose of contributing to the scientific community (Martins, Mello and Turrioni, 2014).

Also, as support, we used the survey *orsurvey*, whose characteristics are of great scope, especially when using a technological tool (whose purpose is also exploratory) to obtain data and information about actions, characteristics or opinions about a group representing the target population and, which greatly facilitates the access and collaboration of the units "focus" to be researched (Forza, 2002). Finally, as the research receives qualitative and quantitative treatment, uses a research instrument, and adopts field research (personal observation and interviews), it also receives the typology of mixed approach or mixed *methods research* (Creswell and Clark, 2007).

3.1 Questionnaire Applied.

The basis of the questionnaire applied electronically (by *SurveyMonkey* and *Googleforms* tools) is shown in Figure 1:

Survey Questionnaire

Dear participants, this questionnaire aims to collect information on **Entrepreneurship** and **Innovation** in your teaching unit, that is, a survey focused on motivation, rescue and maintenance of actions or initiatives that involve companies and people participating in projects of this nature directed at ETECs and CPS FATECs. Your answers will help us to compose a mapping of our current situation of internal and external projects. Thus, we anticipate our thanks for the reports.

- 1 What is your **Gender**? () Male () Female () Other: _____ () I prefer not to say.
- 2 His **Age** is: () 17 to 20 years () 21 to 25 years () 26 to 30 years () 31 to 40 years () More than 40 years
- 3 You are: () CPS **Current Student** or **Former Student** at () ETEC () FATEC: Unit: _____
() **Community Member** close to () ETEC () FATEC: Unit: _____
- 4 In the unit (ETEC / FATEC) that you attend, **are there any initiatives** related to entrepreneurship and / or innovation? () Yes () No
- 5 How many projects have you **proposed** (an idea of your own) or **known** (ideas from your fellow students)? Explain.
- 6 What were **the highlight areas** of these projects?
- 7 **Did you succeed in your project?** So, please define success and explain the reason for that success.
- 8 **Was not successful?** Then, explain why you haven't (yet) achieved this success.
- 9 **Didn't complete your project** or have you given up? For what reason?

Fig.1: Questionnaire Applied.

Source: Prepared by the Authors

IV. RESULTS AND DISCUSSION

4.1 Participants.

Between November 2019 and December 2020, the survey /questionnaire was submitted and multiplied, and from it 327 answers (provisional), 52 representatives of the community, 131 representatives of the ETECs (students and former students) and, of FATECs, 144 students and former students, as can be observed in Figure 2.

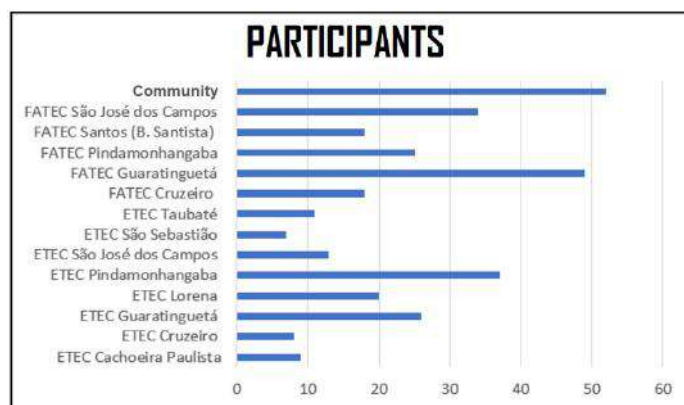


Fig.2: Total Participants/Respondents.

Source: Prepared by the Authors

4.2 Gender

Regarding gender, 188 respondents chose "Male", 112 answered "Female", 19 pointed out the alternative "Other" and, 8 of them "Preferred Not Answer - PNA", as shown in Figure 3.

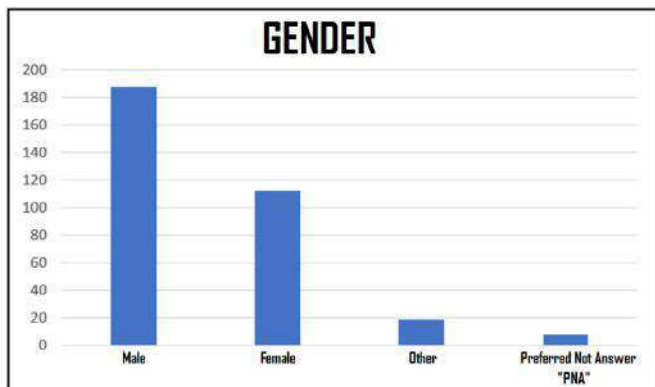


Fig.3: Gender of respondents.

Source: Prepared by the Authors

4.3 Age

As observed in Figure 4, most respondents are between 21 and 25 years old (101 years), followed by the age that intervals 26 and 30 years (86 of them). The minority is part of the interviewed population that is in the age group over 40 years (18 respondents).

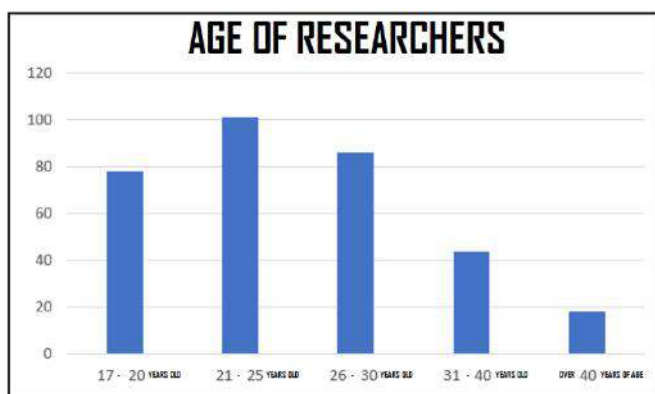


Fig.4: Age of Researchers.

Source: Prepared by the Authors

4.4 Origin

According to the answers obtained the origin of most of the questionnaires that returned are from current students of FATECs (121 responses) and ETECs (78 responses), however, there were many former students of FATECs, ETECs and community members who also helped answering emails and calls (Figure 5).

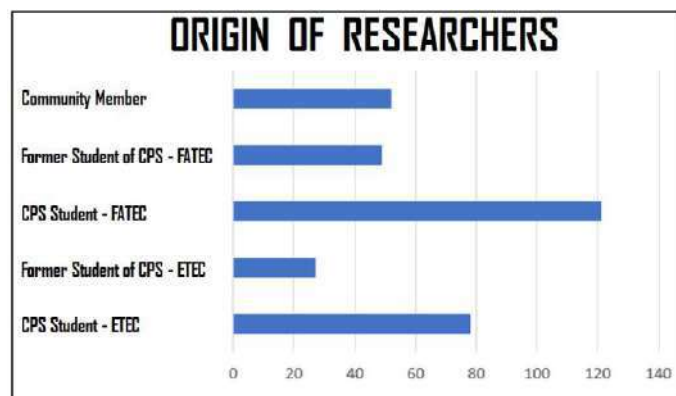


Fig.5: Origin of respondents.

Source: Prepared by the Authors

4.5 Agreement with Entrepreneurship and Innovation Initiatives.

As expected, all respondents agreed that in the CPS units that attend or attended, they had initiatives related to entrepreneurship and/or innovation, as can be seen in the representation (Figure 6).

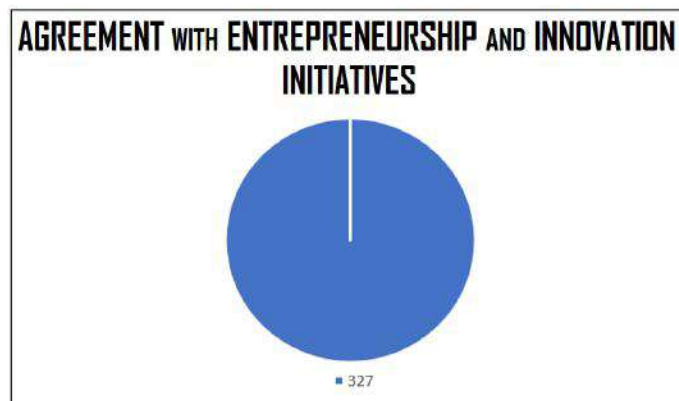


Fig.6: Agreement of Respondents on Initiatives.

Source: Prepared by the Authors

4.6 Proposals (own projects) and Knowledge (projects proposed by colleagues) of Projects.

The respondent was asked whether he proposed or knew any project in the unit and, as a precious information, the number of 948 proposed projects was known, divided into 428 project proposals and 520 projects known (projects proposed by colleagues) or researched (own projects) by respondents in the CPS units, as shown in Figure 7.

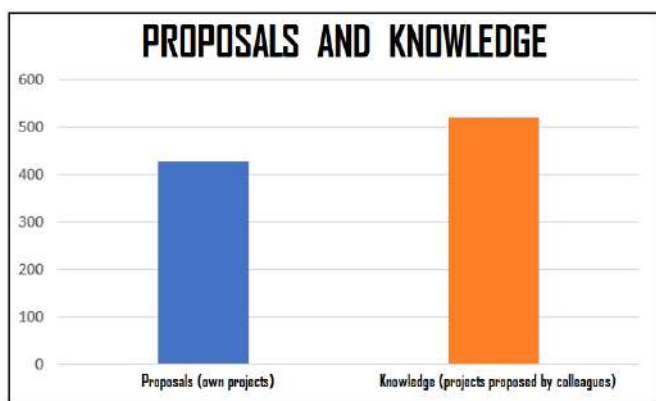


Fig.7: Proposals and Knowledge of Project Respondents.

Source: Prepared by the Authors

4.7 Featured Areas.

As shown in Figure 8, *Services, Applications, Food and Infoproducts* were the areas most highlighted by respondents, when sending /preparing a project or when they researched projects from other colleagues.

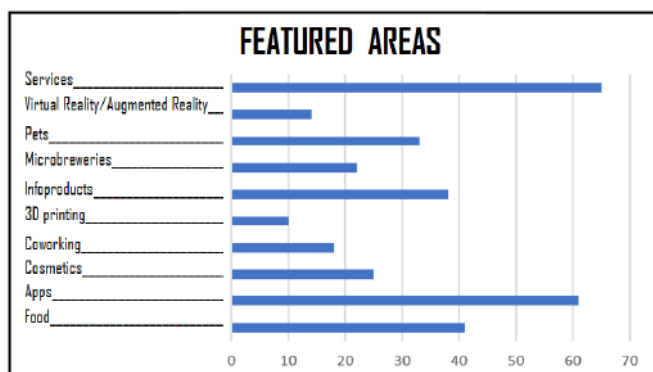


Fig.8: Project Featured Areas.

Source: Prepared by the Authors

4.8 Success in The Project, Definition of This Success in Words and Main Reasons.

When asked if they were successful in the project, 78 of them answered "yes" (Figure 9). Success that in words was defined mainly by *success, competence, triumph, victory, achievement, achievement, good feeling, glory, luck, and happiness*. Among the reasons for this success, were mainly mentioned: *study, help, support, attention, support, investment*.



Fig.9: Project Situation - Success.

Source: Prepared by the Authors

4.9 Failure in The Project (Provisional) And Reasons.

Regarding the provisional failure (projects that are still in progress), 142 respondents understood that they belong to this classification (Figure 10). When asked about the reasons for this failure, the most cited were *little time, inexperience, health problems, personal problems, family problems, inadequate support, little investment, and disinterest*.

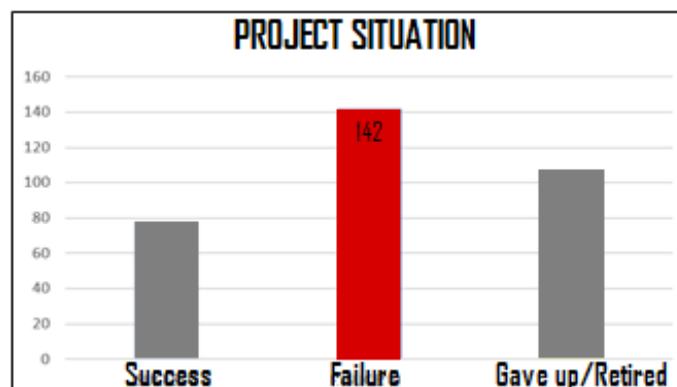


Fig.10: Project Situation - Failure.

Source: Prepared by the Authors

4.10 Definitive "Retired" of Projects

As can be seen in the representation (Figure 11), many respondents who collaborated with the research did not complete their project and Gave up (107 of them) amid various reasons such as *limited time, college or course, graduation, abandonment of colleagues, few resources or investments and entry into employment*.

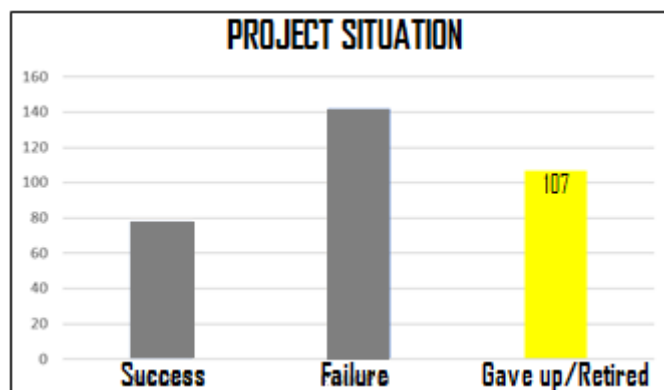


Fig.11: Situation of Projects - They Gave up.

Source: Prepared by the Authors

V. CONCLUSIONS

As mentioned earlier, the idea of this research was to study and map even partially the ecosystem of innovation and entrepreneurship among students of FATEC Guaratinguetá and other FATECs and ETECs located in the Vale region and, with this, check some programs, promote partnerships, list initiatives or research on the subject that occurred in the units and *generate feedback* for those involved.

At first and mainly, it was possible to establish a focus on active and closed *projects*, which was possible with the survey, which until the date of submission of this article, allowed contact with almost 400 companies. With it is perceived the formation, growth, and development of small companies from projects of the institutions of the CPS, being a fact highly praised, the incentive proposed by INTECFATEC and other laboratories and incubators crowded in FATECs and ETECs.

Research shows the success and survival numbers of small businesses, as there are many worrying cases of failure and dropout. It is also important to mention that many of these projects are idealized, but "still" no investments have been inserted in research, development or any other order or nature for the maturation of them. At this point, this article will be used as an alert and communication tool between projects that can be collaborative (using open innovation, for example).

With the results, figures are released for new products or services launched and derived from the projects INTECFATEC, INOVA, or simply from disciplines of FATECs and ETECs, and this is a very important data, due to the insertion of professionals and companies in the market, which slows the unemployment situation in the region and consolidates the quality of work offered by the cps poles.

This research document in its final version (the research is still in final stages) in the future will allow, then, more internal and external dissemination, will be contemplated with more knowledge and support, generate more data on the ecosystem of innovation and local and regional entrepreneurship, raising even more situations in relation to the projects initiated by the CPS programs, satisfaction of students and community members in response to the conviviality and learning they had and took with them. Those involved will again be interviewed and invited again to return with new projects and until they become students again.

Finally, the authors congratulate the drafting, creation, and investment teams. We are on the right track.

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Paths of living waters: Reminiscences and memories of the waters of barreiro in the quilombola Community Barrocas-BA

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Received: 03 Dec 2020;

Received in revised form:

07 Feb 2021;

Accepted: 19 Feb 2021;

Available online: 19 Mar 2021

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Keywords— Clay Pit Water. Memories. Social
Technologies. Curriculum.

Abstract— This article assessed the memories of the inhabitants of the quilombo Barrocas on the access and use of clay pit water, relating them to the Social Technologies for coping with drought, as registered in the curriculum of the course of Environmental Engineering at IFBA, the city of Vitoria da Conquista-Bahia. According to the intended objectives, it was possible to verify, in the reminiscences of the inhabitants: in what way the waters were obtained and used; the existence of records of the implications of improper use of this resource; and the existence of social technologies that validate the access and use of the water. The main theorists who founded this research were, Walter Benjamin, Ivor Goodson and Tomaz Tadeu da Silva. Data collection was done through research methods, indirect documentation and extensive direct observation. The fictional work *A Quadrado das Águas Perdidas* from Elomar Figueira de Mello (1979), contributed with the reflections on this study. Among the final considerations, it was understood that the access to water from clay pits belongs to the past, it is only present in the memories of the interviewees. Moreover, we conclude that the curriculum of the Environmental Engineering course should be practiced in a more humanistic conception, projecting the individual into his social space of experience.

Resumo— Este artigo analisa as lembranças dos moradores do quilombo Barrocas sobre o acesso e a utilização da água de barreiro relacionando-as com as tecnologias sociais de convivência com a seca, registradas no currículo do curso de Engenharia Ambiental do IFBA em Vitória da Conquista, Bahia. Através dos objetivos foi possível verificar, nas reminiscências das memórias dos moradores, de que forma as águas eram obtidas e utilizadas; a existência de registros das implicações do uso inadequado desse recurso; e constatar a existência de tecnologias sociais que validem seu acesso e utilização. Os principais teóricos que fundamentaram essa pesquisa foram, Walter Benjamin, Ivor Goodson e Tomaz Tadeu da Silva. O levantamento de dados foi procedido através dos métodos de pesquisa, documentação indireta e observação direta extensiva. A obra ficcional *A Quadrado das Águas Perdidas* de Elomar Figueira de Mello (1979), contribuiu com as reflexões desse estudo. Dentre as considerações finais, entende-se que o acesso à água de barreiros são ações encerradas, estão presentes apenas nas memórias dos entrevistados e que o currículo do curso de Engenharia Ambiental deve ser praticado numa concepção mais humanista, projetando o indivíduo para dentro do seu espaço social de vivência.

Palavras-chave—Água de barreiro, Memórias, Tecnologias Sociais, Currículo.**I. INTRODUCTION**

The purpose of this study was to assess the memories of the residents of the Barrocas quilombola community regarding the access and use of water from the “barreiro” (clay pit), linking them to the social technologies for coping with drought registered in the curriculum of the Environmental Engineering course of IFBA in Vitória da Conquista, Bahia. The “barreiro” (clay pit) in which water is stored on a clay floor, revealed itself as a space of memories, where the “sertanejo” (country people) dispute their resources and is interspersed with their stories. From the calabash to the pot, the memories revived in this paper reveal that long before the use of the first cans in the Barrocas quilombola community, people used calabashes to take water from the “barreiros” (clay pits) the pot has a double representation, as a storage site and purification space.

For the “sertanejo” (country people), the water supply in the non-rainy season is the most critical issue concerning their survival and also the survival of their animals. Besides the difficulty accessibility to this asset in sufficient amount, the families living in the semi-arid region consume it without suitable treatment. The assessment of the Course Conclusion Papers (TCCs) enabled the verification of the relevance of social technologies for living with drought as important contents in the practical curriculum, formal curriculum mixed with the students' experiences, and the manner in which these technologies address the problems of access, treatment, and storage of untreated water.

Social technologies (ST) are produced in the interaction between individuals and are strengthened in the educational process, according to the Institute of Social Technology (2007). The curriculum approach in this study's scenario is explained by the possibility it brings to make up a “history of action within a theory of context” (GOODSON, 1995, p. 72), focusing on aspects related to individuals' life stories and careers. The changes that the relationships between these individuals or groups sustain over time are also the highlight of the curriculum perspective, therefore establishing interconnections between the individual and social frameworks. Memory is not detached from social events, does not emerge from single individuals, it comes up from the framework of a society, from the interaction and the place that the subjects take up in a social group (GOODSON, 1995; HALBWACHS, 2006).

A primary analysis of the TCCs indicated that the prescribed curriculum and the practical curriculum of the

Environmental Engineering course favor more scientific technologies as opposed to social technologies of popular reach. The distance between subjects, those who constitute, reconstitute and apply social technologies, and the ones who use them, besides limiting the professional graduates, also entails in prejudice to the individuals who no longer benefit from the technologies they would produce. With this in mind, the concept of curriculum developed by Marlucy Paraíso is very substantial, “it is an artifact with many dialogue possibilities with life; with various possibilities of lifestyles, of people and their desires [...] even being a disciplinary setting, for excellence, many things can occur in a curriculum” (PARAÍSO, 2009, p. 277). The assessment of the subjects' memories that indirectly participate in the practical curriculum development, residents of the Barrocas community, contribute to the instrumentation of new research, opening space to compose the prescribed curriculum.

The general goal of the present study was to verify in the Barrocas quilombola community and in the curriculum of the Environmental Engineering course of IFBA the reminiscent memories community regarding the access and use of water from the “barreiro” (clay pit). In particular, the goals were: to assess the reminiscences memories of the residents of the Barrocas quilombola community, how this water was obtained and consumed; to verify the existence of records of the implications of clay pit water inappropriate use; to check, in the reminiscences of memory and in the TCCs, the existence of social technologies that validate the access and use of this water.

The fictional work that contributed to this study's reflections was the song *A Quadrada das Águas Perdidas* by the singer-songwriter Elomar Figueira de Mello (1979). According to Arruda (2014), the album with the same name as the song has topics connected to the “sertanejo” (country person) imaginary and a unique imaginary, mainly the idea of the deep ‘sertão’ (outback), “a sertão(outback) beyond the geographical sertão, a place where characters from his stories live, and that is reached through various portals [...] the ‘quadrada das águas perdidas’ is a mysterious lagoon that is located in the “sertão” (outback) of the Rio do Gavião” (ARRUDA, 2014, p.587). Just like the barreiros (clay pits), this mysterious lagoon, while it produces life, closes to this end, it also carries the sense of incompleteness, its waters disappear more than they emerge, its quality is risky and its location seems always uncertain.

II. THEORETICAL FRAMEWORK

In the process of transformation of Arraial da Conquista into the Imperial Vila da Vitória and eventually into the city of Vitória da Conquista, some quilombos were formed, having as their key factors the reunion of runaway slaves from the large properties and from the natural bad weather that affected the region; slaves who inherited land from their masters; slaves who remained on their masters' land; and slaves who settled on untitled land or on "holy grounds" forming new "black lands". (ANUNCIÃO, 2009; OLIVEIRA, 2010).

In accordance with Oliveira (2012), the colonels João Gonçalves da Costa and João Mendes da Cunha donated to Nossa Senhora das Vitórias a vast extension of land, defined in the deed as Arraial da Conquista. Since then, the urban center of this place and a significant part of the surrounding lands became "terras da santa" (holy grounds), property of Nossa Senhora das Vitórias.

The Barrocasquilombola community, settled nearby to the urban center of Vitória da Conquista, had as its key factor of formation the permanence of freed slaves on "black lands. According to Almeida (1989), mocambos, black communities, quilombos, "black lands", among other designations, have the same definition. According to Souza *et al.* (2013), the community is composed by 236 families with a total of approximately 3,300 inhabitants, its residents derive their livelihood from dealing with coffee cultivation, working on surrounding farms, the village around the second decade of the twentieth century was composed of farmers evicted from their own lands.

The submissive reaction to the illegitimate imprisonment of their land by large landowners was a prevailing characteristic of the social identity of this community, also influencing the topology of the village. In accordance with Max Weber (1999), the symbolic content that imprint the identity is determined by who builds it and to whom it is built for and especially in the meaning for those who identify with it or exclude themselves from it. Therefore, Weber defines the ethnic group as [...] "those human groups which [...] nourish a subjective belief in common provenance, so that this becomes substantial for the propagation of communal relations, being indifferent whether or not an actual blood community exists." (WEBER, 1999, p. 270).

The identification, the rescue of the past, and the forms of social relations constituted among the different groups, just as the action of mediators have taken the ethnic groups to engage and reinforce their social and political identity as the primary means to reclaim and/or protect, at least their housing and working lands. The deciding factor of ethnic community action is its

constitution in the condition of political community, corresponding to the strengthening of the belief in ethnic kinship, luring a symbolism of community building connected by blood ties and favoring the emergence of a community awareness and/or the emergence of a feeling of moral duty linked to the group defense (OLIVEIRA, 1998b; WEBER, 1999).

Ethnic social identity is widely followed by the territory category, which is built of material and immaterial spaces that delimit the areas of dwelling, work, cultural and religious manifestations, extraction, common areas, etc (OLIVEIRA, 1998a). According to Hume (2001), memory and identity are closely linked, to him, memory is classified as "[...] the source of identity", "[...] memory not only exposes identity, but also adds to its production, by producing the similarity relation between perceptions. This occurs whether we consider ourselves or others." (HUME, 2001, p. 293-294). According to Silva (2014), memory unfolds identity because, through memories and remembrances, it revives numb ideas, providing a new frame to present impressions. In Arruda, "The memories built about geographical spaces have great influence on the establishment of feelings of identity [...] and in the very process of change of the same geographical spaces" (ARRUDA, 2000, p. 163).

In this setting, the barreiro (clay pit) is displayed as the most significant space of memories that the residents of the Barrocas quilombola community have about the access to drinking water. As the drought is advancing, the easily obtainable sources of supply, the cisterns, and the "cacimbas" dry up, remaining just the more distant sources. The task of coming and going to the barreiro (clay pit), day after day continuously consuming many hours of work, was so distressful that the memories of the people subjected to this routine seem not to be restricted to a distant past. The memory experienced perceptions are withheld in the mind, more accurately in the faculty of memory, and when a sensitive impression is once again displayed to human nature, such memory is revived eliciting the same sensations of the past (SILVA, 2014).

As seen, this small dam built directly on clay to store rainwater is a source of life, suffering, and many memories, its resources are shared by the livestock, the wild animals, and the man. Barreiros (clay pits) are naturally formed when a stream becomes intermittent and pools of water emerge in its bed, or when a lake or a barrage goes through a strong depression shaping small pools. With the increase in the period of drought, the barreiros (clay pits) dry up, leaving only the ones with harder access and invariably more contaminated waters.

As they dry up, more people use and contaminate them, turning them into sources of suffering.

Sensitive to these demands, the curriculum approach, especially the practical curriculum, should be based on a more humanistic approach, relating to the cluster of knowledge experiences that influence the subjects' life trajectory (SILVA, 2007). Paraíso (2010) displays the following contribution: "the curriculum is a cultural artifact that teaches, educates and produces subjects. [...] It is a space habitable and inhabited by people of different social classes, culture, ages, gender, ethnicities, beliefs and values. (PARAÍSO, 2010, p.11-12).

According to Monteiro (2007), the curriculum may also be designed as a "place of memory", in a context that allow us to relate what was lived (spontaneous memories) with what is taught/learned (curriculum knowledge, taught knowledge, learned knowledge), to review the knowledge and understandings that make them proper and particular, full of a knowledge regarding the world and building the ones of everyday use, of memories (MONTEIRO, 2007).

That way, the assessment of the reminiscent memories of the residents of Barrocas quilombola community and the curricular components of the Environmental Engineering course regarding the access and use of the barreiro (clay pit) water enabled a better reading of the experiences had by these subjects. In Paraíso (2010), we have that the curriculum works in the subjects' production, it is part directly of the lives of those who deal with it and is influenced and build by this same subject. A curriculum that will constitute subjects for their ambiance in the context of the semi-arid should propose technologies for their coexistence with the limitations and capacities that the environment offers them, their life stories and their memories need to interfere in their practical instrumentation.

In this identity relation that intersect the individual with his territory, it is realized that the process that has put the semi-arid northeastern region at the margin of structuring public policies, enablers of development, has highly affected the people of this region. In these marginalized environments, not only are the available technologies unsuitable for the poorest subjects, but they have also been left out from access to credit, information, support, technical assistance, and other services that would have helped them use and adjust the most adequate social technologies for coexisting with the drought periods (BAIARDI, 2014; ALTIERI, 2012).

The oral tradition of the Barrocas community is a remarkable expression of its historical perception. In line with Oliveira (2012), the narratives filled with impressions

from the past enable the appreciation, knowledge and preservation of the memory of a group that never had the opportunity to have their records written. "[...] a lived occasion is finite, or to a lesser extent closed in the lived sphere whilst the remembered event is limitless, because it is just a key to all that came before and after. In another sense, it is reminiscence that precisely prescribes the texture mode" (BENJAMIN, 1994, p.37).

III. METHOD

To implement the study, the methodological procedures were guided by qualitative research frameworks. In accordance with Selau (2004), this approach is concerned to comprehend the past by using interviews and orality. As for the procedures incorporated for the investigation of the key issues in this work, indirect documentation and extensive direct observation were applied. The data collection through indirect documentation is the stage of the research that has the purpose of gathering previous information about the field of interest, this is done in two manners, documentary research, or primary sources, and bibliographic research, or secondary sources (MARCONI; LAKATOS, 2007; GIL, 2007).

For the documentary research the subsequent written documents were used: the Pedagogical Project of the Bachelor's Degree Course in Environmental Engineering; the TCCs of former graduates and the graduates of the semester 2017/1, the authors were not defined, since this was not the purpose of the study, in the place of their names letters were used; and the database of the article entitled *O Acesso à Água na Comunidade Barrocas* (SOUZA et al., 2013), this paper's interviews were carried out with the oldest residents of the Barrocas quilombo. Oral sources are instruments applied so that the subjects can express opinions and values, allowing an approximation of the investigated issue (OLIVEIRA, 1998b; NEVES, 2006). The bibliographical research, with the purpose of theoretically support the outcomes obtained in the course of the study, this was made mainly using the classical bibliographical references of the memory conceptual field.

IV. RESULTS AND DISCUSSION

The assessment of the reminiscent memories of older residents assign to the women the responsibility for accessing and providing water besides household chores and childcare. As a general rule, they also helped the men in the farms. Güther and Razzolini (2008), state that the female member is accountable for providing water at

home. Using the fictional work of the singer and composer Elomar, rain and women can be taken as the same being, or one can understand that when the rain arrives the woman will "return" to the land, her house, and to her husband. In effect, rain and women seem to be linked with life and represent synonyms of happiness for the sertanejo (country person) of the lyric at hand (SILVA, 2015).

The residents report observation indicates a quite precarious situation concerning the conditions of access to water, being necessary to travel long distances for the supply. These women occupation was exhausting, because of the distance covered under the warm sun and the weight of the water recipient (SOUZA et al., 2013). "Oh my god! They would stay there... when I worked in a farm not too far, but like this... close, like in Graúna I would take them. I would take everything. I would take water, I took the troughs, because there wasn't any bowl or anything...". (DONA ZULEICA apud SOUZA et al., 2013, p. 208). "It was a "boqueirão" (geographic accident), inside ... down there ... under those bushes ... There was a caatinga that we used to go to and we couldn't find water... it was a caatinga here in boqueirão, we went to get water and didn't have it there... as I didn't have a donkey, I used to carry [water] on my head" (DONA ZUMIRA apud SOUZA et al., 2013, p. 207).

According to Silva (2014), memory holds the perceptions of any given person, expressing the idea of a single person. For Eric Hobsbawm, "in remembering the history of common people, we are not only trying to give it a retrospective political meaning that it has not always had; we are trying more broadly, to explore an unknown dimension of the past." (HOBSBAWM, 1998, p.216).

The narratives of women interviewed indicate that they had to walk great distances for the supply of water, and it was not possible to determine the exact distance, but it was far from the proximities of the village, they used to cross the surrounding farms and went on their path. Once again, the poetic voice sings that, in a very distant place of "*Carantonha mili légua a caminhá / muito mais, inda mais, muito mais*, there was the *Quadrada das águas perdidas* (Quadrada lake of lost waters), "that is, besides Carantonha the enchanted mountain range that represents a key element for the comprehension of the deep sertão in Elomar". (PORTELA, 2015, p. 93).

"Back then the water was very hard... it was distant..." (DONA JOSELITA apud SOUZA et al., 2013, p. 209). "... there at the tomato plant, after the rock down there... sometimes we used to collect water even there in "Ziziu"... I went through really hard situations..." (DONA BIRA apud SOUZA et al., 2013, p. 209). According to Souza et al., (2013), the distance from the source impacts

on the amount available to do all household chores and for personal use, because the greater the distance and time spent, the lower the amount of water collected and the more restrictive is the use. "There wasn't any can, there was nothing, it was in the calabash. It wasn't enough for many things" (DONA JOSELITA apud SOUZA et al., 2013, p. 208). "as I didn't have a donkey, I used to carry [water] on my head" " (DONA ZULEICA apud SOUZA et al., 2013, p. 207).

As a result of this practice, these women were susceptible to the appearance of "chronic diseases such as back pain, because of the effort performed in the collection and manual transport of water, or in improper practices prompted by the lack of access to water in more accessible sources" (GÜTHER & RAZZOLINI, 2008, p.26). Another issue observed in the women speeches concerning the inaccessibility of a closer source was the difficulty to do laundry.

According to the narratives, the clothes were taken in basins, and they were washed at the water source and returned still humid to be dried at their home. "And the women who suffered did the laundry, put the basin on their heads (...) and we would arrive here and feel our backs hurting " (DONA JOSELITA apud SOUZA et al., 2013, p. 208). "The precariousness was such that there wasn't any soap to do the laundry. It was required alternatives to clean the clothes" (SOUZA et al., 2013, p. 208). "We would dry them there because we couldn't handle to bring them wet. We would sit there [under the bush] and leave them there to dry and after we would bring them back here. To do the laundry there wasn't any soap. They washed the clothes with papaya leaves. They would take the milk foam that came out and rub the clothes until they were clean" (DONA JOSELITA apud SOUZA et al., 2013, p. 208). The psychological and physical present of a person, a social group, living beings, and the universe itself carries the mark of the events that came before them, which enable us to make conclusions regarding them (COELHO, 2004).

As it can be seen in the reports of the oldest residents of the Barrocas community, access to water for people's varied consumption was an assignment of women, which cost them a lot, especially during the increased drought, a period when it was required that they went through long walks to reach the "barreiros" (clay pits). The memories through the memories experiences by these women are so important that they become the "source of their identities" (HUME, 2001, p.294). The perception that one has after assessing the interviews is that the narrated facts, even after several decades have passed, are very much alive in the memories of the interviewed women. Silva (2014) states that "past perceptions recalled by the

mind state the same perceptions felt at the present moment" (SILVA, 2014, p.134).

Consistent with the narratives of the Barrocas quilombo residents, as well as the hard access to water in sufficient amount, it was consumed without proper treatment. In periods of harsh drought, the situation would become even more critical because of the increased distance to the nearest water supply sources, which invariably had water of lower acceptable quality for consumption. According to Souza *et al.*, (2013), scarcity increases the risk of transmission of diseases by water, dehydration, as well as compromising personal, household, and food hygiene. Subhuman situations were reported by local residents: "If we were in a drought like this, we would go to the same place where the cows would drink water. When the tanks here dried up, I would go to the São Joaquim olho d'água (water mine) and get it with water cans, and during the afternoons, the women would go there struggling" (DONA BIRA apud SOUZA *et al.*, 2013, p. 208).

The health risks linked with the access and consume of water from a distant and damaged source are very concrete and possible, and are justified only in situations of extreme shortage. "Experience is not the path to a foreseen purpose, to a goal that is known in advance, but an opening to the unknown, to what one can neither anticipate nor predict." (BONDÍA, 2002, p. 28).

It is noticed in the interviews a relationship between the inaccessibility or precariousness of the path to reach the water and the worsening of living conditions for the Barrocas quilombo residents, "[...] adding to this, the terrible working conditions, a result of socioeconomic inequalities, where the worker has to be submitted to everything to earn a minimal wage for their labor, there is a set of causes that contribute to a lower life expectancy" (SOUZA *et al.*, 2013, p.208). "I had 18 children and 13 lived, we only didn't go to the farm when there was a time that said: 'today the woman only doesn't go to the farm, because she has a dead child'... but otherwise..." (DONA JOSELITA apud SOUZA *et al.*, 2013, p. 208).

"I have a cistern, but the water is not very good, it collects a lot of dust in the bowl. This water [which is taken from a surrounding farm] lasts for 15 days and doesn't collect dust. In this cistern after three days there is already dust on the bottom. It's even good water, we drink it, maybe it doesn't offend the person. (DONA JOSELITA apud SOUZA *et al.*, 2013, p. 209). The expression "dust in the bowl" used in Dona Joselita's speech means turbidity, water with solid substances in suspension. In Souza *et al.*, (2013, p.209), "it is interesting the link that the interviewee has related to the presence of solids in the water and the

possibility or not of getting diseases". It is noticed that the only treatment given to the water before its consumption was the remaining of impurities at the bottom of the pot. According to Souza *et al.*,(2013), "physical parameters such as turbidity, odor, taste and color are the most easily noticed by people, allowing a judgment about its quality" (SOUZA *et al.*,2013, p.209). Barreiro (clay pit) water is the last water alternative for the "sertanejo" (country people), which has high turbidity, coming from clay soils, rich in iron, with the presence of organic matter from contamination brought by winds and animal waste (FURTADO, 2017).

In line with Cáritas Brasileira (2001), the consumption of improper water has become a traditional and naturalized practice, even though it has as a direct implication in the increase of several diseases, with high levels of child mortality. That is the reason why in the semiarid region the struggle for this asset is the struggle for life, forming a key issue of citizenship and freedom.

The narratives assessment allows us to verify another situation of vulnerability to which the residents of the Barrocas community were submitted: the reduced amount of water available per person. According to Howard; Bartram (2003), quoting the World Health Organization (WHO), there is no access when the time spent to collect the liquid taking into account that going to and returning from the source only once exceeds 30 minutes and the volume collected is less than 5 liters per person a day. In this situation, the health risks linked with lack of water are very high (HOWARD; BARTRAM, 2003).

The interviews assessments allowed us to observe that the memory of the respondents is the result of their individual experience and the "way by which the internalization of meanings that compose the network of social meanings is processed" (MONTENEGRO, 1993, p. 56). What enable us to deduce that there is an interlacing in the life stories of the Barrocas quilombo residents shown through their memories of how the access to water from the barreiro(clay pit) used to be. Hume says the following: "(...) memory not only reveals identity, but also contributes to its production, by producing the relation of similarity between perceptions. This happens whether we consider ourselves or others." (HUME, 2001, p. 293). The assessment of the respondents' narratives allows us to verify the care that the "sertanejos" (country people) have with water, and elicit their memories, once learning to store water, due to the memories of the suffering caused by its scarcity is a competence of remembering.

According to Portela (2015), the voice of the sertanejo (country person) informs that, on the northern

side of Minas Gerais, on the border of the sertão (outback) of Rio do Gavião, the lightning bolts announced the arrival of rain, "and concludes with the prediction of 'Mucadim a mãe-do-ri as águas já tomô'. In other words, it may happen that soon the first riverbed (mãe-do-ri) will be flooded by the waters." (PORTELA, 2015, p.96-97). It can be concluded that it is the time to take care of the animals and take action with the arrival of the waters.

It was verified through the narratives that most residents of the Barrocas quilombola community had cisterns in their homes, using this as source for domestic consumption. The key restriction of this source was that it dried up too quickly in dry periods. The water from the cisterns had a brackish taste, however, the residents who keep in their memories the recollections of serious privations faced during periods of harsh drought, consider them as valuable. "Mine is from the cistern. We used to go far away, but today, thank God, at least we have water here for all purposes. In the kitchen there are pots, buckets, everything is filled of water. And the water here is good, at least for me (DONA JOSELITA apud SOUZA et al., 2013, p. 209).

In accordance with Souza et al. (2013), it is unquestionable that for all of them the opening of cisterns on their residences has enhanced the quality of life in the community, but sadly the quality of water in the cisterns is very variable, which places restrictions on human consumption. For that matter, it is important to mention to the emancipatory participation of educational and research institutions, developing and extending technologies and services to society, especially to the most vulnerable ones. "It is through a pedagogical process that allows people to become aware of the role of control and power played by institutions and social structures that they can become emancipated or liberated from their power and control (SILVA, 2007, p.54).

The assessment of the database in Souza *et al.*, (2013) enables us to infer a concern regarding the quality of water for humans not being thirsty, having as indicators official resolutions of the National Council on the Environment (CONAMA), the National Agency for Sanitary Surveillance (ANVISA) and the National Water Agency. The microbiological guidelines were not assessed, as for the physicochemical ones, a little more than half of them were higher than the maximum values permitted.

It is pointed out that the social storage technologies used by the residents of the Barrocas quilombo, barreiro (clay pit), cistern and cacimba, like the mysterious Quadrada das Águas Perdidas lagoon, are risky to use. Nevertheless, it can be noticed that in the memories of the women interviewed, the waters of more difficult

access, from distant places, had a better quality, as if the sacrifice to get them made them more adequate. The memories of common people that are not part of the set of dominant memories, "transported to an official program through publications, continue to exist, and their transmission, happens oftentimes through orality" (POLLAK, 1989, p.5).

Concerning the contributions of the TCCs, it was found that of the twenty-two works examined, only five have social technologies with ample possibilities to be used in semi-arid environments. "Filtration as post-treatment of landfill leachate"; "Forest Biomass Ash as a Soil Acidity Corrective and Source of Calcium and Magnesium for Eucalyptus"; "Environmental Education: an important role of the school and family in teaching children"; "Utilization of domestic sludge from the Sewage Treatment Plant (STP) as Organic Fertilizer in the Crambe Culture" and "Study of the efficiency of the natural coagulant *Moringa oleifera* in the water treatment process of Vitória da Conquista - BA". Of these, only the last one display a proper solution for the treatment of drinking water in the Barrocas community.

It can be seen through the undergraduate monographs that students choose to work with more scientific technologies, of greater relevance for publications in journals better classified in the Qualis/Capes. The STs for coexistence with the semi-arid region do not seem to be set as one of the important themes of the curriculum effectively practiced by the students. According to Silva (2007), the curriculum is always an outcome of a selection and selecting is an operation of power. Technical knowledge is not necessarily a neutral merchandise: "This is particularly important since it is becoming increasingly clear that there is an almost total monopolization of technical knowledge and technological intelligence by companies" (APPLE, 1989, p. 63). Tomaz Tadeu da Silva states that "a curriculum pursues precisely to change the people who will 'follow' that curriculum. [...] To each of these 'models' of human being corresponds a type of knowledge, a type of curriculum. (Silva, 2007, p. 15-16).

It is noticed that in the three realities displayed on this paper, the memories of the Barrocas quilombola community residents, the "deep sertão" (outback) of the mysterious lagoon the *Quadrada das águas perdidas*, and the Environmental Engineering curriculum, also designed as a "place of memory" (MONTEIRO, 2007), the memories of the dryness of the drought and the bad weather are left aside and become dormant with the rains.

V. CONCLUSION

It is noticed in the Barrocas quilombola community as in the Gavião river valley, that the memories of access to water occurs in the merge of two “sertões” (outbacks) the geographical and the symbolic one. Just as the mysterious lagoon is active much beyond Carantonha, in the quadradas perdidas (lost quadradas), to arrive in the barreiros (clay pits) it was necessary to “run a stretch of the path” and enter the deep sertão (outback), displayed in the memories of the interviewed women.

In particular, the goals displayed in this study were achieved. Through the reports of elderly women from Barrocas quilombola community, it was possible to access their memories and realize how painful the journey to the barreiros (clay pits) waters was; that the only treatment performed before human consumption was to settle the powder in the bottom of the pot; that doing laundry in the barreiro (clay pit) sacrificed even more of women's life; and, with the increasing drought and the need to search for more distant places, the suffering they went through made this asset even more valuable..

In spite of the precariousness and the subhuman use of water contaminated with waste, in the women speeches, a discrete relation was noticed between the use of this resource and the appearance of diseases. However, what bothered them the most was the brackish taste and the non-decanted impurities. The interviewed women made did not make any reference to social technologies for the purification and disinfection of the barreiro (clay pit) waters, nothing was added to the clay pots that received the liquid for human consumption. Regarding the presence of social technologies in the students' final course works of the Environmental Engineering course, in the scenario assessed, only five have social technologies adaptable to the semi-arid region, and of these only one effectively display a solution for the effective enhancement of the quality of water obtained from barreiros (clay pits). Due to this reality, the statements of the theorists and the discussions showed in the outcomes of this research, it is beneficial that the curriculum of the Environmental Engineering course is practiced with a more humanistic conception, projecting the individual into his or her social living space. Lastly, an important category of analysis perceived in the respondents' memories is that the access to the waters of the barreiros (clay pits) were closed actions, they are present only in their memories.

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Perceptions of a Brazilian Officer about the Argentine Army Air Assault Course

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Received: 14 Dec 2020;

Received in revised form:

05 Feb 2021;

Accepted: 25 Feb 2021;

Available online: 19 Mar 2021

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Keywords— Air Assault. Army. Argentine.
Brazilian.

Abstract— In Argentina, as well as in Brazil, because they are nations of continental dimensions, the military must be able to fight regardless of the region of the country to which they are assigned. It is noteworthy that, in terms of current regionalism, South American Defense Integration is among Brazil's strategic objectives. In this context, in relation to military courses, the purpose of this article is to report impressions about the Air Assault Course, of the Air Assault Regiment 601. By the Argentine Army, there is great prestige and interest in training military personnel in this activity, since only those who complete will be qualified for employment in Air Assault missions. However, more than half of the volunteers (from various Military Organizations in the Argentine Army) did not make adequate prior preparation to meet the physical requirements of the initial tests. As for the course instructions, organization, preparation and employment, it was evident that the methods and techniques taught are very valid and similar to those used by the Brazilian Army, being adequate to the doctrinal aspects of the United States Army. Anyway, this troop must be able to operate in any operational environment, this time it performs training in several areas of the Argentine territory, aiming to specialize its officers and officers. it was evident that the methods and techniques taught are very valid and similar to those used by the Brazilian Army, being adequate to the doctrinal aspects of the United States Army. Anyway, this troop must be able to operate in any operational environment, this time it performs training in several areas of the Argentine territory, aiming to specialize its officers and officers. it was evident that the methods and techniques taught are very valid and similar to those used by the Brazilian Army, being adequate to the doctrinal aspects of the United States Army. Anyway, this troop must be able to operate in any operational environment, this time it performs training in several areas of the Argentine territory, aiming to specialize its officers and officers.

I. INTRODUCTION

Brazilian foreign policy, in the last decades of the twentieth century, strengthened diplomatic relations with Argentina, cooperating for the formation of the Southern

Common Market, formalized through the Treaty of

Asunción in 1991¹.

In 2008, the Brazilian General Sérgio Etchegoyen, at the time Commander of the Army Command and General Staff School, in a presentation made at the International University of Florida (Miami-USA), when addressing military cooperation in South America, stressed that the international relations can generate conflicts or associations (CEE/ ECEME², 2008, p. 91).

Meanwhile, Brazilian foreign policy maintains South American integration as a strategic objective, as noted in the White Paper on National Defense, for the preservation of peace in the region and as a fundamental element of socioeconomic development (BRASIL, 2012, p. 37). Guimarães (2012) mentions that in the South American context, Brazil should “significantly reinforce technical cooperation programs, including in the military area”.

In this sense, as a form of military exchange and cooperation, the Air Assault Course of the Argentine Army receives military personnel from the Brazilian Army, from the 12th Light Infantry Brigade (Aeromobile), as well as the Aeromobile Operations Internship, of the Brazilian Army, receives military personnel of the Argentine Army. About the Brazilian Internship, it is described as follows:

“[...] Aims to expand the professional training of the military in the tactical employment of Army Aviation in joint missions with the Surface Force, enabling them to know the possibilities, limitations and the correct compliance with the safety standards in the employment of Aviation in the Army. During two weeks of intense activities related to the study and planning of aeromobile operations, Flight Safety, Helicopter Landing Zone instructions, Helitransport Operations and airborne infiltrations/ exfiltrations of military personnel from various Military Organizations

of the EB and friendly nations, where they can experience the challenges of the 3rd dimension of the battlefield, enabling them to operate together with Army Aviation in operational activities, recognizing their possibilities and limitations of the air resources employed, in addition to the faithful compliance with safety standards by the helitransported troops.³”

The light troops of the Brazilian Army are identified by the characteristic designation “Leve”. The Brazilian Army has the 12th Light Infantry Brigade (Aeromobile) whose main characteristic is the speed of its organization, adequate equipment and training to carry out missions in the short term and anywhere in the national territory. Its origin dates back to the beginning of the 20th century, in the 5th Strategic Brigade⁴, created by Decree n°. 7,054, of August 6, 1908, with its initial headquarters in the city of Aquidauana, current state of Mato Grosso do Sul. Currently, it is located in Caçapava, in the state of São Paulo.

It is noteworthy that there are materials essential to the life of the military on campaign, among them the burden of combat, in which items are carried out for the fulfillment of a certain mission, as well as that can provide relative comfort to the combatant.

For this purpose, the individual equipment of the combatant must be prepared according to the operational situation of tactical employment, which can vary between a field or assault bag. The planning requires observation of the cargo transport capacity of each aircraft, characterizing a relevant logistical limitation of the Helicopter Force.

In a military air assault operation, the light infantry troops are able to carry out missions with their organic means, equipment and combat burden, for up to forty-eight hours after the interruption of the logistical flow, hampered by the depth and interposition of Enemy Forces.

From the above, an analysis of the materials contained in this combat burden is necessary, providing a

¹ Available at: <https://www.mercosur.int/pt-br/documento/tratado-asuncion-constitucion-mercado-comun/>. Accessed on: December 18, 2020.

² Center for Strategic Studies of the Army Command and Staff School.

³ Available at: <http://www.ciavex.eb.mil.br/index.php/component/content/article?id=93>. Accessed on: December 4, 2020.

⁴ Available at: <http://www.bdaamv.eb.mil.br/index.php/historico-menu>. Accessed on: December 4, 2020.

clearer and standardized guidance as to the preparation of the materials to be conducted by the military in campaign activities, with the purpose of providing a maximum return on operations.

In Aeromobile Operations, the helicopter force or Aeromobile Force, of Unit or Subunit value, fulfills combat missions, combat support and logistical support. The Aeromobile Assault is the combat mission, carried out in Aeromobile Operations, in which an Aeromobile Task Force, under the command of the Surface Force (segment of the Ground Force for which the Army Aviation is acting to advantage), deploys trained and equipped troops, aiming at the conquest and maintenance of regions of the terrain and the participation in the destruction of enemy forces.

“In the Doctrine of the Brazilian Army, an aeromobile assault is a large-scale operation, carried out by an aeromobile task force (surface force and helicopter force). It does not involve transporting only the marine companies, but also the entire apparatus so that the operation can extend for up to 48 hours. This includes artillery, engineering, cavalry (for reconnaissance).”⁵

As in the Brazilian Army, in the Argentine Army, all Infantry units must be prepared to act integrated with the Army's Aviation assets, and may constitute an Aeromobile Task Force. However, the Light Infantry and Parachutist Infantry troops are the most capable to carry out the Aeromobile Assault, as they have specific instruction and tactical skills.

Whatever the operations or the combat, they need not only physical and psychological preparations, but also concern with the conditions of the material, collective or individual, that will be used.

The Argentine troop characteristic of Light Infantry is the Air Assault Regiment 601. It is important to note that the doctrine used by the Argentine Army is based on the techniques and tactics employed by the United States of America, in the 101st Air Assault Division.

“The aeromobile assault troops are light infantry troops with additional training in abseiling and transport by aircraft, in an aerial insertion

called vertical wrapping. The equipment is modified to facilitate transport, since helicopters have much greater load restrictions than paratroopers and aircraft. While paratroopers are prepared to sustain an action for 72 hours, air force troops sustain combat for only 48 hours. Helicopter support can be intense and includes close air support, reconnaissance, medical evacuation and resupply, as well as transportation. The troops of the 101st Aeromobile Division are trained in rappelling and fast rope. The USMC, on the other hand, only disembarks from the helicopter.”⁶

In this tuning fork, the versatility and unique strength of the Air Assault Task Force is obtained by combining the capacity of the modern rotary-wing aircraft (fast, agile and with firepower) with the Infantry and other combat weapons. To this end, the Air Assault Regiment 601's mission is to carry out Air Assault operations homogeneously integrated with Army Aviation, articulating a quick and flexible response in a crisis or armed conflict.

Basically, the Argentine Army operates with BELL UH-1H aircraft, from the Battalion de Assault 601 Helicopters, with a capacity for eight military personnel, in addition to three crew members, totaling an internal payload capacity of approximately 1000 kg. UH-1⁷s are always remembered as a symbol of the Vietnam War and really participated in the main battles during the conflict. It is worth mentioning that the greater the cargo carried, the smaller the height the aircraft will fly to seek its best use, that is, the greater flight autonomy, which on average is up to 2.5 hours.

“It generally operates in a coordinated manner with the unit responsible for its mobility: the Battalion of Assault Helicopters 601. In 2010 it counted on a battalion

⁵ Available at: <http://sistemasdearmas.com.br/ter/teamv.html>. Accessed on: December 4, 2020.

⁶ Available at: <http://sistemasdearmas.com.br/ter/teamv.html>. Accessed on: December 4, 2020.

⁷ Available at: <http://sistemasdearmas.com.br/ter/teamv.html>. Accessed on: December 4, 2020.

of 500 troops. The members of this unit use a color beret with the emblem of the airborne troops. It is organized in the Assault Companies A, B and C, but a Command and Services Company.⁸

Under the coordination of School of Airborne Troops and Special Operations, the Regiment conducts the Air Assault Course.

The Argentine Army Air Assault Course

The first helicopter to be used in armed conflicts was the *Flettner Fl 282 Kolibri*. It was used in reconnaissance and observation operations by the German army during World War II⁹.

In 2016, from June 1 to June 30, during the harsh Argentine winter, in Campo de Mayo, a region where Military Organizations are centralized in the Province of Buenos Aires, 94 military personnel started their activities with physical tests, of an eliminatory character, remaining 48¹⁰ students for admission (from the Brazilian Army: 01 Captain and 01 Sergeant; and from the Argentine Army: 08 Lieutenants, 20 Sergeants and 18 Soldiers).

The aforementioned test of entry to the Course consisted of a flexion test on the bar, upper arm, abdominal, climbing on the rope and a 50-meter run, with indexes by age categories, with a 3200-meter run at the end performed by all participants. postulants.

Below, succinct observations on aspects related to the course and the course of activities will be presented, as well as materials used, evaluations, among others, exclusive fruits of the practice experienced by Brazilian military personnel in 2016.

Air Assault Combat (1st phase)

In the first week, instructions were given on airborne operations and aerial assault combat. There were instructions in the Aviation of the Argentine Army, in which fixed-wing aircraft (as a support) and rotary aircraft

(being a dedicated Battalion for the Air Assault Regiment 601) are used. Also, there was instruction from the Fast Hope technique, whose form of execution is different from that employed by the Brazilian Army.

One of the evaluations consisted of a 10 km march, for up to 1h30min with a 12 kg backpack (helmet, equipment and rifle with 5 chargers), which was successfully completed by all students. Still in the morning, after the march, the other assessment was theoretical, with 60 minutes of execution. In addition, in the afternoon, the practical tests took place.

Preparation of external loads (2nd phase)

Learning activities for the preparation of External Loads began. Still, there was the flight of adaptation, embarkation and disembarkation of aircraft, by means of UH-1H helicopters, with day and night training, with and without the use of night vision goggles. Also, instructions were given on aircraft marking, use of international signs in case of emergencies, setting up a small space and requesting health support in case of medical emergencies.

A practical load preparation test was carried out in the morning, in the (individual) load preparation control system, with 3 workshops, of 3 minutes each, in which the task was to identify 5 errors in the preparations, as follows:

1- Lohr vehicle (with 120 mm mortar) - Poorly anchored seat or steering wheel, 120 mm mortar badly anchored, sling N°. 9 in place of N°. 20, lack of tailing tape, missing tape on the lanterns, an empty tire, slings crossed, "M" type connector wrongly clicked or inverted, N°. 20 slings crossed in connection with N°. 3 sling and wrong place of placement in the vehicle's Chassis (20 sling).

2- *Chingullo* (armed with students' backpacks) - load poorly distributed, set of moorings badly fixed, ends badly placed in sling N°. 3, type M connector badly fixed, without 1 link or badly positioned, sling N°. 9 in place of the sling of N°. 3, cargo open or poorly prepared and without tie-off tape at the mooring.

3- Container A22 (armed with 4 barrels) - sling N°. 3 with M type connector poorly clicked/ positioned/ missing link, *Clevi Chico* thread not closed, *Clevi Grande* instead of *Clevi Chico*, Cables with the order of inverted placement, no facing outwards or crossed, inverted or missing tie set, ends not finished with adhesive tape, missing corner tie cords, poorly centered load, the 2 side and top corner brakes crossed or not firm, poorly placed metal hook (fixed with fixed - mobile with mobile), parts of the A22 crossed, untied centers, pallet or flat surface under the frame is missing. Later, in the afternoon, the

⁸ Available at:

https://es.wikipedia.org/wiki/Regimiento_de_Asalto_A%C3%A9reo_601. Accessed on: December 4, 2020.

⁹ Available at:

http://www.cdoutex.eb.mil.br/vocesabia/voce_sabia_40.html. Accessed on: December 4, 2020.

¹⁰ The minimum entry rates were reduced, as initially only 21 military personnel were successful in the stipulated physical requirements, in accordance with the provisions of the distributed Directive.

theoretical test took place, with 25 questions to be executed in up to 90 min.

At the end of the week, the 15 km march test took place. The forecast, according to the Directive, was 2h15min. However, the previous day they confirmed the change to 2h.

Special techniques (3rd phase)

In this phase, initially, there were knot instructions and moorings. Night cargo preparations were carried out, using night vision goggles, in the internal area of the Air Assault Regiment 601. There were also theoretical instructions on the execution of an Air Assault operation, based on the necessary planning.

In addition, the instructors demonstrated the execution of Abseiling do *Patin* with a war dog, Australian and inverted mode. The students, on the other hand, performed the Rappelling technique with combat burden, open and armament, at the different levels of the Tower. During the night period, the practice occurred with glasses with appropriate vision.

The Practical Test, referring to the Third Phase of the Course, consisted of 4 workshops:

- 1- Proof of us and theoretical questions;
- 2- Execution of the improvised seat (Swiss) in 90 seconds;
- 3- Rappelling from Plano 90 (Tower); and
- 4- Abseiling do *Patin* (Tower).

After the tests and training activities, there were practices with the use of helicopters.

To finish the stage, there was a 20 km march, for up to 3 hours of execution, with a 12 kg backpack (heavy at the end), open bale, rifle and helmet. In addition, the

Order of Operations was issued on the exercise in the field next week.

Final operation (4th phase)

In La Plata, in the Arana and Magdalena region, the course closing operation took place, despite the possibility of cancellation due to bad weather.

The Operation consisted of air displacement and Assault in enemy territory against actual Platoon value, figured by metal targets in the Shooting Range for tanks. There were also shots from machine guns and attack helicopters.

After the standardization of safety standards, orders were issued by subordinate levels, collective tests and divisions of aircraft boarding spaces were carried out. For overnight stay in a bivouac. The platoon of exploration (equivalent to the platoon for the recognition of Brazilian doctrine) infiltrated aircraft in enemy territory, by abseiling, in order to raise and pass on information from enemies.

External cargo (Lohr vehicle) was transported with Super Puma aircraft (Cougar) for training purposes.

The exercise lasted five days, through continued military operations, from planning to executing the real assault shot. At the end, the Commander of the Rapid Deployment Force approached that this is the newest course of the Argentine Army, and must be constantly improved. Finally, he confirmed that the troop should improve in terms of use and accuracy of the shot on the occasion of the assault, constituted fraction level (platoon and company).

Mosaic: Photos of the activities taken, Buenos Aires, 2016.*Source: the Author*

II. OBSERVED BEST PRACTICES

a. Each phase of the course was closed after a theoretical test, of an eliminatory character, on the subjects seen throughout the week.

b. The instructors and monitors had a great technical capacity and were committed to the transmission of knowledge during the activities.

c. Military physical training, conducted by a physical education teacher from the Argentine Army, suitable for the course, respected the individual limitations and the preparation / recovery for the marches tests.

d. The supply of clothes for cold and rain (like pants and Goretex jacket, in addition to second skin),

subject to caution. The average temperature was below 10 degrees Celsius, sometimes with continuous wind and rainy days.

e. The countless training opportunities in the 15-meter tower, with open bale and rifle, for practical improvement of the various aircraft landing techniques.

f. Prior to the start of activities at the Tower, three inspections were carried out, with different military personnel, to certify the safety items provided for each student.

g. Use of false aircraft, UH-1H, discharged for use only in instructional activities, located in the inner area of the barracks.

h. During the Course there were about 40 flight hours for practical activities and operational training missions.

Others aspects of the Course

a. The Air Assault activity requires the use of manuals in order to standardize and level the procedures.

b. The Argentine Army has a project to change the technique of Fast Hope. Its execution will start to be as taught in Brazil, however they depend on it being approved by the Argentine Army Command. Until this occurs, they will continue to teach the method of "crushing" the rope to end braking.

c. For the Fast Hope test, an aircraft of the Argentine Air Force was used, as it has adequate adaptation to the use of the rope in the "descent".

d. It is advisable to use tarpaulins, blankets or other type of protection for the rope used in the Tower, as the friction of the ropes tends to wear the material.

e. For the Abseiling night, by *Patin* da Torre, it would be appropriate for students to use helmets, which would require adaptation to fit the night vision goggles.

f. The Argentine Army instructs the making of the Swiss seat, for descents, in a slightly different way than what is taught by the Brazilian Army (American seat). It is evident that it loses security and durability, as it quickly needs to be readjusted to give firmness to the body.

III. GENERAL ASSESSMENT

a. The treatment given by all military personnel in the Regiment was very friendly and cordial. With the students, the subjects in the conversation circles, mostly, were about football or comparison between the Armed Forces of Latin America. Sometimes the military talked about the Malvinas disputes. On April 25, 1982, the British recovered South Georgia (Malvinas) from the Argentines. Preceded by a consistent naval fire, they carried out an aeromobile assault with 120 marines, who quickly dominated the Argentine garrison of a few dozen men. This conflict was referenced in graduations and in military songs during the races and displacements inside the Regiment, daily.

b. Military personnel applying for the course must be physically well prepared. For the collective development of attributes of the affective area, such as the body spirit of the group, there were races in the form of torus (trunks of the trunk type) conducted by rotating the number of students.

c. The officers (instructors) are responsible for coordinating the rotation of the instructions, setting up and correcting the evaluations. Sometimes they give some theoretical instruction at the beginning of each Phase. In practice, instructions are conducted by the Squares (subinstructors, which in Brazil would be the same as monitors).

d. The Argentine Army does not use the single cable (10 mm rope), but the ringing cables (rope of up to 8 mm) for making improvised seats for descending with ropes. This thinner rope contributes to, after the practices of descents, causing greater pain in the lumbar and pelvic region, where all the weight of the body (and the equipment when necessary) is concentrated.

e. A relevant difference in employment in relation to EB is that the Air Assault troops themselves are able to prepare and hook the external cargo for transportation in rotary wing aircraft. As for the Brazilian Army, this task is destined for Army Aviation.

f. *Patin's* technique of descent differs from that used by the Brazilian Army. The Argentine Army does not carry out the technique known in Brazil as "bat", tending to pendulate excessively and to extend the rope abruptly in each *Patin* approach.

g. Regarding the compositions of the kits, it is worth mentioning that the experiences presented here were collected in practice. With that, a brief assembly suggestion follows:

1) First Aid Kit: crepe bandage, gauze (10 units), alcohol (50 ml), tape (1 roll), surgical gloves (1 unit), syringe with needle, injectable painkiller, iodized alcohol (10ml), antipyretic (10 units), analgesic (10 units), 0.9% glucose serum (500 ml) and *gelco*¹¹ (16, 17 or 18);

2) Health Kit: hydrogen peroxide (30 ml), ready dressings, oral rehydration, tweezers, ointment for diaper rash and cocoa butter;

3) Armament Maintenance Kit and Combat Knife: oil (50 ml), string, cloths or flannels, whetstone, cleaning brush and tactical handkerchief;

4) Boot Maintenance Kit: black grease (1 unit), grease brush, cleaning brush and cloths or flannels;

5) Survival Kit: pliers, electrical tape, fishing line, lighter, water purifier, salt (small pot), pocket knife, mirror for ground-plane signaling, sinker (3 units), steel sponge, hooks (3 units), coconut soap, candle (2 units), small alkaline battery (2 units) and large BA-30 battery (2 units);

¹¹ *Gelco*: material for administration of serum.

6) Sewing Kit: needles, olive green and black threads and buttons;

7) Personal Hygiene Kit: wipes or cloth with alcohol, toothpaste, toothbrush, comb, soap, towel (carried in the backpack), cream, shaver, brush, dental floss, small mirror and toilet paper (carried in the backpack);

8) Annotation Kit: pencil, eraser, ballpoint pen (blue or black), mementos¹², compass, squares, ruler, scale, 360° protractor, calculator, paper pad, plastic pad, retro pen (2 colors), clipboard (carried in the backpack), alcohol and cloth; and

9) Operations Kit: checkered powder (blue, green and red), symbology (PRPO, ASS, OBJ), miniatures (constructions, armor, soldiers, boats) and chalk (3 colors).

10) With regard to First Aid Kits and Dressings: they must present an easily visible label containing an index with the dosage, use and validity of each item contained in the respective kit.

IV. FINAL CONSIDERATIONS

Easy and pleasant to read, this pioneering article described the Argentine Army's Air Assault Operational Course, carried out by Brazilian military students in 2016, being an officer and 01 sergeant concluding.

It is noteworthy that the Regiment's local structure for practical instructions is very good. In comparison to the Brazilian Army, it is observed that the Argentine Army employs an Assault Bag or Assault Bag for Air Assault Operations, seeking as much as possible to reduce the weight carried by the aircraft. In this way, it allows the best use of your travel autonomy.

In summary, the methods and techniques taught by the Argentine Army remain current and valid, with few differences from the Brazilian Army.

It appears that the campaign backpack, whose transported material stands out below, is moved by another land-based means or by the “chinguillo” (high-strength nylon net) with a transport capacity of up to 5000 kg, as an external load from the aircraft. Despite the aforementioned capacity, the “chinguillo” is used in the BELL UH-1H for useful transport of 900 kg, about 50 ready campaign backpacks.

Table 1- Composition of the Combat Burden

Material conducted by the Argentine Army	Material conducted by the Brazilian Army
PANTALON / FIGHTING SWEATSHIRT (EXTRA)	All the material exposed in the previous column (conducted by the Argentine Army) and the following kits:
FIGHTING BOOTS (EXTRA)	
PONCHO	
LIGHT BLANKET	
SINGLE CABLE (SLING)	<i>sewing kit (sew)</i>
ALM COMPLETE BREASTFEEDING	<i>First aid kit</i>
THERMAL INSULATION (THERMAL AISLAMIENTO)	<i>note-taking kit (scriptures)</i> <i>survival kit</i>
SLEEPING BAG	<i>personal hygiene kit</i>
COLCHÓN DE CAMPAÑA	<i>maintenance kits</i>
RATION/ FOOD	<i>camouflage kit</i>
SCHOOLBAG	<i>health kit</i>
MISCELLANEOUS MATERIALS	<i>operations kit</i>

Source: the Author

It is verified, due to the limitation of material transport in the aircraft, that the Argentine Army doctrinally does not train its troops with the use of kits, as in the Brazilian Army. In their assault rucksacks, only means for immediate use are carried, such as: ammunition, rations and materials to perform specific special tasks, when applicable. In the field backpack, displaced by another means of transport, the responsibility of which is the responsibility of the Logistics Officer, the rest of the bales and personal materials follow.

Therefore, ammunition, operational feed, water, collective and individual weaponry are not objects of this study, however they are also of great relevance and their transport must be considered together with the materials to be presented, and the ammunition must be always within easy reach.

It is concluded that the use of campaign kits favors greater organization and practicality, in addition to waterproofing and protection of the material. In spite of the backpack becoming more bulky, it must be adequate to the tactical planning, as well as to the technical limitation of the cargo transport capacity, internal or external, of the aircraft to be employed.

Finally, the experience lived with the members of the Argentine Military Organization was quite valid,

¹² Miscellaneous elements: private military notes with brief reminders or manual data.

mainly because it is a unique Argentine Army Troop, confirming that it is very similar to the spirit of the Brazilian Army's Light Aeromobile Brigade.

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Health and Science in pandemic times: Narrative review

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Received: 03 Dec 2020;

Received in revised form:

03 Feb 2021;

Accepted: 27 Feb 2021;

Available online: 22 Mar 2021

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Keywords— COVID-19. Health. Science.

Abstract— Objective: This study aimed to describe the aspects related to health and science during the pandemic caused by Sars-Cov-2. Method: It is a narrative review through the search for articles in the scientific databases, published from January 2020 to January 2021. For the treatment of the data, the technique of content analysis with categorization of the findings was used four complete original articles were selected that answer the central question of the research and organized according to the content of their evidence, distributed in five categories. Results: The analysis of the literature highlights important points such as the negative impact of false news on science, interdisciplinarity and its benefits on science and public health, the funding of Science to combat Sars-Cov-2, the safety of scientists in research during the pandemic and vaccine hesitancy. Discussion: It was found that in view of the crisis generated by Covid-19, it was clear to various sectors of society that only science is capable of finding a solution and shows itself as a hope for all humanity, since she is the only one able to find a vaccine and treatment for the New Coronavirus. Conclusion: Furthermore, it is concluded that scientists will certainly generate the necessary knowledge to face the COVID-19 pandemic, as well

as subsidize public policies that will organize health care, reduce inequities and enable comprehensive care to patients.

I. INTRODUCTION

The pandemic caused by the SARS-CoV-2 respiratory virus (COVID-19) has become one of the biggest challenges of the 21st century. Its impacts are still priceless and directly and/or indirectly affect the health and economy of the world population. Worldwide, more than 107 million cases and 2.3 million deaths were reported by February 2021 and it is estimated that an even greater number will be recorded in subsequent months due to the recent discovery of new variant strains of the New Coronavirus. The growing number of cases and deaths has shown itself exponentially and the crisis has worsened in several countries, mainly in developing countries. [1]

Due to the delay in vaccination, the only way to slow the spread of the disease is through precautions. In view of the little scientific knowledge about COVID-19, the high capacity to spread the virus and cause deaths and the doubt about the best strategy to control the pandemic, the use of non-pharmacological containment measures, such as hygiene and hand washing, wearing masks, social distance and isolation of suspected cases.[1]

The strategy of keeping the largest number of people at home helped save lives, gave scientists more time to seek treatments and develop vaccines and for public health authorities and the health system to plan logistics, test and treat patients. This contributed to the flattening of the contagion curve. [1]

In Brazil, through this current scenario, elementary concepts such as Science, University and Unified Health System (SUS) stand out, which undergo a process of resistance and resilience in times of pandemic.[2]

As for Science, with regard to resilience, even with the progressive reduction of investments in science and technology in Brazil, scientists are still involved in research on vaccines, drugs, tests, epidemiological studies, evaluation of health inequalities, among others. Regarding resistance, there is a denial that vaccines can be effective.[2]

Not long ago, in an act of resistance, universities protested against a budgetary blockade that made its operation unfeasible and continued firmly, in an act of resilience, to produce new knowledge about COVID-19 on a daily basis.[2]

As underfunded and defamed as Science and Universities, SUS is preventing the tragedy from becoming even greater. In an act of resistance, the system has managed to provide assistance to all Brazilians with

COVID-19 who depend on it and, with resilience, welcomes people, especially because it is composed of resistant and resilient health professionals, who place collective health above difficulties and continue to provide assistance to Brazilians who need it. [2]

One of the critical nodes when it comes to science is vaccine hesitation. The World Health Organization (WHO) has defined this behavior as being influenced by a number of factors, including issues of trust (not trusting the vaccine or the supplier), complacency (does not realize the need for a vaccine, does not value the vaccine) and convenience (access). [3]

Individuals hesitant about vaccination are a heterogeneous group that maintain varying degrees of indecision about specific vaccines or vaccination in general. They may accept all vaccines, but remain concerned about possible adverse reactions, some may refuse or delay some vaccines, but they accept others, and some individuals may refuse all vaccines. [3]

The present study aimed to describe the aspects related to health and science during the pandemic caused by Sars-Cov-2 through a narrative review.

II. METHOD

The research is a narrative review, whose guiding question consisted of: What are the scientific productions available on aspects related to health and science during the pandemic caused by Sars-Cov-2?

The survey of bibliographic studies took place during February 2021, in which articles published in national and international journals, published in Portuguese and English, were available for free, in full, in electronic format in the Virtual Health Library databases (VHL), Scientific Electronic Library Online (SCIELO), PubMed and Google Scholar.

Then, the descriptors validated in the DeCS / MeSH were used: "COVID-19"; "Health" and "Science", using the Boolean operators AND, published between January 2020 and January 2021.

For data treatment, the content analysis technique was used with categorization of the findings and the articles were identified by the acronyms SC 01 to 04, for better organization of the findings.

III. RESULTS

In the present narrative review, 04 (four) original scientific articles were selected that strictly met the selection of the sample previously established and showed approximations with the object of this study. The findings were organized into 05 categories that address: 1) The negative impact of false reports on science; 2) Interdisciplinarity and its benefits in science and public health; 3) Financing of Science in the fight against Sars-Cov-2; 4) Security of scientists in research during the pandemic; and 5) Vaccine hesitancy.

As for the profile of publications, it was observed that articles in English (75%), bibliographic review (100%), published in international journals (75%) and indexed in the Pubmed database (75%) predominate.

The negative impact of false reports on science

Article SC 01 provides evidence about people's susceptibility to believe in false news that is disseminated and this can be attributed to the lack of scientific knowledge and other aspects such as ideologies and disinformation.[4]

Researchers reinforce that it is necessary to seek information from secure sources and be aware of what is up in society, since many false news are disseminated on purpose.[4]

There are several proposals to tackle false news and some are in the technological and educational field, with an increase in information literacy, the use of safe sources and the construction of tools to help combat disinformation being recommended.[4]

The dissemination of correct information can occur in several spaces, including through Digital Technologies of Information and Communication (TDIC). TDIC are a set of technological bases, such as computers, internet and social media, which facilitate communication between people and enable the exchange of knowledge and help to promote learning.[4]

Scientific dissemination is characterized as an activity that aims to bring scientific knowledge to the non-specialized public, and it is necessary to use resources to make the language understandable and attractive, in addition to carrying out interventions so that the knowledge reaches people in informal spaces or through different digital technologies, such as the internet and radio.[4]

Thus, scientific dissemination can also be carried out through extension actions, one of its pillars being the promotion of scientific knowledge, which benefits both the university and society, since there is the transmission of knowledge produced in universities to the population and

this process contributes to the professional training of university students, who start to experience and practice what was learned in a theoretical way in the classroom, being a pleasant and multidisciplinary way of teaching.[4]

In addition, when carrying out extension actions, the university performs its social commitment and gains credibility by contributing to the improvement of people's quality of life, but for this to happen it is necessary to plan and develop activities that really favor contact with society to gain support from her.[4]

World society is experiencing a delicate and atypical moment, where education is being reinvented in the face of available technological means. Despite the difficulties faced, it is possible to keep an educational process running and, for this reason, there is an increasingly intensified use of vehicles such as radio and social networks, which have been shown to be effective in the process of disseminating knowledge.[4]

The topics discussed within the University must not be restricted to the academic environment only, on the contrary, they must be disseminated to the community in an objective and clear way so that the population understands that science is present in our daily lives. Performing scientific dissemination through an accessible language consists of demystifying and popularizing content that is sometimes considered difficult to understand, precisely because of the methodology and terms used.[4]

Thus, it is possible to reinvent the strategies for building knowledge and social distancing has shown that the means previously used were not as explored, as they are being at the moment. The educator is reviewing his strategies and technology is making an essential contribution to a wider reach of information.[4]

Interdisciplinarity and its benefits in science and public health

Article SC 02 highlights that during the pandemic period, many scientists from around the world have conducted projects related to public health because it is an appropriate and timely discipline for carrying out interdisciplinary studies. Actions to improve public health care require new approaches, including the involvement of complementary disciplines.[5]

Many disciplines such as medicine and pharmacy, molecular and cellular biology, microbiology, biochemistry, genetics, immunology, pharmacology, nutrition, psychology, epidemiology, economics, social sciences, communication, political sciences, health services, nursing care, physics and chemistry, geography, statistics, computational science for big data management,

among others, encompass research perspectives that lead to the observation, analysis, understanding and interpretation of health in view of COVID-19.[5]

The importance of interdisciplinary research in the last three decades has witnessed an increasing tendency for collaborations between researchers from diverse backgrounds of training and education in all regions of the world.[5]

The literature on the theoretical scope and benefits of such collaboration is extensive. Although it is essential to carry out more research through a multidisciplinary approach to establish practical methods to be used on a large scale for treatment and disinfection to inactivate SARS-CoV-2 in different environmental settings, in order to reduce the risk of infection.[5]

Unlike multidisciplinary research, where researchers from different fields work separately or in collaboration, interdisciplinary research refers to teams with varied specialties to unify knowledge and achieve a general objective.[5]

In this context, Rosenfield[6] introduced a three-tier structure to conceptualize the collaboration mechanism between different disciplines: (i) in multidisciplinary, researchers work in parallel or sequentially from a specific basic discipline to solve a common problem; (ii) in Interdisciplinarity, researchers work together, but still on a specific disciplinary basis to address the common problem; (iii) finally, in transdisciplinarity, researchers work together, using a conceptual framework design shared in specific disciplinary theories, concepts and approaches to solve a common problem. These concepts have been used in practice nowadays, since the efforts of the most diverse sectors have been added in tackling the pandemic.[5]

An example of transdisciplinary science relevant to the COVID-19 problem is the integrative science of microbiology, molecular pathology (including immunology and epidemiology, which synthesized results from analytical microbiology methods, including virology) at the laboratory level, along with staff statistics epidemiological analysis, with data from different population groups.[5]

However, there are difficulties in contact or communication within the professions, in addition to lack of confidence, lack of experience, health complexities, lack of organization and standardization, can become a major obstacle to successful communication.[5]

COVID-19 is a medical problem with immense social consequences and scientists around the world need to come together to find the right solutions to control this

pandemic event, manage its consequences and prevent future recurrences of similar pandemics.[5]

The scientific community expects health workers to use the most up-to-date scientific evidence in their clinical practice and be better prepared for emerging epidemics, articulating joint interdisciplinary actions and engaging with the community of educators and mobilizers, thus contributing to the surveillance of systems in order to fill the gaps in health care and assistance.[5]

During the pandemic, while political leaders blocked their countries' borders, we saw scientists tearing down walls and creating global collaboration unlike any other in history. Never before have so many experts in so many countries been simultaneously focused on a single topic, with such urgency and determination.[5]

The role and collaboration of International Health-Related Organizations, such as the World Health Organization (WHO), Food and Agriculture Organization (FAO), International Nutrition Science Union (IUNS) and Non-Governmental Organizations (NGOs), as well as consortia international organizations such as the Universal Scientific Research and Education Network (USERN) and national and international academies, were recognized as crucial for an integrated knowledge of the new coronavirus and impacting on the effective management of COVID-19 worldwide. [5]

Article SC 03 corroborates and points out that although virologists are the most suitable professionals to work in the manipulation of the SARS – CoV-2 virus, this is also the ideal time to develop integrated research among immunologists, computer scientists, modeling and intelligence specialists, artificial, chemists, drug developers, engineers, clinical investigators of infectious diseases and intensivists, among other disciplines. [7]

Financing of Science in the fight against Sars-Cov-2

Article SC 03 addresses how the efforts of the scientific community can be mobilized for research related to COVID-19. In the midst of the health crisis, mass testing of the affected population becomes essential to really determine the impact of the disease.[7]

In order to gather basic biometric data, an organization must quickly organize and execute clinical research with personnel trained in the correct approach and have the infrastructure to carry out high quality research, in order to be deployed in hours or days through platforms that can be mobilized. quickly.[7]

Investments in major research have been carried out, for example, the renowned New Jersey Alliance for Clinical and Translational Science (Rutgers CTSA Hub), which obtained regulatory approval and recruitment started

in 12 days for a prospective and longitudinal study in health professionals exposed to SARS –CoV-2 in 750 participants.[7]

This study will quickly provide data on incidence and prevalence in this public that is considered vulnerable because it is on the front lines of fighting the virus.[7]

Research funding in the United States (USA) provides up to 2024 \$ 8.3 billion, of which \$ 836 million goes to the National Institutes of Health (NIH), \$ 61 million to the Food and Drug Administration (FDA), \$ 950 millions for the Centers for Disease Control and Prevention (CDC) and \$ 2 billion for the Biomedical Authority for Advanced Research and Development (BARDA).[7]

The investment model adopted in the USA has undoubtedly helped in the performance of the quality and impact of research at the time of crisis, with regard to clinical research, generation of protocols and regulatory efforts, which should take place quickly. [7]

Safety of scientists in research during the pandemic

Article SC 03 reflects on how scientists working in research during the pandemic can be safe and productive. He points out that the researchers suffer great frustrations because they feel unproductive and unable to potentially advance in the discoveries due to confinement at home and reduced activities.[7]

However, strategies were adopted to reduce these impacts, such as the establishment of effective communication through various types of videoconferencing, although it does not entirely replace the benefits of face-to-face meetings. Clinical research that does not involve contact with the patient can be maintained remotely, as can many meetings with patients. [7]

Vaccine hesitancy

Article SC 04 makes an assessment of the factors involved in vaccination hesitation and points out that the low acceptance occurs due to: Ethnicity (black / African); Work situation (unemployed); Personal belief (participants with a personal conviction against vaccines) those who have received vaccines (especially influenza) in the past have had greater acceptance; Religiosity was negatively correlated with the vaccination COVID-19; Politics (respondents who declared Democratic political partisanship were less likely to choose and receive vaccination. Those who felt close to radical parties or those who did not vote / felt close to any party were significantly more likely to refuse the vaccine. Who voted for extreme left or extreme right candidate in the last elections were more likely to refuse vaccination. It was observed that political ideology had no relation to the

attitude towards vaccination; Gender (women had less acceptance); Education (participants with low schooling); Age (low age was associated with a lower willingness to receive vaccination); Income (participants with lower income). COVID-19 infection (no difference observed between those who were infected and those who were not); Concern with COVID-19 (those who were very concerned about being infected were less likely to refuse to vaccinate); I work in healthcare settings (healthcare professionals had a higher acceptance).[3]

In this review, there was a high general hesitation of the vaccine in relation to the COVID-19 vaccine, with prevalences varying from 8% to 15% in the world. This phenomenon represents an important problem, because the increase in hesitation leads to falls in coverage and often precedes an outbreak of infectious disease.[3]

Health professionals should be involved in educating people about the importance and benefits of the vaccine. However, although researchers have begun to develop and evaluate interventions for people who hesitate to vaccinate, current data does not support an intervention method as superior to others, so ongoing development and evaluation of interventions is necessary. [3]

IV. DISCUSSION

From the analysis of the articles, it was found that, in view of the crisis generated by Covid-19, it was clear to various sectors of society that only science is capable of finding a solution and shows itself as a hope for all humanity, since she is the only one able to find a vaccine and treatment for the New Coronavirus.

A global study called Edelman Trust Barometer, corroborates the findings by stating that the pandemic has increased confidence in science and that 85% of people in the world believe that it is necessary to listen more to scientists and less to politicians.[8]

It also states that the word "science" has never been mentioned so many times and as much as it is already clear that there is science in every moment of a person's life, from the food he eats, the clothes he wears and the obvious instruments he uses in his work or leisure, awareness of the importance of science had not been achieved as intensely as it is today. [8]

Science is in favor of society, because despite dealing with the cuts in funds and attacks by a part of society, Brazilian scientists and public universities stood out in this very delicate moment and are doing important work, from research to actions that directly help the population.

It is unbelievable that in the 21st century, society is still debating whether it is necessary to have a vaccine. Science

has been breaking this discourse and more and more the population is becoming aware. Experts also point out that never in the history of mankind has there been such an effort and unity of scientists in favor of a single cause. Thus, science has recovered its noble and relevant role, but encouragement is still needed.

While access to information has become more accessible because of the internet, it has also become a way of spreading many false news.

When we think about why the pandemic arose, we see that science was already signaling the consequences of climate change and the predatory relationship between man and the environment. People want to go back to normal, where they were comfortable, but it is necessary to change the pattern of consumption. When it is not pleasant to their lifestyle, people prefer to deny science.

There has always been a gap between the population and science, so it is essential that scientists develop a language to communicate with the entire population more clearly. There is a need for a structural change in the way of seeing science, and that this should start at school with children, because doing Science is about seeking explanations and having a critical sense.

Despite the tragic scenario, the legacy of this pandemic is that health systems need to be strengthened. And the Family Health Strategy and Primary Care Program, which grew in the early 21st century, also requires a special look.

In addition, further studies and publications are necessary for the scientific community to reach a consensus. It is a race against time, but science also needs to be careful in its analysis. The population and politicians want a magic solution, but the scientific process is slow. There is no miracle in science, and if you skip the process, the damage can be even greater.

The pandemic has brought lessons to humanity for rethinking the current way of life, as well as showing the need for collaboration between teams, between universities around the world, in which the results of research have been quickly shared for all groups globally. The advances in the genetic sequencing of viruses, which through bioinformatics, have seen great innovations in the analysis of the sequences of the genetic material of the virus and which have even detected new virus mutations.

The advancement in the development of new diagnostic tests, with results that are increasingly faster and more efficient and that use gene editing tools. The vaccine race, in which it normally takes an average of 4 to 20 years to develop a vaccine. Now, it could be a record of one or a year and a half. The race to search for drugs that are effective, using analyzes in the drug database.

Improvements in the hygiene practices of the population, which is the introduction into the culture of citizens of certain habits that will help to contain this and other outbreaks caused by viruses.

Saving lives, strengthening our SUS and having an agenda for a process that will take longer, fighting for a vaccine and guaranteeing the access of the entire population to the vaccine and other means to protect their health, these are the great challenges

The importance of science in advancing and improving systems and health care, through innovation and the use of information technologies, deserves recognition as the most promising path to be followed for the effective fight of this pandemic. And finally, the delicate relationship between science and society brought important answers to better understand the nuances of the current pandemic scenario.

V. CONCLUSION

From this study, it was possible to discuss some of the priority aspects related to health and science during the pandemic caused by Sars-Cov-2 and understand that the advance of the current pandemic requires quick and conscious measures to preserve the population. Such measures, based on a solid scientific basis, promote and guarantee the strengthening of strategic actions to face COVID-19.

The scientific evidence reported in this review does not answer all the questions, but opens paths and perspectives for a better understanding of the problem, in the sense of qualifying scientific and health care actions. Nevertheless, epidemiological data, as well as research for new drugs and vaccines, can ultimately help humanity in controlling and mitigating the epidemic impacts on society.

Science can only exist with freedom and ethics. It does not mean that scientists can do whatever they want, that is why there are ethics committees that have grown stronger in the world.

Certainly, scientists will generate the knowledge that will make it possible to face not only the COVID-19 pandemic, but also to subsidize public policies that organize health care, reduce inequities and enable comprehensive care for patients.

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Health Education on Type-2 Diabetes Mellitus Prevention and Self-Care Measures for Employees of a Higher Education Institution

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Received: 29 Nov 2020;

Received in revised form:

01 Feb 2021;

Accepted: 25 Feb 2021;

Available online: 23 Mar 2021

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Publication. This is an open access article

Abstract— *Objective: report an experienced experience regarding the educational action related to type 2 Diabetes mellitus and its self-care for employees of a Private Education Institution. Method: This is a descriptive research, of the experience report type, developed by medical and nursing students, and supervised by medical and nursing professionals, in an Institution of Higher Education, theoretical and dialogued exposition, through an educational lecture, with the intention of orienting as to type 2 diabetes mellitus, which was subdivided into two fundamental stages, the*

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Keywords— Diabetes Complications, Chronic Disease, Outcome Assessment, Health Care, Preventive Health Services.

first related to the orientation of the theme and the second as to the verification of capillary glycemia. Results: The concern of the participants was evidenced by their concerns through questions and doubts about the theme. During the process, it was found that approximately 22% of those evaluated had rates between 100mg / dL and 125mg / dL, in addition, about 9% of respondents obtained rates above 125mg / dL. Conclusion: In view of these prevention aspects, it is possible to verify the need for employee evaluation more frequently, guaranteeing, in addition to the benefit to the employees' quality of life, the reduction of absenteeism rates and increasing their productivity for the company.

I. INTRODUCTION

Diabetes Mellitus is a disease of high metabolic complexity with an incidence at national and global level, which is triggered by factors that directly interfere in the quality of life of members, which can result in disabilities or even in the reduction of life expectancy. It is considered a chronic pathology and that due to the great morbidity and mortality related to the affected criteria requires a high cost of investments in this area (Cheng, S. W., Wang, C. Y., & Ko, Y., 2019).

Due to dietary errors and increasing sedentary lifestyle nowadays in addition to other modifiable factors, type-2 diabetes (T2D) has become a worldwide epidemic, bringing with it a high occurrence of microvascular (neuropathy, nephropathy, and retinopathy) and macrovascular (acute myocardial infarction and cerebral vascular accident) (Pivari, F., Mingione, A., Brasacchio, C., & Soldati, L., 2019).

The current aging of citizens has caused a greater prevalence of diabetes, which is related to a high risk of complications in their health. Among these, the diabetic foot (DF) is evidenced by its high incidence and great mutilating power. Regarding this perspective, reducing the incidence and comorbidities associated with T2D is to ensure prophylactic measures, especially in people at high risk, such as individuals who have an altered fasting glycemic index or reduced glucose tolerance. (Martinez, L. C., Sherling, D., & Holley, A., 2019).

In this sense, behavioral and medication measures have influenced the prophylaxis and control of the disease. Thus, changes in life habits, such as therapeutic dietary control, associated with the practice of physical exercises in daily life, in addition to the use of oral agents, have shown satisfactory results (Uusitupa, M., et al, 2019).

Therefore, modifiable agents must be the intervention point for T2D, even though age, family history and other non-alterable variables may be present. A factor of great relevance is obesity, which significantly increases the risk for the evolution of T2D, with the individual's resistance to

insulin enzyme being an important association factor for understanding in conjunction with the high deposition of visceral fat, presenting a high metabolic turnover; and as a sedentary lifestyle is a trend of the world population, the need for intervention tends to become more urgent (Uusitupa, M., et al, 2019).

Thus, any mechanism that aims to reduce weight results in a concomitant reduction in glycemic indexes for T2D. The systematization of physical activities results in benefits to the musculoskeletal structures, with more efficient use of energy, both for adults who live with the disease, and for those who use this habit as a prophylactic form, including directed at young people and children (Bullard, T., Ji, M., An, R., Trinh, L., Mackenzie, M., & Mullen, S. P., 2019).

Therefore, the objective of this research is to report an experience on an educational action related to the prevention and awareness of type 2 Diabetes mellitus and on their self-care of the hyperglycemic state and its possible complications, directed at employees of a Private Education Institution.

II. METHOD

This is a descriptive research, of the type of experience report, by medical and nursing students, supervised by professionals in the field of medicine and nursing, from a Private Education Institution, on August 14, 2020, in the city of Belém, Pará. The action was developed with 64 employees, aged 18 to 52 years old, from a Private Education Institution who work in the sectors of general services, security, assistance and even teachers of the institution, who attended according to the availability presented by each participant and avoiding crowds.

The methodology used was a theoretical and dialogued exposition, through an educational lecture, with the aim of guiding as to type-2 diabetes mellitus, including epidemiology, more frequent signs, and symptoms, in addition to presenting the necessary measures both for the prophylaxis of the disease and for adequate control, aiming

to minimize possible complications, such as diabetic neuropathy.

Subsequently, an individual conversation was held with each of the participants to identify risk factors, and a capillary blood glucose test was performed to check the glycemic index and, from this, to verify if the participant had glycemic alterations, ensuring that there was an understanding of the importance of these interventions more frequently and of the care with the modifiable factors related to T2D, including psychological stress, obesity, hypercaloric and hyperlipidic diets, and sedentarism.

III. RESULTS AND DISCUSSION

The experience made it possible to address the employees' self-care in association with lifestyle habits, a balanced diet, physical activity practices and emotional balance. During the lecture everyone was communicative and focused, thus ensuring an exchange of information. From this, there was a need to explain in detail about Diabetes because these individuals are exposed to risk factors.

In this sense, Cheema S, et al (2018), emphasizes the importance of assessing risk factors, given that these characteristics result in the highest probability of both the development of chronic disease and its complications. Thus, several well-established risk factors were associated with multiple complications and isolated microvascular complications, but each separate microvascular complication was linked to many risk factors, demonstrating the need for preventive care and periodic analyzes with professionals in the field. Therefore, ensuring the evaluation of possible changes over the age and avoiding major complications.

Through this, the participants' concern was evidenced through frequent questions about the theme, whether due to personal modifiable factors, such as food, physical activities, and other life habits, or because of non-modifiable factors, related to heredity, given that many of them did not perform, or performed in a precarious way, the prevention of Diabetes and the diseases present in serious or decompensated forms of the disease.

In this regard, Uusitupa M, et al (2019), demonstrates that the change in lifestyle helps not only in preventing new cases of type 2 diabetes, but also ensures the maintenance of those who have already been diagnosed with the disease, either through glycemic indexes, or with moderate weight reduction. According to this same study, the main gains from lifestyle changes are more related to long-term preventive forms.

During the process it was verified that approximately 22% of the people evaluated had indexes between 100mg/dL and 125mg/dL, besides that, about 9% of the interviewees had indexes above 125mg/dL, and they were oriented to re-educate their life habits and take complementary exams, in cases of possible diagnosis of Type 2 Diabetes Mellitus.

Considering this, Khan R, et al (2019), points out that DM2 is a silent disease that affects numerous individuals progressively, so that 1 in 2 people are unaware of the condition, and this is one of the factors that result in further complications.

Such results associated with the dialogue carried out with the participants, it was found that the lifestyle of each individual or the family history were factors that influenced the achievement of these results. It was noticed that individuals had numerous practices that could increase the morbidity of the disease, such as stressors, which in some cases were frequent, in addition to irregular eating, with the intake of fatty and very caloric foods, often associated with sedentary lifestyle. These aspects demonstrate the importance of frequent and continuous clinical evaluation, with a view to prevention and adequate control.

González-Ruiz, et al (2019) demonstrates the need for professional interventions for proper control and adherence to the treatment of patients with diabetes, demonstrating that not only formal and face-to-face dialogue can be used as a measure, but also the use of technological means that can, in addition to reducing costs, facilitate access to numerous individuals. In this sense, Timpel P., Oswald S., Schwarz P., & Harst L (2020), refer to measures such as telemedicine, as an advance in relation to the potential clinical control of patient with Diabetes, but that careful measures should be taken due to the limitations presented by the tool.

In view of this, it was noticeable that this action allowed a critical and reflective reflection to the employees of the institution, considering that the old personal habits could harm not only their daily performance as a worker, but would also directly affect their quality of life.

IV. CONCLUSION

In view of these prevention aspects, it is possible to verify the need for employee evaluation more frequently, guaranteeing, in addition to the benefit to the employees' quality of life, the reduction of absenteeism rates and increasing their productivity for the company.

Another important factor is the reduction of complications associated with the disease, such as

retinopathy and diabetic neuropathy, which result in permanent limitations to the professionals who acquire them. Thus, these findings reinforce the importance of providing accessible guidance and encouraging patients' self-care.

With this, it is necessary to carry out educational programs with a more accessible language, seeking understanding and interest of the population, thus favoring adherence to treatment, particularly with regard to lifestyle changes, assisting in proper glycemic control as a way to reduce or prevent complications.

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Determinants of Productivity in Brazil: an empirical analysis of the period 1996-2020

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Received: 19 Nov 2020;

Received in revised form:

22 Jan 2021;

Accepted: 15 Feb 2021;

Available online: 23 Mar 2021

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Keywords —*econometric models,
private investment, productivity,
simulation models.*

Abstract—*Empirical studies regarding the determinants of productivity in developing countries, including Brazil, have demonstrated the negative impact of high inflation rates on the industrial capacity. However, the recent Brazilian experience clearly shows that stabilization since 1996, in and of itself, is not capable of recovering the investment rates. With this in mind, this study's goal is to answer, with the help of econometric simulation models, the questions: (i) what are the key-drivers to assess the Brazilian economy since 1996?; and (ii) what are the key-factors to be considered when investments are made, particularly in productivity? To answer the questions we evaluated the impacts of macro-economic variables on private investments, using a strategic bias and a long term vision plan. The estimates demonstrate empirical crowding-in evidence of public investments in infrastructure over private investments as a real impact to productivity. As for public investments (non-infrastructure) we suggest that the crowding-in impact dislocates private investments. All these indicators were obtained as presented in the theory, with the exception of the real interest rates variable (r), in which we observed that the coefficient is positive and insignificant in the estimated equation.*

I. INTRODUCTION

Several studies show the necessity of developing econometric models, using reliable information, in order to obtain further determinants related to productivity in Brazil, especially since the period related to the implementation of the Real Plan until now. The econometric model is only possible by taking into account the advances in the theories regarding simulation and the national macro-economic principles. Consequently, we have an interesting combination of information, simulation models and analysis that enable decision-making processes, which can be seen in [6], [7], [10], [12] and [17].

Over the last few years several organizations have been making efforts to apply simulation models in their businesses. Thus, the objective of this article is to

elaborate an econometric simulation model, focused on productivity and with true possibilities of economic growth during the coming years, due to increases in internal consumption, for example. The econometric models presented can be used for macro-economic analysis, as well as for investment decisions, and especially for the analysis of the scenarios hereby presented.

It is noteworthy that the data used refers to the period between 1996-2020, due to the implementation of the Real Plan, and the unfolding of the ongoing international economic crisis of 2007 and Covid-19 nowadays.

According to [19] the econometric model presented does not take into account the variables related to imports and exports, which justifies this methodological option, due to the fact that any analyses will be directed towards

the internal market, with a high percentage of consumption and service sales, thus increasing the economy's need of profound adjustments in order to achieve sustained and long term growth. We presume that private investment is a function of the GDP growth, however, we will not evaluate the impact of international economies on the Brazilian economy.

However, we will use the real exchange rate as a proxy for the existence of external restrictions, represented by the external debt/GDP rate, in order to investigate the impact of external conditions on private investments in Brazil.

The performance of the proposed econometric model is the result of the variables utilized, of their restrictions, of the temporal series, and of the long-term estimates of associated risk. However, the suggested evaluations are subject to further studies, which may determine the impact of productivity in the economy. The results achieved by the proposed model are consistent, according to the proposed theory, as well as the results generated with empirical evidence for the decision makers.

This study is divided in five sections: the first is the introduction; Section 2 revising the literature describes the literature related to private investments in Brazil. Section 3 presents the methodology that describes the Cross-Section model, which is proposed to assess the impacts of macro-economic variables on productivity in Brazil. Section 4 presents the results of the econometric simulation for the period 1996-2020 and lastly, section 5 presents our conclusions.

1.1 Revising the literature

The goal of the econometric model in question is to test the hypothesis that the series of private investments, governmental investments, the GDP, interest rates, inflation, among other factors, are correlated, which enables the modelling of long term behavior of productivity. Using empirical studies, we will try to identify if there is an inhibiting factor for private

investments derived from the macro-economic instability, from governmental investments and Covid-19 nowadays.

The vital role of capital formation in sustainable economic growth is widely recognized. However, in Brazil and in many other developing countries the investment rates were reduced until the mid 1990's, a fact which was a result mainly of the external debt crises and of lack of inflationary control.

The gross formation of fixed capital in relation to the Brazilian GDP, measured at constant prices, had an average decrease of 23% in the 1970's, of 18.5% in the 1980's and of 15.2% in the 1990-1995 period, [4].

In 1998 Brazil's economy felt the impacts of the so-called Asian crises, and in 2008 the great international financial crises happened. Due to the deceleration of the GDP in 2011 it is quite possible that other fiscal measures will be adopted by the government, in an attempt to stimulate the level of economic activity, especially those related to the increase in credit for 2012 and the years ahead.

The econometric results obtained in other studies related to investments themes, and its determinants in Brazil and in other countries are presented in Table [1]. They summarize the works used as a foundation for the empirical research of this article.

The study of investment behavior, specifically in the private sector, results from the fact that this is a typically endogenous variable and from the observation that the adoption of specific economic actions in the market will increase the relative importance of productivity in the creation of aggregated capital. Particularly important dimensions of this problem are related to measuring the effects of macro-economic instability on the levels of investments in the private sector, and the identification of the type of relationship that exists between public investment and private investment.

Table 1. Comparison of the macro-economic variables used in Brazil and abroad

Methods and Variables	Luporini and Alves (2010)	Santos and Pires (2007)	Pereira (2005)	Serven (2003)	Schmukler and Serven (2002)	Melo and Rodrigues Júnior (1998)	Rocha and Teixeira (1996)
Sampled country	Brazil	Brazil	Brazil	61 Countries	USA	Brazil	Brazil
OLS	X	-	X	-	-	X	X
Private investment	X	X	X	X	X	X	X
Productivity	-	-	-	-	X	-	-

Tributes	-	X	X	-	-	-	-
Util. of Ind. Cap.	X	-	X	-	X	-	-
Credit	X	-	X	X	X	-	-
Public Investment	X	X	X	X	X	X	X
I_{pb}/Y (--)	-	-	-	X	-	-	-
Relative Prices of Capital Goods	-	X	X	-	-	X	X
Inflation (Uncertainty)	X	-	X	X	-	X	-
GDP	X	X	X	-	X	X	X
Cost of Capital (r)	X	-	X	X	-	X	-
Dummies	X	-	-	-	-	-	-
External Debt	X	-	-	-	-	-	-
R^2	0.92092	-	0.9521	N/D	N/D	0.89	0.85
Log Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	(Except r)		(Except r)	(Except r)		(Except r)	

Source: Authors.

II. METHODOLOGY

We tried to not only explain the theoretical model underlying the regression analysis, but also to test the existence of stationary and the co-integration between the temporary series we used.

The proposed econometric model combines the use of a series of data related to economic performance - observing organization's behaviors, productive aspects and growth.

In this model we will present data related to the 1996-2020 period, as this timeframe is relevant for the determination of sector analysis in Brazil, and also to indicate in future studies, the insertion of financial products for organizations.

Section "revising the literature" shows the importance of economic assessment. Thus, the present section tries to conduct a bibliographical survey, with the objective of extracting the relevant data to execute the econometric study. The goal of the econometric model in question is to test the hypothesis that the series of private investments, governmental investments, the GDP, interest rates, inflation, among other factors, are correlated, which enables the modeling of long term behavior of productivity. Using empirical studies, we will try to identify if there is an inhibiting factor for private investments derived from the macro-economic instability and from governmental investments, over the course of the timeframe.

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The study of investment behavior, specifically in the private sector, results from the fact that this is a typically endogenous variable and from the observation that the adoption of specific economic actions in the market will increase the relative importance of private investments in the creation of aggregated capital. Particularly important dimensions of this problem are related to measuring the effects of macro-economic instability on the levels of investments in the private sector, and the identification of the type of relationship that exists between public investment and private investment.

III. ECONOMETRIC MODEL

To explain the issue of private investments we chose the following data as part of the functional form: GDP, utilization of industrial capacity, public investments in infrastructure, public investments in non-infrastructure areas, productivity, real interest rates, relative prices of

capital goods, inflation, a credit availability proxy, tax burden, external restrictions and exchange rates.

The GDP and the utilization of industrial capacity are commonly used factors when specifying equations for level investments, as they reflect the conditions of the demands of the economy and are used to measure the accelerating effect of investment and possible economic cycles. Typically pro-cyclic economies, such as the ones in developing countries, tend to show a strong correlation between private investments and the variables related to demand.

To measure the impact of public investments on private investments we used public investments in a disaggregated form, separating public investments in infrastructure from the investments in electric energy, telecommunications and transportation. All other public investments are considered as non-infrastructure. It is crucial to verify if there is empirical evidence of the crowding-in theoretical effect of public investments in infrastructure over Brazil's private investments, and if not, does the expected crowding-out effect occur.

The possible crowding-in effect of public over private investments in infrastructure is theoretically explained by the fact that such investments increase the productivity of capital for future investments, and save private investors from additional investments they would otherwise have to make in these areas. As for the crowding-out effects of non-infrastructure public investments, these can be theoretically explained by the competition between them for scarce resources available for investments.

A frequently used variable to explain private investments is the real interest rate, the first theoretic proxy of the cost of capital opportunity. This justifies the choice of this variable as a pre-candidate to compose the final functional form.

The relative price of capital goods is also a key-variable in investment decisions, because it directly affects the cost of capital opportunity. It can assess the effects of low competition in the industry of capital goods that result in increasing the prices of these goods above the prices practiced in the rest of the economy, which would negatively impact investments.

Inflation is a commonly used variable as a proxy for uncertainties in the economies of developing countries. This variable was included in the study conducted by Rodrigues Júnior (1998) at Table 1 to assess the impact of Brazil's macro-economic stability over investments.

A proxy variable for the availability of credit in the economy is also commonly used in investment studies, especially in developing countries, in which credit access

is very limited. Obtaining credit or not is, in many projects, a key-element for the impact of credit itself. Thus, the availability of credit should also be taken into account as a pre-candidate variable. In this article we considered the volume of annual disbursements of the BNDES as a proxy for credit availability in Brazil.

The total tax burden (as a percentage of the GDP) should be used as a possible explanatory variable for private investments. Very few empirical articles use this variable, but in the Brazilian case it may be quite relevant, especially with the significant increase of taxes over the last few years. The motivation for using this variable is due to the fact that economic agents of the public and private sectors have been complaining about the excessiveness of Brazilian taxes as being one of the major obstacles for private investments.

As for external influences, several indicators were used on the empirical work, such as deviation of products from their long-term trends, the volatility of the stock exchange, the variability of inflation rates and/or of the exchange rates in relation to the debt/GDP, with negative results for private investments, [18]

And finally, [13] uses the relationship between external debt and exports to investigate the effects of external conditions on private investments in Brazil, and in other Latin American countries, confirming the negative results already uncovered in other studies. More recently, [5] investigated the relationship between exchange rates and private investments. The results indicate that the exchange rates affected negatively and significantly private investments over the analyzed timeframe, which was from 1956 to 1996.

Taking Table [1] into consideration, we propose the following generic theoretical model:

$$\text{Priv_Investments} = f(Y, \text{UCAP}, \text{Pub_Infra_Invest}, \text{Non_Pub_Infra_Invest}, \text{Productivity}, r, P_{\text{rel_bens_k}}, \text{IGP-DI}, \text{Emprest_BNDES}, t, EE, E)$$

In which:

- Priv_Investments = *strictu sensu* gross investment of the private sector (excludes state organizations);
- Y = Real Gross Domestic Product;
- UCAP = average utilization of the industrial capacity;
- Pub_Infra_Invest = public investments in infrastructure;
- Non_Pub_Infra_Invest = non-infrastructure public investments;
- Productivity = productivity, as a function of capital, technology and human capital investments;

- r = real interest rate;
- Rel_Prices_K = relative prices of capital goods;
- IGP-DI= Inflation
- BNDES_Dis = Real disbursement of the BNDES;
- T = Tax burden as a percentage of the GDP;
- EE = External restriction, using as a proxy the series Debt Service/GDP (%);
- E = Real exchange rate;
- Dummy = control variable for times of international crises

Based on this expression, we estimate the following econometric equation for the 1996-2011 timeframe, with expresses variables in natural logarithms (except for the real interest rates variable), in order to directly obtain the elasticity of the variables:

$$\text{LInvest_priv}_t = \beta_0 + \beta_1 \text{LY}_t + \beta_2 \text{LUCAP} + \beta_3 \text{LPub_Infra_Invest} + \beta_4 \text{LNon_Pub_Infra_Invest} + \beta_5 \text{LProductivity} + \beta_6 \text{Lr} + \beta_8 \text{LReal_Prices_K} + \beta_9 \text{LIGP-DI} + \beta_{10} \text{LBNDES_Dis} + \beta_{11} \text{LT} + \beta_{12} \text{LEE} + \beta_{13} \text{LE} + \varepsilon_t$$

In which ε_t is a random disturbance.

In conformity with the model of the investment accelerator, we expect that the increased GDP will generate an increase in productivity, because increased production requires more investments and innovation. The effect of the interest rate is negative and reflects the adverse impact of the cost of capital utilization over investment decisions. Used as a proxy for uncertainty and instability, we expect that the elevation in the inflation rates will decrease investments in the private sector; here the implicit hypothesis is that instability increases the *waiting price* for new information and increases business risks. The relationship between the Private Investment and Public Investment variables is ambiguous, because both crowding-in and crowding-out can predominate between the two types of investment.

Table [2] presents a summary of the pre-candidate variables used to explain private and R&D investments in annual series since 1996 and what are the theoretic expected signals.

Table 2 - Pre-candidate variables

Pre-candidate variable	Expected signal
Real GDP	Positive
Average utilization of industrial capacity	Positive

Public investments in infrastructure	Positive
Non-infrastructure public investments	Negative
Productivity	Positive
Real interest rates	Negative
Relative prices of capital goods	Negative
Inflation	Negative
Real disbursements of the BNDES	Positive
Tax burden as a percentage of the GDP	Negative
External restrictions	Negative
Real exchange rates	Negative

Source: authors.

IV. RESULTS

For the econometric analysis all variables, with the exception of the real interest rates variable, were log-linearized using the natural logarithm, and the remaining series were calculated using the fixed prices of 1995. Because the series used in the estimations of the investment equations are temporal series, we presume that these series are random variables ordered over time. The usual methods of estimation and inference presume that these variables are stationary. The non-stationarity of a stochastic process is due to the existence of a unit root or a stochastic trend in the auto-regressive process (AR), which generates the presence (or absence) of stationarity in the variables used in the estimations.

Stationarity tests

Initially the series were subjected to augmented Dickey and Fuller (ADF) unit root tests [2], in level and in first difference. The ADF test is well known and will be described in this section, [3]. It should be remembered that the test statistic is similar to the t-student test.

The aim of the tests is to show statistical evidence of the integration order of the variables and are, in fact, pre-tests for co-integration, since theoretically only variables with the same integration order can co-integrate.

According to [8], the null hypothesis is that $\alpha=0$, in which α is the coefficient associated to the first lag range of the series, which enters as a regressor AR(p) for the first difference of the hypothesis. The criterion of rejection indicates rejecting H_0 if $|ADF| > VC$, in which VC is the critical value of the distribution. As in the case of the existence of a unit root, the asymptotic distribution of t is not the same if the series is stationary (in this case the t of student). Thus, we used critical values tabulated by [9]. The correct choice of lags is important, as they can influence the performance of the tests. What we did was

choose a number which was sufficient to eliminate any possible serial correlation of residues. The choice was made by minimizing information criteria.

The Table [3] below summarizes the results of the stationarity tests. For the timeframe being analyzed the results of the tests favor the hypothesis of a unit root and also indicate that the series contains a stochastic trend.

The unit root tests for the selected on level variables do not reject the possibility of the existence of a unit root in all cases at a 1% level, the only rejection occurred in the LnIGP-DI variable. In other words, there are no statistical evidences that the variables are $I(0)$. The analyses of the results indicates that the series for private investments (Ln Priv_Investments), GDP (LnY), utilization of industrial capacity (LnUCAP), public investments (LnPub_Infra_Invest and Ln Non_Pub_Infra_Invest), Productivity (Ln_Productivity), real interest rates (r), relative prices of capital goods (Rel_Prices_K), loans from the BNDES (LnBNDES_Dis) and taxation (LnT), may all be considered stationary.

Based on this, one can say that there is statistical evidence that the variables in question can be treated as $I(1)$, and that regressions without their levels (log on level, in the case of the specification used here) are possible and will not present dubious results, as long as the conditions of co-integration are verified. The theory suggests the

possibility of a trend, besides the constant, for the formulations of the unit root tests for the GDP and investments, and that was properly considered.

Considering the other in level significances, we observed that there were rejections for the variables: LY for 5% and 10%, LnUCAP for 10%, LnBNDES_Dis for 5 and 10%, and LnIGP-DI for 1%, 5% and 10%. A possible explanation for this fact is that the stationarity tests are susceptible to the specification and the measure unit of the variables, which creates difficulties for the analysis of results. Furthermore, the unreliability of the tests makes it difficult to discriminate stochastic series with high dependencies. The real exchange rate (LnE) can be considered stationary with the ADF of -2.6534 with the rejection of the null hypothesis at a 10% level of significance. For the EE variable we have an ADF, in level, of -2.2719 with an integration order $I(1)$.

Given these characteristics, the investment equations were estimated by means of the Ordinary Least Squares methodology. Some of the studies of investment determinants presented in literature use the co-integration technique by means of a system of auto-regressive vectors (VAR). The estimator of Ordinary Least Squares is one of the few estimators whose properties are solidly established in specialized literature.

Table 3. Results of the stationarity tests for the pre-candidate variables on the productivity model using annual data from 1996-2020

Variables	t-ADF	Critical value test 1% significance	Critical value test 5% significance	Critical value test 10% significance	p-value
On level variables					
LnPriv_Invet	- 1,872	- 4,0573	- 3,1099	- 2,7010	0,329
LnY	- 3,431	- 3,9545	- 3,0210	- 2,6801	0,021
LnUCAP	- 2,340	- 3,9501	- 3,0310	- 2,6800	0,175
Ln_Pub_Infra_Inves	- 1,163	- 3,8991	- 3,0700	- 2,6800	0,609
Ln_Non_Pub_Inv_I	- 0,760	- 3,8591	- 3,0011	- 2,6800	0,733
Ln_Productivity	- 1,744	- 4,0470	- 3,01133	- 2,6000	0,231
R	- 1,821	- 3,9101	- 3,0700	- 2,6801	0,321
Ln_Real_Prices_K	- 1,201	- 3,9541	- 3,0001	- 2,6801	0,640
LnIGP-DI	- 5,262	- 4,2000	- 3,1701	- 2,7201	0,001
Ln_BNDES_Dis	- 3,979	- 4,0044	- 3,0914	- 2,6901	0,008
LnT	- 2,061	- 4,0569	- 3,1143	- 2,7001	0,599
First difference variables					
DLnInv_Priv	- 1,800	- 4,0520	- 3,1100	- 2,7011	0,087
DLY	- 3,300	- 3,9500	- 3,0800	- 2,6813	0,004

DLnUCAP	- 2,329	- 3,9500	- 3,0800	- 2,6813	0,035
Ln_Pub_Infra_Inves	- 1,150	- 3,9500	- 3,0800	- 2,6813	0,263
Ln_Non_Pub_Inv_I	- 0,760	- 3,9500	- 3,0800	- 2,6813	0,454
Ln_Productivity	- 1,766	- 4,8300	- 3,0800	- 2,7011	0,059
Dr	- 1,820	- 3,9540	- 3,0800	- 2,6813	0,088
DP_Real_Prices_K	- 1,199	- 3,9540	- 3,0800	- 2,6813	0,249
DLnIGP-DI	- 5,200	- 4,1000	- 3,1001	- 2,7289	0,000
DLnBNDES_Dis	- 3,930	- 4,1000	- 3,0902	- 2,6904	0,001
DLnT	- 2,055	- 4,1000	- 3,1088	- 2,7011	0,069

Source: authors.

For the unit root tests of the selected variables in first difference we observed that the results repeat themselves, as they do not reject the possibility of the existence of a unit root in all of the cases at a level of 1%, the only rejection occurred in the DLnIGP-DI variable. In other words, there are no statistical evidences that the variables are I(0).

The main objective of the estimations presented on Table [3] is to test the hypothesis of the crowding-in effect of public investments on infrastructure over private investments.

Final functional form for annual data related to 1996-2020

The Table [4] below shows a summary of the pre-candidate variables used to explain productivity in Brazil, in annual series from 1996 onwards, and the expected signals for the relationship between each one of them and private investments.

Contrary to the study performed by [1], this analysis opted for including the variables that presented low significance in the final model. The model presented low significance for the variable that assesses uncertainties (LnIGP-DI), which was also confirmed by the stationarity tests, and also for the total tax burden variable (LnT).

Furthermore, our analysis specified a dynamic model, including the lag in the private investment variable (DLnInv_Priv(-1)), because by using contemporaneous variables the model would present problems with the auto-correlation of residues. The first lag of the private investment variable is commonly used in several studies, due to the fact that some investments cannot be completed in only one year, which explains the use of this variable to assess the inertia effect on investments.

In the first equation estimated we inserted a control variable for times of political instability, represented by a dummy (D1), which assumes unitary values for the years

of 1997 (Asian Crises), 1998 (Russian Crises), 1999 (Argentinean Crises and the Brazilian Currency Devaluation), 2008 (World Financial Crises) and 2020 (Covid-19).

Overall the model presented a satisfactory explanatory rate ($R^2 = 0.95$), which is a result coherent with the majority of the studies shown in Table [1]. One can also observe the importance of the irreversibility of the investment, reflected in the coefficient of the first lag of private investment, which was positive and significant, indicating that current investments depend on their past values.

This evidence indicates the existence of lags in the decision making process and in the implementation of private investments, and suggests that current investments not only reflect partial adjustments of current capital to desired levels, but also tend to happen in an accumulated manner or clustered in time (lumpiness).

The signs found for the estimated coefficients were positive, statistically significant and are in accordance with the economic theory, which indicates income increase (LnY) and increase in economic activity (LnUCAP), encouraging and increasing productivity in the country. In the case of the utilization of industrial capacity (LnUCAP) we observed the extremely pro-cyclic characteristic of the Brazilian economy, with a high and positive coefficient (2.86).

This result is compatible with the majority of the existing empirical studies concerning the determinants of investments in Brazil and in other developing countries, where the variables used to assess the conditions of demand were also significant and relevant in the estimated models.

The results show empirical evidence of the crowding-in effect on public investments in infrastructure (Ln_Pub_Infra_Invest) over private investments, a positive sign. This means that a stimulus of 1% in public

investments for infrastructure will result in a 0.113% increase in private investments.

As for non-infrastructure public investments (Ln_Non_Pub_Infra_Invest) the sign obtained is also correct (negative), which suggests that the impact of the

crowding-out effect dislocates private investments. This means that a stimulus of 1% in non-infrastructure public investments will result in a 0.0741% decrease in private investments.

Table 4. Productivity determinants

Ordinary Least Squares - Dependent Variables: Private Investment (1996-2011)			
Explanatory Variables	Coefficients	Expected signal	Obtained signal
Constant	- 9,3500 (-6,0381) [0,0000]	Negative	Negative
DLnProv_Inv(-1)	0,4830 (3,76613) [0,0009]	Positive	Positive
LY	0,499 (1,8263) [0,0697]	Positive	Positive
LnUCAP	2,801 (9,7258) [0,0000]	Positive	Positive
Ln_Pub_Infra_Inves	0,101 (7,3445) [0,0000]	Positive	Positive
Ln_Non_Pub_Inv_I	-0,0703 (-8,0360) [0,0000]	Negative	Negative
Productivity	0,101 (7,3575) [0,00000]	Positive	Positive
R	(7,3433) [0,0000] [0,0527]	Positive/ Negative	Positive
Ln_Real_Prices_K	-1,3581 (-9,8211) 0,0000	Negative	Negative
Explanatory Variables	Coefficients	Expected signal	Obtained signal
LnIGP-DI	-0,0474 (0,0522) [0,0000]	Negative	Negative

Ln_BNDES_Dis	0,1705 (9,791057) [0,0000]	Positive	Positive
LnT	- 1.1800 (0,008) [0,0000]	Negative	Negative
LnE	-0.09251 (-2.19204) [0.03720]	Negative	Negative
Dummy 1	-6,45 (-3,0061) [0,9951]	Negative	Negative
R ²	0.956458		
Adjusted R ²	0,953631		
DW	2.59		
Log Likelihood	338.5426		
Statistic F	338.2824		
Prob(F)	0,0000		

Source: Elaborated by the authors

Note: t statistics are between parentheses and p-values are between brackets.

However, the theory suggests that after the initial perverse effect of the competition for resources between private and non-infrastructure public investments, it is reasonable to suppose that these investments can also contribute (even if just a little, when compared to the infrastructure investments) to increase the productivity of private capital to be invested in the future (public investments in education, productivity and each other).

In the case of the real interest rates variable (r) we observed that the coefficient is positive and non-significant in the estimated equation. Although the estimated coefficient signal goes against what was theoretically expected, the coefficient is numerically very close to zero (and non-significant), which indicates that this proxy for capital use costs did not contribute to the productivity. This evidence was also found by [7] who also estimated equations using macro-economic data for the 1972-1996 and 1970-2005 timeframes, respectively.

Although capital cost is theoretically important for the determination of the productivity, the difficulty to obtain significant coefficients with negative signs for this variable is widely spread in specialized literature. In the Brazilian case, especially, cost capital coefficients so close to zero can be explained, on one hand, by the organizational

tradition of not seeking external financing for the company, and on the other hand, by the volatility of the interest rates during periods with high inflation, which made interest rates a negligible reference for calculating the opportunity costs of investments.

Literature also indicates that if interest rates rise and if competition for limited resources increases this will result in the dominance of the crowding-out effect over the crowding-in effect. This can be partially explained by the progressive deterioration of the Brazilian's government capacity to invest in infrastructure, because it is the type of public spending that presents the most evident complementarities with private inversions.

Results indicate that an increase in the offer of credit (Ln_BNDES_Dis), by means of elevating credit operations aimed at the private sector, will increase private investment in the subsequent years, which confirms the hypothesis that Brazilian organizations face credit restrictions. The results obtained are consistent with the studies performed by [12] and [18], which include financial variables in their empirical studies and indicate that credit availability is one of the relevant variables for private investments in developing countries.

The uncertainties caused by international crisis (assessed by the Dummy 1 "International Crisis" variable) were also relevant in the determination of investments in Brazil, and the negative coefficient obtained indicates that in times of international economic crisis private investments decrease. Thus, the implementation of responsible and consistent policies over the course of time is crucial to minimize economic uncertainties and to encourage private investments in the country.

We tried to investigate the impact of external conditions on private investments in Brazil, using the External restriction variable (EE), having as a proxy the series Debts of Service/GDP (%). As for external conditions, we suggest that external debts of service did not affect private investments in a significant way during the analyzed timeframe. In fact, the effect of this variable was insignificant in the model and thus, was not included in the final model. One possible explanation for this result is the participation of the public sector in obtaining resources during periods of external crisis, acting as a guarantor for loans contracted by the private sector, and financing investments during periods of external restrictions, and even encouraging the improvement of conditions for external financing.

Finally, the estimated coefficient for exchange rates (LnE) was significant and presented a negative sign, indicating that increased (or devalued) exchange rates do not encourage imports of capital goods, and consequently reduces economic investments. This result is confirmed by [12], who obtained results indicating that the first difference of exchange rates has a significant and negative effect over private investments in Brazil.

V. CONCLUSION

This article analyzed the major determinants of productivity in Brazil for the period of 1996 to 2020, using data obtained from the Novo Sistema de Contas Nacionais do IBGE (New System of National Accounts of the IBGE), which were recently published by the IPEA. We proposed the elaboration of a model of econometric simulation, focused on productivity connected to the real possibilities of economic growth for the coming years.

The empirical evidence obtained in the models tested confirm the predominance of quantitative variables, such as product and capacity of use, which indicates that increases in income and in economic activity encouraged productivity in Brazil over the course of the studied period. The accelerating effect observed is complemented by the existence of lags in the decision making processes and in the implementation of private investments, which suggests the hypothesis of irreversibility of investment.

The estimation shows evidence that if interest rates are increased and/or if the competition for real limited resources increases, this will cause the dominance of the crowding-out effect over the crowding-in effect.

The cost of capital utilization, measured by the real interest rates, was not significant, which indicates that the real interest rates do not contribute to reduce productivity, which is a result consistent with the elevated volume of auto-financing by Brazilian organizations. On the other hand, in a wider perspective, the volume of credit for the private sector demonstrated its importance by positively affecting private investment. In this aspect, expanding long term financing lines, adequate for the creation of fixed capital by the organizations, would be extremely important to increase the rate of economic investments.

Besides credit, external factors and exchange devaluations caused, in general, adverse effects on the gross formation of fixed capital in the private sector and on the Brazilian economy during the timeframe analyzed. These results indicate the existence of credit restrictions for Brazilian organizations and also indicate the importance of macro-economic stability and the execution of public policies as an encouraging factor for productivity.

The analysis conducted identified very few articles conducive to econometric studies analyzing sector performance, especially on the productivity and in the insertion of products or services. As a result of these analysis, it is essential that data surveys be conducted to simulate the impacts of macro-economic variables on the productivity, by regions and by sectors in Brazil, adopting the Monte Carlo simulation models, in an attempt to obtain long term estimates. And finally, we hope that this article encourages new studies, with strategic biases and long term vision of innovation, in order to propose innovation strategies.

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Data Driven: An Overview and Practical Measures for Organizations

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Received: 25 Nov 2020;

Received in revised form:

19 Jan 2021;

Accepted: 16 Feb 2021;

Available online: 25 Mar 2021

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Keywords—Data-Driven, Prediction Models,
Analytics, Big-Data, i4.0, Internet of Things,
Artificial Intelligence.

Abstract—Data is considered a primary resource for innovation. The existence of a large amount of available data, as well as technological tools capable of explore them, allows companies to extract information that can be used to create and implement new ideas and new projects. To this end, the details regarding the care that organizations should have with data are explored. The difficulties regarding the adoption of data-driven approach and some measures to implement this type of decision-making approach are also discussed. Some examples of data-driven approaches for diverse industries and products are shown. A real example of prediction model for decision making that is based on industrial data is also discussed. This example shows the difficulties in the preparation of data for the building of these models, which confirms that most of the time spent in the construction of predictive models it is due to this step. The use of the data-driven approach allows organizations to obtain superior results in their processes, thus becoming a tremendous competitive advantage and a special strategic factor in a highly competitive market, regardless of the field of activity.

I. INTRODUCTION

Business decisions are usually based on the instincts of leaders. However, if they were based on data transformed into reliable and high-level information, it would certainly be more assertive decisions. Lately, there has been a revolution in data collection, processing, and use. Organizations today can gather data in a detailed way to provide knowledge to their partner, consumers, and competitors [1]. In addition, a huge variety of devices have been designed with the ability to continuously collect data [2]. The technology called Internet of Things is a revolution in this area and refers to scenarios where network connectivity and computational capacity extend to objects, sensors, and everyday items, which are not considered computers [3].

The Big-Data is one of the key technologies in the so-called Industry 4.0 or Fourth Industrial Revolution (See figure 1[4]). This has the potential to transform the industrial production system with the introduction of new technologies, such as autonomous robots, Internet of Things, Cloud Computing, Big-Data itself, Artificial Intelligence, Additive Manufacturing and Virtual Reality. And these technologies will increase connectivity, inside and outside organizations, by creating a network of physical systems known as Cyber-Physical systems [5]. The digitization that proliferates in society and the economy has been causing marked changes in the conditions that prevail in this market. Consumer habits are changing rapidly, such as product customization according to consumer wishes. These changes are creating a vast number of potential opportunities in terms of new business. Organizations can discover new ways to provide, create and capture value. The vast amount of data

generated is not only the basis for an organization's existence, but this data offers organizations the chance to make sense of it, extracting information and using it for their own benefit, to simplify the decision-making process[6].



Fig.1: Characteristics of each industrial revolution.

The latest innovations are based on the use of technology, most often in the form of digital innovation or digitization. Digital innovation means the combination of physical and digital components to produce new products, which offer different services, which will dissolve the frontiers of industry and products. Digital innovation not only implies a change in technology, but also indicates a change in the dynamics of relationships within businesses and markets [7]. In an innovative approach on the use of information and decision-making within organizational environments, carrying out activities with a higher degree of complexity requires the processing of a large amount of data to provide information. Thus, it is necessary for organizations to design information processing. The improvement of organizational performance, which includes the reduction of costs, is a function of the use of technologies that allow the massive collection of data, that generates information, in addition to facilitating the flow of information within an organization [8]. The dramatic improvements in data collection, storage and processing capabilities have created opportunities for businesses in recent years. In particular, the collection and reliability of data that can be used for managerial activities, like data-driven decision making. Evidence suggests that better performance in a sample of public companies is associated with the intensive use of data [9]. Digital technologies have stimulated an exponential growth in the availability of data, which has generated great demand for adequate processing to extract information from this data. The Big-Data were created due to this high availability of data [10], [11]. Evidently, the data started to have an enormous value in this new context, starting to be the new oil [12].

This paper is divided into five sections. The following sections are divided as follows: Section 2 discuss the main topics relating to an organization that wants to become

Data-Driven. Section 3 discuss some examples of Data-Driven Approaches for Solving real problems. Section 4 discusses the organization of data that will be used on the construction of a predictive model based on Artificial Intelligence (Artificial Neural Networks). Section 5 presents the conclusion and final considerations.

II. TOPICS TO BE CONSIDERED WHEN BUILDING A DATA-DRIVEN ORGANIZATION

The following topics, 2.1 to 2.5, aims to show some topics to be considered when an organization wants to be data-driven from a practical point of view. This type of organization is one that makes decisions based on data on an ongoing basis. It is an organization that build tools, skills and maintain a data-based culture [13].

2.A. Collection and accessing the Data.

Data is a key enabler for smart manufacturing and data-driven organizations. However, data in its raw form is not so useful in providing good information. These need to be "turned" into something more valuable, and this is usually done in several stages. The different stages of data collection, storage, analysis, and visualization can be referred to as the "data life cycle" [14].

The collection of the data is the beginning of all. The data collected must be the right data and must be relevant to the solution of the issue that the company wants to solve. Such data must be easy to obtain, must be accurate, clear, and impartial and, above all, reliable. Unfortunately, such data can lead to numerous inaccuracies and errors, which requires a previous assessment and cleaning step, to make them reliable. If used in the way they were obtained, there is a great chance of generating false information and leading to wrong actions in companies, which could result in losses. This step of cleaning and processing the data is very time consuming, difficult, and expensive, and can require 80% of the time of a data scientist, whereas the construction of the models, the analysis of the results and conclusions take only 20% of the time. The data alone is not enough. And a small amount of clean and reliable data can be more valuable than a huge amount of raw data that has not been cleaned or treated [13], [15].

There are numerous pre-requisites when it comes to data quality [13]:

- Accessible: Data, as well as analysis tools, must be accessible to analysts;
- Accurate: Such data must represent the true value or state of the entity. Badly typed values, or badly collected, do not represent accurate data;

- **Coherent:** Refers to the combination of certain data with other data in a precise way, bringing a more complete and real image to a given situation. For this, its correct identification is essential;
- **Complete:** There can be no gaps, or data not saved in a databank;
- **Consistent:** The data is the same regardless of the source consulted. Otherwise, there must be a reliable source and the one with inconsistencies must be evaluated and corrected;
- **Defined:** There must be a well-understood and unambiguous meaning for each individual data field. If a data dictionary is available that explains the origin and meaning of that data, the quality of the data will improve;
- **Relevant:** The data must be relevant for the analysis of the phenomenon of interest;
- **Reliable:** Refers to how complete this data is as well as its accuracy, if the correct information is provided;
- **Timely:** Refers to the shortest possible time between data collection and its availability for analysis. The smaller the better.

Having accurate, timely and relevant data is not a sufficient condition for an organization to be considered as Data Driven. The next session will discuss about reports, analysis, the difference between them and the main professional roles necessary to an organization to be data driven.

2.B. Reports, Analysis, and people involved with Analytics.

Reports and alerts are not sufficient characteristics for an organization to be considered as Data Driven. Something more is needed. However, both reports and alerts are of great importance, especially reports. There are legal demands for reports, and they may not necessarily represent an internal aspect aimed at improving the business. Analysis, otherwise, allows organizations to find out the real causes of why a process is changing, and make some actions to know why it is changing. The definitions of reports and analysis are [13]:

- **Reports:** They are the process of preparing informative summaries from organized data. They aim to monitor the performance of several areas of an organization;
- **Analysis:** **It is about transforming data**, a form of assets, into information that will increase the competitiveness of organizations, which will allow better business decisions.

The reports are descriptive whereas the analysis is prescriptive. Table 1 shows the difference between reports and analyzes [13].

Table 1. Main attributes of reports versus analyzes.

Reports	Analysis
Descriptive	Prescriptive
What?	Why?
Backward looking	Forward looking
Raise questions	Answer questions
Data → information	Data + information → insights
Reports, dashboards, alerts	Findings, recommendations, predictions
No context	Context + storytelling

Analysis always seeks to answer why a problem has occurred and is not limited to just describing it, as occurs in the Reports. Instead of raising questions, the analysis already seeks to answer them and with the use of the information obtained from the data, there is an insight into the problems, which leads to their anticipation through recommendations and forecasts. Therefore, in a problem-solving context, the Analysis can solve them, the opposite of what happens with the Reports, which basically describes the problem.

A useful structure for understanding the analysis is shown in Table 2 [13]. Report (A) and alert (B) are not based on data. There is simply an assertion that something out of the ordinary has happened in the past or at that very moment. The reason for the event is not explained, nor its causes, and there is no recommendation on how to avoid a recurrence of the situation. (D) is close to Data-Driven since it already uses modeling and design of experiments. (E) and (F) represent what is Data-Driven, but only if the information is used since its basis is the understanding of the phenomenon and only this understanding allows the formulation of a plan or recommendations. (C) is a danger zone since the extrapolation may not allow the necessary precision. Therefore, the causal model should be pursued [13].

As shown in table 1, the analysis allows anticipating problems through recommendations and forecasts. From table 2 we have that only the approaches (E) and (F) can be considered as Data-Driven and this only occurs due to the ability of prediction possible with the use of predictive models. Thus, organizations must seek predictive capacity to anticipate their problems and consequently increase their competitive potential.

Table 2. Hypothetical issues addressed by the analysis. D) is a valuable analysis, but only E) and F) are data driven and if, and only if, the information is used.

	Past	Present	Future
Information	A) What happened? Reporting.	B) What is happening now? Alerts.	C) What will happen? Extrapolation
Insight	D) How and why did it happen? Modeling, experimental Design.	E) What is the next best action? Recommendation.	F) What is the best/worst that can happen? Prediction, optimization, simulation.

Experts who make use of data analysis tools, who know what the necessary analyzes are, and the meaning of the results from these analyzes can work in several areas, such as: Business Analysis, Data Analysis, Big-Data Analysis and Data Science [16]. A data-driven organization is likely to have a variety of analyst roles, usually organized into multiple teams [13].

- Data analyst: They are generally more focused on collecting and preparing data. The specific roles in an organization depend on the size, maturity, domain, and market of the organization. The delivery will be a mix of reports and analysis. In addition to the breadth of the domain, analysts vary widely in their level of technical skills;
- Data engineers and analytical engineers: Responsible for obtaining, cleaning, and adjusting the data and making it available in such a way that analysts can access and analyze it;
- Business analysts: They act as the interface between business stakeholders and the technology department. Its function is to improve business processes or help to design and develop new or improved features;
- Data scientists: They are the professionals most inclined to mathematics or statistics, usually with advanced degrees (usually in quantitative disciplines, such as mathematics, science, and computer science) and developed coding skills. They divide their time working on a variety of projects, from building statistical models and algorithms;
- Statisticians: These are professionals who focus on statistical modeling across the organization. They are involved not only in the analysis, but in the research design, experiments, and collection protocols to obtain

the raw data. The job may involve increasing the quality of a new data source;

- Quantitative Analysts: They are mathematically qualified professionals working in the financial services sector, securities modeling, risk management and stock movements on the buy and sell side of the market;
- Accountants and Financial Analysts: These are professionals with a focus on internal financial statements, auditing, forecasting, business performance analysis, etc.;
- Experts in data visualization: These are the professionals who create infographics, panels, and other design assets.

A data-driven organization will have a team with an emphasis on analytics with different roles, as shown above, and people with complementary skills. As in any other area of an organization, it is necessary to know the team's skills and thus strengthen the fields of knowledge that are sometimes absent and sometimes weak [13]. The next session will go deeper on the definitions of data-analysis and the maturity levels on this activity.

2.C. Data-Analysis and Maturity

Data analysis is the basis of what is also known as process mining. This is a field of studies that deals with the discovery of processes, verification of compliance and improvement using data from that process. By considering records (or labeled data) in large quantities, it is possible to discover an accurate representation of the model. Such a model can be used to discover possible deviations from the process from the use of new data not yet processed. Such models can be improved through the use and learning from new data [14]. Data-Analysis concerns the transformation of data (assets) into competitive perceptions (information) that will serve as beacons for decisions and actions. There is a total of six types of analysis, starting with the simplest to the most complex [13]:

- Descriptive: Describes a data set in a quantitative way, however it does not describe anything about the data population from which that set originates. Its objective is only to describe numerically the main characteristics of the sample;
- Exploratory: Use of graphics to examine and visualize data, which helps in viewing the big picture. It is possible to gain insights from exploratory analysis;
- Inferential: The purpose of this type of analysis is to infer information (Parameters, distributions, or relationships) about the broader population from which the sample originates. The hypothesis test, used

to test and analyze the understanding of the underlying mechanisms, can be started from inferential analysis;

- **Predictive:** This type of analysis is based on inferential analysis and aims to learn about the relationships between the variables in a training data set and thereby develop a statistical model capable of predicting output values for new data, whether these are incomplete and future. **The potential of predictive analytics is enormous with a wide range of applications;**
- **Causal:** Type of analysis where a series of experiments are carried out and in which the greatest possible number of variables is controlled. In these experiments, only one of the variables is changed at a time and the results are evaluated. Such experiments provide a causal understanding and with greater depth of the system being analyzed, allowing greater understanding and how to act to influence its results, optimizing a system for example;
- **Mechanistic:** It is a type of analysis that allows an understanding of a system at a high level of depth. It is derived from studies of a stable system with many experiments over many years.

Depending on the activity one or more types of analysis can be used within the same organization. For example, the R&D area can prefer to use a mechanistic approach instead of a predictive approach that can be more useful for a financial area.

There are 8 levels of maturity in Data Analysis [13]:

- [1] Standard Reports: What happened? When happened?
- [2] Ad-Hoc reports: How much? How often? Where?
- [3] Detailed query (Or online analytical processing): Where exactly is the problem? How do the answers can be found?
- [4] Alerts: When the reaction is necessary? What actions are needed now?
- [5] Statistical Analysis: Why is this happening? What opportunities are missed?
- [6] Forecasting: What happens if these trends continue? How much is needed? When will it be necessary?
- [7] Predictive modeling: What happens next? How will it affect the business?
- [8] Optimization: How do it better? What is the best decision for a complex problem?

One of the possible ways to interpret these 8 levels of maturity in data analysis is to think that the maximum level at which the organization is engaged is positively

correlated with the level of commitment, investment and usefulness of the analysis and the analytical competitiveness. As the level rises, there is a greater sophistication in the use of data, with evident improvement in the causal analysis and definition of countermeasures in the solution of problems. Certainly, business results will be substantially better in a level 8 organization compared to a level 1 organization.

2.D. Metrics and Storytelling with the data

Data-driven organizations, like any organization, need to define their business strategy and create a set of metrics, the Key Performance Indicators (KPI's). The key performance indicators (KPIs) are the set of metrics linked to the organization's strategic objectives. They help to define and track the direction the company is taking and to achieve its goals. It is extremely important that KPI's [13]:

- Are clearly defined;
- Be measurable;
- Have goals;
- Be visible;
- Reflect what the organization is trying to achieve.

Each company needs to choose and adapt its set of KPIs for its sector, its specific business model, its life cycle stage, and its specific objectives. KPIs will tend to cover all major areas of the business and any parts of the business that are the specific strategic focus for that period, usually one year. These KPIs are targeted at business divisions and it is possible that each division has specific additional KPIs. At the end, there are operational and diagnostic indicators that monitor tasks, programs, projects, and even strategic process variables. Thus, such indicators need to be well designed, to reflect what is really happening in organizations. There are several prerequisites when choosing or designing a metric [13]:

- **Simple:** They feature the ease of definition, the ease of disclosing to people, which allows greater understanding and less confusion. Other advantages: Simplicity in implementation, less likelihood of being incorrectly calculated and ease of comparison between teams and even between organizations;
- **Standardized:** Refers to the use of standard metrics. It allows greater understanding for new colleagues from other organizations, in addition to facilitating the comparison between organizations through benchmark studies;
- **Accurate:** The average numerical value must be like the true underlying average value. Inaccurate metrics have a bias so that their average differs from the true average in a constant or systemic way;

- **Precise:** Metrics must be precise. Similar values should be returned if repeated under the same conditions;
- **Relative versus absolute:** Absolute or relative metrics can generate a quite different image of the same scenario, so they must be chosen wisely and appropriate to what is intended to be shown;
- **Robust:** The metrics must be insensitive to individual extreme values, that is, there can be no significant variation of the values solely due to a single occurrence;
- **Direct:** Metrics should directly measure the process of interest.

Three questions must be considered about storytelling with the data [13]:

- [1] What is the objective? One must keep in mind what is wanted with this data and what is expected to happen;
- [2] Who is the audience? Is it an audience that has some knowledge about data? What is the level of expectations, interest, motivation, and availability of this audience?
- [3] What is the medium to be used? How will the data be presented?

These three questions are essential to better define how the means of transmission of the message will be prepared (Type of presentation, style, depth) aiming at the greatest impact on the audience. The greatest chance of knowing the dominant patterns in the data is through a very well-planned experiment, the choice of good metrics and, mainly, through a well-defined question. And the analyst's job is to find among the data the cleanest and most important standards, interpret them and translate them in a way that has an impact on the business. However, there is more than one possible potential interpretation of these data [13].

The next session will discuss the characteristics and some cultural aspects of a truly data-driven organization.

2.E. Characteristics of truly data-driven organizations and decision-making

In times of Big-Data Analytics, leadership must act as an agent of change within organizations [17], constantly dealing with challenges that involve understanding the benefits and availability of data, the development of analytical skills and data integration in organizational culture [18]. Leading means improving productivity in organizations [19] as well as positively connecting people [20]. Leaders must develop an analytical mindset to transform organizations into a decision-making

environment that uses data in a very local way [21]. The organizations that are truly data-driven have the following characteristics [13]:

- Such organizations may be testing on an ongoing basis. These tests may include tests with users, where real consumers or users give feedback on new attributes or products;
- **A truly data-driven organization has a mindset of continuous improvement.** They frequently optimize its main processes. And this occurs from the realization of careful analyzes as well as the construction of mathematical or statistical models and the use of these for simulations;
- Such organizations may be involved in predictive modeling. But, even more important, it is the use of model errors as well as other lessons learned in improving the predictive capacity of these models;
- A data-driven organization will certainly guide its decisions using a set of weighted variables. The data for each set of variables that are of interest must be collected and the weights between them must be determined to allow the generation of a leadership decision that is reliable.

A truly data-driven organization will have at least one of these characteristics, looking to the future, where the data is first-class citizens. An organization that has high quality data in addition to the qualified personnel to analyze it cannot yet be considered as truly data driven. If there is no interest from people in knowing the analyzes and if the decisions of the decision makers are not influenced by these analyzes but by opinions and instinct, it cannot be said that these organizations are data driven. For organizations to be guided by data, such data must generate reports, which must influence the analysis that reaches decision makers so that they can incorporate them into their decision-making process. It is a fundamental step for an organization to be considered as data driven. [13].

III. EXAMPLES OF DATA-DRIVEN APPROACHES FOR SOLVING PROBLEMS

In this section, some examples of data-driven approaches to solving problems will be explored. It is intended to give a practical view of how the information obtained from the data can provide superior results compared to other forms of decision making. Examples are related to Materials Science, Industrial Productivity, Energy (Gas, Oil and Wind) and Health (wearable devices).

On a new data-driven solution method, without the use of models, used in variational brittle fracture mechanics, the idea was to remove the assumptions of fracture modeling from the formulation and let the behavior constituting the fracture be guided exclusively by a set of material data, while maintaining the epistemic fracture laws that come from variational principles. The results obtained showed excellent agreement with those obtained via counterparts based on standard fracture mechanics. Another important point was the excellent robustness regarding noise in the data set used, despite the quality of these data being sensitive to noise[22]. A data-based approach was shown to diagnose production bottlenecks, using combined knowledge of maintenance and data science. Perceptions about these bottlenecks are obtained using artificial intelligence techniques such as machine learning, and real-world data sets extracted directly from the production line. The tool built in this way helps its users to plan specific maintenance actions to improve the availability of process bottlenecks and thus improve process productivity[23].

Shale gas is a natural source of unconventional gas with immense reserves. Due to its ultra-low porosity and permeability, its extraction requires special drilling techniques. Accurate forecasting of its production is crucial for the reasonable design of the development plan. However, due to the complex hydraulic fracture network and the gas flow mechanism, the physics-based forecasting model does not yet exist and therefore the data-based model provides an alternative way of dealing with the production forecasting problem. The tool thus obtained, based on the random-forest method, showed the ability to make reasonable predictions of gas production when the physical model is not yet fully available[24]. Dealing with the problem of optimization of the lay-out of wind power generation parks to maximize the generation of electric energy. Due to the complexity of the lay-out problem, calculating the cost function takes a lot of time. To reduce the high computational cost of this calculation, while maintaining the performance of the obtained solution, an adaptive data-driven differential evolution algorithm was proposed. In most of the tested cases, a better or competitive performance was obtained with other algorithms in terms of output strength[25]. In the work carried out by [26] research is discussed where an integrated data-driven framework assisted by machine learning algorithms acquires signals based on personalized characteristics of elderly patients. Such work, based on wearable devices with a focus on patients' health, aims to improve the detection performance, based on reduced quantity of measurements, aiming at better model accuracy. With the introduction of a statistical framework,

better results were obtained. And laboratory simulations showed that the performance of the system, in addition to user satisfaction, is superior to that of other conventional systems.

IV. ORGANIZING A DATABANK FOR A DATA-DRIVEN PREDICTIVE MODEL

This section aims to illustrate the process of organizing a databank for the development of an empirical predictive model for decision making and the process used to configure a prediction model. Thus, it explores the search for data, its evaluation in seek of noise, the development of the criteria for the elimination of these noises and the treatment performed for their elimination. It can be said that most of the time spent to build the model is related to the previous treatment of the data. With this it is expected that the reader will be aware of the previous steps for the building of a data-driven predictive model and all the difficulties inherent to an industrial process since this example comes from a real project, developed for the steelmaking industry. The objective of these steps is to build a data-driven Artificial Neural Networks(ANN) model that is capable to provide predictive capacity for quality parameters of steel beams in a steelmaking industry. This model was built from several databanks and the steps used were as follows on the section 4.1 to 4.5[27]. Such a model allows to know in advance the quality results (mechanical properties) of the steel beam. In addition, it allows decision-making to adjust rolling processes in view of the initial chemical composition characteristics obtained at the melting-shop. A tool like that (**Prediction, optimization, simulation**) can answer the question, according to the table 2: "F) What is the best/worst that can happen?". This is an approach that can be considered as Data-Driven because it allows prediction. Models like that are a particularly useful tool for quality checking and Research and Development of new products.

4.A. The Databank

The databank, which was used for training and validating the artificial neural network, contained data from some steps of the production process. Data that allowed the identification of the campaign and the type of steel were also used. From this bank, data with the following characteristics were selected [27]:

- Numerous technical standards;
- Numerous standardized chemical compositions;
- Total occurrences equal to 461.

Due to limitations of the Integrated Rolling Control System, only the following information can be used in the process of implementing the prediction model [27]:

- Chemical composition of steel, with analysis of the contents of 24 different chemical elements present in steel;
- Final Rolling Temperature;
- Thickness of the test specimen;
- Tensile Strength, Yield Strength and Elongation.

After analyzing the data recovered, it was observed that 11 of the available chemical elements did not present all the values of results in the databank. These elements were discarded as input for the model. They were Ni, Co, Ca, Ti, B, W, Zr, As, Sb, Te and Pb. The data about mechanical properties, the objective of the model, came from another databank. As this secondary databank has the same identification information as the databank originating from the Integrated Rolling Control System, it was possible to build a third, final databank, which aggregated all the information necessary for the building of the models [27].

4.B. Statistical Analysis of Databank Variables

The databank obtained from the considerations of the previous steps has a high number of variables. However, it is expected that a large part of them will be strongly correlated or have a minor influence on the mechanical properties of the steel beam. For this last situation it is expected that they do not need to be included in the prediction model. To analyze the relationship between the various input variables with the mechanical properties, a statistical analysis of the data obtained was carried out to determine which variables would be used in the training of the Artificial Neural Network and in the final prediction model. The following analyzes were carried out [27]:

- Graphical, Scatter, analysis of the data;
- Correlation analysis between the various input variables (Chemical Composition, Temperatures, Reductions) and the outputs (LE, LR and A);
- Determination of average, minimum, maximum, and standard deviations of the input data;
- Histograms;
- Data Treatment: statistical analysis of the variables involved was carried out through the MINITAB Statistical Software. The data used were only those that were included within the range ± 3 standard deviations to decrease the total variability of the databank;
- Elimination of outliers: Elimination of data that was not considered to be representative of the process. In

the case of mechanical properties (LE, LR), the maximum difference of 20MPa was used as an acceptance criterion within the same production order (same steel heat, rolled in the same batch), for both LE and LR. Events with differences greater than 20MPa were excluded. The 20MPa criterion was adopted because production orders normally have lower values than this. Higher values are usually linked to some process abnormality, such as sampling and testing.

The techniques mentioned above were used to eliminate the presence of discrepant data, measurement errors, in short, noises that could compromise the reliability of the databank[27].

4.C. Data Graphical Analysis

Once the data for model development was defined, MINITAB was used to graphically analyze the relationship of the output variables (LE, LR and A) with the input variables. The purpose of this procedure was to verify the impact of the variation of the input data on the mechanical properties [27].

It was observed that the chemical composition data of the databank were truncated, that is, they presented the decimal places lower than that obtained by the chemical analysis on the lab. As an example, the carbon content results (% by weight) in the databank had only two decimal places while the chemical analysis process provided results with greater precision. This loss of information could reduce the learning of the ANN model that was intended to be developed and, even, hinder the process of minimizing its error. Thus, it was decided to replace the chemical composition information originally obtained with the primary correspondents. Figure 2 (a) shows the carbon content histograms for the truncated data (originally contained in the databank). Truncating the input values is a considerable problem for the process of training and validating an ANN, as it hides important characteristics of the variable's behavior, which are indispensable for minimizing the model's prediction error. After the recovery of the original data, all the indicated analyzes were performed again. Figure 2 (b) shows the Histogram for the carbon content after updating the bank with the revised data [27]:

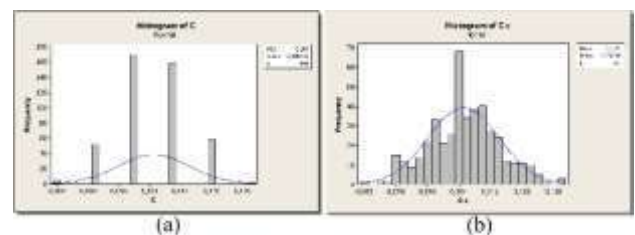


Fig.2: Grouped data (a) and non-grouped data (b) for the carbon content.

4.D. Graphical analysis of the databank

The figure 3 illustrates the dependence of the Yield Strength in relation to some process variables, Carbon, Manganese, Phosphorus and Silicon [27].

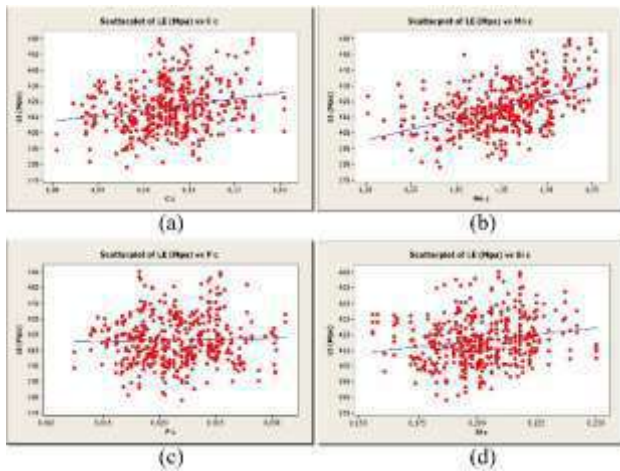


Fig.3: Yield Strength (LE) dependence due to some process variables. (a) Carbon, (b) Manganese, (c) Phosphorus and (d) Silicon.

This figure illustrates the dispersion found in the data. In this data set there may be discrepant data, data with measurement errors or even registration errors. To eliminate such noises, these data will be submitted to a previous evaluation stage to reduce the incidence of these noises as much as possible, as discussed on sections 4.1 and 4.2. What is aimed at is the development of a model that provides high precision, and, for that, it is necessary to work with the minimum possible noise.

4.E. Summary of Databank with Statistical Treatment

After performing all the procedures described in sections 4.1 and 4.2, a databank with 444 occurrences was obtained. Table 3 summarizes the statistical information from the original and the final databank that will be used in the modeling [27].

Table 3: Statistical Summary –Original and Final Databank.

Variable	Description	Original databank		Final databank	
		Average	Standard Deviation	Average	Standard Deviation
Y1	LE (MPa)	416.93	15.36	416.49	15.23
Y2	LR (MPa)	507.92	15.58	507.45	15.53
Y3	A (%)	28.84	2.03	28.94	1.88
X1	C (%)	0.1052	0.0089	0.1051	0.0090
X2	Mn (%)	1.3521	0.0508	1.3511	0.0510

X3	Si (%)	0.2011	0.0174	0.2012	0.0175
X4	S (%)	0.0075	0.0026	0.0073	0.0023
X5	Cr (%)	0.0302	0.0073	0.0303	0.0073
X6	Nb (%)	0.0360	0.0035	0.0278	0.0035
X7	N ₂ (%)	0.0044	0.0009	0.0044	0.0009
X8	Final Rolling Temperature (FRT) (°C)	972.50	12.45	972.29	12.37
X9	Thickness Reduction (%)	85.58	0.31	85.58	0.31

For most of the variables the standard deviation of the final databank was smaller if compared with the original databank. An additional reduction of the standard variation could be possible, but the learning of the ANN could be compromised. After choosing and defining the databank, the process of adjusting the ANN began with the objective of obtaining the best configuration, that is, the optimal number of neurons in the hidden layer. It was observed during the training process that the simulations could present different performances for the same network configuration. An explanation for this fact would be the existence of biased data in the sample set and, as they are selected randomly, depending on the distribution, the impacts would be perceived in the training phase or in the validation phase. Another explanation would be the random choice of initial weights, which would lead to different results in each simulation [27].

A two-layer ANN architecture was used (one hidden layer and one output layer). The optimal number of neurons in the hidden layer was defined using the trial-and-error method, and configurations with at least 4 neurons were tested. The output layer was built for just one neuron. Three networks were developed, one for each output variable (Tensile Strength, Yield Strength and Elongation). The variation observed in the training of the networks created difficulties to define the optimal number of neurons in the hidden layer. Thus, the procedure started with a statistical approach where 10 simulations were performed for each number of neurons. The results were analyzed using the following performance parameters in the simulation [27]:

- Minimum and maximum percentage error in the validation;
- Average percentage error in the validation;
- Linear correlation, R^2 , between estimated and measured output values.

The table 4 below show an example for the results of the adjustment of the ANN for the Yield Strength, number of neurons equal to 4[27].

Table 4: Simulations for Artificial Neural Network with 4 neurons in the hidden layer, Yield Strength.

Sim.	Numb er of epochs	Train ing SSE	Min. Error, (%)	Max. Error, (%)	Avera geErr or,(%)	R ² , LE's (%)
1	300	6.7677	0.02	6.81	2.24	66.4
2	173	4.4042	0.01	7.94	2.23	64.4
3	152	4.2218	0.03	6.90	2.26	62.9
4	188	4.4674	0.06	6.77	2.27	71.1
5	358	6.4770	0.09	6.95	2.44	66.1
6	119	4.6452	0.04	7.95	1.94	70.2
7	153	4.1389	0.11	8.28	2.41	66.0
8	233	4.5037	0.02	6.27	2.20	65,1
9	183	5.3227	0.00	8.19	2.16	58.9
10	516	6.7560	0.02	7,71	2.26	66.3

An Analysis of Variance (ANOVA) was performed through MINITAB Statistical Software for the results obtained for the 10 simulations performed for each network configuration. From the results obtained, the ideal network configuration was defined, in terms of number of neurons on the hidden layer[27]. Table 5 shows the summary of the characteristics of the Artificial Neural Networks used in this work:

Table 5: Summary of Characteristics of Artificial Neural Networks.

Characteristic	Criteria	MATLAB
Partition of data set	Training set = 75%, Validation set = 25%.	RANPERM
Net weigh initialization	-	INITNW
Net learning ratio	-	TRAINGDX
Transfer Function	-	TANSIG
Convergence Criteria	-	
Minimum error aimed	0,001	-
Number of training cycle	700	-
Training mode	BT	-
Number of hidden layers	1	-

Size of hidden layer, LE Model	6	-
Net training mode	-	TRAINBR

The same process was repeated to LR and A to define the best configuration for the prediction model. For the LE model (6 neurons on the hidden layer) the correlation between the measured LE value and the predicted was equal to 0.65; the average error was equal to 2.27%, the minimum error was equal to 0,00% while the maximum error was equal to 7.77%. Most of the established metallurgical trends was confirmed and the model could be considered a reliable prediction tool to calculations of scenarios, decision making, and to optimize the steelmaking process, from the melting shop to the rolling mill.

V. CONCLUSION

This paper discussed the theoretical background related to Data-Drive Decision Making, its correlation with the increasing availability of data, and how organizations that use this strategy can deliver better results. Practical examples of earnings gains from data-driven organizations were also given. The details necessary for an organization to be in fact data-driven were discussed in detail, the necessary aspects related to basic characteristics: Collection and access to data; Reports, Alerts, Teams, Data Analysis; Data Analysis Maturity; Metrics; Telling Stories with Data; Information Delivery and Decision Making. It also explores the characteristics of organizations that are truly data-driven, as well as what factors can influence decision-making, factors that would prevent organizations from being data-driven. Some examples of data-driven approaches to solving problems on Materials Science, Industrial Productivity, Energy (Gas, Oil and Wind) and Health (wearable devices) was discussed. An example of Data-Driven prediction model was discussed in detail: The development of a real predictive model that enables the decision-taking in a steel industry with minimum error and metallurgically accurate. This last case is discussed with a focus on the noise reduction of the data used and the methodology used to adjust the Artificial Neural Network. This article is expected to contribute to the growth of the technical knowledge of its readers.

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The use of handgrip strength (HGS) in outpatient care for patients with Alzheimer's Disease

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Received: 07 Nov 2020;

Received in revised form:

21 Jan 2021;

Accepted: 22 Feb 2021;

Available online: 27 Mar 2021

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Keywords— hand grip strength, dementia,
Alzheimer's disease, elderly.

Abstract—To evaluate the contribution of handgrip strength (HGS) in outpatient care for elderly patients with Alzheimer's disease (AD). Cross-sectional study, with AD patients, >65 years of age, who underwent cognitive, nutritional and HGS assessment, International Physical Activity Questionnaire (IPAQ-SF) and Disability Assessment in Dementia (DAD). The data were compared to a similar control group (CG) composed of 51 elderly people, with $p < 0.05$. The 43 elderly people with AD exhibited lower HGS scores when compared to the CG (13.4 ± 8.2 vs 17.5 ± 8.0 ; $p = 0.008$, Mann-Whitney). There was no difference in HGS according to the severity of dementia, cognitive aspects, the IPAQ-SF and in the activities of daily living in the DAD. Higher HGS values were associated with males and younger age. There was a correlation with some anthropometric indicators. HGS was significantly lower in elderly people with AD. In Alzheimer's disease, higher HGS values were associated with males, younger age and some anthropometric indicators

I. INTRODUCTION

Aging is associated with motor and physical fitness impairment resulting from the loss of the motor unit. In elderly people with dementia, cognitive impairment is associated with a reduction in the ability to perform routine physical activities with a consequent loss of functional capacity [1].

Among the different instruments that assess global muscle strength, the measurement of handgrip strength (HGS) is a relatively convenient, objective and simple functionality measurement; it is sensitive to physiological changes, it is a sarcopenia and fragility marker and is associated with cardiovascular mortality risk [2].

Some studies have shown the decline of HGS associated with dementia in a Japanese community

[3], and the authors pointed out that a major reduction in HGS could be considered an indicator of late onset of dementia, from middle age to old age. In another study [4] that investigated reference values in a Brazilian population, HGS showed a negative correlation with age among healthy adults and elderly people. The study in question [4] did not identify HGS values in different clinical situations, but it was able to show the behavior of this indicator. HGS could also be considered an indicator for the prediction of cognitive impairment in obese women [5], and other studies suggest that HGS could be considered an indicator of the muscle strength capacity of overall health status [6].

Despite some evidence in the literature, there are still gaps in the knowledge of the contribution of the use of HGS in nutritional assessment and in its

relationship with clinical and lifestyle aspects of elderly people with AD.

Thus, the objective of the study was to evaluate the contribution of handgrip strength (HGS) in outpatient care for elderly patients with Alzheimer's disease (AD).

II. METHOD

Cases

This cross-sectional study included elderly patients in outpatient care with clinical diagnosis of Alzheimer's disease (AD), according to the Diagnostic and Statistical Manual of Mental Disorders [7], the Recommendations of the European Federation of Neurological Societies [8] and the Brazilian Academy of Neurology [9], monitored at the neurology outpatient clinic of PUC-Campinas Hospital. A control group (CG) was formed with similar socio-cultural conditions, without cognitive complaints and without neurological or psychiatric diseases. The Human Research Ethics Committee of the University, protocol no. 1,234,677, approved the study. All participants signed an informed consent term.

Procedures

-Cognitive evaluation: The Mini-Mental State Examination (MMSE) [10], the simple memory drawing [11], the verbal fluency test [11] and the clock drawing test were evaluated [11].

-Clinical dementia rating (CDR) [12]:–The CDR score was used to classify the degree of severity of dementia as mild, moderate or severe.

-Anthropometric indicators: Body mass index (BMI)[13], arm circumference (AC) [14,15], triceps skinfold (TSF)[14,15], arm muscle circumference (AMC)[14,15], subscapular skinfold (SSF)[14,15], calf circumference (CC)[14], waist circumference (WC)[16,17], and the thickness of the adductor pollicis muscle (TAPM)[18,19] were assessed. The procedures and cutoff points standardized in the relevant literature were used.

-Handgrip strength (HGS): It is a measure of the amount of force produced by an isometric contraction, applied over the dynamometer's loops, with three measurements, and the scores are subsequently averaged. The data were recorded in kilogram-force (Kgf). The measurement was performed with the individuals sitting with their feet flat on the floor, with adducted shoulder and elbow flexed at 90°, forearm in neutral position and wrist between 0 and

30° extension. A SAEHAN® model SH5002 mechanical dynamometer was used [3,20,21].

-Mini Nutritional Assessment (MNA): The Mini Nutritional Assessment (MNA) [22] form was used to assess nutritional status, with patients being classified as eutrophic, with or without malnutrition risk or malnutrition.

-International Physical Activity Questionnaire- Short Form (IPAQ): Physical activity was assessed and patients classified as sedentary or active, according to a standardized and validated instrument for the Brazilian population [23].

-Disability Assessment in Dementia (DAD): Basic activities of daily living (BADLs) and instrumental activities of daily living (IADLs) were assessed through a questionnaire that evaluates perception by elderly people [24,25].

Statistical analysis

A descriptive analysis was carried out with presentation of measures of position and dispersion for continuous variables. To compare continuous or orderable measurements between 2 groups, the Mann-Whitney test was applied. To verify the relationship between continuous or orderable measurements, Spearman's correlation coefficient was used. The level of significance adopted for the statistical tests was 5% [26,27].

III. RESULTS

The study included 43 patients aged 65 years and over, 65.1% (n=28) being female. A CG was formed with 51 individuals, with an average age of 78.3 ± 7.8 years. There was no significant difference in age and gender between the groups. The elderly with AD were classified as having mild dementia in 16 cases, moderate dementia in 19 cases and severe dementia in 8 cases, according to the CDR.

The exploratory factor analysis [28] was used to summarize the cognitive assessment determined by several tests in a single component. The method of extraction was by principal components. The global measure of sample adequacy by the Kaiser-Meyer-Olkin (KMO) criterion was 0.6205, considered reasonable for the application of the analysis. The sample adequacy measures (MAA) of the four (4) variables, were greater than 0.50, complying with the adequacy criteria (*Cognitive Factor*, Table 1).

The values of the correlation analysis between the mean maximum handgrip strength (HGS) and

the anthropometric parameters and the cognitive assessment can be seen in Table 1.

Table 1. Correlation between maximum average HGS and anthropometric parameters and cognitive assessment.

Variables	Coefficient (r) *	P-value
Cognitive Factor	0.09006	0.5658
HGS vs age	-0.45051	0.0024*
HGS vs weight	0.55317	0.0001*
HGS vs height	0.55610	0.0001*
HGS vs body mass index	0.29336	0.0562
HGS vs arm circumference	0.41500	0.0057
HGS vs triceps skin fold	-0.04677	0.7658
HGS vs subscapular skinfold	0.10175	0.5162
HGS vs arm muscle circumference	0.56314	<.0001*
HGS vs waist circumference	0.38548	0.0107*
HGS vs calf circumference	0.39423	0.0089*
HGS vs TAPM	0.25972	0.0967

Cognitive Factor:- exploratory factor analysis ²⁶

HGS: handgrip strength; TAPM: thickness of the adductor pollicis muscle. Spearman's correlation coefficient. * $p < 0.05$.

When comparing the HGS scores, among the elderly with AD and those in the CG, it was observed that significantly, the elderly with AD exhibited lower scores for the HGS-right arm (13.9 ± 8.6 vs 18.0 ± 8.0 ; Mann-Whitney, $p = 0.006$); HGS-left arm (12.9 ± 8.0 vs 17.0 ± 8.2 , $p = 0.008$), and the HGS-maximum mean between the two arms (13.4 ± 8.2 vs 17.5 ± 8.0 , $p = 0.008$). (Data not reported in tables).

The score values of handgrip strength according to gender, CDR and MNA of the elderly with AD, are shown in Table 2.

Table 2. Descriptive analysis of HGS according to gender, CDR and MNA.

	Handgrip strength		
	Right	Left	Mean
Gender			
Male (n=15)	21.8 (± 8.6)	20.3 (± 7.8)	21.0 (± 8.1)
Female (n=28)	9.7 (± 4.8)	9.0 (± 4.6)	9.3 (± 4.6)
p-value	<0.001*	<0.001*	<0.001*
CDR			
Mild (n=16)	16.5 (± 10.1)	15.5 (± 9.0)	16.0 (± 9.5)
Moderate (n=19)	12.2 (± 7.1)	11.4 (± 7.1)	11.8 (± 7.0)
Serious (n=8)	12.7 (± 8.1)	11.3 (± 7.0)	12.0 (± 7.5)
p-value	0.474	0.361	0.461
MNA			
No nutritional risk	17.0 (± 10.1)	15.2 (± 9.7)	16.1 (± 9.8)
With nutritional risk and malnutrition	11.5 (± 6.3)	11.1 (± 5.8)	11.3 (± 6.0)
p-value	0.06	0.198	0.08

HGS: handgrip strength; CDR: clinical dementia rating; MNA: mini nutritional assessment. Mann-Whitney Test; * $p < 0.05$.

There was no significant difference between the HGS scores and the practice of physical activity (IPAQ). There was no significant correlation between HGS and daily living activities in the DAD (Table 3).

Table 3. Descriptive analysis of HGS according to the practice of physical activity and activities of daily living.

	HGS r	HGS l	Maximum average HGS
IPAQ			
Sedentary (n=26)	14.0 \pm 8.5	12.9 \pm 7.4	13.4 \pm 7.8
Active (n=17)	13.8 \pm 9.0	12.9 \pm 9.0	13.3 \pm 8.9
p-value	0.97 ^a	0.84 ^a	0.88 ^a
DAD			
BADL	0.186; $p = 0.23^b$	0.185; $p = 0.23^b$	0.186; $p = 0.23^b$
IADL	0.127; $p = 0.41^b$	0.085; $p = 0.58^b$	0.109; $p = 0.48^b$
ADL	0.160; $p = 0.30^b$	0.137; $p = 0.37^b$	0.149; $p = 0.33^b$

IPAQ: International Physical Activity Questionnaire; DAD: Disability Assessment for Dementia; HGS: handgrip strength; HGSr: right arm Handgrip strength; HGSl: left arm Handgrip strength; BADL: basic activities of daily living; IADL: instrumental activities of daily living; ADL: *Activities of daily living*. ^a Mann-Whitney; ^b Spearman's correlation; * $p < 0.05$.

Discussion

Studies investigating changes in cognition in connection with HGS changes as well as studies that investigated HGS changes, in connection with the cognitive function changes, have been reported in the relevant literature. It is known that with advancing age and with the progression of dementia, the ability to perform activities of daily living and HGS, decrease with time; but these issues still need further clarification, both with regard to HGS, as well as in relation to day-to-day activities.

Our data showed significant differences regarding HGS among patients with AD and patients in the control group and HGS was weaker in patients with AD. In a Korean longitudinal study [5] with elderly women over 65 years of age, HGS was associated with a reduced risk of cognitive impairment in obese women, but not in non-obese women. And in another longitudinal Korean aging study [29], which assessed the relationship between HGS and the cognitive function, a significant bidirectional relationship was observed between these variables; and the authors suggested that this should be better elucidated in further investigations. HGS could also be used in the assessment of cognitive status, and the strength capacity and cognitive function could parallel each other [30], where the functionality loss in one factor, could predict the loss of functionality in the other, as shown in that study conducted with elderly Americans [30]. No difference was observed in our investigation between HGS and physical activity and daily living activities.

Other studies in the relevant literature [31,32] showed that cognitive decline would be associated with a specific pattern of functional losses, which started with impairment in the performance of advanced activities of daily living, followed by losses in instrumental activities of daily living towards basic activities of daily living. And in a longitudinal observational study [33] with elderly inpatients over 70 years of age, HGS was associated with basic activities of daily living and with instrumental activities of daily living, and the authors suggested that HGS be further explored as a predictive marker in elderly patients.

Study Limitations

The small sample size and the type of study (cross-sectional), were considered the main limitations of

this study. It is noteworthy, however, that the Service where the study was conducted, serves a representative population of a large metropolitan region and, thus, the population of patients with AD, assessed here, reflects a considerable group of patients with this disease, who are routinely and rigorously monitored in an outpatient clinical neurology service.

IV. CONCLUSION

HGS was significantly lower in elderly people with AD. In Alzheimer's disease, higher HGS values were associated with males, younger age and some nutritional indicators.

ACKNOWLEDGMENTS

We are grateful to the Pontifical Catholic University of Campinas-SP-Brazil, for their support.

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Does the type of disease and diet influence hospital weight loss? An analysis using the Generalized Estimating Equation method

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Received: 22 Dec 2020;

Received in revised form:

19 Feb 2021;

Accepted: 05 Mar 2021;

Available online: 27 Mar 2021

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Keywords— disease, diet, body weight, hospitalized patients, Generalized Estimating Equations (GEE).

Abstract—Investigate weight evolution during hospitalization and its association with the type of disease and diet, over time. Retrospective study with 133 in-patients, investigating indicators of nutritional status, diet, disease, surgery and the evolution of body weight during hospitalization. The chi-square, Kruskal-Wallis tests and the method of Generalized Estimating Equation (GEE) were used for the study of weight evolution over time, depending on the diet and type of disease. Underweight according to body mass index, malnutrition by subjective global assessment and nutritional risk according to nutritional risk screening (NRS), were found in 19.5%, 27.8% and 46.6% patients, respectively. There was no influence of the type of diet on weight evolution over time ($p=0.0779$), but there was an influence of the disease ($p=0.0100$). In digestive neoplasms, a greater reduction in body weight was observed. The NRS was more sensitive in the diagnosis of malnutrition. The type of disease influenced weight loss, but the type of diet did not influence the evolution of body weight over time.

I. INTRODUCTION

Many studies have shown that hospitalized patients endure malnutrition, and ESPEN (European Society of Clinical Nutrition and Metabolism) published a consensus [1] on malnutrition in hospitalized patients, emphasizing the importance of some anthropometric indicators, such as the reduction of the body mass index (BMI) and this reduction was also considered for the evaluation of malnutrition by the World Health Organization (WHO) [2].

Other instruments have been used to determine nutritional risk in hospitalized patients, such as nutritional risk screening (NRS), subjective global assessment, among others [3,4,5,6,7]; the relevance of

NRS was highlighted in a recent study [8] that showed that the reduction of BMI and recent weight loss were the factors that most contributed to the diagnosis of nutritional risk and the joint use of NRS with serum albumin [9] also proved to be useful in patients' nutritional screening. A reduced risk of hospitalization was associated with weight gain while weight loss was associated with a higher rate of hospitalization, especially of low weight patients [10]. Another interesting recent study [11] that investigated characteristics and outcomes of malnourished patients, pointed out that malnutrition is still underestimated, and that among the criteria used to identify malnourished patients the most important were the reduction of energy consumption and weight loss.

The objective of this study was to investigate the weight evolution during hospitalization and its association with the type of disease and diet, analyzed over time using the Generalized Estimating Equations (GEE) method.

II. METHOD

Study design and ethical aspects:-

A retrospective study was carried out with data collection in medical records of adult patients hospitalized by the Unified Health System (SUS), in a surgery ward of a university hospital in the State of São Paulo, Brazil. The indicators of nutritional status, type of prescribed diet, type of disease and surgery, and body weight records during hospitalization were surveyed. The study was approved by the Research Ethics Committee (CEP) of the institution.

Study participants:-

We included hospitalized patients of both genders over the age of 20 years, without terminal illnesses, with at least three records of measurement of body weight on different days of hospitalization and with all clinical, nutritional data and type of prescribed diet, duly registered in the medical records. Patients admitted only for clinical investigation and those who had not undergone nutritional assessment in the first 48 hours of hospitalization were excluded. Thus, the sample size included 133 in-patients.

Procedures:-

All screening and risk assessment and nutritional status instruments were performed within the first 48 hours of hospitalization, using the nutritional risk screening (NRS), subjective global assessment (SGA), anthropometry and laboratory tests (hemoglobin, hematocrit and lymphocyte count). Anthropometric measurements included: body weight, body mass index (BMI), arm circumference (AC), triceps skinfold (TSF) and arm muscle circumference (AMC). The diagnosis at admission (type of disease), type of surgery, type of prescribed diet (whether oral, enteral or parenteral diet and fasting), prescription of hypercaloric and hyperproteic nutritional supplement, length of stay, age and gender were investigated. All this information was properly documented in the medical records of the hospital.

For the classification and analysis of the evaluated indicators, the cutoff points standardized by the relevant literature for the NRS (*with and without nutritional risk*) were adopted [12,13]; SGA (*well nourished and malnourished*) [14]; BMI (*normal, overweight and underweight, for adults and the elderly*)

[2,15]; AC, TSF and AMC (*percentile classification $\leq P15$, $P15-P85$ and $\geq P85$*) [16,17] and laboratory tests [18]. Finally, body weight measurements on 3 different days of hospitalization were recorded among all the variables studied.

Statistical Analysis:-

Initially, the characteristics of the studied population were described and compared in relation to the type of diet prescribed. Subsequently, weight gain was related to the type of diet prescribed and the type of disease.

Categorical variables were expressed as frequency and percentage, and continuous variables were expressed as mean and standard deviation. To compare proportions, the Chi-square test or Fisher's exact test was used; when necessary. To compare the numerical measures summarized between the groups on the prescribed diet, the Kruskal-Wallis test was used, followed by the Dunn test to locate the differences; when necessary. For the study of weight evolution during the hospitalization period, depending on the prescribed diet and the type of disease, the Generalized Estimating Equations (GEE) method was used in this study. The level of significance adopted for the statistical tests was 5% [19,20].

III. RESULTS

The study consisted of 133 in-patients with a mean age of 60.7 ± 12.7 years, 64.7% (n=86) male and 35.3% (n=47) female, who were hospitalized during approximately 15.1 ± 11.5 days. At the beginning of hospitalization, these patients exhibited a body weight of 69.4 ± 16.7 kg; BMI 25.4 ± 6.2 kg/m²; lymphocytes $1,658.4 \pm 912.2$ cells/mm³ and hemoglobin 11.4 ± 2.3 g/dl. The most frequent diseases were: vascular diseases 29.3% (n=39); colorectal neoplasms 24.1% (n=32); head and neck neoplasms 13.5% (n=18); digestive tract diseases 12.8% (n=17); digestive neoplasms 12% (n=16) and fractures 8.3% (n=11). In this population, 73.7% (n=98) of the patients underwent some type of surgical procedure, including rectosigmoidectomy (18.4%); head and neck surgery (16.3%); colectomy (14.3%); esophagectomy (9.2%); exploratory laparotomy (8.2%); cardiac surgery (7.1%); gastrectomy (7.1%); cholecystectomy (4.1%); amputation (3.1%); vascular surgery (3.1%); debridement (3.1%); osteosynthesis (3.1%); appendectomy (1%); ileostomy (1%) and tracheostomy (1%).

Regarding nutritional indicators at the beginning of hospitalization, 19.5% patients (n=26) were underweight according to BMI and 39.1% (n=52); 20.3% (n=27) and 42.1% (n=56), were classified as equal to or

below the 15th percentile ($\leq P15$) for AC, TSF and AMC, respectively. According to the SGA, 27.8% (n=37) patients were malnourished and with the NRS it was found that 46.6% (n=62) patients were at nutritional risk. Regarding the type of diet at the beginning of hospitalization, 66.2% (n=88) of the patients were on oral diet; 16.5% (n=22) on enteral and parenteral diet and 17.3% (23) on oral fasting. The use of oral nutritional supplementation was observed in 6.8% (n=9) of the patients. No patient died.

A comparison was made between all the variables studied (numerical, categorical variables, body composition and nutritional status at the beginning of hospitalization) and the types of diet in the first dietary prescription, with the aim of verifying whether any characterization variable at the beginning of hospital stay, was associated with the type of diet. When the relationship between the three types of diets prescribed in the first evaluation and all the variables was assessed, there was a significant difference only in body weight ($p=0.0470$), BMI ($p=0.0147$) and hemoglobin ($p=0.0377$) (analyzed by the Kruskal-Wallis test, followed by the Dunn test to find the differences); in gender ($p=0.0152$), type of disease (<0.0001), surgery ($p=0.0007$), in AC ($p=0.0094$) and in SGA ($p=0.0278$) (analyzed by the chi-square test).

In the relationship between the evolution of body weight during hospitalization and the type of diet prescribed, analyzed by the GEE method, there was no significant influence of the type of diet on weight evolution over time (hospital stay) ($p=0.0779$) (Table 1). In relation to the evolution of body weight over time (hospital stay) and the type of disease, there was a statistically significant difference ($p = 0.0100$), using the GEE method (Table 2). It was found that in digestive neoplasms, the reduction in body weight over time was greater in relation to other diseases.

Table 1. Association between body weight throughout hospitalization and the type of diet prescribed, analyzed by the GEE method.

Diets	Weight	N	X \pm SD	Median
Prescribed diet ^A				
Oral	Body weight ¹	88	71.23 \pm 16.82	70.00
	Body weight ²	88	71.05 \pm 16.71	69.58
	Body weight ³	88	70.77 \pm 16.69	70.65
Fasting	Body weight ¹	23	70.35 \pm 16.75	72.00
	Body	23	71.00 \pm 16.84	73.00

Enteral/Parenteral	weight ²			
	Body weight ³	23	70.27 \pm 16.39	69.00
	Body weight ¹	22	60.90 \pm 14.32	62.18
	Body weight ²	22	59.99 \pm 13.60	59.20
Prescribed diet ^B	Body weight ³	22	60.07 \pm 13.18	59.10
	Body weight ¹	88	70.61 \pm 16.97	68.73
Oral	Body weight ²	88	70.78 \pm 16.82	67.75
	Body weight ³	88	70.37 \pm 16.92	67.50
Fasting	Body weight ¹	22	72.61 \pm 16.03	73.35
	Body weight ²	22	71.40 \pm 16.34	73.10
	Body weight ³	22	70.92 \pm 15.68	71.83
Enteral/Parenteral	Body weight ¹	23	61.55 \pm 14.73	62.50
	Body weight ²	23	61.10 \pm 14.46	59.20
Prescribed diet ^C	Body weight ³	23	61.41 \pm 13.84	59.30
	Body weight ¹	97	71.28 \pm 15.90	70.00
Oral	Body weight ²	97	71.14 \pm 15.90	70.00
	Body weight ³	97	70.77 \pm 15.93	70.30
Fasting	Body weight ¹	8	70.28 \pm 13.14	71.00
	Body weight ²	8	69.86 \pm 13.81	71.00
	Body weight ³	8	68.70 \pm 13.73	68.05
Enteral/Parenteral	Body weight ¹	25	63.05 \pm 19.49	61.85

Body weight ²	25	62.44±19.13	59.20
Body weight ³	25	62.66±18.30	59.30

GEE: Generalized Estimating Equations-GEE.

A:- first prescription; B:- second prescription; C:- third prescription.

1:- first assessment; 2:- second assessment; 3:- third assessment.

$p=0,0759$ value (GEE); without significant influence of the type of diet prescribed on body weight during hospitalization.

Table 2. Association between body weight assessment during hospitalization and the type of disease, analyzed by the GEE method.

Diseases	Weight	N	X±SD	Median
Digestive tract disease	Body weight ¹	17	75.49±16.08	77.00
	Body weight ²	17	74.71±16.29	77.00
	Body weight ³	17	73.73±16.58	77.00
Vascular disease	Body weight ¹	39	71.36±14.93	70.00
	Body weight ²	39	71.16±15.05	69.90
	Body weight ³	39	70.75±15.05	67.90
Fracture	Body weight ¹	11	77.25±15.85	74.00
	Body weight ²	11	76.50±16.02	74.00
	Body weight ³	11	76.19±16.18	74.00
Colon rectal neoplasm	Body weight ¹	32	70.23±18.79	71.55
	Body weight ²	32	70.97±18.47	72.50
	Body weight ³	32	70.33±18.15	70.73
Head and neck neoplasm	Body weight ¹	18	64.02±14.87	64.95
	Body	18	64.12±14.28	63.35

weight ²			
Body weight ³	18	64.54±14.99	65.00
Body weight ¹	16	56.91±13.35	56.45
Body weight ²	16	55.81±12.96	54.15
Body weight ³	16	56.39±12.06	52.95

GEE: Generalized Estimating Equations-GEE.

1:- first assessment; 2:- second assessment; 3:- third assessment.

$p=0,0100$ value (GEE); significant difference in body weight for diseases. Differences between: - digestive tract disease and digestive neoplasia; fracture and digestive neoplasia; colon rectal cancer and digestive neoplasm.

IV. DISCUSSION

This study investigated the evolution of body weight during hospitalization and its relationship with adult in-patients' clinical and nutritional status variables. As evidenced by the findings, NRS was more sensitive than the other indicators in the diagnosis of malnutrition. The initial hypothesis of this investigation was to assess any influence of a few indicators of nutritional status and the type of diet prescribed on the weight evolution during hospitalization, and no influence was observed here. However, the type of disease on the evolution of body weight over time was observed, with a greater reduction in weight over time in digestive neoplasm; in relation to other diseases. In the present study, the GEE method was adopted as the method of analysis for the study of body weight over time, as a function of the type of diet prescribed and the type of disease. The selection of this method of analysis allowed better adjustments in relation to the distribution of variables. With this method of analysis (GEE), it was possible to model both the response (body weight) and the factor under study (diet prescribed and type of disease), with repeated measurements (assessments over time).

In a retrospective study [11] with adult patients, it was observed that 62% of the patients exhibited malnutrition due to chronic disease, and the most common criteria for identifying malnourished patients were weight loss and reduced energy consumption. It has been reported that during hospitalization, significant changes in nutritional status can occur [21], with important changes in anthropometric and laboratory indicators.

As indicated by ESPEN [1], low BMI in conjunction with weight loss can constitute a diagnosis of malnutrition in patients at nutritional risk; in addition, the Malnutrition Universal Screening Tool (MUST) [22] related to the ESPEN criteria for the definition of malnutrition should also be considered.

Multivariate models showed a decline in nutritional status [23] by SGA and loss of body weight, being significantly associated with longer hospital stays. In an investigation of the prevalence of malnutrition with the criteria of weight loss and BMI [24], preoperative malnutrition was associated with an increased risk of serious complications. And an additional study [25] further pointed out that self-reported weight loss can be considered an important prognostic factor in hospitalized patients. Another study that investigated the effects of nutritional support in hospitalized patients with malnutrition [26], reported increased energy and protein consumption, and body weight. There are also studies showing that there was no influence of the type of diet on weight loss in hospitalized patients [27] and that weight loss during hospitalization was related only to sex and type of disease [28].

The relevance of assessing body weight loss has also been reported in several studies with different clinical situations [29], which can also be associated with other markers of malnutrition, such as laboratory tests, body composition and muscle strength assessment, energy consumption and nutritional screening instruments assessment [30].

The limitations of this study include the loss of some data, inherent to the type of retrospective study and data collection in medical records. Another limitation refers to the fact that acceptance of the hospital diet was not evaluated, but only the dietary prescription adopted at the beginning of hospitalization. However, this type of retrospective observational study has the advantage of being able to show the findings and results of the hospital routine, as it actually occurs in the hospital, and not in a controlled manner.

V. CONCLUSION

The NRS was more sensitive in the diagnosis of malnutrition. The type of disease influenced weight loss, but the type of diet did not influence the evolution of body weight over time.

ACKNOWLEDGMENTS

We are grateful to the Pontifical Catholic University of Campinas-SP-Brazil.

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Incentive Regulations for Renewable Energy: A Critical Analysis

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Received: 15 Dec 2020;

Received in revised form:

18 Feb 2021;

Accepted: 01 Mar 2021;

Available online: 27 Mar 2021

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Keywords— *Compensation scheme, feed-in tariff, renewable energy, renewable portfolio standard, regulation, subsidies, swap, tendering.*

Abstract— *Regulations tools to incentivize the use of renewable electrical sources are used worldwide, with different mechanisms. This work evaluates the most used ones, based on experiences across the globe, defining them, evaluating their advantages and disadvantages and their impacts in the cost of electricity, in technology prices and in the change of the power generation mix. The discussed methods are Feed-in tariff, compensation schemes (net-energy metering and net-billing), Renewable Portfolio Standards and Renewable Energy Certificates, subsidies, tendering and fiscal measures. After the regulation evaluation, a brief analysis of the encouraged technologies is performed, analyzing how these tools distort the electricity market and the long-term impacts of encouraging the use of variable and inverter-based generation. Also, it is dedicated some effort in discussing the consequences of many incentives, as seen in Germany, Spain and Brazil.*

I. INTRODUCTION

The distributed generation through renewable electrical sources is assuming a notable space in the electrical generation mix worldwide. This tendency is guided by sustainable development policies focused in environmental preservation, in special climate change issues, which started mainly with the signature of the Kyoto Protocol in 1997. The objective aspired with the Kyoto Protocol was to reduce the emission of GHG gases in 5% from 2008 to 2012, and to reduce 18% from 2013 to 2020 considering the level of emissions measured in 1990, with the main goal of limiting the increase of the global temperature (United Nations, 1997) (United Nations, 2012). In the Paris Agreement, signed in 2015, the goal is to avoid the increase of the world average temperature over 1.5°C in the better case, and 2°C in the limit.

From this global initiative, Nations started to develop own political measures to reach these targets, focused in three major areas: reduction of emission of GHG, energy production through renewable sources and energetic

efficiency measures. As implications to these objectives, political incentives for the installation of renewable sources started to be created, in order to increase the penetration of renewable sources in the electrical generation mix and also leading to the change of the role of the consumers in the context of electrical energy generation. Consumers not only consume electrical energy, but also generate electrical energy and model their demands actively (Brown, Hall & Davis, 2020). Some examples of countries that had success in this expansion are the USA, China with aggressive policies of renewable sources expansion and the European Union, highlighting Spain, Germany, United Kingdom, and Italy.

To tackle the economical dimension for electrical energy generation companies, and for consumers, different strategies of political financial incentives have been developed around the world to make the renewable electrical generation economically viable. These types of incentives for the generator owners and utilities can be divided in the payment of special tariffs; indirect payment

through energy or billing credits; fiscal policies, tradable certificates of energy origin, imposition to generators to source a certain amount of energy from renewable energy sources (RES) and tendering. Furthermore, these strategies can be combined in hybrid approaches, to use their advantages and reduce their disadvantages.

All these strategies have advantages and disadvantages and each state have decided which one to use, based on previous experiences or research. The objective of this work is to present the definition of the main regulation strategies, their advantages and disadvantages based on successful and unsuccessful examples, to present a critical analysis of each case and discuss future implications of such regulations.

In chapter 2 it is presented the definitions of the main employed regulation tools to incentive renewable energy sources. In chapter 3, examples of use of each regulation tools are depicted, and their advantages, disadvantages and applicability are discussed using as references cases of application in different countries. Chapter 4 discusses future impacts caused using incentive regulations and the future acceptability of renewable energy sources worldwide. Finally, chapter 5 summarizes the main conclusions regarding this work.

II. DEFINITION OF INCENTIVE REGULATIONS FOR RENEWABLE ENERGY SOURCES

Different strategies of regulations have been established around the world to incentive the production of electrical energy by renewable electrical sources. The main ones are described in the following sub-sections.

2.1. Feed-in Tariff

Feed-in Tariffs (FIT) are characterized by the payment of a special tariff value by the Transmission System Operator (TSO) or Distribution System Operator (DSO) to electrical energy producers, according to the amount of energy generated through renewable sources and injected in the network for a certain period (normally between 15 and 30 years). The FIT can be fixed, where its value is established in the beginning of the period, or premium, where generators receive an additional value added to the market value for the electrical energy generated (Baitelo, 2011). Albeit being paid by the TSO or DSO, the FIT cost is divided equally among all final consumers, leading to the increase of the electricity bill. Anyhow, in this case, governments only act as regulators, not necessary funding this policy. FIT is used to ensure a return for the investors, creating a higher demand for this type of technologies and leading to a further development of technologies. Feed-In Tariffs are considered for some authors, especially by

Mendonça, Jacobs and Sovacool (2009), as the best legislation tool to incentive RES.

To define the FIT for a specific location, some features must be defined. Firstly, the type of technology, type/size of plants, which will be supported by FIT shall be defined. Secondly the tariff calculation method shall be established, as explained by Mendonça, Jacobs and Sovacool (2009), considering the investment cost for each plant, grid-related and administrative costs, operation and maintenance cost and fuel cost. This calculation may lead to different values of tariffs for different types of technologies and size of the plants (less mature technology shall be rewarded with higher tariffs and larger plants shall be rewarded with lesser tariffs). The duration of the tariff payment shall be established, but it can be changed for new installations according to the penetration or development of such technology. It is also suggested, in the definition of the FIT, that all energy generated by renewable sources shall be purchased and distributed by grid operators, having priority dispatch.

As a counterpart, the limitation of the amount of generation supported by the FIT, or even the cessation of this tariff, has the capacity of restraining new projects, previously viable because of the tariffs. Such decision can be made to hold back the expansion of distributed generated or can be caused by economic crisis (Caramizaru & Uihlen, 2020).

2.2. Electrical energy compensation

Some mechanisms to compensate electrical energy injected by generators, limited to a certain capacity, have also been developed in regulations in the world. In this case, there are two main mechanisms used: net metering and net billing. These mechanisms can have different formats as per Hughes and Bell (2006), where it is reported that 22 different formats were found in different countries.

In the case of net metering, the exceeding electrical energy generated by prosumers and injected in the electrical grid is used to discount the energetic consumption from future periods. Some authors characterize the net metering system as the system where the value of the energy exported and imported have the same value and only one energy meter is required (Dufo-Lopez & Bernal-Agustin, 2015). In some cases, where the levies related to the use of the grid is paid, the consumer shall have two different energy meters to allow the utility to measure the amount of energy consumed from the operator and calculate the levies.

Net metering has some modalities according to the regulation of the countries. In the simple modality, if there is a negative difference between the injected and exported

energy, the consumer shall pay to the utility; if the difference is positive, the consumer has no compensation (Dufo-Lopez & Bernal-Agustin, 2015). The buyback scheme is an extension of the simple modality, where the utility pays for the excess energy generated by the prosumer (Hughes & Bell, 2006). The rolling credit scheme is characterized as the case when the customer-generator has exported more energy than imported during the billing period, earning energetic credits that can be spent during a certain period to be defined by the regulation established in each country (Dufo-Lopez & Bernal-Agustin, 2015). The utilities have two possibilities at the end of the validity of the credits, give no financial compensation for the remaining credits of the prosumer or pay for the credits in the end of the defined compensation period, in this last case the scheme is known as net metering with rolling credit and buyback (Hughes & Bell, 2006). The use of one energy meter for the net-metering is presented in Fig. 1.

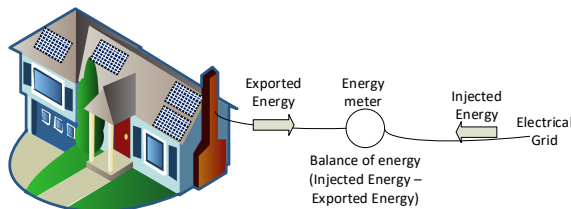


Fig. 1: Net-metering scheme

In the case of net billing, exceeding electrical energy generated by prosumers and injected in the electrical grid is used to discount the energetic consumption in monetary terms. Some authors consider net billing as the scheme where the generator buys energy for the retail price and sells the exceeding generator for a different price. In this case, two meters are necessary. In the simple modality, if there is a negative difference between the cost of the injected and exported energy (different values for injection and importation), the consumer shall pay to the utility the difference, and if the difference is positive, the consumer has no compensation. The buyback scheme is characterized as the case where the customer generator pays for the imported energy and the utility buys the exported energy. The rolling credit (with or without buy-back) is the same as for the net metering, but with monetary credits (Dufo-Lopez & Bernal-Agustin, 2015). Fig. 2 presents the use of two energy meters for the net-billing practice.

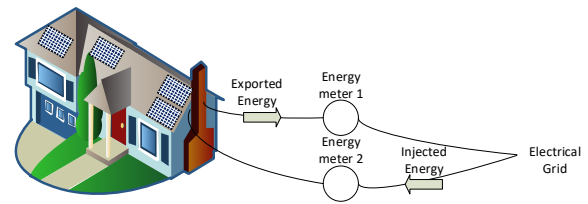


Fig. 2: Net-billing scheme

In the other hand, to detain the growth of DER installation, the exceeding electrical energy generated and injected into the electrical grid cannot be compensated or even the injection of electrical energy by the prosumers can be forbidden as in Colombia (Rickerson et al, 2014).

2.3. Renewable Portfolio Standard / Renewable Energy Certificates

Renewable Portfolio Standard (RPS) requires electricity suppliers to source a certain quantity of electrical energy generated from renewable sources, generally in MWh. These policies have the main goal to increase or maintain the participation of renewable energy in the electrical energy mix.

To design this type of policy, some factors shall be analyzed. Firstly, the eligible renewable electrical sources shall be defined according to the geographical availability of resources, typically wind, solar, geothermal, landfill-gas and ocean-based energy resources are used. Further on, the regulator shall define the amount of energy from eligible RES that shall be sold in the electricity market during a defined period. The amount can be given in absolute generation or installed capacity or even as a percentage share of electricity sales. Finally, it is necessary to ensure for the investors that the renewable energy market will continue to exist over the life of the installation, thus a government entity shall enforce penalties for utilities, which do not comply with the designated RPS. Therefore, some methods shall be used to track the renewable energy origin (Heeter, Speer & Glick, 2019). The most used method is known as Renewable Energy Certificate (REC), which have different nomenclatures according to the country where it is established and has a similar approach as carbon credits. REC purchasers can be voluntaries or by compliances need. The voluntaries are organizations that focus on reducing their GHG emissions, by establishing their own goals or even just by knowing the origin of their electrical energy (Energy Sage, 2020). The compliance buyers are the utilities participating in the RPS, that are obliged to source a quantity of electrical energy produced by renewable sources and can use RECs to prove the origin of the electrical energy.

Renewable Energy Certificates (REC) increase flexibility and ease tracking. A REC is a certificate associated with the generation and injection of each MWh from renewable sources in the electrical grid. It is enough for utilities to demonstrate compliance with the RPS to regulators to purchase certificates, instead of directly buying the electrical energy.

REC shall contain the information about the used resource, period of generation and its location. In some states, it is allowed for the generators to unbundle the generated energy from the REC, being allowed to sell two different goods. This action frees generators to deliver electrical energy directly to users in real time, allowing the renewable electrical energy to be generated where it makes more sense, avoiding costs for new installations of transmission and distribution and giving a geographical flexibility for the generated energy (United States Environmental Protection Agency, 2008).

This practice is presented in Fig. 3 and Fig. 4. RPS associated with RECs benefits

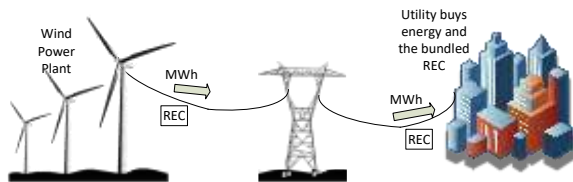


Fig. 3: Utility buys the REC bundled with energy

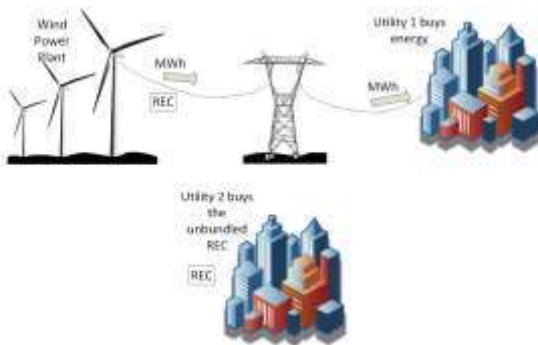


Fig. 4: Utility 1 buys electrical energy and utility 2 buys the unbundled REC.

2.4. Tendering

Renewable energy tendering is a mechanism where governments call for tenders to procure a specific quantity of electricity or capacity to be built at a strike price or government may offer a fixed budget to bidders and the quantity of electricity for that budget is bid. In general terms, the participants submit a bid with a price per unit of electricity, through which they are capable to make the project affordable. The bids are evaluated and then it is signed a Power Purchase Agreement (PPA) between the

winner and the government as stated by the International Renewable Energy Agency (2015) and by Hochberg and Poudineh (2018). The winner is chosen by the lowest-price bid. This is a more competitive approach, allowing generators to further develop their technologies.

The tendering mechanism for long-term contracts is a regulatory intervention in response to the absence of efficient short-term market price signal. This ensures long-term revenues for generators, especially for renewable electrical sources, which have problems to dispatch energy in times where the electricity price is higher (Hochberg & Poudineh, 2018).

To design auctions some features shall be considered according to International Renewable Energy Agency (2015) and to Hochberg and Poudineh (2018). First, the volume of auction shall be defined in terms of MW, MWh or budget, additionally the number of rounds shall be established. Next, the types of technologies able to compete shall be defined among the following options: technology neutral (any technology), technology specific (a certain kind of technology, example only renewable sources) and standalone (only one type of technology is allowed).

The conditions allowing suppliers to participate shall be defined, being the auctioneer responsible to define minimum requirements (reputation, experience), the necessary documentation and penalties for not completing the goals in the contracts. More participants tend to be part of auctions, if there are lesser barrier to enter and if the perception of the risk is low. This is important to prevent collusion and price manipulation

The auction procedure shall be established. The following options exist: sealed bid is when suppliers shall provide bid information to auctioneers and the offers are opened in the day of the auction. There are some variations to this type of auction, in some the winner is the one who bided the lowest value, however the PPA is signed according to the second least value. The other one is known as pay-as-bid, where the supplier is compromised to the value that it has offered. Another type of auction is the iterative process, where bidders are able to gradually disclose their bids during the rounds. The most common used is the descending clock auction, where in each round the auctioneer proposes a lower price in each round and bidders make their offers until the supply and demand match. There is also the hybrid approach, where characteristics from both methods are used.

After being selected, the winner and the auctioneer sign the PPA. It is important that auctions occur frequently, in order to allow the suppliers to foresee future auctions and further develop their products.

2.5. Fiscal policy and Subsidies

Fiscal policies as incentive correspond to credits or taxes exemption, to allow the consumer to overcome the initial cost of the investment (Baitelo, 2011). While subsidies are characterized as the ceasing of money by the government with the intent of keeping the products prices accessible to the people. Acting in this manner, the consumer has access to cheaper credit or even directly to cheaper products. Another approach is the act of divestment of subsidies given by governments to a certain type of technology and invest this remaining money in a different technology. This exchange is known as swap.

Additionally, the introduction of new consumers able to generate their own may lead to a tariff system restructuration can lead to new taxes targeted in prosumers. And in the case of subsidies, they can be temporary or even not be granted by the government.

2.6. Hybrid Approaches

By knowing the objective of each regulation tool, their advantages and disadvantages, governments may use hybrid approaches to tackle different types of renewable energy sources according to technology prices and sizes of power plants (utilities or consumer scales).

III. IMPACT ANALISYS OF THE REGULATION TOOLS

This sub-section discusses the positive and negative impacts of each type of incentive regulation based on cases around the world.

3.1. FIT

The FIT policy was considered as the main responsible for the growth of prosumers in many countries, as Germany, Spain, China and in some American states, as California, among others, as it gives an investment return safety for investors during a certain period. By having such security, the demand for these technologies grows, technology development is incentivized, and concurrence arises. This type of incentive can support different technologies and plant sizes, as stated by Mendonça, Jacobs and Sovacool (2009).

This kind of regulation is used mostly in the European Union (EU), highlighting the case of Germany, where this type of regulation is a mature case to be discussed. Since 1990, Germany established distributed generation incentive policies, starting by the 1000 Roofs Program combined with the Feed-In Electricity Act (from the German *Stromeinspeisegesetz*) in 1991, which were the first laws to introduce the feed-in tariffs for distributed and renewable generation. With the rise of environmental

policies in the EU, focused on the reduction of GHG emission, increase of energy generation by renewable sources, and energetic efficiency, Germany promulgated in 2000 the Renewable Energy Sources Act (from the German "*Erneuerbaren-Energien-Gesetz*"), which is known as EEG (Peter et al, 2015). With the EEG, the German target to 2020 was to increase the penetration of renewable sources in its electrical energy matrix. The objectives are to reach 35% of this type of generation until 2020, 55% until 2025, from 65% until 2040 and finally to reach 80% until 2050 (International Renewable Energy Agency, 2015).

The EEG was the tool to reach the set goals, by establishing two types of FITs paid for the generated electrical energy by renewable sources: the fixed and the premium. In the fixed tariff, utilities buy the amount of energy generated by consumers using renewable sources for a fixed tariff for 20 years, to ensure security for the investment. In the premium tariff, generators can sell electricity directly in the energy market, receiving a bonus. Additionally, renewable energy generators were granted priority dispatch and connection to the closest grid point, entitling grid operators to pay for infrastructure improvements (Peter et al, 2015). The amount paid for generators by end users was established as the EEG surcharge, which is the difference between the cost of the FIT paid to energy producers and the market price of the electricity.

In 2004, the first reform of EEG was implemented. In this reform, the photovoltaics installations received more stimulus than other RES, caused by the low interest in this kind of source in the period (Ramalho et al, 2017), being the FIT divided by the size of the installation. This reform has also established an annual 5% regression in the FIT (Ramalho et al, 2017).

In 2009, the new version of the EEG issued established a higher reduction in the FIT and a complete modification in the annual regression, where the amount paid started to vary, when a defined threshold of annual capacity installed in the previous year was reached (Ramalho et al, 2017).

The new reforms from 2012, 2014 and later in 2017, created the term EEG 2.0. In 2012, the main modification was related to the regression rate of FIT, which became determined monthly based on the growth of capacity of RES in electrical generation mix. In 2014, all systems with a capacity higher than 100kWp could only apply for the FIT premium (the smaller ones could still choose between FIT fixed or premium) and all systems above 10kWp should pay a tax on self-consumption, in order to compensate the surcharge caused by the introduction of the FIT (Ramalho, 2017). The EEG 2.0 in 2017 introduced the

tendering system for renewable generation sources installation exceeding 750kW, over the FIT model (Agora, 2015).

The implementation of FIT in Germany, along with the reduction in the prices of the technologies, led to a vigorous increase in the percentage of the total electrical energy generated by renewable sources as presented in Fig. 5. In 1990, from the total amount of electricity generation, 4% were generated by RES. In 2019, 41.8% of the total amount was generated by renewable sources, highlighting the wind sources with 20.3% of participation.

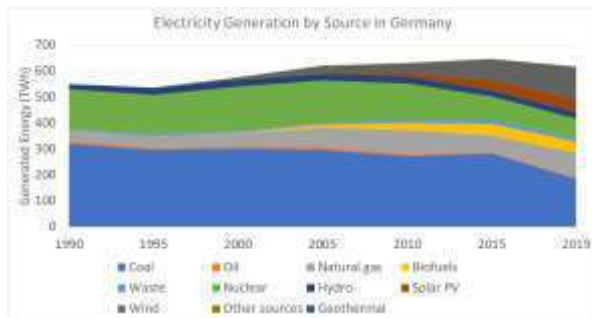


Fig. 5: Participation of renewable sources in the electrical generation mix. Based on the International Energy Agency (2019).

Currently, wind energy occupies a prominent position in the total share of electrical energy generation, incentivized since the 00's. Solar energy started to compose the generation mix after 2004, when FIT for photovoltaic technologies increased. With the reduction in

its price, specially caused by the expansion of Chinese industry, proportionally higher than the reduction of the FITs, a great expansion can be seen, leveraged by the increase in the number of prosumers, as presented in Fig. 6.

The highest disadvantage for this tool is the increase in the energy price for all end users, to cover the Feed in Tariff for producers. The EEG surcharge corresponds to more than 20% of the tariff in 2019, thus, even with the reduction of the retail electricity price since 2011, the total tariff increased approximately 20% until 2020. The evolution of the average electricity tariff for German consumers, with a yearly consumption equal to 3500kWh is presented in Fig. 7. In developing countries, such magnitude of increase could lead to a social problem. Thus, the overall benefits shall be analyzed by the legislator before defining the chosen regulation for this incentive.



Fig. 6 Share of PV systems in Germany by cumulative capacity and number of systems. Based on the Institute Fraunhofer (2019)

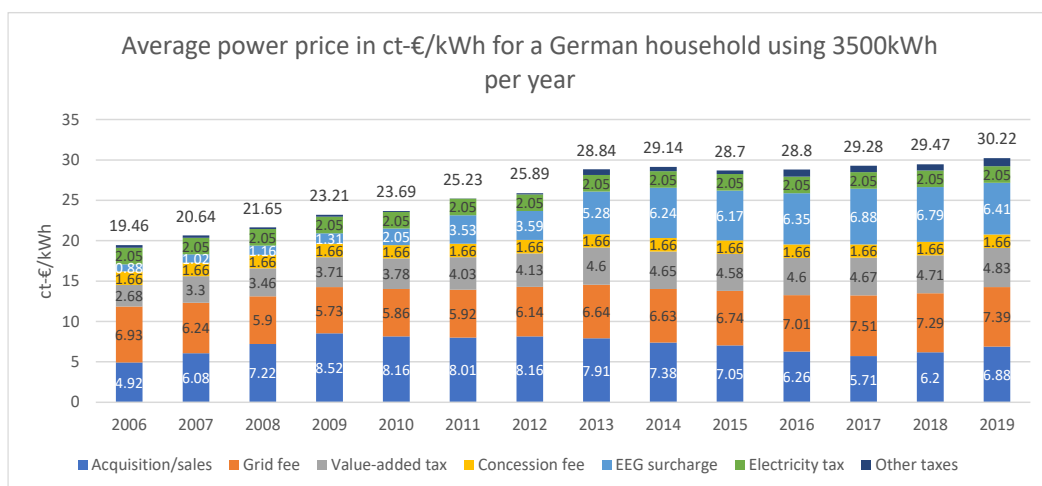


Fig. 7 Composition of average electricity tariff for a Germany consumer of 3500kWh per year. Based on the German Association of Energy and Water Industries (2019).

3.2. Compensation

Net metering and billing scheme encourage the rise of prosumers and distributed generation, as it is applicable

specially for small generation plants. Thus, if a country has the interest of expanding the participation of renewable energy in the electrical energy mix, other policies shall be established reaching large-scale power plants.

One state that has established an incentive regulation of net metering since 1996 is the state of California, in a program called Net Energy Metering (NEM).

NEM 1.0 was introduced in 1996 with the objective of encouraging the installation of costumer-sited renewable resources, known by the term distributed energy resources (DER). The scheme net metering with rolling credits was adopted for residential photovoltaic system with less than 10kW of installed capacity, where energy credits were valid for 12 months. In the end of the period, utilities should purchase them at the avoided costs rate or if no credit was left, the prosumer was charged with the standard rate (Camara, 2017). These rules were valid until the amount of energy generated by DER reached a cap of 0.1% of utility's aggregate consumer demand (Aurora Solar Inc., 2017). Many changes in the regulation were performed since 1996 to allow more consumers to become prosumers. These modifications are listed below according to Camara (2017):

- Modifications in 1998 and 2001 allowed a higher number of consumers to become prosumers, including commercial, industrial, and agricultural sectors and enabled installations with installed capacity up to 1MW to integrate the NEM.

- In 1998, the obligation of utilities to pay the excess generation was extinct, however in the contract between the consumer and utility, a tariff could be agreed between both parts. In 2009, the payment of the excess of generated energy was re-established, being paid the value equal to the 12 months electricity retail rate moving average and the credits could be rolled for more 12 months.

- Finally, in 2013, the system level capacity cap was increased to 5% of the utilities aggregate peak demand and utilities could charge a monthly fee for the prosumers.

In 2016, by the approximation of the established cap, it was decided to revise the NEM program, creating NEM 2.0. NEM 2.0 was written based on the experience with the NEM 1.0. Overall, the highest problem observed was the electricity rate shift from the prosumers to the default customers. This happens because the prosumers stop paying or pay less fixed costs for transmission and distribution systems, and these costs are transferred to the default customer. It was estimated that the regular customers had an increase in their bills of \$65 yearly and the amount tends to surge as the number of prosumers continues to grow. This occurs mostly in the residential market, where 98% of the installations of new PV system occurred in 2019 (Petek, 2020).

NEM 2.0 defined that the new prosumers would have to pay a fixed interconnection fee, in the moment of the installation of DER (around \$75 to \$150); prosumers

would pay a non-bypassable charge, which is approximately 3 cents per kWh consumed from the grid, independent from the energy exported to the grid; prosumers would be automatically enrolled in the Time of Use (TOU) pricing, aiming the reduction of the income of prosumers during off-peak hours (Camara, 2017) (Petek., 2020).

Fig. 8 presents the amount of new installations supported by NEM 1.0 and 2.0 and the cumulative capacity. After 2009, the number of new installations grew rapidly, considering the definition of the mandatory payment for excess energy and fiscal policies adopted in California. It is possible to highlight 2014 and 2015 with the highest increase in the number of systems.

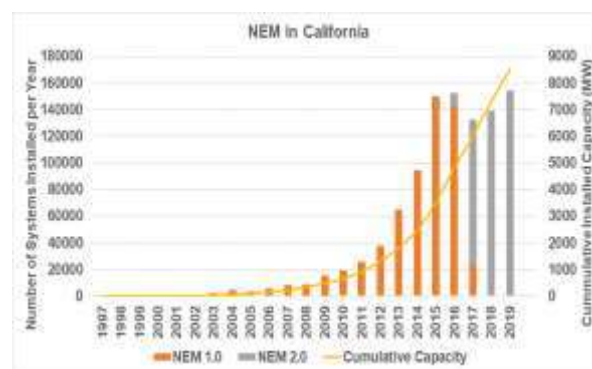


Fig. 8: Systems installed yearly using NEM 1.0 and 2.0. Based on Itron (2020).

Another cause of this rise is the increase in the price of electricity, depicted in Fig. 9. Especially after 2014, the electricity price took a rise tendency, being one of these factors the fixed cost shift to the regular consumer.

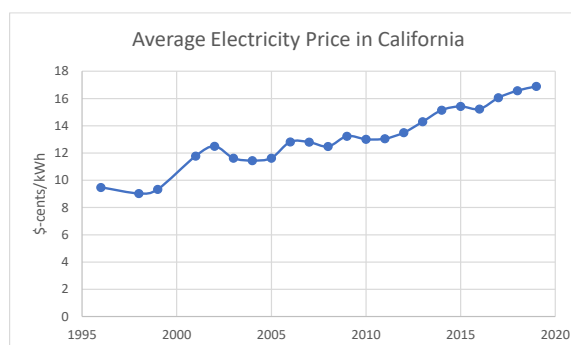


Fig. 9: Electricity price in California from 1996 to 2019. Based on (United States Energy Information Agency, 2020).

3.3. RPS and RECs

As explained in the previous section, RPS impose utilities to source a certain amount of energy from

renewable sources. This strategy does not require financial investment from the government and is characterized as a market-oriented strategy. This encourages competition to develop renewable technologies, as in this case the utilities will prefer to buy energy or RECs from cheaper electrical sources.

States in the USA were ones of the first to implement such policies in their territories. The first state was Iowa in 1983, and after the publication of California's intended policies related to renewable sources in 1995, the number of states with such regulations increased (Wyser et al, 2007). Currently 29 states plus the District of Columbia impose mandatory RPS and another 8 states allow voluntary RPS. From these states, five have already reached their goals for 2020 and the remaining have goals until 2040/2045 (Zhou & Solomon, 2020). These goals can be changed through the years, with the intentions to expand or strengthen them, or they can be changed to incentivize a specific electrical energy resource.

During the 00's, the USA have seen an increase in the capacity of non-hydro renewable electrical generation. RPS established a total of 168TWh increase from 2000-2018, however the total amount rose by 371TWh in the period. A relationship between the technology development and the RPS is stated, being the reduction of costs seen as one of the factors of the growth of the participation of renewable generation apart from the goals established in the RPS. Along with the reduction of the costs are other policies implemented by the states and voluntary green power markets (Barbose, 2019).

Fig. 10 presents the annual addition of renewable capacity in the USA. It is possible to see, that the percentage of renewable energy generation installed as established in RPS reduced along the last years. Since 2014, the participation of non-RPS in RES installation was over 50%, reaching the smallest number of 30% in 2018. The evolution of technologies and their consequent reduction of prices makes their voluntary installation attractive for investors.



Fig. 10: Annual renewable capacity additions in the USA.
Based on (Barbose, 2019)

Finally, the advantages seen for the RPS regulation is the market-oriented policy enabling scale economy; the control of the expansion in the beginning of the cycle; RPS can be applied in a monopoly or open electricity market; contracts concern only energy producers and utilities. Additionally, international initiatives are created to allow the trade of certificates outside the own country's territory, by using International RECs (I-RECs). These initiatives tend to integrate the world in the same goal and to benefit countries with a green electrical energy generation mix. These standardized certificates are traded in North America, Europe, Latin America, Asia, Africa, Middle East and Latin America (Brazil) (Jensen, 2020).

The disadvantages are its complexity to be implemented; investors shall have long-term investment return insurance; it may not support the diversity of renewable sources if the state promulgator does not mandate it and may only support large power plants (higher than 1 MW) (Wiser, Porter & Grace, 2005). In a first moment the cheapest electrical source will be preferred over others, however with their technology development and consequent cost reduction, these other sources start to be incorporated in the electrical power generation mix. This happened in the USA, where in the first years the wind electrical generation was preferred, however in the coming years the solar PV plants started to be used and represented a greater capacity addition.

3.4. Tendering

Tendering regulation is a market-based mechanism, based on competitive auctions in the scope of utility-scale renewable energy development. It allows governments to concede the electrical energy production to third-parties for a certain period, with the winner being the lowest price bid, thus enabling the consumers to pay less for electricity.

Tendering processes are currently used in many countries, and the case of Brazil is discussed. In 2002, after the energy crisis lived in previous years, the Brazilian government introduced competitive auctions for generation procurement. Among others, the reform determined a comprehensive auction system.

The organizations, who actuates in auctions are the Ministry of Energy and Mines, responsible to define technical requirements and general conditions at a high level of planning; the National Agency of Electrical Energy (from the Portuguese *Agência Nacional de Energia Elétrica*) is the regulator of the auctions, coordinating the auction documents; after submission of specifications of the developers, the Company of Energy Research (from the Portuguese *Empresa de Pesquisa Energética* - EPE) evaluates the proposals and technical certifications; the MME endorses the EPE's analysis and the Chamber of Commercialization of Electric Energy (from Portuguese *Câmara de Comercialização de Energia Elétrica*) operates the auction via an electronic platform.

In the Brazilian model, bidders must demonstrate preliminary grid access, environmental permitting and impact assessment, land use rights, and financial qualifications.

The total volume of auctions is defined based on the load forecasted by distribution companies. In reserve auctions, which have the objective to increase the electric system's reserve margin, the government through CCEE decides the auctioned volume and by consequence a reserve energy charge is to consumers connected in the grid. These auctions do not require FECs.

The auction volume is determined in two ways for renewable energy auctions. The first one is a demand function, regulating total offered volume to ensure a suitable supply-demand ratio. In this case, the auction's supply shall be equal to the total offered total volume times the demand function determined by the auctioneer. The second method divides total volume to different renewable sources, according to the proportion of bids from each technology type. For solar and biomass, it is also defined a maximum share that these technologies can represented in the auction (Hochberg & Poudineh, 2018).

The bid format consists of a two-phase hybrid auction design. In the preliminary phase, bidders submit the amount of electricity they would like to offer at the ceiling price, disclosed ahead of the auction. In phase one, the descending clock method is used, where the auctioneer announces a high price, and the bidders must decide if they will supply the quantity presented in the preliminary phase with the price. In the following rounds, the price continues to decrease. The phase ends when the offered energy

exceeds the auctioned demand by a margin. In the second-phase, winners of phase-one bid a final sealed-bid price, that cannot exceed the price established in phase-one and are not allowed to change the amount of energy from the preliminary phase. In this phase, bidders do not know the quantity of surplus demand, being incentivized to lower their bids.

Auction bids for variable energy resources are also subjected to settlement rules due to their variable generation to define their price for evaluation by means of a correction factor (positive or negative). This factor correlates the average spot price profile and the project profile, ensuring that different generation bids are evaluated in the same basis. For predicted future spot prices high, variable energy resources' auction bid receive additional compensation. In the other hand, if the future spot price is low, they are penalized. Anyhow, the remuneration of the plant will be based on its original price bid (International Renewable Energy Agency, 2015).

The winning auction bidders sign contracts with the participating distribution utilities, being the total amount of purchased volume distributed proportionally among them. The winners also have a lead time to finish their projects (normally three of five years). The contracts must be backed by firm energy certificates (FEC), which represent the maximum amount of energy offered by means of contracts, issued to all generators connected to the grid (Hochberg & Poudineh, 2018).

Penalties are applicable when there is a difference of 10 percent between the contracted energy and annual generation or if the average production in 4-year basis are less than the contracted. In these cases, generators shall pay the amount of energy undelivered times the contract price or average spot price. For delay or non-completion, it is considered the same logic from before, but considering that 100% of the energy was not delivered (Hochberg & Poudineh, 2018).

In Brazil, from 2004 to 2017 74 electric generations auctions were held, with 8,700,000 GWh of electric generation and US\$ 488 billion in investment. During this time, the renewable electricity price decreased (e.g. the average price of wind generation was 52.62R\$/MWh, in comparison to the first value of 150R\$/MWh) (International Renewable Energy Agency, 2015).

The tendering mechanism is considered one of the most effective in developing utility-scale electrical sources, as it is a market-oriented tool. Even countries like Germany, whose policies were based on FIT, are changing to the tendering process for large-scale plants, as the electricity price for renewable sources is decreasing.

The main advantages of this method are its flexibility, allowing combinations from single, specific types of technologies and neutral technologies to compete for the tendering; it allows the government to discover the electricity price for each type of technology; it also gives the opportunity to governments to control both price and quantity of capacity inserted in its energy power mix; finally, it is a transparent method with commitment between auctioneer and winner parts.

The disadvantages are that it favors the continuation of the current centralized generation, transmission, and distribution model; it can incur high transaction costs with administrative costs for both auctioneers and bidders; and it can lead to a risk of underbidding and delays in the process, which can be penalized.

3.5. Fiscal subsidies

Fiscal subsidies may be used along with the other types of incentive regulations, complementing them.

In Brazil, some fiscal measures were taken, e.g. Agreement number 16/2015, in which the states that adhere to it are allowed to concede exemption from taxes incident to electrical energy supplied by the utility to the consumer unit, in the corresponding amount of the electrical energy injected in the electrical grid by this prosumer (Economy Minister of Brazil, 2015). In California, due to the high number of incentive policies, there was the need to reform the tariff system, where the consumers started to pay a fixed tariff per month, even if no energy consumption from the grid was measured; they were also obliged to adhere to time-of-use tariffs, they also pay for a unique tax to connect their DER installation to the grid and additional tariffs based on the electrical consumption from the grid (Camara, 2017). In the case of Spain, in 2012 new taxes were created and imposed to the self-consumed electrical generation of the owner of the installation (this tax was known as the sun tax) (Rickerson et al, 2014).

The USA federal government has been subsidizing the payment of DER with the Solar Investment Tax Credit (ITC). Since 2006, the Americans that install PV system in their household, can deduct part of the installation value in federal taxes. Between 2006 and 2019, it was possible to deduct 30% of this value, in 2020 the percentual value declined to 26% and in 2021 it will be equal to 21%, being 2021 the last year of this subsidy (Solar Energy Industries Association, 2020).

Another approach would be the swap of subsidies from fossil fuels to renewable energy sources. This action is suggested for governments by environmentally friendly organizations, as Greenpeace, Go Fossil Free, among others (Hopke & Hestres, 2017). A case of swap of

subsidies from fossil fuel to renewable energy is the case of India, even being an emerging economy country. From the fiscal year 2014 to 2017, the support to petroleum products decreased by almost three quarters, while at the same time, the support for renewable energy has increased almost six times (Bridle et al, 2019).

3.6. Summary

Table 1 summarizes the main features of each regulation tool, where the arrows indicate a rise (↑) or a decrease (↓) in the prices and the number of arrows indicate the influence of each regulation tool in the presented parameters.

Table.1: Summary of regulation tools

Regulation Tool	Electricity Price Influence	Technology Price Influence	Size of the plant benefited
FIT	↑↑↑	↓↓	Large and small plants
Compensation Mechanisms	↑↑	↓	Small scale
RPC / REC	↑	↓↓	Large scale
Tendering	↓	↓↓	Large scale
Fiscal	↑	↓	Large and small plants

IV. DISCUSSIONS ABOUT THE FUTURE OF INCENTIVE REGULATIONS

Incentive regulations for renewable electrical sources are tools used by governments to incentive the expansion of renewable sources in their electrical power generation mix. As seen in previous sections, these tools incentive indeed this rise, however it can lead to distortions in the electricity market.

FIT tools are one of the most flexible, as they can be used directly for any technology and for any size of power plants. This tool can lead to the expansion of distributed generation, quick development of technologies and by consequence reduction of their prices. However along with that, there is a rise in the electricity price for the end user, especially during the beginning of the use of new technologies. Thus, this method is applicable for developed countries, which have the goal to change its electricity power mix in short-term.

After the development of technologies and capacity to concur of conventional ones, in the scale of utilities generation, tendering process are the most suited compared to RPS. Both are market-oriented practices, but the auction method enables end users to pay the cheapest value for the electricity price, it also allows the government to control the amount of energy from renewable sources, having more control in this case to establish its electrical energy policy compared to RPS scheme. In the other side, both mechanisms do not favour distributed generation.

To concur with FIT for distributed generation expansion, the government can establish compensation mechanisms, net-metering or net-billing. The regulator has the capability to create a program that does not burden other consumers in the same magnitude as the FIT, as the example of the last regulations from California.

With this basis, it is possible to conclude that currently the most suited regulation tools to incentive renewable sources are tendering process (utility scale) and compensating schemes (distributed generation).

Along with the regulation incentives, some other questions rise, regarding the encouraged RES:

- For how long should they be kept?

The regulation shall be kept until their cost of generation, considering the whole life cycle, is able to compete with the conventional electrical sources.

- What are the impacts of these technologies in short/long term in relation to the traditional electrical energy sources?

In short-term, the high penetration of inverter-based generators affects the quality of energy, even if other regulation imposes features to inverters to emulate conventional generation, thus their response to transients shall be evaluated carefully.

In long term, it could be interesting to expand the use of firm electrical power sources (e.g. nuclear power plants, as they do not pollute the environment for electricity generation), in parallel to variable electrical sources, aiming a certain level of grid stability while techniques of energy storage and demand response become structured and with good value. The literature indicates installed capacity levels of renewable sources from 20% to 30% of the total installed capacity as a physical and economical limit for the penetration of RES (Prado, Filho & Pereira, 2020).

Additionally, the high penetration of RES affects the formation of the electricity price in two ways. Electrical Systems Independent Operators define the spot price based on energy offers per type of electrical energy sources compared to the demand for a future period (normally the day-ahead), being all the available generators equally remunerated. With a higher penetration of renewable energies sources, the spot price of the electrical system tends to reduce, as the electrical energy price for renewable sources is lower compared to traditional sources. The definition of the least cost price is known as Merit Order Effect (MOE). This effect tends to compromise the remuneration of the traditional sources (Prado, Filho & Pereira, 2020). Simultaneously to the reduction of the spot price, a competition between thermal

power plants can arise, to allow them to compete with other electrical sources, prioritizing the least capital cost ones. Fig. 11 presents qualitatively the formation of the electricity price with the presence of RES in the electricity generation mix, where each source offers their generation with specific prices and availability, being the y-axis associated to the price, the x-axis with the capacity and the D curve with the demand.

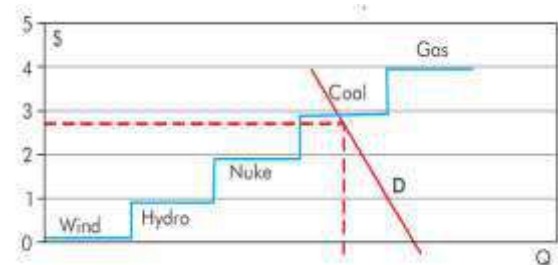


Fig. 11: Formation of marginal cost of operation with the presence of RES (Prado, Filho & Pereira, 2020)

In the case of Germany, the increase in the electricity price (surcharge) was compensated with the reduction of the electricity spot price. However, as presented in section even by reducing the spot price, German residential electricity tariff doubled from 2000 to 2013, what made necessary revisions in the EEG during this period. The rise in the electricity price to compensate the FITs tend to impact more the electricity price.

This increase in the penetration of RES in electrical generation mix worldwide can also lead to negative spot prices, specifically in countries that do not impose limits for spot prices (Prado, Filho & Pereira, 2020). This situation can happen when the demand is low, and the electrical energy offer is high, especially caused by non-dispatchable power plants (RES); low flexibility of traditional electrical power plants to adjust their energy production; obligations associated to ancillaries services; co-generation contracts; and long term contracts with pre-established electricity prices (Prado, 2020). Fig. 12 depicts this situation, in which the market clearing price is established in the point where the power demand curve and the power supply curves meet. These curves are determined by all bids to sell a certain amount of electrical energy (power supply curve) and to buy a certain amount of electrical energy (power demand curve):

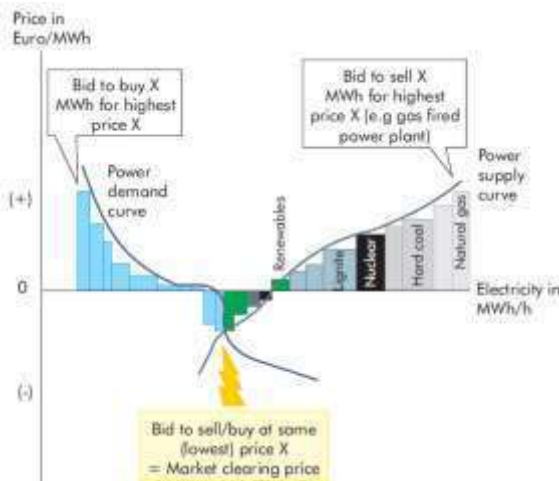


Fig. 12: Formation of marginal cost of operation with the presence of RES (Amelang & Appunn, 2018)

The negative electricity price may not be a problem for generators. In case of incentives like FIT, even if the electricity price becomes negative, the generator shall receive an income, equal to the difference between the FIT and the negative price. Thus, in the case that negative prices are observed, these generators will not stop their energy production.

In countries like Germany, it is expected 1000 hours/year with negative electricity price in 2022. The negative prices are decreasing, from (-) 17.8 Euro/MWh in 2016 to (-) 26.5 Euro/MWh in 2018 (Prado, Filho & Pereira, 2020). This fact also affects the energy transactions, where Germany pays more for the importation than for the exportation of electrical energy, reducing the electricity price in other countries.

Another impact of RES in relation to traditional ones is the rise of the stranded costs, associated to investments and changes in the market that impacts the maturity of long-term investments and long-term contracts. This is an argument used against fossil fuel and nuclear divestment or swap of subsidies, which could be the most impacted power plants (Fischer & Baron, 2015). Fossil fuels power plants, specially based on coal, had high fixed costs to be built and to be kept in operation, thus the stranded costs associated to these plants will be the most significant with the decarbonization of the electrical generation mix. In Germany, the most significant stranded costs are associated to the nuclear industry, as they all shall be shut off in German territory by 2022, leading to difficulties to retrieve the investments for the responsible companies (Hammond & Rossi, 2016).

To deal with MOE and stranded costs, it is important that governments respect the contracts signed with traditional electrical sources until its end, creating

conditions to deal with the MOE if necessary, and future contracts may include different modalities to deal with MOE

- How are the utilities impacted with the increase of distributed generation?

With the expansion of distributed generation, the utilities income may erode, as prosumers shall consume their own energy, and their distribution systems may become overestimated, leading to tariffs raise. With the rise in the electricity tariff, more consumers may install their own generation devices, leading to the death spiral for utilities (Castaneda et al, 2017). Net metering systems may cause more unbalance to the industry, however along with net-metering systems, tariff restructuration shall be performed to ensure that the consumers do not pay the energy for the prosumers connected to the grid, e.g. prosumers may pay a monthly fee to be connected to the grid, even not consuming electrical energy; prosumers may be obliged to adhere to Time-of-Use tariffs.

- Are the chosen renewable energy technologies with incentives the most suitable for our world?

Variable RES have as characteristic low surface power density (m^2), so, to produce a great amount of energy, a great size of area shall be used. Thus, the expansion of renewable energy sources is limited.

The life-cycle of the renewable technologies (especially wind and solar) shall be evaluated, including what shall be done with them in end of their lives. In this case, a destination for old solar panels and wind blades shall be evaluated by the government along with the producers, avoiding the discard of such components without recycling.

- Are these technologies still going to be socially accepted in the future?

In the short past, high hydroelectrically power plants were acceptable, however their use started to be questioned as their environmental impacts have been experienced. The mentality “green x green” for the current acceptable renewable sources can arise and they can start to be considered aggressive to the environment. For example, impacts in the extraction of kinetic energy from winds could lead to global impacts or even the density of energy is much lower than compared to conventional plants.

V. CONCLUSIONS

Incentive regulations for renewable electrical energy sources have been used all over the world. Different countries have used different mechanisms with distinct

results. These results helped to create best practices guidelines for each type of regulation and studies presented their benefits and disadvantages.

For distributed generation, the most suited policies are FIT and compensation schemes. FITs have been used in many countries, highlighting the European experience. This experience has shown that the number of installations and development of renewable sources under this policy rise quickly, however with financial impacts for the remaining end users. Compensation schemes also create financial distortions, however its design can be changed to compensate these distortions.

FITs can also be applied for utility-scale power plants, with the same drawbacks presented for distributed generation. RPS and tendering process allow the government to better control the amount of electricity produced by renewable sources, however RPS frequently lead to the development of the least cost renewable source, what can delay the development of other types. Tendering process has a good approach, as it gives flexibility to the government and also gives to the end users the opportunity to pay cheaper electricity prices.

For future works, the regulation period can be discussed, evaluating the optimal period where their impacts for end users reduces. Additionally, technical solutions for the current chosen renewable sources shall be evaluated, especially for the long-term impacts of their use.

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Parental Experience after Separation / Divorce

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Received: 09 Dec 2020;

Received in revised form:

11 Feb 2021;

Accepted: 07 Mar 2021;

Available online: 27 Mar 2021

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Keywords— Parenting practices, Parental
involvement, Divorce.

Abstract— This article examines the theoretical foundations that address the relationship between parents and children after marital separation, proposes to discuss the parenting practices of separated / divorced mothers and fathers with their children. For this purpose, 20 subjects (2 parents / 18 mothers) with school-age children were surveyed, who answered the Inventory of Parenting Practices. This instrument evaluated parental involvement in five areas: affective involvement, didactic involvement, social involvement, disciplinary involvement and responsibility. The results show greater maternal than paternal involvement with the children after the divorce, both direct (care, interaction) and indirect (monitoring, concern).

I. INTRODUCTION

Data from the Brazilian Statistics Institute (IBGE 2000) comprovam that currently the number of divorced or separated people have become increasingly larger, recognizing that a new type of family organization arises when couples who have children disrupt conjugal union. At this time, the rights and duties of each member of the family must be respected and fulfilled, especially those that refer to the education of children and adolescents and the care for them, due to their peculiar condition as people in a special stage of development.

The promulgation of the Brazilian Federal Constitution in 1988 reflects the population's recognition of the changes observed in the concept of family and affiliation, also providing for gender equality in aspects of conjugal society. Within the scope of Family Law, the Judiciary is constantly asked to regulate the visitation and custody of children of couples who choose marital separation. It should be noted, however, that these causes involve issues related to Psychology, such as mental health, family relationships, parenting and child development - factors that justify and indicate the

contribution of this discipline in the study of the theme. After marital separation, parents may experience adverse moments in their relationship with their children, due to the distance that is imposed. Certainly, there is no precise roadmap for role-playing in the new scenario. It is understood, however, that the roles of father and mother cannot be changed when the curtains are opened, now bringing guardians and visitors to the scene. With the marital breakup, what will be changed is the relationship between husband and wife. Father and mother continue to exercise their rights and duties, changing only the context in which they perform their duties. It is noteworthy, however, that the way parents will relate to their children after separation cannot be explained only as a private matter. This will suffer interference from the social context which, in various ways, transmits messages on how to think, feel and behave as a result of separation. Since birth, the family is the only reference for the child, and based on this interaction, the first rules, values and beliefs are formed.

The relationship familiar is of great importance in the development of feelings of belonging and competence, environmental control (immunity), etc. As

children who perceive low levels of support and family tend to be more withdrawn and less active in their environments, more inattentive, offensive, in addition to having more hopelessness, which may reflect on their adult lives, increasing the chances of developing mental disorders, especially mood swings. The aim is to identify the relationship of parents and children by separating and the problems it can cause.

Schabbel (2005) described divorce as a state of legal discord between the couple. It sets up a dispute process and requires the creation of new structures for domestic coexistence, especially with regard to parents and children. In both clinical and forensic studies, studies show that the conflicts experienced by parents before and during the separation process cause adjustment problems in children who experience divorce as a mystery that needs to be explained clearly and objectively. All family members experience uncertainties and anxieties that threaten personal stability, requiring the elaboration of a loss. These events start to trigger failures in communication and erroneous interpretations permeated by hurt and resentment, thus generating numerous conflicts, directly affecting parental exercise. In view of this reality, the present study sought to recognize the effects that marital separation causes on parents and children. Likewise, clarifying the distinction between parenting and conjugality, given that in the face of the separation process, it is crucial to recognize the difference between parental and conjugal exercise so that the experience of this process is healthier for everyone involved. In this perspective, the role of Psychology as a science and profession is inclined to understand the challenges of the eminence of new family arrangements that institute the redefinition of roles and dynamics seen as traditional in the family.

To a great questioning of the role of fathers and mothers in the education of children, due to changes in the relationships between parents and children due to the transformations that families have been going through. Responsibility and education requirement with the children are the responsibility of both, so that they acquire an individuality and self-affirmation through the support of parental coexistence. It is important to separate, the couple seeks all possible maturity to guide the children's reaction well, and knowing how to deal with the developmental phase in which the child is at the moment of separation. It is important that you take care not to practice acts of parental alienation. Parental alienation occurs when one parent (or whoever has custody of the child, such as grandparents, for example) tries to "program" the child to hate the other parent. One parent uses the child to attack the other indirectly, or tries to

control the child's feelings towards the other parent through emotional blackmail. The National Council of Justice (CNJ) launched in 2013 a campaign to warn about the dangers that parental alienation brings to the child. For the CNJ, the practice or act of parental alienation constitutes moral abuse against the child or adolescent, and violates the fundamental right to a healthy family life. The child is always the biggest victim of parental alienation. For a more detailed analysis, a survey of twenty (20) fathers / mothers was carried out through the application of a questionnaire in order to point out the points in which they affected or not affected the child's development.

Although, at present, paternity is seen as a process in constant construction that is established between the parent and the child, Muzio (1998) points to the influence of socio-cultural determinations in the performance of this role. Being tender, expressing feelings, having an empathetic and nutritious closeness to children are not characteristics usually attributed to men, due to the process of cultural construction. In turn, women have been valued, for many centuries, for the attributes related to motherhood, coming to think of a biological determinism, or, perhaps, a natural gift for the care of children.

Regarding the research developed, it referred to the collection of data with separate fathers and mothers, residing in Tarumirim, municipality of the State of Minas Gerais, trying to observe how they related to their children after the end of the conjugal union. It was thus, through research carried out with parents, that we developed this article.

Following the International Convention on the Rights of the Child, we find in France the example that, since 1993, legislation has received joint parental authority. The changes that occurred in that country lead to the understanding that father and mother must remain close to their children after the marriage separation. This fact becomes evident when the nomenclature "guardian" is no longer used, replaced by the expression "joint parental authority". In other words, the notion of possession of the child is removed, and the figure of the visitor also disappears. In the same direction, joint custody has become a possibility in several countries such as Portugal, the United States, England, Sweden, among others. In this custody model, parents remain responsible for raising their children with regard to the fundamental rights of these children and adolescents, such as, for example, education, health, food and leisure.

II. METHODOLOGY

Twenty subjects participated in this study, being 02 fathers and 18 separated / divorced mothers (with

rupture of the marital bond, regardless of civil status), with at least one of the children of school age (6 to 12 years).

Parents and divorced mothers, who participated in the research, responded to a questionnaire which was adapted by the model proposed by the "Inventory Practices Parentais" (Benetti & Balbinotti, 2002), which is attached. This inventory (IPP) was built to evaluate parenting practices, considering affective involvement, didactics (education), discipline, social aspects and the responsibility of parental involvement. The complete Inventory has 29 evaluation items, which are constituted in affirmative sentences, however for our questionnaire only 22 items were made which would be sufficient for our analysis.

Those involved in the research participated spontaneously and were selected for publicly declaring that they were separated and / or divorced. Thus consenting to answer the proposed questionnaire.

III. RESULTS AND DISCUSSION

By analyzing the data obtained through the questionnaire, Can Do's consider that the average time of separation or divorce became in four years, which can be considered a time suitable or sufficient to overcome the most difficult times post-divorce as indicate the researchers of the theme (Grzybowski, 2002). The average age of the mothers / fathers surveyed was 30 years old, working mothers, the majority with a high school degree only 2% with a college degree. All men reported receiving no financial support from their ex-spouse, while more than half of the women investigated receive it. Here too, something traditional about the post-divorce constellation is expressed, a reality in which, more commonly, it is the men who pay and not those who receive a pension from their ex-women. However, it must be considered that all women are the custodians of their children.

The average age of children is 8 years. All the eighteen (18) mothers participating in the study live with their children, reflecting a family arrangement more found among the reality of post-divorce families, however we observed a particular case that a father cohabits with his son even though he is divorced.

The frequency of visits by parents to their children was quite distributed among the intervals presented. However, it is observed that the intervals that refer to the highest frequency of visits (once a week, biweekly, once a month) concentrated the highest response rates of parents. This fact can represent, in isolation, a greater involvement of parents, although we know that the frequency of visits is not enough to assess the content and quality of the parental relationship that is established. The majority of parents had no other children

from other relationships. Both fathers and mothers reported having social support to care for their children. Mothers showed greater involvement with their children in all dimensions of the inventory, as well as in most items, when analyzed individually.

Regarding the conversation with the child, fathers and mothers demonstrated that they do not have significant differences between them, having similar averages, which shows that both are managing to dialogue in an equal way in relation to religion, their work, school and friendly conversations. Cohabitation, which seems to be associated with greater involvement of the mother in the emotional and didactic sense (affective support and school support), here does not seem to be decisive for a dialogue and conversation between parents and children.

In involvement with discipline, mothers show less significant results than fathers. However, as all sentences have a negative connotation or problems with educational practices (I scream, slap, argue, threaten, have difficulties), it is necessary to carefully analyze the difference between fathers and mothers. The mothers' higher averages show that they are more involved with the discipline of their children, but they can also demonstrate that they have difficulties in this function, perhaps due to the daily and immediate educational requirements. Regarding indirect responsibility, that is, involvement related to the concern, supervision and zeal for the child's well-being, mothers also had averages significantly higher than those of fathers. Both men and women reported being able to talk to their ex-partners about the future of their children, which perhaps indicates the preservation of this nuance of the coparental function, even after the marital breakup. And both showed that they are attentive to their children's routines (I know where my son is), available (he knows where to find me if he needs anything) and zealous (me to the doctor).

Emotional involvement (affective support) and didactic involvement (school / knowledge) were significantly higher in the group of mothers. However, in relation to talking with the children, both showed balance in carrying out this educational practice. In addition to the issue related to cohabitation, it can be thought that the greater affective and didactic involvement of mothers is also due to the female gender prerogatives, which historically have determined that mothers were the main caregivers and responsible for the education of their children. In addition, it can be assumed that the fact that they relapse less frequently than men favors this greater dedication to their children, although this is not decisive.

The results also showed that parents have greater social involvement with respect to activities in

the public space (park, cinema), while mothers become more involved with this in private area (TV, music), which shows the performance a classic function of women in the domestic space and an affirmation of paternal parenting in the social / public space. Involvement with discipline also proved to be a significantly greater prerogative for mothers, however, the results of both fathers and mothers confirm that this educational task is arduous and with inherent difficulties, although fathers / men have shown fewer problems than mothers with such an aspect. The exercise of authority becomes exhausting for women due to the intensity of the daily demand imposed by cohabitation with their children. Massive female cohabitation stands out here.

Thus, we can observe that the characteristics of the social context (combinations of visits, housing arrangements) and of the parents (occupation, education, issues of conjugality) seem to be important in determining parental educational practices. The cohabitation and visitation arrangements reflect on parenting and parental involvement, evidencing the maintenance of traditional patterns of divorced parenting, in which there is a greater global involvement of mothers with their children, except for the social / public involvement of parents.

IV. CONSIDERATIONS

We conclude that it is important even with the separation \ divorce, the coexistence between father \ mother before the child, whether it be of harmony, mutual help and understanding, thus providing a warm and welcoming home for the son \ daughter who in this dilemma will always be the most affected part. Therefore, considering the Belsky Model (1984), we think that it would be important to hear the opinion of the children about this phenomenon, in order to broaden the understanding of it and not to centralize the evaluation of parenting only in parents. In addition, it is also necessary to understand this phenomenon in a qualitative way, seeking to deepen the understanding and perception of how the variables associated with parental involvement are manifested in the daily lives of families and what are the justifications for the greater or lesser involvement with the children after the advent of divorce.

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The Implementation of Integrative and Complementary Health Practices in the State of Rio Grande do Sul, Brazil

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Received: 08 Dec 2020;

Received in revised form:

13 Feb 2021;

Accepted: 04 Mar 2021;

Available online: 28 Mar 2021

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Keywords— *Health management. Health policy. Integrative and Complementary Health Practices.*

Abstract— *This study aims to describe the implementation of the Integrative and Complementary Health Practices (PICS) in the state of Rio Grande do Sul, located in the extreme south of Brazil. It uses the norms related to the National Policy of Integrative and Complementary Health Practices (PNPIC) and the State Policy of Integrative and Complementary Practices of Rio Grande do Sul (PEPIC / RS) in addition to other government documents and published papers reports on policies for describe this process that started in 2006 with the publication of the PNPIC. The main results include the standardization of twenty-nine PICS within the scope of Unified Health System (SUS) and the preparation of a manual for their implementation, in addition to the preparation of nine Technical Notes in Rio Grande do Sul as a way to encourage municipal managers to bid the PICS. There are still difficulties facing the dissemination and financing of these practices.*

I. INTRODUCTION

The Brazilian national health system respects three constitutional principles (universality, integrality and equity), being structured through a network of regionalized and hierarchical health services and actions, with additional participation from the private network and free of charge to the end user. There are a series of national policies focused on comprehensive care by life cycle (eg: National policy for comprehensive health care for children and adolescents, the elderly; women, men), with specific care programs (eg: the National Pharmaceutical Assistance Program for Hypertension and Diabetes Mellitus, part of the National Plan for Attention to Hypertension and Diabetes Mellitus) [1,2,3].

The National Policy of Integrative and Complementary Health Practices (PNPIC) was regulated in 2006, following the approval of Ordinance number 971/2006 of the Ministry of Health. The elaboration of this policy is the result of a wide debate involving questions

about the integration of traditional medicine to the health system and guarantees of safety and effectiveness of such practices [4].

The use of Complementary Therapies has always been present in the daily life of the population that uses traditional practices, such as teas, acupuncture, homeopathy and herbal medicines [5]. However, these practices have always been on the margins of the public health system. Thus, PNPIC was created to include traditional practices to the Unified Health System (Brazilian public national health system - SUS), respecting its principles and objectives.

According to the text published in 2006 and updated in 2015, the PNPIC aims to guarantee integrality in health care by supporting the experiences that had already been developed in the public health network [4]. In addition to political, technical, economic, social and cultural issues appearing in the policy justification, the symbolic character of regulating such practices must be

emphasized. Something that had already been recommended by the World Health Organization (WHO) from the document Strategies for traditional medicine 2002-2005 [6].

Some recent data shows how the PICS have gained visibility and acceptance. For example, the number of collective activities, such as yoga and tai chi chuan, went from 216 thousand to 315 thousand activities in Brazil between 2017 and 2018 [7]. Approximately one third of patients with a history of cancer used Complementary Therapies between the years 2018 and 2019, the most frequent being: herbal supplements, osteopathic manipulation chiropractic, massage, yoga, tai chi chuan, mantra, mindfulness and spiritual meditation - 29 % of these patients not reporting the use of these therapies to their doctor [8].

However, despite its regulation having occurred 15 years ago, its actions are still unknown to a large part of the population, although many people routinely employ some therapies regulated by the aforementioned policies. For example: a study carried out in the city of Montes Claros (State of Minas Gerais), shows that around 70% of families used popular practices such as prayers, blessings, folk remedies and body practices [9]. That is, even using Complementary Therapies, the population is not aware of these therapies through the public health system.

Professional training, health system management and conceptions centered on the biomedical paradigm [7] are obstacles to the implementation of integrative and complementary practices in the health system, even in Primary Care, when some practices are offered without disclosure and at the initiative of the professional [10].

Considering the importance of PICS in the scope of public policies, this article intends to present the process of construction and implementation of the National Policy of Integrative and Complementary Health Practices (PNPIC), and its version in the state of Rio Grande do Sul - State Policy of Integrative and Complementary Health Practices of Rio Grande do Sul (PEPIC-RS).

II. METHODS

Brazil is divided administratively into 26 states and the Federal District. The state of Rio Grande do Sul is located in the southern region, at its extreme, comprising 497 municipalities and an estimated population of 11.4 million inhabitants for 2020 [11]. To this end, this state is responsible for designing actions to implement PICS in its territory.

This article describes the implementation of the National Policy of Integrative and Complementary Health Practices (PNPIC) and the State Policy of Integrative and Complementary Health Practices of Rio Grande do Sul (PEPIC / RS). For that, a descriptive analysis of such policies will be carried out through the documents referring to them as well as other works that describe their effects after 15 years of implementation of both.

It is an intrinsic case study [10] since, when choosing the case of the PNPIC implantation and its development in Rio Grande do Sul, there is an interest in understanding this case in its particularity.

The documents regulating the PNPIC [12–15] and PEPIC / RS [16,17] were consulted, as well as the websites that disseminate these policies and related academic works.

III. THE NATIONAL POLICY OF INTEGRATIVE AND COMPLEMENTARY HEALTH PRACTICES (PNPIC) CONSTRUCTION PROCESS

The PNPIC construction process reveals a wide technical and political discussion that permeates the health issue. Three National Health Conferences prior to 2006 are cited in the PNPIC text as a way of explaining the demand and the social legitimation of such practices, so that they could be incorporated into SUS [4]. These are: the 1st National Conference on Health Surveillance (2001), the 1st National Conference on Pharmaceutical Assistance (2003) and the 2nd National Conference on Science, Technology and Innovation in Health (2004).

From a meeting of the Minister of Health with representatives of the national associations of Phytotherapy, Homeopathy, Acupuncture and Anthroposophical Medicine, a working group was formed in 2003 to discuss and implement actions in order to elaborate a national politics. Subsequently, working subgroups were created, according to the specificities of the areas. The subgroups functioned independently, with the support of various sectors of the Ministry of Health as well as associations related to practices, using the development of national forums for the broad participation of organized civil society, technical meetings, WHO documents, among other strategies to, at the end, consolidate a technical document for national policy [4].

Among the activities developed by the subgroups, a situational diagnosis was carried out by sending 5,560 questionnaires to all state and municipal health managers, in order to identify the experiences that were being developed in the public health network in

relation to traditional practices. From the responses of 1,340 questionnaires, it was identified that 232 municipalities had these structured practices and, among these, 19 of the 26 state capitals [4]. The responses pointed to the presence of some practices that later became part of the policy, including acupuncture, homeopathy, anthroposophical medicine, phytotherapy and crenotherapy.

These practices were previously regulated by the Interministerial Commission for Planning and Coordination (Ciplan) and by specific institutions such as the Federal Council of Medicine, Pharmacy and Veterinary Medicine. In addition, acupuncture and homeopathy were included in the Outpatient Information System (SIA / SUS) in 1999 [4].

After the diagnosis made by the working groups, confirming the use of the aforementioned therapies, the document - until that moment called National Policy on Natural Medicine and Complementary Practices - was finalized and evaluated by the Technical Chambers of the National Councils of State and Municipal Health Secretaries and agreed by the Tripartite Inter-Management Commission. In September 2003, this document was presented to the National Health Council (CNS) and submitted to the Sanitary and Pharmacoepidemiological Surveillance Commission for evaluation and recommendations. After modifications, the document returned to the CNS, which appointed a subcommittee to discuss and prepare the final proposal to be evaluated again by the Council. The proposal was approved in February 2006, consolidating the National Policy of Integrative and Complementary Practices in SUS, already with this name, published in ordinances No. 971 and No. 1,600, respectively in May and July 2006 [4,12,13].

Ordinance No. 971/2006 instituted the National Policy of Integrative and Complementary Practices (PNPIC) in SUS, approving the therapies: Traditional Chinese Medicine-Acupuncture, Homeopathy, Medicinal Plants and Phytotherapy, and Social Thermalism or Crenotherapy [13]. Ordinance nº 1,600 / 2006 acts as a complement to the previous one, creating the Observatory of Anthroposophical Medicine Experiences in SUS, as a way to develop appropriate methodology and informative materials for this practice [13].

The Ministry of Health, from the publication of these ordinances in 2006, regulates the implementation of actions related to PICS and recommends the adoption of these practices to the Health Departments of the states, the Federal District and the municipalities.

In view of the objectives of the PNPIC, specific guidelines and processes necessary for the implementation of each of the practices in the health system were developed [4]. The guidelines contemplate particular aspects of each PICS, but there are common points related to the ways of hiring and training professionals, access by the population, monitoring and evaluating the insertion of these practices. Among its guidelines is the strengthening of existing initiatives, the establishment of financing mechanisms and actions aimed at training professionals, as well as the encouragement of research in PICS. However, the guidelines do not determine how states and municipalities should do this. They only suggest the need to create the standardization of procedures to enable the financing, training of professionals and the evaluation of this policy. Thus, it is up to municipal and state managers to specify the actions to be taken in their area of expertise.

Ordinance No. 971/2006 [12] also defines the institutional responsibilities of the federal, state and municipal managers, which are similar, varying only the level of breadth of their actions. These actions at the federal level are intended to foster, regulate and monitor national policy. State managers, on the other hand, are responsible for defining implementation strategies, articulating the actors and monitoring the policy in their respective states, just as it is for municipal managers to articulate these actions in their municipalities.

The main contribution of Ordinance No. 971/2006 is to support state and municipal managers who intend to implement PICS [12]. However, this implementation requires, in addition to this support, financial resources, trained professionals and structure that many states and municipalities do not have. The National Policy does not guarantee these resources, much less trained professionals, which would require changes in the undergraduate curricula of health professionals. Gatti et al. [18] revealed that, despite the approval of the ordinance that inaugurated the PNPIC in 2006, even in 2015, educational institutions had not been presenting pedagogical projects that favored the holistic view of the patient and there was a shortage of scientific works that explained its use.

Despite this, some studies show an increase in the use of Complementary Health Practices since 2006. As for example Telesi Jr [19], when showing that the number of health units in the São Paulo Health Department that offer meditation has increased from 45 in 2006 to 85 in 2015. According to the Implementation Manual of Services of Integrative and Complementary Practices in SUS [20], 8,200 basic health units (19% of the total) offered some PICS in 2017, so that these practices were

present in 3,018 municipalities (54% of the total) and in 100% of the capitals. The Ministry of Health itself points to an increase in the number of acupuncture consultations, with more than 850 thousand sessions being held in 2012 and, in 2013, 908 establishments registered to offer this practice [21]. Another relevant data points out that in 2016 there were 2,203,661 individual visits in PICS and 224,258 collective activities, which involved more than 5 million people [22].

Eleven years after the creation of PNPIC, which until then included five practices, in March 2017 the Ministry of Health approved Ordinance No. 849 [14], which includes fourteen other health practices: Art Therapy, Ayurveda, Biodanza, Circular Dance, Meditation, Music Therapy, Naturopathy, Osteopathy, Chiropractic, Reflexotherapy, Reiki, Shantala, Integrative Community Therapy and Yoga. In this document, the Ministry states that PNPIC has promoted an increase in the use of Integrative and Complementary Health Practices since 2006. In addition, the Ordinance justifies that the fourteen practices included would already be present in the health service, according to the second cycle of the National Program of Improvement in Access and Quality

in Primary Care (PMAQ) [22], but were not regulated by SUS.

Almost a year after the expansion of the PNPIC, the Ministry of Health includes ten more practices to this Policy through Ordinance No. 702 of March 21, 2018: Aromatherapy, apitherapy, bioenergetics, family constellation, chromotherapy, geotherapy, hypnotherapy, laying on of hands, anthroposophical medicine / anthroposophy applied to health, ozone therapy, floral therapy and social thermalism / crenotherapy [15]. The 2006 Ordinance already regulated the practices of anthroposophy applied to health and social thermalism; however, in 2018, they were updated from the document WHO Strategies on Traditional Medicines for 2014-2023 [23].

After the implementation of the PNPIC in 2006, and the inclusion of Complementary Therapies in 2017 and 2018, this policy now includes 29 integrative and complementary health practices. Table 1 list all practices that are part of the PNPIC and the corresponding Ordinances, as a way of facilitating the visualization of what is currently covered by this policy.

Table 1: List of ordinances and practices included in the National Policy of Integrative and Complementary Practices (PNPIC)

Ordinance No.	Practices
Ordinance No. 971, of May 3, 2006 [12]	1. Traditional Chinese Medicine - Acupuncture
	2. Medicinal Plants and Phytotherapy
	3. Homeopathy
	4. Social Thermalism / Crenotherapy
Ordinance No. 1600, of July 17, 2006 [13]	5. Anthroposophical Medicine
Ordinance No. 849, of March 27, 2017 [14]	6. Art Therapy
	7. Ayurveda
	8. Biodanza
	9. Circular Dance
	10. Meditation
	11. Music therapy
	12. Naturopathy
	13. Osteopathy
	14. Chiropractic
	15. Reflexotherapy
	16. Reiki
	17. Shantala
	18. Integrative Community Therapy (ICT)
	19. Yoga

Ordinance No. 702, of March 21, 2018 [15]	20. Apitherapy
	21. Aromatherapy
	22. Bioenergetics
	23. Family Constellation
	24. Cromotherapy
	25. Geotherapy
	26. Hypnotherapy
	27. Laying On Of Hands
	28. Ozone Therapy
	29. Flower Therapy

Source: Prepared by the author (2021).

From Table 1, it is possible to see that, although the PNPIC was instituted in 2006, it is in the years 2017 and 2018 that it aggregates most of the practices in its scope.

Before the publication of Ordinance No. 976/2006, the diagnosis made by the Ministry of Health pointed out that only 6.52% of the states and / or municipalities had a law or institutional act on the creation of PICS [4], while in 2018 they were offered in almost 54% of Brazilian municipalities [20]. In addition, according to the third assessment cycle of the PMAQ, in 2016, 31.48% of the teams registered in the Family Health Strategy offered PICS [22]. There was also a greater concentration of services related to PICS in Primary Care: today 78% are offered at this level of care, 18% in medium complexity and 4% in high complexity [20], while before Ordinance No. 976/2006, 42.5% of PICS were offered in Primary Care [4].

Even observing some increase in the offer since the promulgation of the national policy, it is up to the states to submit a proposal for the inclusion of the PICS to the State Health Councils (CES). The objective of this work is to describe specifically the process of construction of the State Policy of Integrative and Complementary Health Practices in Rio Grande do Sul (PEPIC / RS), presented in the item below.

IV. THE STATE POLICY OF INTEGRATIVE AND COMPLEMENTARY HEALTH PRACTICES IN RIO GRANDE DO SUL, BRAZIL (PEPIC / RS)

In the state of Rio Grande do Sul, the construction of PEPIC / RS is the result of a search for other forms of care, which are more integrative and health-promoting [24]. The state of Rio Grande do Sul stands out

in the production of scientific knowledge in health, with little space for counter-hegemonic practices related to this theme [25]. However, there are recommendations in the resolutions of the state health conferences and a political climate of greater acceptance of these practices. The implementation by the state government of the Intersectoral Policy for Medicinal Plants and Herbal Medicines (PIPMF) opened a space in the political agenda focused on PICS [25].

The PEPIC begins with the creation of a committee for the formulation of a state policy for PICS, in which professionals from the State Health Secretariat (SES) and representatives of the Regional Health Coordinators participated.

Some of these SES professionals already had experiences with PICS and such personal experiences influenced the interest in implementing them in SUS [24]. Thiago and Tesser [26] reveal that the professionals who implement PICS are sensitive to them and understand that they have a broader approach to the health-disease process than other medical rationales, so these professionals look for a personal experience alternative treatment. Thus, the PICS offer depends on the direction that the professional gives to the practice and how he uses this resource. These professionals declare themselves self-taught and many seek knowledge about PICS that they wish to apply outside working hours [27].

Following the appointment of the PEPIC / RS formulation committee in 2012, periodic meetings are scheduled to develop this proposal. The proposal was submitted and approved in December 2013 by the Bipartite Inter-Management Commission (CIB) as Resolution No. 695/2013 [27,17]. The approval of the resolution by this commission enabled it to be approved before the change of state management, guaranteeing the continuity of the

policy [24]. As the State Health Council (CES / RS) is responsible for implementing state policies, in December 2014 it approved the Resolution No. 14/2014 [17]. The fact that the policy was approved by CIB and CES conferred it an important social legitimation and portrays the importance of the political engagement of the actors involved in its construction [24].

For the formulation of PEPIC-RS, the responsible committee recognized the need to carry out a diagnosis that sought to map the municipalities in the state that were already offering PICS within the scope of their public health care network; identify professionals with training in PICS; and to know which PICS, present or not in the PNPIC, were offered by the municipal public health institutions in the state. To this end, questionnaires were sent to 497 municipalities, of which 130 responded. Of this total, 83 municipalities did not offer PICS, in 36 there

were already PICS implemented and in 11 there were trained professionals, but with no offer [16].

The structuring phase of PEPIC took place in 2015 and 2016, when PEPIC / RS was included in the Pluriannual Plan (PPA) 2016-2019 and in the State Health Plan [25]. Soon after, in 2017, with the insertion of more practices in national policy, and greater dissemination of PICS, a phase begins in which doubts about the process of implementing these practices emerge from the growing interest of the population and municipal managers. As a result, the PEPIC / RS management committee was created, which met monthly to discuss and study strategies for implementing them [25]. In addition, working groups were created organized by PICS, which had the objective of regulating a specific practice, preparing Technical Notes made available on the website of the State Health Secretariat and assisting in the implementation of PICS in the municipalities [26].

Table 2: Technical Notes Prepared for State Policy of Integrative and Complementary Practices in Rio Grande do Sul, Brazil (PEPIC / RS)

Technical Note	Guidelines
Technical Note PEPIC-RS / DAS No. 01/2017 [30]	General guidelines for the implementation of Integrative and Complementary Practices. It contains, in addition to the guidelines for the preparation of an Action Plan, guidance on the financing of Integrative and Complementary Practices in the Brazilian public health system and the registration of them in information systems.
Technical Note PEPIC-RS/DAS No. 01/2018 [31]	About Floral Therapy in the Health Care Network.
Technical Note PEPIC-RS/DAS No. 02/2018 [32]	About Yoga in the Health Care Network.
Technical Note PEPIC-RS/DAS No. 03/2018 [33]	About Biodanza in the Health Care Network.
Technical Note - Mental Health /DAS No. 01/2018 [34]	On the insertion of Integrative and Complementary Practices in the activities of Therapeutic Mental Health Workshops in Primary Health Care.
Technical Note PEPIC-RS/DAS No. 01/2019 [35]	Insertion of Chinese traditional body practices in the Health Care Network.
Technical Note PEPIC-RS/DAS No. 02/2019 [36]	Guidelines for the implementation of Homeopathy in the Health Care Network.
Technical Note PEPIC-RS/DAS No. 03/2019 [37]	Insertion of Integrative and Complementary Practices in the Support Groups for Smoking Cessation of the Health Care Network.
Technical Note PEPIC-RS/DAS No. 01/2020 [38]	Guidelines for the implementation of Reiki in the Health Care Network.

Source: Prepared by the author (2021).

From Chart 2, it is possible to see that the team designated by the State Health Department was concerned with structuring PICS implementation manuals so that the municipalities could carry out these actions and start

offering these practices to their users. However, it is important to note that both PNPIC and PEPIC /RS do not create mandatory implementation of PICS, nor do they generate financial benefits. The only existing counterpart

is the PMAQ, which has variables related to the implementation of PICS and, being a quality incentive program in Primary Care, “increases the transfer of funds from the federal incentive to participating municipalities that achieve improvement in the quality standard in attendance” [22].

With this, the Technical Notes created by the team generate an indirect influence for the implementation, as they facilitate this process for the municipalities that intend to do it. However, they do not always encourage the offer of PICS or mobilize managers and professionals who have no predisposition or acceptance of them, since there is no such obligation.

V. THE IMPLEMENTATION OF PNPIC AND PEPIC / RS

PNPIC brought the standardization of PICS, the increase in actions, the qualification of professionals, the development of knowledge related to them, as well as the expansion of therapeutic options to users [7]. Among the possible difficulties for the implementation of the PNPIC, the following stand out: the training and qualification of professionals in sufficient numbers, the supply of inputs, the structure and the investment in the development of technologies [7]. The Ministry of Health points out that, despite the growth in supply and demand for PICS, both in the private and public spheres, there are still some challenges “such as expanding access and supply to these practices, the sustainability of these services through financing involving the three spheres of management, and the evolution in the legislative field that guarantees the right to care and be cared for [20].

In order to mitigate the challenges faced for the implementation of the PNPIC, the Ministry of Health published in 2018 the Manual for the implementation of services of integrative and complementary practices in SUS. This aims to present SUS model managers with a model for implementing the PICS [20].

The Manual presents some strategies adopted by the Ministry of Health to assist and encourage managers to implement PICS [20]. In a very detailed way, it brings suggested steps for the implementation of the practices. Regarding financing, the policy's weak point, constantly cited by authors studying the topic, the suggestion is to include the needs, offers and possibilities of supply of PICS (previously mapped) in the Municipal Health Plan and in the Municipal Budgetary Law [20]. As there is no specific transfer to the PICS to the states and municipalities, it is up to each manager to schedule this financing from the local health plan.

One of the suggestions of the Ministry of Health for the implantation of PICS is the registration of health units and their professionals in the National Registry of Health Establishments (CNES) as well as in the Health Information System for Primary Care [20]. This register enables the planning, monitoring and evaluation of actions related to PICS, as well as contributing to the quality of this information for studies on the theme and other related initiatives. However, as a recent practice, without goals linked to it that generate financial benefits for the municipalities, there is a precariousness in these data.

In order to train professionals interested in offering a service related to PICS, the Ministry of Health suggests that the activities in Permanent Education in Health be used, where there are already courses aimed at this training. Furthermore, it suggests horizontal cooperation between different municipalities and states. In this sense, an important step to facilitate the implementation of PNPIC was the officialization of a Brazilian Network of Integrative and Complementary Health Practices, “an open space for collaboration, articulation, debate, reflection and dissemination to strengthen integrative, complementary and traditional practices in the Unified Health System” [39]. It is formed by social actors, users, managers, workers, researchers and institutions from all over the country [20]. With the objective of “integrating and organizing the different social actors that work, research, teach, study and / or use the integrative practices in SUS to strengthen the practices. Also promote the inclusion of traditional Brazilian medicines” [39]. This reinforces the role of social actors and health professionals engaged with the theme of PICS.

Barbosa et al. [40] analyzed the insertion of PICS based on data from a national survey, collected between 2015-2016, and the PMAQ, between 2013-2014, identifying the absence of consistent data and its low institutionalization in most municipalities. One of the factors that contributes to this is the role of health professionals in offering PICS, linked to personal initiatives and not the health manager [40]. This fact can lead to a punctual diffusion in the Family Health Teams in which there is sensitivity and some competence of the professional in a given PIC, which causes an unsustainability of the policy and restricts it to users of that unit, contrary to the SUS principles of universality of access [40]. Thus, the authors point out the need for managers to take ownership of what is developed in the ESF in terms of PICS and to mobilize institutional resources as a way to implement the PNPIC.

At the state level, in Rio Grande do Sul the role of professionals is also noted [27, 24]. This fact occurs

because even though managers recognize the limitations of the biomedical model, they often reproduce this concept in directing health actions. Thus, despite the manager's incentive, there is no organized strategy for offering these practices. The implementation of PEPIC / RS reinforces the need for the legitimacy of popular knowledge, since the dialogue between them and technical knowledge generates a greater potential to face complex public health problems [24].

Over the ten years of PNPIC implementation, there are difficulties in developing actions and strategies that can operationalize this policy in the different services of the health system. What happens is an informal offer, discontinued and with little perceived appreciation. Although the professionals are distant from the process of articulating the implementation of the policy, it is their initiative to carry out the actions related to the PICS. It is not enough to create a policy for the insertion of PICS to take place in SUS: it is necessary to give visibility and legitimacy to the practices that already happen in health services and to enhance and enable the practices already developed by professionals [27].

In addition, other elements do not contribute to the implementation of the PNPIC, such as professional training, adequate funding and professional availability [40]. Another fact that hinders the implementation of these practices is the absence of specific indicators that are able to respond and adapt to the needs and specificities of practices with a vital dimension [40]. This contributes to the difficulty of comparing the impact of PNPIC and its reflexes to health.

VI. CONCLUSION

It is noticed that despite the PNPIC and PEPIC / RS there are still difficulties in implementing the practices in order to act together with biomedical treatments. This is because the health concept of the SUS medical-care model does not contribute to the effective implementation of PICS. All care logic of the health care network takes the user to a form of curative and medication treatment. So that for PICS to be effective in this system, it is necessary that the logic of SUS itself (in practice) be able to embrace this other meaning of health / medical rationality and to integrate these forms of care.

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Investigating Users' Acceptance of Mobile Money Services Interoperability: A Case Study of Tanzania

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Received: 11 Dec 2020;

Received in revised form:

03 Feb 2021;

Accepted: 25 Feb 2021;

Available online: 28 Mar 2021

Keywords— Mobile money services, mobile money interoperability, Security and Trust, task characteristics, price value

Abstract— Using mobile phones for financial transactions has been on a sharp increase globally and in Tanzania in particular. The introduction of mobile money interoperability allows customers to undertake money transfers across different telecom mobile money accounts and bank accounts. This study aimed to find out factors that may influence the acceptance and successful use of mobile money services interoperability that are tailored to banking and unbanked users' intention by integrating three globally accepted theories; DeLone and McLean information system success model (D&M), The Technology Acceptance Model (TAM) and The Task-Technology Fit (TTF) Theory. The study hypotheses were empirically tested using data from 447 mobile money users from both telecom and banks. Data were analysed using the correlation and regression technique. This study found that approximately 81.5% of the dependent variable, which is interoperability of mobile money services was accounted for by the regression analysis and therefore can strongly be explained very well by independent variables which are Perceived Ease of Use; price value; Network Availability; Security and Trust; Service quality; Task Characteristics. This study's findings provide valuable understandings for formulating effective strategies concerning financial inclusion to mobile money service providers, governments, and other stakeholders and expand the existing customer base to mobile money service providers. Moreover, this study's results will provide the basis for further refinement of technology acceptance and success models in the emerging mobile money service domain.

I. INTRODUCTION

Today, mobile phones can be used as a means of communication and the means of financial inclusion in most low-income countries. 65% of adults in the world's poorest economies still lack access to even the most basic transaction account that would allow them to send and receive payments more safely and efficiently (Pazarbasioglu et al., 2020). The mobile phone has made mobile money services possible and now reaches millions of unbanked low-income populations in developing countries, especially in rural areas (GSMA, 2019; Demirguc-Kant et al., 2018). According to UNCTAD (2019), mobile money has improved financial inclusion,

making it easier, real-time insight at a lower cost, cheaper and safer to transfer money, and paying for goods and services. By the end of 2019, 5.2 billion people subscribed to mobile services, accounting for 67% of the global population, and forecasted that in 2023 more than \$1 trillion will be transacted via mobile platforms annually, with over \$2.8 billion a day (GSMA, 2020). Evidence shows that there are over 1.04 billion registered mobile money accounts worldwide, of which 469 million are from Sub-Saharan Africa. There are 229 live mobile money deployments in 95 countries transacting US dollars 40.8 billion processing over US dollars 1.9 billion per day globally (GSMA, 2019). Tanzania has experienced explosive growth in the use of mobile money since the

service was first introduced in 2008 and has now become the primary tool used to access financial services and achieve financial inclusion (Max & Claudia, 2018; UNCTAD, 2020). The statistics show that the number of active registered mobile money accounts in Tanzania was estimated to be 29,659,961 at the end of June 2020 with the value of transactions about US dollars 4.6 billion (TCRA, 2020). The evidence shows that every month there is an increase in the number of subscribers in each telecom company. This implies that more people will register to use mobile money services in the coming future and hence will trigger the growth in transaction volume and values and increase usage of mobile money services.

The utilisation of interoperability capability in mobile financial services contributes to the overall growth of total mobile money transactions in Tanzania (BOT, 2019). Interoperability with banks and account-to-account (A2A) and integration via an Application Programming Interface (APIs) with organisations ranging from government agencies to utility companies, online businesses, and local entrepreneurs are also on the rise (GSMA, 2019). Using API mobile money, service providers can access data from different public and private systems with speed and reduce costs without compromising safety and reliability (UNCTAD, 2020). With interoperability, mobile money customers can undertake money transfers between two accounts at different mobile money service providers or transfer money between accounts at telecom mobile money and bank accounts (Pasti, 2018). Tanzania launched mobile money interoperability in September 2014. Interoperability began with a bilateral agreement between Airtel and Tigo, joined by Zantel in 2014, and Vodacom in 2016 (Gilman, 2016). To date, five major MNO's are interoperable with each other and with various banks. With the interoperability through bilateral arrangements, mobile money customers can transfer mobile money directly and in real-time between accounts from different MNOs and between telecom mobile money accounts and bank accounts in the same market (GSMA, 2015). For example, nowadays, NMB Bank customers with PesaFasta or CRDB Bank with SIM Banking services can transfer money to TigoPesa or M-Pesa interchangeably.

II. STATEMENT OF THE PROBLEM

Evidence suggests that increased interoperability stimulates the circulation of digital values. For instance, in the first three years of introducing mobile money interoperability in Tanzania, transactions grew for 16 per cent (UNCTAD, 2020). Interoperability between Mobile Money Providers (MMPs) increases mobile money

adoption because it improves convenience for users, enhances efficiency by enabling sharing of different transaction channels, and promotes competition amongst providers (UNCTAD, 2020). The understood factors for user adoption of mobile money services interoperability have currently been an issue of concern to researchers, and it is essential to understand whether it would be well accepted by the potential users (GSMA, 2020). Investigating customers' intentions and adoption of mobile money services has attracted the focus of many researchers (Hamdan, 2019; Mustafa & Sifat, 2018). Despite various studies providing a better understanding of the critical factors for predicting consumers' intentions and use of mobile money services, there are further essential aspects left to study.

In Tanzania, this is even more crucial, especially during the fifth government regime in which the core agenda is an industrial economy, and financial inclusion is the backbone of the agenda (Lotto, 2018). Various factors such as fear of security, fraud in mobile money transfer, users' awareness and lack of education among most mobile money users and agents, poor network connectivity, and unreliable services, are some of the significant concerns of mobile money services interoperability in developing countries such as Tanzania (Mustafa & Sifat, 2018; Devadevan, 2013). Understanding customer acceptance and usage of technology innovation requires an emphasis on the technical aspects and the social aspects (Yeh, 2019). Although numerous studies (Mandari, Koloseni & Macha, 2020; Koloseni & Mandari, 2017; Lema, 2017; Lubua & Semlambo, 2017; Abdinoor & Mbamba, 2017) have been conducted on individuals and institutions in Tanzania regarding the factors that influence customer acceptance of mobile money services. However, very little research attention has been given to the use of mobile money service interoperability.

Interoperability will become a permanent issue of research and experimentation since heterogeneity and constant change will persist for the foreseeable future (Cheni & Doumeings, 2005). Therefore, this study aimed to find out factors that may influence the intention to use for mobile money service interoperability using Technology Acceptance Model (TAM), D&M IS success model and The Task-Technology Fit (TTF) to help develop not only practical useful models but also provide a basis for gaining a deeper understanding of strong correlations among factors that influence the usage of mobile money services and get better exploratory power than the individual theory use (Dahlberg et al., 2015; Rahi et al., 2018a; Anouze & Alamo, 2020). For example, Chale & Mbamba (2014) combined TAM, DoI, and UTAUT theories to provide a basis for a deeper understanding of

SMEs' need to continue using mobile money to enhance their businesses.

III. LITERATURE REVIEW, MODEL AND HYPOTHESES DEVELOPMENT

KEY FACTORS OF MOBILE MONEY SERVICES INTEROPERABILITY AND INTEGRATION OF USER'S ADOPTION

Interoperability means that two co-operating software systems can efficiently work together without a particular interfacing effort. It also means establishing communication and sharing information and services between software applications, regardless of the hardware platform(s) (Chen & Doumeingts, 2005). In terms of mobile money services, interoperability is defined as the possibility to transfer money between customer accounts at different mobile money schemes and between accounts at mobile money schemes and accounts at banks (GSMA, 2014). Interoperable payment systems can make it easier for people to send payments to anyone and receive payments from anyone quickly and cheaply (Arabehty et al., 2016). While integration is the connecting application so that data from one system can be accessed by the other one with a middleware aid that translates the data and makes it "work" for the receiving system. The following summarises the common critical factors for mobile money services interoperability and integration.

Empirical Literature Review and Hypothesis Development

When determining the selection of hypotheses to formulate variables/constructs that can affect the adoption of mobile money services interoperability, this study considered theories and models for technology acceptance and knowledge gaps that were not addressed by previous studies. In this context, the followings are the hypothesis formulated from previous theories and empirical studies:

Theoretical Model

Many theories have been developed and applied to study the users' acceptance, actual adoption, and success of new technology products or services. Each of these theories tries to examine different aspects and adopts a different perspective. These theories have been validated, widely recognised, and most cited in various studies in e-commerce systems, knowledge management systems, e-banking systems, mobile money payment, e-government systems, health information systems, and much more. These theories among others, are the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975), the Technology Acceptance Model (TAM) (Davis, 1989), the Diffusion of Innovation Theory (Rogers, 1995), the Extended

Technology Acceptance Model (TAM2) (Venkatesh and Davis, 2000), the Theory of Planned Behaviour (TPB) (Ajzen, 1991), The Task-Technology Fit (TTF) (Goodhue & Thompson, 1995), the Unified Technology Acceptance User Technology (UTAUT) (Venkatesh et al., 2003) and D&M IS success model (DeLone & McLean, 1992) to mention a few

All these models and theories are seen to be related to some ideas and complement one another. For example, Lin, Wang, & Chen (2019) incorporated the UTAUT2 and Innovation Diffusion theory and included other variables that might affect consumers' use of mobile payments. Elias & Mtebe (2019) on examining the factors impacting Tanzanian drug dispensaries' perceptions of the potential benefits of using a mobile health (mHealth) reporting system, combines two models: the updated D&M IS success model and the extended unified theory of acceptance and use of technology. However, there is still a need for systematic investigation and theorising of the salient factors applicable to context-based consumer technology use (Anouze & Alamro, 2020).

The Technology Acceptance Model (TAM): TAM is the extended theory from the Theory of Reasoned Action (TRA) developed by Fishbein & Ajzen in 1975 for user acceptance of an information system. The TAM has already been used and validated by many other researchers in various academic disciplines of information systems (Anouze & Alamro, 2020; Lu et al., 2005; Yang, 2005). TAM has become one of the most widely used models due to its simplicity and robustness (Mital et al., 2018). TAM hypothesises two critical beliefs determining a user's adoption intention and actual usage of information technology. Davis (1989) argues that user's perceived usefulness (PU) and perceived-ease-of-use (PEOU) are crucial determinants for overall attitude towards using specific information technology and applications. Several researchers have proposed the extended and modified TAM versions due to its simplicity and ease in describing behavioural intention (Ali & Maideen, 2019). In the context of mobile money services adoption, TAM's significance can be found in the study of Lema (2017), which investigated the factors influencing the adoption of mobile financial services in the unbanked population in Tanzania.

The updated D&M IS success model: The updated D&M IS success model was extended from the original D&M model IS success (DeLone & McLean, 1992). The Updated D&M model identified six dimensions of IS success. These are system quality, information quality, service quality, (intention to) use, user satisfaction, and net benefits. The updated D&M model replaced individual impact and organisational impact with the net benefits,

while service quality was added as a new factor (DeLone & McLean, 2003).

The Task-Technology Fit (TTF) Theory: Goodhue and Thompson (1995) proposed the TTF model, which extends the TAM by considering how task affects the use of technology (Tam & Oliveira, 2016). The Task-Technology Fit (TTF) theory is well-accepted and has been applied in various ways for assessing information technology, with an increasing number of studies focusing on mobile technology (Grobbelaar, Botha, & Spies, 2020). Goodhue and Thompson (1995) claim that customers will adopt new technology if it is smart enough to perform a daily task. Empirical results suggested that TTF can better predict IT impacts on individual task performance if not used alone. TTF can be used in any condition or circumstance where people use technology to perform specific tasks (Gikas & Grant, 2013). Tam & Oliveira (2016) and Alanazi et al. (2020) recognise the importance and practical application of constructs of TTF as a significant contributor in their frameworks. In general, TTF corresponds to the relationship of matching amongst task characteristics, user abilities, and functionality of technology.

Based on TAM, TTF, the updated D&M IS success model, and previous works of literature, six (6) variables were selected. These variables have been indicated in the literature that they influence the intention to use and later the success of mobile money service interoperability. These variables are perceived ease of use, service quality, security and trust associated with mobile services, perceived price value, task characteristics, and perceived network availability. All of these selected variables have been theorised, validated, and examined in various technology usage contexts and seem to be a stronger predictor of intention to use information technology products or services (Davis, 1989; DeLone & McLean, 2016; Abdinoor & Mbamba, 2017; Lin et al., 2019).

Hypotheses and Theoretical Framework

Perceived Ease of Use

Davis (1989) argues that users will use new technology when that technology is perceived to be easy to use and useful to them. Ease of use is a degree to which a person believes that using a particular system will be free of effort (Davis, 1989). The individuals' perceptions of the ease of use greatly influence mobile ICT diffusion and acceptance of mobile money services (Meso et al., 2005; Bångens & Söderberg, 2009; Richard & Mandari, 2017; Lin et al., 2019). Based on these findings, this study hypothesises two relationships as follows:

H1: Perceived Ease of use positively affects Tanzanian users' attitude to use mobile money service interoperability.

Services quality

This construct has been derived from the updated D&M IS success model. Users are highly comfortable using the mobile money service if there is a quality of support from service providers. The service quality is the service provided by the developers of the information system (DeLone and McLean, 2003). This includes the quality of support that mobile money users receive from mobile money provider personnel. Users with good system support are likely to continue using the system (DeLone & McLean, 2016). The better system support, the more likely it is to have a positive perception of the service quality (Tam & Oliveira, 2016). Service quality has been found as one of the indicators of success and growth of the money transfer technology. An increase in customer support's perceived quality influences the intention to continue using mobile money services (Lubua & Semlambo, 2017; Wilson & Mbamba, 2017). To ensure the adoption of mobile money service interoperability, MMP should provide support to users. Hence, this study hypothesises this relationship as follows:

H2a: Service quality positively affects Tanzanian users' intention to use mobile money service interoperability.

H2b: Service quality positively affects Tanzanian users' actual use of mobile money service interoperability.

Security and Trust Associated with Mobile Services

Mobile communication is an open environment; hence much care must be taken when transferring sensitive information, primarily when related to financial data (Abdullah & Abdul-Hadi, 2009). Identity theft and sending money to the wrong account acted as factors for accepting mobile money services (Omol, Abeka, & Wauyo, 2017). Maintaining consumer trust is critical to the growth of mobile money services. Consumer concerns around data privacy and security impact trust are critical concerns when considering whether to use mobile money (GSMA, 2018). In the study conducted in Uganda, mobile money's acceptance has mostly been low due to security issues and challenges associated with the system. The findings revealed that the critical security issues are identity theft, authentication attacks, phishing attack, personal identification number (PIN) sharing, and agent-driven fraud (Guma, Mussa, & Anael, 2020).

H3: Security and Trust Associated with Mobile Services positively affects Tanzanian users' attitudes to using mobile money service interoperability.

Price Value

The price value is a factor drawn from the updated D&M IS success model. It is the degree to which the costs of adopting mobile payments are in proportion to the

benefits received. The cost of mobile money services can be in form of service charges based on the transaction for sending, withdraw and balance requests to customers. Lema (2017) argues that high costs of mobile financial services are a barrier to mobile financial service adoption among the unbanked population. Koloseni & Mandari (2017) and Abdinoor & Mbamba (2017) also found that the transaction cost is one of the barriers to the usage of mobile financial services in Tanzania. When the price value of a service is high, the adoption of mobile money services will be low, but if it is affordable, it can be a motivation for faster adoption (Oliveira, Thomas, Baptista, & Campos, 2016). Based on the literature review and theory, the following hypothesis is proposed: Hence, this study derives the following hypothesis:

H4a: Price value positively affects Tanzanian users' intention to use mobile money service interoperability

H4b: Price value positively affects Tanzanian users' actual use of mobile money service interoperability.

Network Availability

Senso & Venkatakrishnan (2013) found that network or service failures were the major factors that hindered many customers from using mobile money service. This poses the risk of losing cash, wasting time, and other problems like loss of customer goodwill. Anthony and Mutalemwa (2014) investigated factors influencing the use of mobile payments in Tanzania. Their analysis of the findings revealed that system failures or network problems are among the factors influencing the use of mobile payments in Tanzania. Therefore, the following hypothesis can be articulated based on the above discussion

H5: Network Availability positively affects Tanzanian users' attitude to use mobile money service interoperability

Task Characteristics

When mobile users feel that technology can support the task at hand, they show good performance (Tam & Oliveira, 2016). Therefore, mobile money interoperability enables users to smooth transfer money, reduce the time of performing transactions, do more transactions, have more access to more services providers, and make the task easily accomplished without limitations to service providers. A study conducted by Changchun, Haider & Akram (2017) found that task technology fit significantly affects m-banking adoption. Customers are willing to adopt new technology-related products or services when that technology solves their real problems and become useful in their day to day lives. (Bångens & Söderberg, 2009; Lin et al., 2019). Therefore, based on the findings cited above, it is essential to examine the task characteristics of

information technology services. Hence, this study hypothesises this relationship as follows:

H6a: Task characteristics positively affect Tanzanian users' intention to use mobile money service interoperability

H6b: Task characteristics positively affect Tanzanian users' actual use of mobile money service interoperability.

IV. METHODOLOGY

Research Design

This paper adopted a descriptive research design with a case study approach. The case study approach was considered a robust research method particularly when a holistic, in-depth investigation is required (Mohamed & Ismail 2009) and useful for testing whether a specific theory and model applies to phenomena in the real world (Sacred Heart University Library, 2019). Based on this approach, a quantitative approach was adopted to quantify factors that influenced the use of mobile money services. Besides, a quantitative method was deemed useful in summarising the study results in numerical terms with a specified degree of confidence (Abeyasekera, 2005).

Sampling Techniques.

Three cities from Tanzania (Tanga, Arusha, and Dar es Salaam) were conveniently selected due to the unavailability of actual statistical data about the number of users of mobile money services, and it is possible to collect the data more efficiently (Ahmed & Ali, 2017; Rahi, 2017). Conveniently, the researcher selected customers from three (3) MNOs (Tigo, Airtel, and Vodacom) and two (2) banks (National Microfinance Bank (NMB) and CRDB Bank Plc). These banks and MNOs were purposively selected because they are pioneers to introduce mobile money services and have a large market share in users of mobile money services (UNCTAD, 2012; TCRA, 2020). This study limited the study to only experienced mobile money service users because of their mobile money usage experience. The study was also limited to only domestic mobile money transfers. The convenience sampling technique was used to select respondents from three groups of registered mobile money customers, including (a) customers with bank accounts, (b) unbanked customers, and (c) mobile money agents.

Sample Size

In order to determine the minimum acceptable sample size for this study, the formula proposed by Green (1991) was adopted and suggested. The minimum sample size can be calculated as $N_{\min} \geq 50 + 8m$, where N_{\min} is the minimum sample size and m is the number of predictor variables.

The study had five factors. Therefore, the minimum sample size required for this study was $50 + (8 \times 6) = 98$. Table 3.1 summarises the sample size that participated in the study. The ratio of the distribution was based according to the Tanzania National Bureau of Statistics (2013). A

total of 500 questionnaires were issued to the respondents of which 130 were from Tanga, 100 from Arusha, and 270 from Dar es Salaam. However, 450 out of the 500 questionnaires issued were successfully returned. Therefore, the required minimum sample size was met.

Table 3. 1: Overview of respondents who were given a questionnaire

Register Money Users	Mobile Services	TANGA		ARUSHA		DAR ES SALAAM		TOTAL	
		Issued	Returned	Issued	Returned	Issued	Returned	Issued	Returned
With Bank Accounts		50	48	40	37	150	145	240	230
Unbanked Customers		50	37	40	36	70	47	160	120
Mobile Money Agents		30	27	20	25	50	48	100	100
Total		130	112	100	98	270	240	500	450

Source: This research 2020

Data Collection Methods

In this study, data collection was done in the morning, afternoon, and evening to avoid potential bias. Data was conveniently collected from a population that was close at hand and easily accessible to the researcher. This allows a researcher to complete interviews or get responses cost-effectively (Rahi, 2017; Hair *et al.*, 2013). Both primary and secondary data sources were used to identify factors that influence customers' use of mobile money services interoperability. The data collection started in September 2019 and ended in February 2020.

Collection of Primary Sources of Data

Questionnaire

The questionnaire was developed using constructs and items from literature reviews of both previous empirical studies and theories. A 5-point Likert-type scale was used to measure customers' satisfaction level on the use of mobile money and mobile banking services. The questionnaires were physically circulated to all respondents to get opinions for the research questions. Moreover, the questionnaire was translated into the Swahili language during the interview. This is because most respondents use the Swahili language to communicate in both rural and urban areas.

Data Quality Control

Pilot study

To ensure the reliability and validity of the questionnaire, the researcher conducted a pilot study. The pilot test was done at the Njiro ward in Arusha in August 2019. Twenty-five (25) sample questionnaires were piloted through face-to-face interviews with the respondents. Hertzog (2008) suggests that a sample size of 10 to 40 per group is enough to validate the questionnaire intended to meet various aims. The pilot study aimed to reveal

deficiencies in the questionnaire in terms of wording, clarity, relevance, and time spent on completion, gaining additional comments on the content and structure to ensure that all relevant investigations to the study were made and data were recorded without problems. A pilot test was used to avoid problems for the respondents in answering the questions. The revealed shortcomings through the pilot study were addressed and adjusted accordingly. In the study's validity, the researcher adopted face validity whereby the questionnaire was subjected to three subject matter experts to ensure whether it measured what it was intended to measure for content validity.

Triangulation of data collection methods

As presented above, to ensure the quality of the data, the study triangulated its data collection methods. Specifically, the study employed secondary sources of data, questionnaires, key informant interviews, and on-site participant observation.

Data Treatment

Before the data from the questionnaires were analysed, raw data from returned questionnaires were cleaned, organised, validated, and coded. All questionnaires that were insufficiently completed, or where there is evidence that the respondent did not take the completion seriously were discarded (Rowley, 2014). Epidata program was used to compare quantitative data to check for consistency while a logic check was used for qualitative data. In this case, two database files were created. The two files were then compared using the Epidata program. All mismatched records, miss-codes, or missing data due to omissions or mistakes in the data entry were validated, cleaned, and then corrected using the original hard copy questionnaire. Upon reviewing, cleaning, and eliminating incomplete questionnaires, a total of 447 out of 450 returned questionnaires were complete and appropriate for analysis.

Reliability and Validity of the Items/Measurements

The validity and reliability of the scales used in research are essential factors that enable the research to yield beneficial results (Sürücü & Maslakçi, 2020). Before testing the research hypothesis for meaningful interpretation, it is always good practice to examine each construct item for reliability and validity (Anderson & Gerbing, 1988; Hair Jr et al., 2014) to assure the integrity and quality of a measurement instrument (Kimberlin & Winterstein, 2008). Validity is the extent to which any measuring instrument measures what it is intended to measure (Thatcher, 2010; Ginty, 2013), while reliability measures consistency, precision, repeatability, and research trustworthiness (Chakrabarty, 2013). The validity and reliability of the constructs and items of constructs in this study were measured using SPSS (Anderson & Gerbing, 1988; Hair et al., 2013). SPSS is widely accepted

and used by researchers in different disciplines (Edwin, Silvan, & Fred, 2017).

This study used Cronbach's Alpha (CA) and Composite Reliability (CR) to assess the reliability and validity of constructs (Keith, 2018; Henseler, Ringle, & Sinkovics, 2009) as shown in table 3.2. Cronbach's alpha coefficient was used to calculate the internal consistency reliability, that is, how closely related a set of items are intended to measure the same variable, while CR was used to measure the overall reliability of a collection of heterogeneous but similar items (Fornell & Larcker, 1981; Cronbach & Shavelson, 2004) as well as to test for the validity of constructs. This study adopted a cut-off value for CA and CR to be 0.70 or greater as recommended by many scholars (Straub, 1989; Hair et al., 2017; Fornell & Larcker, 1981) and therefore not questionable to be reliable significant, and consistent, and thus qualified for further analysis.

Table 3.2: Constructs Reliability

Construct / Variable	No. of Measurement Items	Cronbach's Alpha(α) (CA)	Composite Reliability(CR)
Ease of Use (EU)	4	0.901	0.921
Service Quality (SQ)	5	0.786	0.870
Security and Trust (ST)	7	0.873	0.884
Price Value (PV)	3	0.824	0.991
Network Availability (NA)	3	0.775	0.871
Task Characteristics (TC)	5	0.801	0.894
Adoption of Mobile Money Service interoperability (AMMSI)	3	0.881	0.925

Source: Research findings, 2020

As shown in Table 3.3, the values of CA ranged from 0.775 (NA) to 0.901(EU), while CR ranged from 0.870 (SQ). Both CA and CR for all constructs were found to be greater than the recommended cut-off value of 0.70.

V. DATA FINDINGS AND ANALYSIS

Descriptive statistics on the use of Mobile Money Services

Using a questionnaire, the frequency with which customers' used mobile money services were found. As shown in table 4.1, it has been revealed that over 60% of respondents had used the service 4-5 times each month.

Therefore, based on these results, it can be confirmed that the reliability and validity of the constructs of the measurement model have satisfactorily fulfilled the requirements and hence achieved.

Table 4.1: Respondents' use of Mobile Money Services (n =447)

Duration of mobile money usage				
Less than 6 months	7-12 months	1-2 years	More than 2 years	Total
25 (6%)	84 (19%)	105(23%)	233(52%)	447
Frequency use of mobile money services per month				
1 time	2-3 times	4-5 times	More than 6 times	Total
30 (7%)	131 (29%)	267(60%)	19 (4%)	447

Customers who have a mobile money account				
Only One	Two	Three	More than three	Total
47 (11%)	267 (60%)	120 (27%)	13 (3%)	447

Source: Research findings, 2020

By asking the respondents, the study further found that frequent use by customers was to transfer money to other people's either to the mobile telecom accounts or to the bank account, checking of account balances, payment of their bills for utilities (electric power, water, TV subscription and others) and purchase of airtime. Further investigations revealed that most respondents that account for over 60% have over one mobile money telecom and bank account. It has been further found that 52% of respondents have been using mobile money services for over two years. Table 4.1 shows the percentage and frequency analysis for the user's mobile money usage duration, mobile money services per month, and customers who have mobile money accounts.

The Regression and The Pearson Product-Moment Correlation (PPMC) analysis

To establish the relationship between the dependent and independent variables, the Multiple Regression and PPMC Analysis were used. In this study, the independent variables were Perceived Ease of Use, Price Value, Network Availability, Security and Trust, Service Quality, and Task Characteristics while the dependent variable was interoperability of Mobile Money Services. Coefficient Correlation (r) for the PPMC was used to determine if relationships between independent variables were positive or negative. The coefficient of correlation may be between

-1 and +1. Nearer correlation to +1 or -1 indicates very high, while it is low when the correlation coefficient is nearer to zero. A positive correlation indicates a direct relationship, while a negative correlation indicates an inverse relationship (Bordens & Abbott, 2011).

Correlation results

The results of the PPMC coefficient for this study are indicated in Table 4.2. The results show that all independent variables were positively and highly correlated. The evidence shows that each independent variable influences the other independent variables and on the dependent variable. The correlation coefficients for all independent variables were between $r = .529^{**}$ (PV against NA) to $r = .958^{**}$ (TC against EU). Furthermore, the result shows that the EU has a strong relationship with ST at $p < 0.01$ with $r = .944^{**}$. EU has again shown a strong association with NA, PV, SQ and AMMSI at $r = .774^{**}$, $r = .737^{**}$, $r = .848^{**}$ and $r = .808^{**}$ respectively. It has also revealed that NA shows a weak relationship with PV with $r = .529^{**}$ and SQ with $r = .659^{**}$ at $p < 0.01$. Additionally, associations were strongly significant between independent constructs (EU, NA, SQ) and dependent construct, which is mobile money service interoperability.

Table 4.2 The Pearson Product-Moment Correlation (PPMC) as extracted from SPSS

CONSTRUCT		EU	PV	NA	ST	SQ	TC	AMMSI
Ease of Use	Pearson Correlation	1	.737**	.774**	.944**	.848**	.958**	.808**
	Sig.(2-tailed)		.000	.000	.000	.000	.000	.000
Price Value	Pearson Correlation	.737**	1	.529**	.801**	.733**	.825**	.717**
	Sig.(2-tailed)	.000		.000	.000	.000	.000	.000
Network Availability	Pearson Correlation	.774**	.529**	1	.649**	.659**	.779**	.829**
	Sig.(2-tailed)	.000	.000		.000	.000	.000	.000
Security and Trust	Pearson Correlation	.944**	.801**	.649**	1	.770**	.851**	.609**
	Sig.(2-tailed)	.000	.000	.000		.000	.000	.000
Service Quality	Pearson Correlation	.848**	.733**	.659**	.770**	1	.859**	.860**
	Sig.(2-tailed)	.000	.000	.000	.000		.000	.000
Task	Pearson Correlation	.958**	.825**	.779**	.851**	.859**	1	.730**

Characteristics	Sig.(2-tailed)	.000	.000	.000	.000	.000		.000
Adoption of mobile money service interoperability	Pearson Correlation	.808**	.717**	.829**	.609**	.860**	.730**	1
	Sig.(2-tailed)	.000	.000	.000	.000	.000	.000	
**. Correlation is significant at the 0.01 level (2-tailed). ; N=447								

Source: Research findings, 2020

Regression Analysis

Multiple regression analysis was done to determine how independent variables could be used to predict the use of mobile money services interoperability. The results of the regression analysis are provided in Table 4.3. The value of R, the multiple correlation coefficients was .903, which indicates an adequate level of prediction of the variables. R Square in the regression analysis provides an index of the amount of variability in the dependent variable accounted for by the predictor variables (Bordens & Abbott, 2011). To know if the R-squared is significant, it has been recommended by looking at the significance of an F test of ANOVA (Mark & Jolley, 2010).

The ANOVA analysis shows that $F(5, 441) = 388.793$, $p < .05$, which suggests the regression is a good fit for the data and statistically significant. Since the value of R-square is high, which generally indicates a better model and therefore, it is a measure that provides a good fit to the data in the model.

As shown in table 4.3, the results show that the value of R square was .815, showing that collectively, approximately 81.5% of the dependent variable, which is interoperability of mobile money services was accounted for by the regression analysis and therefore can strongly be explained very well by independent variables which are Perceived Ease of Use; price value; Network Availability;

Security and Trust; Service quality; Task Characteristics. Moreover, it is 81.5% confident that the regression model provides an adequate fit to the data. All Six variables were statistically significant in predicting mobile money services due to interoperability since their p-values are less than the threshold value, which is .05. The result shows that task characteristics which its p-value being less than 0.05 ($\beta = 0.425$, $p < 0.05$) and ease of use which its p-value being less than 0.05 ($\beta = 0.69$, $p < 0.05$). Both these two constructs are positively predicting the use of mobile money services interoperability. Thus, these findings indicated that task characteristics and ease of use of mobile money service interoperability were not a limiting factor. Users of mobile money services interoperability were willing to adopt the service because it solves their actual problems, useful in their daily lives, and free of effort on usage. Moreover, the results revealed that there is negative relationship of security and trust ($\beta = -0.425$, $p < 0.05$), network availability ($\beta = -0.511$, $p < 0.05$), and price value ($\beta = -0.478$, $p < 0.05$) due to the use of interoperability of mobile money services. Thus, the results suggest that users fear using mobile money services interoperability due to lack of security and trust, high price value, and poor network connectivity.

Table 4.3: Multiple Regression Results as extracted from SPSS

MODEL SUMMARY						
Model		R	R Square	Adjusted R Square	Std. Error of the Estimate	
		.903 ^a	0.815	0.813	0.406	
COEFFICIENTS						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	6.459	0.491		13.144	0
	Price Value	-1.05	0.085	-0.478	-12.317	0
	Network Availability	-0.479	0.033	-0.511	14.336	0
	Security & Trust	-0.79	0.155	-0.425	-5.081	0

	Service Quality	-0.555	0.059	-0.417	9.445	0
	Ease of Use	0.492	0.072	0.69	6.82	0
	Task Characteristics	0.3512	0.054	0.425	9.682	0
ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	320.679	5	64.136	388.793	.000 ^a
	Residual	72.748	441	0.165		
	Total	393.427	446			

Source: Research findings, 2020

a. Predictors: (Constant), Ease of Use, Affordability & Transaction Cost, Network Availability, Service quality & Convenience, Security & Trust

b. Dependent Variable: Interoperability & Integration; c. 95% Confidence Interval for B

VI. DISCUSSION OF FINDINGS

This study aimed to investigate the factors that influence the acceptance and success of the interoperability of mobile money services in developing countries with the case study of Tanzania. The study reveals that users are willing to use mobile money service interoperability since it is easy to use. This result matches with the study by Bångens & Söderberg (2009) and Richard & Mandari (2017) in which they found that users opt for technology that is easy to use and solves real problems as such, more customers are attracted to use mobile money services (Mbogo, 2010; Isaacs, 2009). It was also found that price value on the use of mobile money service interoperability was a major factor which influences the intention to use and actual usage of mobile money service interoperability. This finding is also the same as for studies conducted by Lema (2017) and Richard & Mandari (2017) on factors influencing mobile financial services' adoption. The above studies suggest that high costs of mobile financial services are a barrier to mobile financial service adoption among the unbanked population in Tanzania. However, if the service is affordable, it can motivate faster adoption (Oliveira, Thomas, Baptista, & Campos, 2016). For proper utilisation of the integration of mobile money services, the reduction of transactional cost of mobile financial services should be considered.

The evidence from the study findings revealed that security and Trust were found to have a significant positive influence on the use of mobile money services due to service interoperability. The result supports the findings of other studies that found identity theft and sending money to the wrong account acted as factors for accepting mobile money services (Omol & Abeka, 2017). Moreover,

the study findings are similar to the one conducted by GSMA (2018), which found that data privacy and security impact trust are the critical concern of users when considering whether to use mobile money. Furthermore, much care must be taken when transferring sensitive information, especially when related to financial data (Abdullah & Abdul-Hadi, 2009). Moreover, the findings revealed that the vital security issues are identity theft, authentication attack, phishing attack, personal identification number (PIN) sharing, and agent-driven fraud (Guma, Mussa, & Anael, 2020). Data should be protected in all stages: data at rest, data in motion, and people (Stallings, 1999).

Service quality was also a factor that was considered for the integration and interoperability of mobile money services. This study again is similar to the one conducted in Tanzania that found Service quality one of the indicators of success and growth of the money transfer technology. Users are highly comfortable with the quality of support from service providers (Lubua & Semlambo, 2017; Wilson & Mbamba, 2017). The increase in the perceived quality of customer support influences the intention to continue using mobile money. Improving service quality will attract and retain more customers.

Furthermore, the study found that convenience was statistically significant for the integration and interoperability of mobile money services. Typically, users who send the money need a fair price, transparency, certainty, convenience, and speed. Users do not need to travel a long distance or give up a day's work to collect money, need minimal documentation, and should not suffer fee deductions. This study is similar to the one conducted in Kenya by Isaacs (2009). The findings show

that network availability is statistically significant in the design consideration of mobile money services.

This study is again similar to Senso, & Venkatakrishana (2013) and Mutalemwa & Anthony (2014) that found network or service failures to be the primary factor that hindered a large population of customers from using mobile money service. Failure of network connectivity or problem may risk losing cash, wasting time, and other problems like loss of customer goodwill. Most of the time, network availability failure may affect the e-float top-up, check bank balances, and even withdraw money from either the service provider or mobile money agent. Additionally, the study found that task characteristics significantly affect the acceptance and successful use of mobile money service interoperability. This result is the same as the one revealed by Tam & Oliveira (2016) and Changchun, Haider, & Akram (2017) which found that mobile users feel to use technology services if they support the task at hand. Therefore, mobile money interoperability enables users to smooth transfer money, reduce the time of performing transactions, do more transactions and have more access to more service providers. Also, it makes the tasks easily accomplished without limitations to service providers.

VII. CONCLUSIONS AND AREAS FOR FURTHER STUDIES

This study investigates factors for acceptance and successful use of mobile money services interoperability in developing countries such as Tanzania. This study concluded that, for the mobile money service interoperability to be useable, the security and trust of mobile payment transactions, network availability, and service quality were found to be the primary concerns for users. Other factors found were easy to use, task characteristics, and price value. The results obtained in this study are not sufficient for generalisation because most of the data were collected in a few cities from Tanzania. Therefore, further studies should be conducted in various cities or even across East Africa countries.

Categorically, studies should be done on factors that influence the mobile money services interoperability with Post offices, Money Gram, Western Union, and Telegraphic Transfer (TT) as the other means of money transfers. This study contributes the understanding and enhances the body of knowledge in the literature on factors that influence the acceptance and successful use of mobile money service interoperability in Tanzania. The study found that the D&M model, TAM, and The Task-Technology Fit (TTF) Theories directly affect the acceptance and successful use of mobile money service

interoperability. Therefore, the results provided theoretical and empirical support for the newly developed integrated model (Rahi *et al.*, 2019). The results will provide the basis for further refinement of technology acceptance and success models in the emerging mobile money service domain. Also, the findings of this study provide valuable understandings for formulating effective strategies concerning financial inclusion to mobile money service providers, government, and other stakeholders and expand the existing customer base to mobile money service providers (Dahlberg, Guo, & Ondrus, 2015).

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Intervention through Physical Therapy in the Recovery of an Employee after Suffering a Tibial Fracture in an Accident at Work

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Received: 17 Dec 2020;

Received in revised form:

01 Feb 2021;

Accepted: 19 Feb 2021;

Available online: 28 Mar 2021

Keywords— Accident at work, Fracture, Functional recovery Knee injury, Tibial injury.

Abstract— Fractures are the main cause of workers' licenses especially in urban centers. Based on the importance of fractures as a cause of the licensing of company employees as well as the importance of implementing regulatory legislation on safety in work environments and the importance of the functional recovery process through physiotherapy, our study proposed this study case. In our study we described how an employee that suffered a type of work-related accident was recovered through physical therapy after defining strategies or methods during thirty days of treatment. We also verify the effectiveness of the accident prevention standards assumed by the company. The physical therapy resources used were Transcutaneous Electrical Nerve Stimulation -TENS, lymphatic drainage, laser therapy, passive mobilization, joint mobilization, kinesiotherapy and stretching. The employee that was hit by an industrial battery of one ton and eight hundred kilos, fracturing the proximal portion of his tibia, presented partially functional recovery after treatment according to the data of the joint's angular amplitude, visual analogue scale of pain, gait evaluation and muscle strength. The study suggests that Physiotherapy has a fundamental role in the physical and functional recovery of workers that suffer accidents in the workplace, positively reinforcing their psychological condition, with social support.

I. INTRODUCTION

Employees of companies need to comply with different demands, resist inadequate work conditions, experience work pressures and responsibilities imposed by the organization or structure of the work environment [1]. All companies must have employees engaged under an employment contract and follow the plans and actions to prevent accidents or illnesses according to the Labor Law in Brazil (CLT - Consolidation of Labor Laws) [1]. The main objectives of the modernization and simplification process of the Regulatory Norms (NR) of work are to stimulate business competitiveness and guarantee health and workplace safety [1,2]. There are several regulatory standards in Brazil, such as NR5 (Regulatory Norms -5),

which requires the company to implement an internal accident prevention commission (CIPA) composed of employees [2]. CIPA is responsible for collaborating in the medical control program (NR7) and health risk prevention program in the workplace (NR9). In addition to other programs all related to occupational health [2].

Studies report an average of 611,000 work-related accidents per year in Brazil of which 14,000 remain with sequelae and 2,300 employees die. [3,4]. Results show that the number of accidents at work has been decreasing. However, in urban centers, such São Paulo city, fractures continue to be the major cause of removal of employees due to sick leave [1,3,4,5].

Bone fracture is characterized by the disruption of the bone cortex, caused by the conversion of energy that is transmitted to other tissues [5,6]. The bones present in the human species are generally strong and can withstand intense impacts. However, if the impact is very intense or there is something wrong with the bone, it can fracture [5,6]. Complications of bone fractures are classified according to their severity, which can be determined through the following parameters: the history and mechanism of the trauma; vascular extremity trauma; the size of the cutaneous injuries; injury associated with tissue loss; periosteal changes, devitalization and bone necrosis; the fracture line, shattered bone and / or bone loss; contamination and compartment syndrome [7]. The fracture classification is done by adding the degree of intensity of each evaluated parameter. The classification may contribute to the elaboration or choice of the most appropriate treatment [7]. Tibial shaft fractures may be associated with important complications such as infection, pseudoarthrosis and vicious consolidation [7]. The geometric characteristics will depend on the direction in which the force was applied, its magnitude and degrees of knee flexion [7]. Based on the importance of fractures as a cause of the licensing of company employees as well as the importance of implementing regulatory legislation on safety in work environments and the importance of the functional recovery process through physiotherapy, our study proposed this study case. In our study we describe how an employee acquired and recovered from a tibial fracture through an individualized therapeutic treatment process. We also analyzed the effectiveness of the accident safety standards assumed by the company. We wait with our study to describe the functional recovery process of an employee who suffered an accident with fracture of the tibia and contribute to the knowledge about functional recovery.

II. METHODS

The retrospective descriptive case study was carried out with the beginning of the functional recovery of a tibial fracture. Data were collected from medical records and records of therapy results from its beginning to one year after the date of the accident. After being communicated about the importance of participating in a case study and the need for authorization to conduct the study, the employee signed a free and informed consent form. Then identification and anamnesis data were collected. The following criteria for the analysis of functional recovery were used: sensory evaluation, analysis of joint movement and analysis of muscle strength using the Kendall scale. Complementary laboratory data were collected from the start of treatment until the patient's recovery.

Physiotherapeutic treatment was divided into phases with well-defined objectives. At the end of one year of treatment, complete functional recovery of the patient was expected.

III. CASE REPORT

Patient J.G.A, 37 years old, male, with the position of administrator of a logistics company, was victim of an accident in his work environment, requiring emergency medical assistance. The accident occurred in June 2018 when the employee left his office to carry out what he calls "field work" or supervise the work of the team that dealt with the handling of machinery and equipment. According to his report, the company is dedicated to the transport of equipment or machines with heavy loads and the transport also takes place inside the company's own yard. In the company's yard there are metal tracks that facilitate intersectoral transport. It was during the attempt to help the team that a battery of approximately one ton and eight hundred kilograms (1.8 T), containing industrial acid, fell on the employee, causing serious injuries to the proximal portion of the right tibia. According to the victim's words, "I work a lot because I like it and I'm exacerbated, work for me is the most important thing, I work 12 hours a day because I like it and I always do this outside activity, I wanted to help. Then the worker was removed to the traumatic orthopedic emergency service, where he underwent a surgical procedure with insertion of osteosynthesis, plate and screw in the proximal region of the right tibia (Fig.1). After the post-surgical hospitalization period (12 days), the worker was transferred to a private physiotherapy clinic in Niterói RJ on 07/11/2018. The patient was received by the physiotherapy department of the clinic, showing dislocation and fracture of the proximal portion of the right tibia. The patient reported that he remained hospitalized for nine days and that only on the tenth day the surgical procedure was performed. The main complaints of the patient in the physiotherapy sector of the clinic were the sensations of pain and difficulties in moving the knee. The patient is not a smoker and does not use alcohol. He is not hypertensive and does not have diabetes. The injured employee was speculated by the researchers if he felt harmed by the company for admitting that the employee left his activity in the administration office to attend other functions even without training. The employee replied that the company provided all the support from the treatment to his return to work. It was clear to the interviewers that the employee shied away from questions when speculated about the company's security policy and the issuance of the Work Accident Report (CAT), whether he had access to INSS benefits, whether his work permit was paid by social

security (INSS - National Institute of Social Security) or not. It was asked if the worker made any kind of agreement with the company and that this agreement proposed the maintenance of the salary during the period of restoration of his health. It was asked whether the employee received the monetary value of his unemployment insurance or the Severance Pay Fund (FGTS). The worker always responded to change the subject, with periods of silence after short, incomplete answers, which forced researchers to change their question. There was clearly a lack of information in the answers given by the employee. He tried to avoid questioning. In the initial clinical evaluation of the patient, it was possible to verify, through physical examination, the presence of generalized edema in the right knee. The range of motion for knee flexion found was grade 0. There was a deficit of muscle strength in the entire right lower limb being classified as grade 1, according to the Manual Strength Scale for flexion movement (hamstring muscles) and knee extension (quadriceps muscle) [8]. Arthrogenic muscle inhibition of the quadriceps muscle and joint block for flexion with a rigid "final sensation" in the right knee were identified. The patient reported feeling intense pain when trying to contract the quadriceps muscles, classified as intense according to the Visual Analog Pain Scale [9]. The patient needed orthoses (two Canadian crutches) to move from place to place. The Romberg test was performed and showed a positive result for equilibrium deficit and there was also a reduction in strength in the upper limbs, which showed grade 4 according to the Manual Strength Scale [8]. Based on the data found through the initial clinical evaluation, the following short-term treatment objectives were established: pain reduction; reduction of edema and prevention of scar adhesion. Physiotherapeutic resources such as high frequency stimulation (TENS), were used on the right lower limb, on the right knee, for 20 minutes; cryotherapy on the right knee for 20 minutes with TENS. We tried to combine the depression of the sensitivity of the pain receptors and the containment of the edema caused by the postoperative. Manual lymphatic drainage was performed on the right lower limb; The laser (J/cm²) was applied by the punctual technique and passive scar mobilization was performed. This physiotherapy procedure was planned for the first ten days and extended for the next ten days. A new evaluation of the patient allowed the elaboration of new objectives, such as: to increase muscular strength in lower limb muscles, mainly ischio - tibial muscles, quadriceps muscles, hip adductors and abductors; increase the range of motion of the hip and right knee joint for flexion and full extension; improve gait, seeking basic functional recovery of gait and functional independence of the

patient. Passive joint mobilization (arthro- and osteokinematics) was performed on the right knee. The knee osteo-kinematic movements (flexion and extension) respected the patient's perception and tolerance of pain; the arthro-kinematic movements (sliding, rotation and traction) were carefully performed to avoid the risk of severe pain in hypersensitive regions that were identified in post-operative recovery. Osteokinematics movements were also for extension and flexion, adduction and abduction, medial rotation, and lateral hip rotation, bilateral. In addition, passive mobilization of the patella and myofascial release of the thigh and right leg muscles. There was also intervention with passive stretching of the posterior and anterior thigh and leg muscles, bilaterally, in addition to the continuity of treatment with high frequency stimulation (TENS) and laser (J/cm²). This treatment phase was completed in 30 days and the observations noted in the medical record. The purpose of the treatment was to make the patient gain more functionality and independence even with the severity of the injury presented. After 45 days of treatment, it was found that the prescription and physical therapy treatment partially achieved the proposed objectives. The new clinic evaluation was satisfactory with results that demonstrated more functional independence for walking and changes in posture. Then, new guidelines were added, such as assisted and resisted kinesiotherapy, partial weight unloading, assisted walking and independent walking aiming at removing the orthoses. According to the patient's evolution, the exercise loads were gradually increased new exercises could be prescribed. The patient's discipline helped a lot in his evolution. The patient systematically performed the activities at home, which were prescribed by the physiotherapist, mainly aiming at the total flexion of the right knee. The muscle strength progressed to the grade 4 in the manual strength test for knee flexion, and his angle of joint amplitude for knee flexion was already at 90 °, allowing more independence in activities of daily living. On 12/06/2019 the patient returned to work activities, but still maintaining the physiotherapy treatment physiotherapy for muscle strengthening and improve coordination and proprioception of the right lower limb. When comparing the data between the first clinical evaluation (July 2018) and the last clinical evaluation (December 2019), the patient presented an evolution in joint amplitude for knee flexion from 0 degrees to 90 degrees; muscle strength from grade 1 (vastus lateralis, vastus intermediate, rectus femoris and vastus medial, semimembranaceous, semitendinosus and biceps femoris) to grade 4; pain level rated from 10 (intense) to 2 (mild), according to the Visual Analogue Scale and the gait that was initially performed with the help of two Canadian

crutches in December was no longer necessary. Joint amplitude reached functional levels with changes in gait and posture, increased muscle strength and analgesia. The patient's gait was functionally organized, without the use of orthosis. In the following months, the patient completely abandoned assistance or contact with physiotherapists. After a few months, the researchers contacted the patient and new information was obtained. The patient said that he abandoned the treatment because he was having a lot of work at the company and thought he could improve naturally. However, the patient also reported that after a few months he had difficulties to completely recover his movements and the pain intensified. He also said that he tried to make an appointment with his doctor, but it was not possible. A clinical evaluation was made by another doctor who identified the bad positioning of the screws and the presence of excess scar tissue at the surgery site. The employee had to undergo a second surgery. Currently, he did not use the physiotherapy services of the initial clinic and even after the second surgery, he still reports difficulties in performing the movements and many pains.



Fig. 1: Conventional radiograph image taken after placing the osteosynthesis.

IV. DISCUSSION

Bone fractures are difficult to treat because loads, compression and joint movements make it difficult to analyze the affected segment [7,8]. Imaging tests such as radiation (X-ray) and computed tomography are necessary, which can expose the dimensions of the fracture and what should be researched in the physical evaluation. In addition, they help in the prescription of treatment and in setting goals [10]. Evaluation with anamnesis and functional physical examination is also essential for the development of a functional recovery plan [10]. The physiotherapist must have full knowledge of biomechanics and bone formation [11]. A study reports that cryotherapy associated with TENS has an analgesic effect, but the

effectiveness is not clear [12]. In our study the initial procedures were chosen to reduce the patient's pain to ensure the proper and efficient application of subsequent procedures. The presence of pain causes arthrogenic muscle inhibition, weakness and joint instability [12]. The techniques chosen for the treatment of the patient were based on the anatomy and biomechanics of the knee respecting the patient's pain threshold which proved to be effective. After the first 10 days of treatment the patient showed improvement in the level of pain, absence of edema and less arthrogenic muscle inhibition. The patient sought his functional recovery respecting all conducts at this stage of treatment. Thus, it was possible to deal with variations in techniques so that new objectives could be achieved. The techniques selected for this case were arthrocinematic and osteokinematic mobilization of the joint and elongation of the posterior thigh muscles. Range of motion is defined as the mobility capacity of a joint determined by bone structures and tissues in this region [13]. Joint mobilization is one of the most used techniques in kinesiotherapy in the treatment of joint mobility restriction [13]. At the end of the 30 days of treatment, the patient had less tension and less retracted muscles due to the application of the passive stretching technique. There was an improvement in joint movements due to the mobilizations performed. Passive mobilizations were made with the aim of improving arthrocinematic movements, improving the flexion of the patient's knee, stimulating the rotation and medial flexion movements of the tibia. This training was performed several times with the patient in the prone position, evolving to the supine position. During the execution of the arthrocinematic movements, it was possible to observe evidence of a possible rigid block in the injured region. Arthrocinematic work improved the performance of osteokinematic movements and thus included muscle strengthening in the treatment. There was a gradual acquisition of strength that allowed the patient to leave the orthoses. Great care was taken to remove the orthoses. Before the patient had to gain confidence and security. The patient walked without crutches, but this process was extremely respected and included several positive verbal stimuli. After 45 days of treatment, the patient was still in the clinic being treated with assisted and resisted kinesiotherapy, partial weight unloading, assisted walking and independent walking for removing the orthoses. During the treatment of the patient, there was an improvement in muscle strengthening and increased functional independence, however, he still had a rigid joint block that seemed to be possible to correct only with surgery. In strengthening training, all exercises were planned and performed according to the characteristics of the injury. All work was done first on an open kinetic

chain (CCA) and evolved into a closed kinetic chain (CCF). Special attention was focused on soft tissues for functional movement recovery. Myofascial release is a procedure similar to massage, which involves manual contact with the patient [13]. No treatment followed an existing protocol. For each stage, a different protocol of techniques was developed based on the evidence of the effectiveness of the conducts. Continuous physical therapy is essential for the patient's functional recovery. A clinical evaluation, prescription and execution, added to the home orientation of specific exercises or directed to the recovery of injuries and function, contribute to positive responses to treatment [13]. About the fact that the employee does not speculate about the record of the accident suffered in the Work Accident Report (CAT) by the company or does not adequately answer questions about his access to INSS benefits, if his work permit has been paid by O INSS or if the company kept its salary or if the FGTS was collected, it demonstrated that the employee avoided being questioned and tried to protect the company. The employee demonstrated that he assumed specific roles for his position and other functions typical of other positions to avoid resigning the position. We must remember that the employee suffered an accident while acting as an assistant in the transportation of cargo at the shipyard, even without receiving prior training. This leads us to reflect on how flexible the employee allows himself to be, exploited in the performance of functions other than his own, because he is afraid of being unemployed. The employee seems to imagine that he must do everything for the company, everything must be part of his obligation as an employee or subordinate. The employee's need to defend or protect the company during the interview suggests the notion of culture as a network which makes employees in general assume the company's interactive standards that can represent greater security, regularity and identity as an employee [14]. Thus, for the worker to "belong" and "remain" in the company, he must accept and share his norms, values and interaction patterns [14]. We know that organizations and society are still a long way from enforcing the ethical values that must regulate actions and guarantee the safety of employees in the institutions [14]. The adoption of the current neoliberal economic model brought with it the loss of the employee's rights, the reduction of the role of the State that started to transfer all responsibility to the employee who is now without support to be inserted or to remain in the productive system [15]. Thus, the worker is an orphan of the State [15]. The employee, submitting to the rules and exploitation or will be unemployed [14,15]. The employee learns that he must do everything for the company even if it affects physical integrity or health, everything must be done for the

company's project [15]. It is in this contractual employment relationship that employee rights weaken (all rights are applied only when there is regulation and inspection) and are transformed into exchange values, between money and products [15]. The biggest negative aspect that modern times have brought us seems to be the lack of an assessment of reality in the face of inhuman actions imposed by the rules of the consumer market [15, 16]. Today there is an uncritical population, everything seems to be possible even in the different forms of explicit totalitarianism [16].

V. CONCLUSION

There was a functional recovery of the patient favoring the return to activities. The recovery was seen a consequence of measures taken through the initial assessment and pre-defined objectives. The prescription, the physiotherapeutic plan and the execution of the treatment with objectives made possible the functional evolution of the patient. The response to the proposed physiotherapeutic treatment, culminated in the patient's functional recovery and his return to his activities.

The social inclusion of the patient after treatment occurred gradually after gaining some self-confidence and to experience his independence.

There are several factors that cannot be neglected in relation to physical therapy treatment: pain, physical discomfort and psychological impairments. These factors affect the ability to roam freely, to solve problems, to regain self-confidence, to gain self-esteem and to make constant comparisons with conditions before treatment.

Physiotherapy has a fundamental role in the individual's physical and functional recovery and reinforces the psychological condition. Individualized treatment and frequent patient evaluations favored his recovery.

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Age and Nutritional Status by Mini-Nutritional Assessment (MNA) can discriminate Alzheimer's Disease Severity

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Received: 06 Dec 2020;

Received in revised form:

03 Feb 2021;

Accepted: 27 Feb 2021;

Available online: 28 Mar 2021

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Keywords— Alzheimer disease, anthropometry, mini-nutritional assessment, associated factors.

Abstract— Investigate the risk factors associated with Clinical Dementia Rating (CDR) in patients with Alzheimer's disease (AD). Cross-sectional study with 43 elderly people with AD. Parameters assessing nutritional status (anthropometry and mini-nutritional assessment-MNA), neurocognitive assessment and Clinical Dementia Rating (CDR) were investigated. For the investigation of AD severity risk factors, statistical analysis was performed using logistic regression models. The level of significance adopted was 5%. No statistically significant difference in the relationship between the parameters of anthropometry nutritional assessment and the CDR score were found. In the final regression model; only MNA ($p=0.0159$; $OR=4.815$; $IC95\%=1.342$; 17.282) and age ($p=0.0481$; $OR= 1.097$; $IC95\%=1.001$; 1.202), were associated with the severity of the disease (CDR). Age and MNA discriminate the severity of the disease and were considered risk factors for the severity of AD.

I. INTRODUCTION

Alzheimer's disease (AD) is a neurodegenerative disease prevalent in the elderly. It is well known that incorporation of lifestyle changes, as well as physical and recreational activities, diet and cognitive activity, among others, are important to prevent the disease¹. Evidence of preventive interventions¹ could encourage or contribute to the treatment of this population. Recent studies^{2,3} have indicated the importance of some nutrients which shortage is associated with the development of AD. These nutrients contribute to the synthesis of neurotransmitters, modulation in epigenetic mechanisms and with antioxidants². In elderly patients with subjective cognitive decline, clinically relevant findings have been associated with the quality of the diet³.

Regarding the nutritional status of patients with AD, a study⁴ showed a high prevalence of malnutrition or risk of malnutrition detected by the mini nutritional assessment (MAN), in patients with different severity, also associated with reduced functional status. Another recent study⁵ which investigated the association between nutritional status and clinical and cognitive aspects of patients with AD, showed significant progressive impairment of nutritional and cognitive indicators related to disease progression. In a cross-sectional study⁶, assessing the nutritional status and body composition and mild cognitive impairment in patients with AD, the MAN score was significantly lower, compared to healthy elderly controls. Dementia was also considered an independent predictor of malnutrition risk, when compared to cognitively intact individuals⁷.

Recently, a prospective multicenter study⁸ investigating the nutritional status in AD and its influence on disease progression, found that nutritional impairment was highly prevalent in patients with AD. The authors also pointed out that the identification of the nutritional status in early diagnosis, could help those patients who are at a higher risk of disease progression.⁸ The relevance of assessing the nutritional status with different indicators in patients with AD, was also reported in other investigations^{9,10,11}.

In view of all the findings discussed above, this study investigated nutritional risk factors using the clinical dementia rating (CDR), in patients with Alzheimer's disease (AD).

II. CASES AND METHOD

This study is part of a more comprehensive research project on lifestyle aspects in elderly patients with dementia. Some nutritional aspects have been addressed in another paper⁵.

This was a cross-sectional study, which included outpatient elderly individuals (n=43) aged ≥ 65 years with diagnosis of suspected DA, according to the Diagnostic and Statistical Manual of Mental Disorders¹², the recommendations of the European Federation of Neurological Societies¹³ and the Brazilian Academy of Neurology¹⁴. Clinical dementia rating (CDR)¹⁵ was used to stage the severity of dementia, that was classified as mild, moderate or severe. Patients with other serious illnesses and patients and/or caregivers unable to answer the evaluation questions were excluded. The study was approved by the institution's ethics research committee (No. 1,234,677) and was started after the guardians signed the free and informed consent form.

Methodological procedures:

a) *Nutritional assessment by anthropometry*: According to standardized procedures and cutoff points reported in the literature such as the body mass index (BMI) for the elderly¹⁶, the calf circumference (CC)¹⁷, the thickness of the adductor pollicis muscle (APM)^{18,19}, the handgrip strength (HGS)^{20,21,22} and waist circumference^{23,24}. The anthropometric indicators of body composition^{17,25} of arm

circumference (AC), triceps skinfold (TSF), arm muscle circumference (AMC) and sub-scapular skinfold (SSF), were classified in percentile distribution as: lower than the 5th percentile (<P5: depletion); between the 5th percentile and below the 10th percentile (P5 - <P10: risk of depletion); between 10th and 90th percentiles (P10 - P90: normal weight); above the 90th percentile and up to the 95th percentile (> P90 - P95: risk for excess) and above the 95th percentile (> P95: excess).

b) *Mini Nutritional Assessment (MNA)*: The MNA questionnaire was applied and the nutritional status was classified according to the cutoff points established as eutrophic, risk of malnutrition and malnutrition²⁶.

c) *International physical activity questionnaire - short form (IPAQ-SF)*: Physical activity was assessed according to a standardized and validated instrument for the Brazilian population²⁷. For the purpose of analysis, in this study, physical activity was classified as: sedentary or active.

d) *Statistical analysis*: A descriptive analysis was performed with frequency tables for categorical variables and measures of position and dispersion for continuous variables. The Chi-square or Fisher's exact test was used, when necessary; for comparing proportions. To compare continuous or orderable measurements between 2 groups, the Mann-Whitney test was applied and among 3 groups, the Kruskal-Wallis test. Later, to identify the predictors of disease severity by the CDR clinical score, regression models were used, such as univariate and multiple logistic regression analysis. The variable selection process employed was stepwise. The level of significance adopted for the statistical tests was 5%.

III. RESULTS

In our study's population (n=43), 16 (37.2%) patients were rated by CDR in the mild stage; 19 (44.1%) patients in the moderate stage and 8 (18.6%) patients in the severe stage. The sample included 28 (65.1%) female patients and 15 (34.9%) male patients.

There was no statistically significant difference in the relationship between all anthropometric parameters, age and IPAQ-SF with the CDR scores (Table 1).

Table 1. Descriptive analysis of the studied variables and comparisons with the CDR score.

Variables	Classification		CDR - L N=16	CDR - M N=19	CDR - G N=8	Total N=43	P-value
Age	years	$\bar{x} \pm dp$	77.6 ± 6.0	82.2 ± 7.5	82.8 ± 6.3	80.6 ± 7.0	0.0959 ¹
Weight	Kg	$\bar{x} \pm dp$	65.8 ± 13.8	61.5 ± 13.5	55.2 ± 9.2	62.0 ± 13.2	0.1728 ¹

Height	cm	x±dp	155.9 ± 10.3	152.4 ± 8.8	154.6 ± 9.4	154.1 ± 9.4	0.6743 ¹
BMI	kg/m ²	x±dp	26.9 ± 4.1	26.3 ± 4.5	23.2 ± 3.9	26.0 ± 4.4	0.1129 ¹
HGS-bd	Kg	x±dp	16.5 ± 10.1	12.2 ± 7.2	12.8 ± 8.2	13.9 ± 8.6	0.4745 ¹
HGS-be	Kg	x±dp	15.6 ± 9.1	11.4 ± 7.2	11.4 ± 7.1	13.0 ± 8.0	0.3847 ¹
HGS average	Kg	x±dp	16.0 ± 9.6	11.8 ± 7.1	12.1 ± 7.6	13.4 ± 8.2	0.4618 ¹
AC	P10 – P90	n (%)	7 (43.8)	8 (42.1)	4 (50.0)	19 (44.2)	1.0000 ³
	>P90 – P95	n (%)	9 (56.3)	11 (57.9)	4 (50.0)	24 (55.8)	
TSF	P10 – P90	n (%)	8 (50.0)	10 (52.6)	4 (50.0)	22 (51.2)	0.9854 ²
	>P90 – P95	n (%)	8 (50.0)	9 (47.4)	4 (50.0)	21 (48.8)	
AMC	P10 – P90	n (%)	9 (56.3)	11 (57.9)	8 (100.0)	28 (65.1)	0.0715 ²
	>P90 – P95	n (%)	7 (43.8)	8 (42.1)	0 (0.0)	15 (34.9)	
SSF	P5 – <P10	n (%)	1 (6.3)	2 (10.5)	0 (0.0)	3 (7.0)	1.0000 ³
	P10 – P90	n (%)	15 (93.8)	17 (89.5)	8 (100.0)	40 (93.0)	
CC (cm)	>31 cm	n (%)	13 (81.3)	14 (73.7)	4 (50.0)	31 (72.1)	0.3240 ³
	≤31 cm	n (%)	3 (18.8)	5 (26.3)	4 (50.0)	12 (27.9)	
WC (cm)	no risk	n (%)	2 (12.5)	4 (21.1)	1 (12.5)	7 (16.3)	0.8653 ³
	with risk	n (%)	14 (87.5)	15 (78.9)	7 (87.5)	36 (83.7)	
IMC (kg/m ²)	22 – 27	n (%)	7 (43.8)	9 (47.4)	5 (62.5)	21 (48.8)	0.6600 ³
	<22	n (%)	2 (12.5)	3 (15.8)	2 (25.0)	7 (16.3)	
	>27	n (%)	7 (43.8)	7 (36.8)	1 (12.5)	15 (34.9)	

MNA	eutrophic	n (%)	10 (62.5)	8 (42.1)	1 (12.5)	19 (44.2)	0.0658 ³
	MR	n (%)	6 (37.5)	11 (57.9)	7 (87.5)	24 (55.8)	
TAPM (mm)	minimum (7 or 5)	n (%)	15 (93.8)	18 (100.0)	7 (87.5)	40 (95.2)	-
	median (12 or 11)	n (%)	1 (6.3)	0 (0.0)	1 (12.5)	2 (4.8)	
	maximum (20 or 18)	-	-	-	-	-	
CLAPA	sedentary	n (%)	9 (56.3)	11 (57.9)	6 (75.0)	26 (60.5)	0.7758 ³
	active	n (%)	7 (43.8)	8 (42.1)	2 (25.0)	17 (39.5)	

¹ Kruskal-Wallis test; ² Chi-square test; ³ Fisher's exact test.

Legend:- CDR: clinical dementia rating; BMI: body mass index; HGSra: hand grip strength - right arm; HGSla: hand grip strength-left arm; HGS Max: maximum handgrip strength; AC: arm circumference; TSF: tricipital skin fold; AMC: arm muscle circumference; SSF: subscapular skin fold; CC: calf circumference; WC: waist circumference; MNA: mini nutritional assessment; MR: risk of malnutrition, TAPM: thickness of the adductor pollicis muscle; CLAPA: classified physical activity. P: percentile.

CDR - L: clinical dementia rating - mild; CDR-M: clinical dementia rating - moderate; CDR - G: clinical dementia rating - serious

In the analysis among all the anthropometry parameters and physical activity classified by IPAQ, no significant statistical difference was found in all the variables studied (Table 2). The other anthropometric data were not significantly related to the practice of Physical Activities in AD elderly (Table 2).

Table 2. Descriptive analysis of the variables studied and comparisons with physical activity by the IPAQ classified.

Variables	Classification		PA sedentary N=26	PA active N=17	Total N=43	P-value
Age	years	x±dp	80.1 ± 7.6	81.3 ± 6.2	80.6 ± 7.0	0.7843 ¹
Weight	Kg	x±dp	61.1 ± 13.7	63.3 ± 12.7	62.0 ± 13.2	0.5594 ¹
Height	cm	x±dp	153.3 ± 10.5	155.2 ± 7.4	154.1 ± 9.4	0.4486 ¹
BMI	kg/m ²	x±dp	25.9 ± 4.7	26.1 ± 4.0	26.0 ± 4.4	0.8913 ¹
HGS-bd	Kg	x±dp	14.0 ± 8.5	13.8 ± 9.0	13.9 ± 8.6	0.9702 ¹
HGS-be	Kg	x±dp	13.0 ± 7.4	12.9 ± 9.0	13.0 ± 8.0	0.8423 ¹
HGS average	Kg	x±dp	13.5 ± 7.9	13.4 ± 9.0	13.4 ± 8.2	0.8815 ¹

AC	P10 – P90	n (%)	10 (38.5)	9 (52.9)	19 (44.2)	0.3499 ²
	>P90 – P95	n (%)	16 (61.5)	8 (47.1)	24 (55.8)	
TSF	P10 – P90	n (%)	12 (46.2)	10 (58.8)	22 (51.2)	0.4164 ²
	>P90 – P95	n (%)	14 (53.8)	7 (41.2)	21 (48.8)	
AMC	P10 – P90	n (%)	16 (61.5)	12 (70.6)	28 (65.1)	0.5427 ²
	>P90 – P95	n (%)	10 (38.5)	5 (29.4)	15 (34.9)	
SSF	P5 – <P10	n (%)	1 (3.8)	2 (11.8)	3 (7.0)	0.5523 ³
	P10 – P90	n (%)	25 (96.2)	15 (88.2)	40 (93.0)	
CC (cm)	>31 cm	n (%)	17 (65.4)	14 (82.4)	31 (72.1)	0.3065 ³
	≤31 cm	n (%)	9 (34.6)	3 (17.6)	12 (27.9)	
WC (cm)	no risk	n (%)	4 (15.4)	3 (17.6)	7 (16.3)	1.0000 ³
	with risk	n (%)	22 (84.6)	14 (82.4)	36 (83.7)	
IMC (kg/m ²)	22 – 27	n (%)	12 (46.2)	9 (52.9)	21 (48.8)	0.9154 ³
	<22	n (%)	4 (15.4)	3 (17.6)	7 (16.3)	
	>27	n (%)	10 (38.5)	5 (29.4)	15 (34.9)	
MNA	euthrophic	n (%)	9 (34.6)	10 (58.8)	19 (44.2)	0.1181 ²
	MR	n (%)	17 (65.4)	7 (41.2)	24 (55.8)	

¹ Mann-Whitney test, ² Chi-square test, ³ Fisher's exact test

Legend:- PA: physical activity, BMI: body mass index; HGS-ra: hand grip strength-right arm; HGS-la: hand grip strength-left arm; HGS: handgrip strength; AC: arm circumference; TSF: tricipital skin fold; AMC: muscle circumference of the arm; SSF: subscapular skin fold; CC: calf circumference; WC: waist circumference; P: percentile; MNA: mini nutritional assessment; MR: malnutrition risk.

When investigating the risk factors associated with the CDR score, using univariate and multiple logistic regression analysis, it was found that in the final model, age ($p=0.0481$; $OR=1.097$; 95% $CI=1.001$; 1,202) and the assessment of nutritional status by MNA ($p=0.0159$; $OR=4.815$; 95% $CI=1.342$; 17,282), were the factors that, together, better discriminated the

severity of the disease. Each additional year of age increased by 9.7% the chance of CDR score 2 or 3. The patients' nutritional status by MNA, yielded patients classified as malnourished or at risk of malnutrition with a chance of being a score 2 or 3, 4.8 times higher when compared to the nutritional status of normal weight (Table 3).

Table 3. Risk factors associated with the CDR score, investigated by univariate and multiple logistic regression analysis.

Univariate Analysis				
Variable	Reference	P-value	OR	CI (95%)
Age		0.0564	1.088	0.998; 1.187
BMI		0.0896	0.888	0.775; 1.018
HGS		0.1504	0.948	0.882; 1.019
AC		0.1355	0.897	0.779; 1.034
AMC		0.3214	0.990	0.970; 1.010
SSF		0.2401	0.946	0.862; 1.038
WC		0.4333	0.980	0.932; 1.031
CC		0.1137	0.870	0.732; 1.034
TAPM		0.4622	0.926	0.754; 1.137
TSF	eutrophy versus ER + excess	0.9576	1.031	0.336; 3.158
SSF	Depletion + DPR versus eutrophy + excess	0.8051	0.757	0.083; 6.920
AC	eutrophy versus ER + excess	0.8405	1.123	0.364; 3.466
CC	eutrophy versus malnutrition	0.1344	0.375	0.104; 1.354
AMC	eutrophy versus ER + excess	0.0976	2.817	0.827; 9.593
IMC	eutrophy versus overweight	0.2427	2.132	0.599; 7.592
	thinness versus overweight	0.2469	2.747	0.497; 15.204
WC	no risk versus with risk	0.8261	1.185	0.261; 5.386
MNA	MR+D	0.0248	4.006	1.192; 13.464
	MA versus eutrophy			
CLAPA	sedentary versus active			
Multiple analysis*				
Variable	Reference	P-value	OR	CI (95%)
Age		0.0481	1.097	1.001; 1.202
MNA	MR+MA versus eutrophy	0.0159	4.815	1.342; 17.282

Legend:- CDR: clinical dementia rating; BMI: body mass index; HGS: handgrip strength; AC: arm circumference; AMC: arm muscle circumference; SSF: subscapular skin fold; DPR: depletion risk; ER: excess risk; WC: waist circumference; CC: calf circumference; TAPM: thickness of the adductor pollicis muscle; TSF: triceps skin fold; MNA: mini nutritional assessment; MAR malnutrition risk; MA: malnourished; CLAPA: classified physical activity.

* multiple model: stepwise process, model accuracy (statistics): $c = 0.725$.

IV. DISCUSSION

This investigation used several anthropometric parameters to assess the nutritional status of elderly people

with AD, and the initial hypothesis of this investigation was to find an association between the different anthropometric parameters used and the disease severity

score (CDR), yet this association was not observed. In the regression models, investigating what the risk factors associated with the severity of the disease would be, only age and MNA remained in the final model. The MNA addresses in its assessment instrument, the indicators of arm and calf circumference, functional capacity, dietary and body weight changes, nutritional problems, disease, elderly people physical evaluation ²⁶. And, the present study pointed out MNA (risk of malnutrition and malnutrition), as a predictor of the severity of the disease in elderly people with AD. The pathophysiological mechanisms between nutritional status and AD are not yet fully understood. Our data suggest that older age and risk of malnutrition and malnutrition and nutritional imbalance conditions are associated with greater severity of dementia in elderly people with AD. An association between nutritional status and the rate of cognitive and functional decline was also observed in an observational longitudinal study ¹¹, using MNA, CDR and the Mini-Mental State Exam. In the study in question, it was found that a worsening of the CDR, during dementia, was associated with lower MNA scores ¹¹.

Other studies suggest an association between a greater impairment of nutritional status with more advanced AD stages, faster cognitive and functional decline and higher mortality rates ^{4,8,28}.

Unlike the findings found in this investigation, a prospective study recently carried out in Portugal ²⁹ with elderly patients with AD, showed that malnutrition, unintentional weight loss, low weight, low values of calf circumference and muscle circumference of the arm, of handgrip strength and gait speed, were associated with a higher risk of death, regardless of gender, age, marital status, education and cognitive function status²⁹. In our study, among the investigated nutritional variables, only malnutrition was associated with AD. And in a Korean study ⁷ that investigated the nutritional status and clinical risk factors of malnourished patients, the authors observed that dementia was considered an independent predictor for the risk of malnutrition, further suggesting that cortical thinning in the left temporal regions, could be related to nutritional status. Another recent study with female patients with mild cognitive impairment and early-stage Alzheimer's disease, found malnutrition associated with behavioral and psychiatric symptoms of dementia ³⁰.

Other recent findings ³¹ suggest that malnutrition may be related not only to impaired cognition, but also to the pathology of AD. The authors pointed out that AD biomarkers were associated with the MNA score, waist circumference and BMI, and the

associations with the MNA score remained after adjustment for cognitive performance ³¹.

The present study found no association between the severity of the disease and the HGS. Different data were recently reported in a study with an elderly Japanese population, which showed a greater decline in HGS in the elderly, associated with the late onset of dementia ²¹.

As limiting factors of this study, it is highlighted that our service is a university hospital, but not a tertiary public health center in Brazil. This study is cross-sectional, with a relatively small sample of cases, although it is a specific population with elderly population with AD, monitored on an outpatient basis. However, we must consider that the hospital and outpatient service, where our study was conducted, is part of a representative clinical and surgical neurology service that includes AD patients care in a large metropolitan region. Thus, the individuals who participated in this study were representative of all those who undergo routine clinical treatment, besides the fact that this population underwent specific screening that allowed diagnostic tracking of the severity of the disease. These points can be considered the strong points of our investigation. Anyway, further investigations with a larger sample size are still need to assess the impact of these findings. We can also suggest that nutritional counseling be offered to those patients who are at risk of malnutrition.

V. CONCLUSION

The findings in this study allowed us to conclude that age and MNA, discriminate the severity of AD and were considered risk factors for the severity of the disease.

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Digital platforms contribution to improvement of service provision to citizens in Nampula

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Received: 25 Nov 2020;

Received in revised form:

02 Feb 2021;

Accepted: 25 Feb 2021;

Available online: 28 Mar 2021

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Keywords—*public administration, digital platforms, debureaucratisation, electronic government.*

Abstract— *This research has as its central subject the evaluation of digital platforms contribution to improvement of public sector service provision to citizens in the city and Province of Nampula, in Mozambique. In 2001, the Government of Mozambique launched the Public Sector Global Reform Strategy (EGRSP), which is the basic and fundamental document that outlines the guidelines for implementing all public sector policies, strategy and sector plans. Before launching the EGRSP in 2000, the Government approved the Informatics Policy, aimed to include Mozambique in the world of information and communication technologies, which has Internet as the highest exponent. In 2006, e-Gov program is approved, which in the following years it is materialized with the creation of specific sector platforms for service provision to citizens and companies, which is the subject of analysis of this study. Methodologically, the study is documentary, of qualitative nature; 8 interviewees participated in the study. It used content analysis technique for data analysis. The results show that the contribution of the implementation of digital platforms in the Public Sector allowed for greater speed, less bureaucracy, flexibility in the processes of document acquisition, in addition to collection of revenue for the State Treasury. However, despite the contributions found, it is understood that the electronic systems need interconnections with other public sector systems in order to allow speed and quality in service provision to citizens.*

Resumo— *O presente trabalho tem como tema central a avaliação do contributo das plataformas digitais na melhoria de prestação de serviços aos cidadãos pela Função Pública na cidade e Província de Nampula em Moçambique. Em 2001, o Governo de Moçambique lança a Estratégia Global da Reforma do Sector Público (EGRSP), que é o documento base e fundamental que traça as linhas mestras para implementação de todas as políticas, estratégia e planos sectoriais da Função Pública. Antes de lançar a EGRSP, o Governo aprova em 2000 a Política de Informática, com o objectivo de incluir Moçambique no*

mundo das tecnologias de informação e comunicação, que têm na Internet o seu expoente mais alto. Em 2006 aprova o programa o e-Gov que no anos subsequentes, veio se materializar com a criação de plataformas específicas sectoriais para PS ao cidadão e empresas, que é objeto de análise deste estudo. Metodologicamente, o estudo é documental e de natureza qualitativa e participaram 8 entrevistados e empregou a técnica de análise de conteúdo temática para a análise dos dados. Os resultados alcançados demonstram que o contributo da implementação das plataformas digitais na Função Pública (FP), permitiu maior celeridade, desburocratização, flexibilidade nos processos de aquisição de documentos, para além de arrecadar receita para os Cofres do Estado. Contudo, pese embora os contributos verificados, entende-se que os sistemas electrónicos necessitam de interconexões com outros sistemas da FP para permitir uma maior rapidez e qualidade no atendimento ao cidadão.

Palavras-chave— administração pública, plataformas digitais, desburocratização, governo eletrónico.

I. INTRODUCTION

In recent years, it is perceived an increasing interest in ICTs, because the modern world is profoundly dominated by the ICTs, a society of knowledge in which governments struggle to maximize quality public service provision by using information and communication technology in order to respond to citizens' demands and achieve its good governance goals, on one hand. On the other hand, governments strive to provide, through Electronic Portals, relevant information about public services. It is noticed the importance held today by the information and communication technologies to people, organisations, institutions, business, especially to development towards achievement of Millennium Goals. Mozambique is integrated in this global society of information and communication technologies, in which knowledge circulates at a speed never seen before in the history of mankind, affecting all aspects of the lives of Mozambicans, and all aspects political, economic, and sociocultural activities. For the ICTs to perform their catalytic function in the scope of national efforts aimed at eradicating absolute poverty and improving the living conditions of the Mozambicans it was formulated a regulating instrument.

The way public administration was in the post-independence period, between 1975 to 2000, it could not continue. That is why the Government of Mozambique adopted the Electronic Government, whose implementation occurred in the framework of the Public Sector Global Reform Strategy (2001-2011), and, in 2005, they approved the Electronic Government Strategy as in integral part.

Various authors consider that the Electronic Government has assumed an increasing importance in current society, considering itself as a vital process for public sector modernization, having as major priority to improve significantly the quality of public services provision, through utilization of the ICTs and presenting itself as a strategic area

for construction of the Society of Information and Knowledge (Gouveia, 2004).

For better understanding of the present work, it is important to highlight that according to Mateus (2008, p.1), for example, *“Electronic Government is seen as a strategic process in order to improve the relationship between citizens and companies, and the public administration, contributing, moreover, to its modernization”*.

The Informatics Policy offers a set of principles and objectives which may allow *“information and communication technologies to be the driving force for several aspects of national development”* (Resolução n° 28/2000, de 12 de Dezembro).

The creation of the Electronic Government in Mozambique in 2011 drove the creation of other specific and sector platforms for improvement of services provision to citizens.

As a response to and complying with the degree of e-Gov implementation in Mozambique, there were implemented several Integrated Platforms for Service Provision to the citizen and companies based on e-Gov.

Regarding to the importance the ICTs present, Xavier states that:

Information and communication technologies have been modifying the interaction relationship paradigm between people and institutions, particularly in public administration. The initiatives and projects promoted by the successive governments aim to allow the utilization of public resources in a more economical and efficient way, that is, allowing the State to improve their services with little, through dematerialization of processes and services, making them possible to be executed online and through a single point

of contact, thus, privileging a multichannel structure (Xavier, 2015, p.8).

The Government of Mozambique conceived, approved and implemented projects of electronic platforms through Informatics Policy, Electronic Government Strategy, and Electronic Government Strategic Plan as a way of operationalizing the Electronic Government (e-Gov) in order to rationalize the utilization of information technologies in the public sector.

Like in other countries, significant progress has been made in recent years in the utilization of digital technologies for promotion of internal efficacy, simplification of governmental procedures and improvement of public services. Meanwhile, in order to obtain all the benefits resulting from the utilization of technologies and to modernize its essential administrative capacities, such as, tax collection, expense monitoring and public sector management, progress regarding its policies and practices in digital government must prevail (OCDE, 2018). The study objective was to examine the contribution of the implementation of digital platforms in the public sector for Mozambique social and economic development.

II. METHOD

This study is exploratory and of qualitative nature. Its exploratory typology is justified by the fact that the subject under study has been little explored in Mozambique, especially in Nampula, this study site.

According to Nielsen, G.A.F, Olivio, F.L.R and Morilhas, J.L, (2018, pp. 111-123) and based on studies, the present scientific research is characterized in four aspects.

In terms of its nature, it is basic because it intends to explore an area of knowledge without concerns about developing immediate practical applications. In this context, two government models are analysed: the old and the modern, consisting of electronic platforms and the gains obtained from their implementation. In terms of approach, the research is qualitative because its objective is to conduct an in-depth analysis of the electronic platform phenomenon and interpret, in details, the electronic platform under analysis. In terms of goals, the present research is classified as exploratory, descriptive and explanatory because it studies a little-known phenomenon and aims to know it better (particularly, to analyse the electronic system and its effective implementation for quality management of services delivered to citizens), and because it aims to present the characteristics and to describe the phenomenon under study

(specifically the functions of the platform). Third, because it explains the phenomenon under study, which is analysis of the introduction of the electronic system for commercial licensing. In this case, it explains the cause and effect/reasons and result relationship. The reasons that led the Government of Mozambique and their cooperation partners to introduce the electronic platforms was decrease and elimination of bureaucracy and fighting corruption, while the effect or result of the electronic system implementation is to completely improve service delivery to the citizen. Finally, in terms of technical procedures, the research is classified as bibliographical and documentary (Flavio et al., 2018, pp 111-123).

For Minayo (2014) qualitative research is one which devotes itself to the study of the history, relationships, representations, beliefs, perceptions, and opinions, which are products of the interpretations made by humans regarding the way they live, construe their artifacts and themselves, feel and think.

The data collection was conducted by means of document analysis and semi-structured interviews. The document analysis consisted in reading the legislation about the creation of the Policy, Strategy and Informatics Strategic Plan, of the e-Government and other electronic systems. The data analysis was made with the utilization of the categorial content analysis technique.

The content analysis technique implies three fundamental phases: *pre-analysis, exploration of the material, and treatment of the results*. In this particular study, at pre-analysis stage, it was done interview transcription. At exploration phase, speech codification and fluent reading was done. At this very same phase, categories were defined based on the defined objectives and data were collected later. In this context, there were created four categories, namely: a) services provided by the systems; b) systems positive effects; c) systems limitation; and d) proposals for systems improvement.

History and evolution of the electronic government in Mozambique

Mozambique is pursuing three key-programs in order to get prepared and fortified to face growth, development and globalization challenges: Absolute Poverty Reduction Action Plan (PARPA), Public Sector Reform Program (PRSP), and Informatics Policy Implementation Strategy, whose main vectors are retrieved and ratified in the Government Five-year Programs (2005-2009, 2009-2014, 2014-2019). The planning, development and success of the Electronic

Government in Mozambique will depend upon and will be measured by its ability and capacity to coordinated, converge and interact with the objectives of the three programs, through utilization of the ICTs and the Internet. Apart from being an integrating element, the implementation of the Electronic Government will bring systematic changes on processes, more transparent results, improvement in data management and manoeuvre, more focused monitoring and accompaniment of projects, generalisation of trainings, and elevation of a set of public sector competences.

The changes will also impact and bring about transparency and accountability, as well as reduce corruption, codify procedures and orientations, and establish a solid foundation to offer public assistance, opportunity for voting, participating and feedback. All the projects in the scope of PARPA, Public Sector Reform, and Informatics Policy will directly benefit from all the systematic changes, impact and effects of the Electronic Government. All ministries and institutions which design and implement policies, and which are connected to and through the Electronic Government have better chances of having the objectives of their policies, programs and projects achieved at all levels (EGE, 2005:6).

Just as in other countries, the entry of Mozambique to the Information Society started in the 90s with the first “dial up” Internet services provided by *Centro de Informática da Universidade Eduardo Mondlane*, CIUEM, since 1993.

Thereafter, Mozambique adopted the digital inclusion model promoted by the Mozambican public policy for promotion of competences and computing tools manoeuvre through the Informatics Policy Committee, CPI, an organ created by the government in order to design the Mozambique Informatics Policy and the Technical Unit for Informatics Policy Implementation, UTICT, responsible for computerisation of the public sector; Technical Unit for the State Financial Management Reform, UTRAFE; Mozambique National Communication Institute, INCM, Information Bureau, GABINFO, an institution connected to the Prime Minister’s Office responsible for registering the media; and *Universidade Eduardo Mondlane*, UEM, the first public university (Sangonet, 2009). According to the document produced by Sangonet (2009), a civil society organization based in South Africa, Mozambique was one of the pioneers in Africa to recognize the importance of using ICTs for development promotion.

According to Joanguete (2015), the enthusiasm of the State for ICTs has been waning over the years to the extent of not to be the government’s priority any longer. Despite the recognition of the revolutionary importance of the ICTs for government, citizen’s involvement in political participation, and for processes and public service delivery streamlining, technologies are well regarded in all political speeches as one of the basic factors for development, poverty combat, and improvement of the Mozambicans’ living conditions.

In order to standardize as well as to adequate themselves to current demands and concepts related to the ICTs and the digital era, the country created and implemented a series of measures, such as decrees, laws, rules, policies, and development strategies that aim to keep track of the world and regional dynamics of innovation and development. From 2000 onward, the government started to include the ICTs approach in their agenda, in their planning and orientation documents, and in their development plans and programs, namely, Government Five-year Plan, Economic and Social Plan, Absolute Poverty Relieve and Reduction Plan, and Mid- and Long-Term Fiscal Scenery.

This is how, on 28 March 2000, it is created, through Presidential Decree Nr. 5/2000, the Public Sector Reform Inter-Ministerial Committee, also known as CIRESP, reporting to the Council of Ministers, the committee which designed the EGRSP. On 4 April 2000, through Presidential Decree Nr 6/2000, it was created the Technical Unit for Public Sector Reform, also known as UTRESP, aimed to assist the operation of CIRESP and assure an integrated planning, coordination, articulation, and accompaniment of reform programs and projects.

On 25 June 2001, it is officially launched by the former President of the Republic of Mozambique Joaquim Chissano the **Public Sector Reform Global Strategy** (EGRSP) in Mozambique, which is the key and orienting document for all policies, plans and strategies for the country’s social and economic development.

It is important to underline that the EGRSP is also the operating-basis document for successful implementation of all programs, plans, policies, resolution, decrees as well as sector strategies of the whole public sector in Mozambique. That is why the EGRSP as well as the Informatics Policy Implementation Strategy, the Mozambique Science, Technology and Innovation Strategy, and the Mozambique Electronic Government Strategy already foresee the creation and implementation of electronic portals and websites,

electronic platforms and online citizen and businesses services in order to promote and galvanize Mozambique social and economic development.

The EGRSP recommended the following:

- Public Sector modernization with high incorporation of technology (EGRSP, 2001:62);
- Promotion and dissemination of e-mail in the Public Sector as an embryo for Internet and e-Government, which includes electronic portals, websites, electronic platforms, software and hardware (EGRSP, 2001:62).

As consequence of the EGRSP dynamic, there were approved the following orienting legal instruments:

The Government of Mozambique approved, through **Resolution Nr 28/2000, of 12 December, the Informatics Policy**, aimed at including Mozambique in the ICTs world, which has the Internet as its highest exponents. The Informatics Policy offers a framework of principles and objectives which may allow *“information and communication technologies to be the driving force for various aspects of national development, contributing to absolute poverty reduction and general improvement of the lives of the Mozambicans; to a wider citizen participation in the Global Society of Information; to government improvement and democracy further development; to its participation in the world economy, increasingly founded on information and knowledge* (Resolution Nr 28/2000, of 12 December).

The Informatics Policy Implementation Strategy (EIPi) was approved in 2002 by the Government of Mozambique. With the implementation strategy, it is intended to make ICTs a decisive instrument for materialization of the Government Plan and the Absolute Poverty Reduction Action Plan (PARPA) as well as the full accomplishment of the Informatics Policy objectives, namely (EIPi,2002:3):

- To contribute to absolute poverty reduction and improve the living conditions of the Mozambicans;
- To contribute to illiteracy fight and to accelerate human resources development;
- To provide citizens with universal access to information and world knowledge;
- To raise public and private institutions efficiency and efficacy;
- To improve public government and administration;

- To create a favourable legal and business environment for production and dissemination of information and communication technologies; and
- To make Mozambique an active and competitive partner in the Global Society of Information and in the world economy.

In 4 February 2005, through Presidential Decree Nr 13/2005, it was created the **Ministry of Science and Technology (MCT)**, emphasizing therefore the component of science and technology for development.

In 2006, the Government of Mozambique approved the **Mozambique Science, Technology and Innovation Strategy (ECTIM)**, aimed to establish a framework conducive to the achievement of strategic objectives and programs that promote the development of an articulated system of science, technology and innovation. With ECTIM it is pursued a science and technology that contributes visibly to poverty reduction, to economic growth and improvement of the lives of the Mozambicans.

The ECTIM is based on the following vision and mission:

- Vision: All Mozambicans have the right of access to and equity in the utilization of science, technology, innovation, and information and communication technologies in order to accelerate the process of wealth creation, poverty eradication, and, thereby, to accelerate the improvement of the quality of life.
- Mission: To promote the delivery of scientific and technological solutions in strategic areas of development defined in the Government Five-year Program (2005-2009), in PARPA, in 2025 Agenda, and in other national development documents, aiming to raise the quality of life of Mozambican citizens (ECTIM,2006:7).

Since 2000, the Ministry of Higher Education, Science and Technology is created, and in June 2003, the Council of Ministers approved the Science and Technology Policy (PCT). In 2006, it is published the Mozambique Science, Technology and Innovation Strategy. It is noticed in these two documents the great Government's interest in creating infrastructures that will allow access to ICTs at a large national scale.

The Mozambique Electronic Government Strategy (EGE) was approved in 2006 by the Council of Ministers. EGE is an extremely important document in this ICT era.

EGE serves as an instrument which is more adequate for placing public services within any citizen's reach, at any time and any place, for a more effective, efficient and less costly service provision, and for the decrease of bureaucracy and corruption opportunities. In the last resort, Electronic Government may be transformed into a powerful instrument for the fight against poverty and for achievement of the Millennium Development Goals (EGE,2006:5).

In 2007, there were created through Decree 24/2007 of 5 July, named after CRCT, three Sciences and Technology Regional Centres, namely, headquarters Maputo-South Region, Nampula-North Region, and Beira-Central Region, in order to coordinated sciences and technology activities. In 2007, there were also created in all provinces of Mozambique the Provincial Digital Resources Centres, named after CPRD.

Main Progress Made

In recent decades, the ICTs have played an important role in boosting Mozambique development. Among the main developments the following are highlighted:

Education

- Inclusion of ICTs in the curriculum;
- Development of higher education programs in the ICTs area;
- Implementation of the education sector technological plan;

Business Sector

- Development of business and professional associativism;
- Development of private accelerators and incubators;
- Software and hardware development;
- Private sector modernization;

Science and Technology Park

- The Science and Technology Park built by the Government of Mozambique in Maluana, Maputo Province, consists of infrastructures and management services for production, development and dissemination of knowledge, as well as for the establishment and development of science and technology-based companies. It is open for academy services, private and public sector, civil society and local community. It consists of three main areas: technology-based businesses incubator, a teaching and learning centre, and company hosting (Information Society Policy, 2018:4).

It is important to refer that all government organs and agencies, as well as Government programs and plans were created in order to accommodate and implement the ICTs policy for Mozambicans social and economic development. We present Figure 1 below which addresses the execution and evolution diagram of the plans and strategy, from the macro plan to EGRSP, passing through the intermediaries, EGE, PARPA, ECT, PQG up to the micro plan, which is the effective creation and implementation of other several sectoral electronic platforms of the Public Sector.

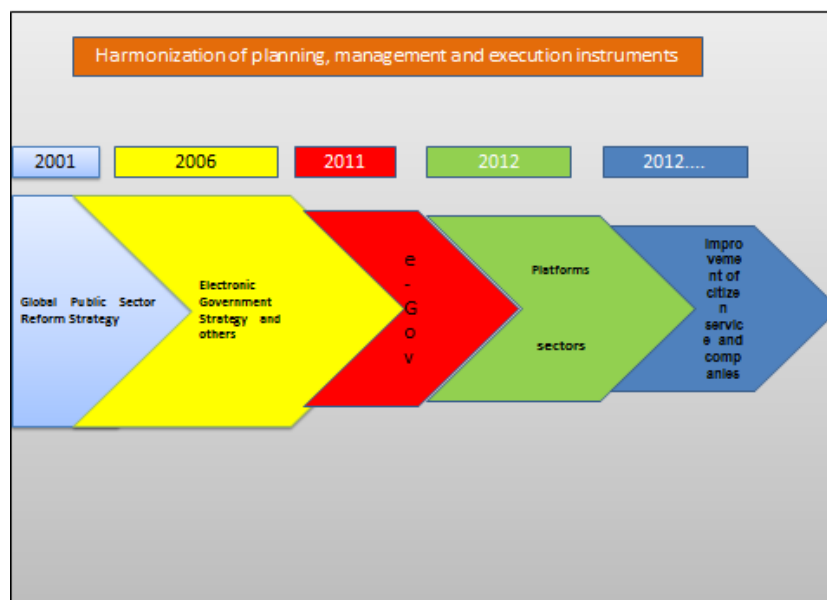


Fig.1: Execution and evolution of plans and strategy up to the other sectoral electronic platforms of the public sector.

As it was previously mentioned, post-independence Mozambique presented a poor administration, firstly because of the former colonial administration dismantling, followed by the civil war until 1992. According to CIP (2008), the Mozambican public sector presented operating problems caused by excessive bureaucratization, an obsolete legal framework and low qualified people coupled with a poor human, financial and material resources management, what, to some extent, might create conditions for corruption activities.

To make public administration more effective, in other words, to operate better and less costly, the Mozambique State introduced reforms in the Public Sector in 2001, for a period of 10 years, and for its execution it was designed the Public Sector Reform Global Strategy. It is in the context of these reforms that the Government approved, on 11 July 2006, the Electronic Government Strategy, according to the Report about the Level of Implementation of the Electronic Government Strategy (2015), as a result of a long period of work and collaboration between the Policy Committee (CPInfo) and the Public Sector Reform International Committee (CIRES), through their technical units (i) Technical Unit for Informatics Policy Implementation (UTICT), later transformed into National Institute of Communication and Information Technology (UTICT), and (ii) the Technical Unit for Public Sector Reform (UTRESP) – in an exercise assisted by a team of national and international consultants, and funded by the United Nations Department for Economic and Social Affairs (UNDESA).

This instrument results from the implementation of the Informatics Policy and Strategy, which defined, among other priority areas, the Electronic Government, with the goal of raising the efficacy and efficiency, reduce operating costs and corruption, as well as raise the public servants' responsibility. The motto of the Electronic Government aims to *"place public services next to the citizen"* (Mozambique Electronic Government Strategy, 2005, p. 1), with an overview that when implementing the *"Electronic Government Strategy would give to any Mozambican in any government area, in any sector of the Economy, and at any level of the society the right to access, process and apply all the required information to achieve the maximum level of their potential as an individual with knowledge, a responsible citizen and a global competitor"* (EGE, 2005, p.11).

To this end, there is the need of modernization and computerization of administrative procedures for faster

public services and significant reduction of the influence of human factor in the conduct of proceedings and authorization of tax and fee collection, and in other situations of direct contact of the citizen with the public administration. Bearing in mind all the factors that govern the conception, the implementation of the Electronic Government Strategy had the fundamental goal of improving the public service provision, through the utilization of Information and Communication Technologies, in line with the Public Sector Reform Global Strategy. In this context, the following point analyses the main achievements in the scope of the implementation of the Electronic Government Strategy.

Electronic Government Main Achievements

The Report about the level of implementation of the Electronic Government Strategy (2015) presents some achievements in the scope of the Electronic Government Strategy worth bringing into discussion. The Electronic Government, according to the report, was one of the priority areas of the Informatics Policy Strategy which aimed to:

- Raise efficacy and efficiency; to reduce operating costs; to reduce bureaucracy and corruption, as well as to reduce public servants' responsibility;

The Technical Unit for Informatics Policy Implementation was moved to the National Institute of Information and Communication Technologies (INTIC) in 2011, and currently to the National Institute of Electronic Government. This institute reports to the Ministry of Science and Technology and it has been acting in different fronts, especially infrastructure and access to Internet services, capacity building, and consolidation of an integrated environment of information systems and databases devoted to provision of quality services to citizen, while progressively consolidating the Mozambique Electronic Government. This institute is informing and strengthening policy formulation and monitoring, resulting in good governance at all Government level. In order to respond to challenges, several institutions started to develop and implement information systems which currently contribute to the materialization of the Electronic Government in Mozambique.

The report points out to the following main achievements:

- i. Attitude change among the State employees and;
- ii. Improvements in public services provision to the citizen,

- iii. Territorial extension of the Government Electronic Network (GovNET), which currently reaches all capital cities, and from there to some districts;
- iv. Increase of the State employees and citizens' knowledge of the utilization of the various services and tools through the ICTs.

In relation to connectivity, the report recommends every Government network to be connected to the same Common Communication Platform in order to share resources and electronic services. The Government Portal (www.portaldogoverno.gov.mz), according to the report, represents one of the flags of the GovNET and it is the starting point towards the Electronic Government. It has the capacity to provide with important information just in time to the Government, private sector, and mainly to the citizen. In this journey, the following were the success factors: great political will; leadership of the process from the top, with in-depth auscultation of the society regarding the needs to be satisfied; great ability to mobilize aid from international organizations for national development plans, allocation of a centralized fund in order to assure the State electronic communications, resulting in greater efficiency and saving; great dedication and commitment of the staff responsible for execution of defined programs.

The evaluation also found out that Mozambique was internationally recognized as the African country with the best Informatics Policy from 2004 to 2005; with the highest level of e-Participation from 2006 to 2007 and as the country with a Government Portal highly centered to the citizen in 2009 (Jóse, 2014).

Current situation of the Electronic Government in Mozambique

The Informatics Policy priority areas were many, among them the Electronic Government is highlighted, which was responsible for increasing the efficacy and efficiency of services provided by the State institutions and other entities, through utilization of ICTs. In this context, the Electronic Government implemented the anchor project, Communication Common Platform and the Interoperability Framework, a tool that assures the establishment of the public sector data communication infrastructure and necessary interoperability for various systems, aiming at better citizen satisfaction. From the platform, it was possible to create the Government Electronic Network (GovNET), which according to the Report, it is a Government of Mozambique data communication private network which interconnects public institutions at Central, Provincial,

District and Municipal level, with a vision that until 2016 all the Government networks should be connected to a common communication platform for sharing resources and electronic services.

Analysis of the contribution of digital platforms implementation

The approval of the Informatics Policy in 2000 through Resolution Nr 28/2000, of 12 December paved way to the creation of the Mozambique Electronic Government – e-Gov. These instruments caused the creation and implementation of other sectoral digital platforms for licensing and service provision to the citizen and companies, namely: e-BAÚ, MCNet (Mozambique Community Network), e-SISTAFE, e-CAF, e-Tributação, Moztis, e-CREL and Muhlbauer ID Services, whose contribution we will be analyse below:

Sophisticated Electronic Government services available to citizens and companies

The introduction and implementation of digital platforms in the Mozambican public sector allowed the creation of various services available to the citizen and companies which are presented below:

The e-BAÚ system

In 2015, BAÚ benefit from installation of computer software/program, a modern system using Internet, the IGRP (Integrated Government Resource Planning) for commercial activity licensing called e-BAÚ, or electronic shop, one stop shop – Integrated Platform for licensing and service provision to the citizen – Citizen Portal, reducing waiting time and accelerating the administrative procedures. The Electronic Government public services available electronically to the citizens are the following:

- Issuance of wholesale, retail and industrial commercial license;
- Issuance of simplified license and mere advance communication;
- Issuance of internal and external trade license;

MCNet system (Mozambique Community Network)

In 2011, it was created and implemented the MCNet, which consists in a public-private partnership which manages the technological application Single Electronic Window (JUE). JUE system is composed of two distinct IT subsystems which interact with each other: CMS and Tradenet. The CMS (customs management system) is a customs management platform. This system belongs to the Ministry of Economy and Finance – Mozambique Tax Authority –

ATM. The Electronic Government public services electronically available to citizens are the following: to process customs clearance of goods – issuance of customs declaration.

e-SISTAFE (State Financial Administration Electronic System)

It is an electronic platform introduced and implemented in 2005 which allows the processing of various payments, system safety proceedings, as well as registration and maintenance of users' bank address, and tracking all financial transactions made with reliable safety. It allows to make managers and other intervenient accountable in case of defrauding the State.

Apart from e-Sistafe, there is the e-CAF, one of the modules of e-Sistafe. The Electronic Government public services electronically available to citizens are the following:

- Processing of various payments, salaries, subsidies, allowances, per diems;
- Operating expenses processing and payment;
- Investments processing and payment;
- Processing and payment of provision of various services;
- Revenue processing;
- Processing of electronic registration of State staff and agents.

e-Tributação

It is an electronic platform from the Ministry of Economy and Finances, DAF – Fiscal Sector Directorate. This system is further divided into two, one is for tax and fees payment and the other is for NUITs. The Electronic Government public services electronically available to citizens are the following:

- Processing and payment of tax and fees, such as Corporate Income Tax, Personal Income Tax and VAT.
- Personal and corporate NUITs processing and issuance.

Mühlbauer ID Services Electronic System

It is an electronic platform for biometric format identification document issuance, and it was created and implemented in 2018. The system is further composed of 2 subsystems, one for personal identification document and the other for foreign trips document. This platform belongs to the Ministry of Interior, the Civil Identification Directorate (DIC) and the National Migration Services – SENAMI. Apart from these two systems, there is the Scheduling and

Validation Management System – SIGAV, for scheduling and audiences. The Electronic Government public services electronically available to citizens are the following:

- Identification Documents (IDs) processing and Issuance;
- Processing and issuance of Passports, visas, emergence travel documents and *DIRE* (Expatriate Identification and Residence Document);
- Online audience scheduling to request any document through SIGAV;
- SMS notification services about the date of a scheduled audience and reception of documents.

Moztis System – Virtual Counter

It is an electronic platform created and implemented in 2017, as a virtual counter aiming to enable the issuance of biometric documents for vehicle and automobile driving license. This system belongs to the Ministry of Transports and Communications – the National Institute of Highway Transports - INATTE. The Electronic Government public services electronically available to citizens are the following:

- Driving licenses processing and issuance;
- Control of fines for Highway Code infringement;

e-CREL

It is an electronic platform created and implemented in 2016, and is used for corporate registration. This platform belongs to the Ministry of Justice and Constitutional Affairs – Legal Entities Registration – CREL. The Electronic Government public services electronically available to citizens are the following:

- Processing and searching for the name of the company which is intended to be opened;
- Processing and issuance of company name booking;
- Processing and issuance of permanent registration certificate;
- Processing and issuance of commercial certificates;
- Processing and issuance of corporations' statements.

Contribution of Digital technologies implementation

The benefits of the Electronic Government constitute a great contribute to the Mozambique social and economic development process.

The revolution brought by the ICTs is a reality in Mozambique and the rest of the world, and it has significant impacts in history and way of living, working and interacting with mankind (Política Para Sociedade de Informação, 2018:1).

The approval of the PSI brought changes associated to other development initiatives in place in the field. In line with the Government plans, they made the country a more inclusive society. The PSI provided the vision, mission, goals and a framework of principles which allows the ICTs to assume a leverage role for Mozambique social and economic development, promoting poverty reduction and improvement of the Mozambicans' living conditions and competitiveness in the corporate sector and further economic growth; modernization of the State and service provision to the citizen, and greater social justice through democracy consolidation and promotion of transparency (Politica Para Sociedade de Informacao, 2018:2).

Some of the problems which the former Mozambique public administration presented before the introduction and effective implementation of digital platforms in the public sector were corruption activities, excessive administrative bureaucracy, very slow citizen and corporate service provision, complex requisites and procedures for documents acquisition, and high operating costs.

Our interviewee (E1), who was asked about the contributes of the implementation of digital platforms said, *"The introduction of electronic systems in the Public Sector brought about improvements in service provision to the citizen in terms of speed and desired quality"*.

In turn, the second interviewee (E2) said, *"it as a good idea, once it enabled speed in proceedings; it reduced considerably the waiting time for conduct of proceedings"*. Similarly, the sixth interviewee commented saying:

The electronic platforms are meant to improve, simplify, loosen and accelerate operations in procedural protocols, and in social and economic activities; my assessment is positive once with the implementation of these electronic systems, if all platforms intervenient of the process are working on the platform, it is possible to obtain, in a few hours or a few days, licenses, passports, visas, DIREs, NUITs, driving licenses, IDs, declarations of payment of tax and fees, VAT, IRPC, IRPS, custom's clearance declaration. They are so fast if the internet is working properly. Likewise, he said that the clients and economic agents are satisfied with the introduction

of digital platforms because in a few days they can have their documents ready. (E6)

Furthermore, the other interviewee corroborated saying that, *"we welcome the introduction of platforms, once it partially reduced bureaucracy and corruption problems; the facilities presented by the system improved slightly, since spots of corruption and bureaucracy prevail at certain moments"* (E7). This thought was shared by the last interviewee when admitting that, *"indeed I have the same opinion that decision making process for documents acquisition has improved"* (E8).

According to the Policy for Information Society, the benefits of the ICTs in Mozambique are truly visible, as it can be seen in some of the examples presented below:

- Time and money saving through the utilization of Internet;
- Greater knowledge and education;
- Increase of access and satisfaction with public services;
- Reinforcement of productivity and profitability efficiency;
- Diversification of opportunities, new markets and clients;
- Increase of public services efficiency, efficacy, productivity and transparency;
- Improve of the State administrative and financial management;
- Dissemination of information and promotion of participatory government through electronic means;
- Reduction of social exclusion;
- Reduction of poverty factors;
- Reduction of State and user's costs of internal operation, Public Sector service provision (Politica Para Sociedade de Informação, 2018, p.2).

III. DISCUSSION

The results of the present study show that, on the whole, the contribution of digital platforms in Mozambique Public Sector brought changes in service provision to the citizen and entrepreneurs who look for those services, both in reduction of procedures, number of documents required and/or presented in order to benefit from services, reduction of waiting time for document acquisition and of costs of acquisition, with consequences of the cause and effect binomial, considerable increase of revenue to the State

Treasury, that is, in fact, the introduction and effective implementation of electronic platforms in the Public Sector, simplified, and accelerated the administrative procedures in relation to the requests presented by citizens and entrepreneurs.

A similar study conducted recently by the Public Sector Reform Inter-Ministerial Committee, which led to the conception of the Policy for Information Society (PSI) in Mozambique (2018), revealed that *“the revolution brought by the ICTs is a reality in Mozambique and it has significant impact in history, way mankind lives, works and interacts”*.

Likewise, there were considered benefits of the ICTs in Mozambique when referring that, *“in fact, the benefits of ICTs in Mozambique are already visible in various fronts, namely, saving of time and money with Internet-based resources, reinforcement of efficiency, productivity, and consequently, of the profitability and increase of efficiency, efficacy, productivity and transparency of public services (Política para a Sociedade de Informação em Moçambique, 2018:1).*

The present research, apart from analysing the contributions of the implementation of digital platforms to the improvement of service provision to the citizens and entrepreneurs in the Public Sector, it also analysed the limitations of the systems under study. It was found that some of them present gaps and weaknesses, for instance, in detecting false documents, lack in interoperability with other electronic platforms of the Public Sector and private organizations, which can contribute to system manipulation and bring prejudices at the social, political and economic level.

Gouveia (2004) states that the interoperability of ICT-based systems, sharing and reutilization of information and integration of administrative processes, both at internal and external level of the public sector organizations is essential for assuring high quality, innovation and transparent services and client/citizen centredness.

Interoperability results in a fundamental requisite for development of efficient and effective services, both from the economic and technical perspective (Gouveia, 2004, p.40).

According to the *Política para a Sociedade de Informação em Moçambique* (2018), it was found weak dissemination of the electronic government and their respective sectoral digital platforms. Therefore, it was launched the society awareness raising process about the role and potentialities of the ICTs as a leverage for social and economic development.

From the author's perspective, to improve operation of the Electronic Government program and their sectoral digital platforms in the Public Sector, there is a need to solve the new challenges imposed by the increasing ICTs progress, namely: to reduce bureaucracy and unnecessary interactions between the citizen and the staff operating the electronic systems; to enable online services provision to citizens and companies, decrease of crowds (waiting queues and time), citizens and companies that search for in-person services with the introduction of digital platforms, and, consequently, to reduce corruption rates; reduce physical contact between public sector staff and citizens and companies; to take advantage of and to use technology in order to improve service provision and public sector performance; to disseminate services provided by the public sector; increase transparency between citizens, companies and the public sector; increase public sectors efficacy and efficiency, and effective implementation of the Mozambique Policy for Information Society, and Information Society Strategic Plan, as well as to identify and disseminate tools, techniques and good practices do public managers; and effective implementation of the electronic government interoperability framework.

Campelo (2006) yet considers that a program has the opportunity to improve its performance regarding public service provision focusing on the citizen, when orienting public organs to be better ware of their electronic services target group, and to be better aware of the needs and opinions about the quality of these services.

IV. CONCLUSIONS

The present study aimed to analyse the contribution of the implementation of digital platforms to the provision of services to the citizen, entrepreneurs in the public sector, in Nampula City and Province, in Mozambique. The results of the study presented indicate that these electronic platforms (Mulhbauser ID, MozTis, e-CREL, *e-Tributação*, MCNet, e-SISTAFE, and e-CAF) brought significant changes in electronic government and in the public sector in Mozambique, in a way that there was decrease in waiting time, procedures and costs to obtain documents.

The aforementioned decrease improved significantly service provision to the citizen and entrepreneurs by means of simplification, loosening and speed of administrative procedures and, as consequence, there was saving of time and money when resorting to Internet-based services; there was reinforcement of efficiency, productivity and profitability,

and increase of public services efficacy, efficiency, productivity and transparency; and there was improvement of financial and administrative management.

Notwithstanding, it was also found that the electronic platforms under analysis present some limitations and weaknesses that for not to be able to detect false and out-of-date documents and for not to be interconnected with systems from other institutions (e-Banking, Mulh Bauer ID, MozTis, e-CREL, *e-Tributação*, MCNet, e-SISTAFE, and e-CAF), they show vulnerability worth to be corrected.

Gouveia (2004) warns that the focus of e-government must not be the Information and Communication Technologies, but their use, which when combined with organizational changes and new competences, they improve public service provision, public policies, and the exercise of democracy, being them the real sense of e-government (thus being both the e-government and the ICTs instruments for a better and more efficient and effective government).

The gaps, weaknesses, limitations and delay in effective implementation of some digital platforms' interoperability may cause social, political and economic problems.

Given these findings, it is suggested that measures to solve these problems are taken so that the digital platforms start operating fully and with the desired quality (implementing the interoperability mechanisms that allow data cross-checking and controls for detection and confirmation of information allowing screening, amongst others, the use of false or inexistent documents).

The present study was conducted with digital platforms from the city and province of Nampula. Meanwhile, a major share of what is presented allows generalization of these results to be made to all the institutions which use the digital platforms analysed, in the Mozambican context.

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Improving Cross Layer Design for Multimedia Applications Over Distributed Radio Network using Adaptive Equalizer

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Received: 21 Nov 2020;

Received in revised form:

04 Feb 2021;

Accepted: 21 Feb 2021;

Available online: 28 Mar 2021

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Keywords—adaptive equalizer, cross layer, multimedia application

Abstract—Delay in the passage of piece of information from the transmitting point to the receiving point has become a very big problem in our communication network. This can be overcome by improving cross layer design for multimedia applications over distributed radio network using adaptive equalizer. This is done in this manner by characterizing the network under study, determining the bit error rate and congestion from the characterized network that could cause the passage of information from sender to receiver difficult, determining the shortest route from the characterized network, designing a Simulink model that will reduce interference and congestion in improving cross layer design for multimedia applications over distributed radio network using adaptive equalizer and Comparing conventional and optimized adaptive equalizer. The result obtained from the analysis shows that using adaptive equalizer gives a better communication network than using conventional approach.

I. INTRODUCTION

Over the last years a number of new protocols have been developed for multimedia applications in the whole OSI layer's scale. The RTP and RTCP protocols (Schulzrinne, 2003), which operate on the transport layer usually on top of the UDP protocol, have been especially designed for multimedia data transmission. The RTSP (Schulzrinne, 1998) protocol offers control mechanisms over real time multimedia transmission whereas SIP (Schulzrinne, 2002) and H.323 are used in multimedia conferencing. Apart from the above developments there have been a number of proposals for improving QoS in multimedia applications through cross layer adaptation strategies. In Van der (Schaar, 2005) the need of a cross-layer optimization is examined and an adaptation framework is proposed amongst the APP, the MAC and the Physical (PHY) layers. In Shakkottai, 2003 the issue of cross-layer design

in wireless networks is addressed. The focus is on the way that higher layers share knowledge of the PHY and MAC layers conditions in order to provide efficient methods to allocate network resources over the Internet. In Van der Schaar, 2003 a joined APP and MAC adaptation is proposed with the use of MPEG-4 and the latest Fine Granularity Scalability (FGS) extension. In this work, packets containing multimedia data are classified into different classes and in the light of poor network conditions only packets with high value are transmitted. The network conditions are jointly measured by combining the information obtained by the retransmission number of a lost MAC frames (ARQ) and the information provided by the RTCP protocol. Signaling issues between the layers for cross-layer optimization over wireless networks are examined in Wang, 2003.

II. DESIGN METHODOLOGY

1. To characterize the network understudy.

Distributed Radio Systems include distributed antenna systems, distributed MIMO, distributed wireless networks and distributed spectrum sensing. ... a) is the traditional

tree structure of a cellular system. Mobile terminals or antennas send the signal to base transceiver station (BTS).

An hourly measured data of packet loss was collected from GLO network in Enugu metropolis for eight days as shown in table 1.

Table 1 Date of Data Collection: 1st TO 8th of February, 2018

Source; (Ngatek Global Services Limited)

TIME	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	Day 8
12.00 AM	5	8	4	8	7	6	5	8
1.00 AM	4	7	6	3	5	7	5	7
2.00 AM	6	5	8	7	5	4	6	5
3.00 AM	8	5	7	8	7	9	10	9
4.00 AM	6	10	8	11	9	12	11	8
5.00 AM	12	11	12	10	14	9	10	13
6.00 AM	18	15	17	19	15	17	18	16
7.00 AM	22	19	20	25	23	22	24	21
8.00 AM	30	35	33	30	40	42	39	37
9.00 AM	49	52	55	50	53	51	54	53
10.00 AM	33	38	40	37	35	40	43	39
11.00 AM	29	31	27	33	30	29	28	33
12.00 PM	22	26	21	23	25	22	23	25
1.00 PM	30	34	32	31	33	35	38	36
2.00 PM	45	40	50	55	49	53	48	52
3.00 PM	19	24	22	26	20	24	21	23
4.00 PM	28	27	30	29	33	28	31	32
5.00PM	55	50	53	57	51	49	52	56
6.00 PM	48	52	47	50	49	44	48	51
7.00 PM	30	28	33	29	31	35	32	31
8.00 PM	18	22	19	21	20	25	23	22
9.00 PM	14	12	15	18	16	13	15	14
10.00PM	12	9	11	13	11	9	10	11
11.00PM	8	7	6	5	7	9	8	6
TOTAL	452	595	576	734	548	594	602	578

The reason of collecting this packet loss data is to enable the researcher to analytically compute the congestion in the communication network where these packet losses are hourly experienced. The packet loss is used to develop a mathematical model as shown in equation 3.1

2. To determine the bit error rate and congestion from the characterized network that could cause the passage of information from sender to receiver difficult

Table 2: Total packet loss and congestion experienced for 8 Days

Total packet loss for eight days	Congestion experienced for the eight days
452	0.07681
595	0.06695
576	0.2111
734	0.06027
548	0.06976
594	0.21116
602	0.066555
578	0.06793

The mathematical model for congestion control in improving cross layer design for multimedia applications over distributed radio network using adaptive equalize is as shown in equation 3.2

$$L = 8/3W^2 \text{-----}1$$

Where L is packet loss

W is the network congestion

Then, make W the subject formula in equation 1

The mathematical model for congestion in the network is as shown in equation 2

$$W = \sqrt{8/3L} \text{-----}2$$

To find the network congestion in day one

$$W1 = \sqrt{8/3 \times 452}$$

$$W1 = \sqrt{8/1356} = 0.07681$$

Congestion in day two

$$W2 = \sqrt{8/3 \times 595} = \sqrt{8/1785} = 0.0044818$$

$$W2 = \sqrt{0.0044818}$$

$$W2 = 0.06695$$

Congestion in day three

$$W3 = \sqrt{8/3 \times 576}$$

$$W3 = \sqrt{8/1728} = 0.04456$$

$$W3 = \sqrt{0.04456} = 0.2111$$

Congestion in day four

$$W4 = \sqrt{8/3 \times 734}$$

$$W4 = \sqrt{8/2202}$$

$$W4 = \sqrt{0.003633}$$

$$W4 = 0.06027$$

Congestion in day five

$$W5 = \sqrt{8/3 \times 548}$$

$$W5 = \sqrt{8/1644}$$

$$W5 = \sqrt{0.004866}$$

$$W5 = 0.06976$$

Congestion in day six

$$W6 = \sqrt{8/3 \times 594}$$

$$W6 = \sqrt{8/1782}$$

$$W6 = \sqrt{0.04489}$$

$$W6 = 0.21116$$

Congestion in seventh day

$$W7 = \sqrt{8/3 \times 602}$$

$$W7 = \sqrt{8/1806}$$

$$W7 = \sqrt{0.0044296}$$

$$W7 = 0.066555$$

Congestion in day eight

$$W8 = \sqrt{8/3 \times 578}$$

$$W8 = \sqrt{8/1734}$$

$$W8 = \sqrt{0.004614}$$

$$W8 = 0.06793$$

3. To determine an ideal bit error rate convenient for the characterized network

The bit error rate that caused the collected packet loss in the communication network understudy is calculated with equation 3 Taking into consideration the worst-case scenario, the linear relationship between BER and packet error rate (PER) is expressed as:

$$PER = 8 \times BER \times MTU \times 66/64 \text{-----}3$$

Where the MTU is the maximum transmission unit, and using the Ethernet standards it is set to 1500 bytes for the simulations and then the MTU is increased to improve performance. A conversion from 8 bits to 1 byte is shown, Recall 1 byte = 8bits, 1500bytes = 8 x 1500 = 12000bits MTU = 12000bits

PER is packet loss and BER is bit error rate to evaluate the bit error rate in day one when the packet loss is 452.

Make BER the subject formula in equation 3

$$BER1 = PER/8 \times MTU \times 1.03125 \text{-----}4$$

$$BER1 = 452/8 \times 12000 \times 1.03125 = 452/9900 = 0.0457\text{bits}$$

To find the bit error rate in day two BER2 = 595/9900 = 0.0601

Bit error rate in day three BER3 = 576/9900 = 0.058

Bit error rate in day four, BER4 = 734/9900 = 0.0741bits

Bit error rate in day five BER5 = 548/9900 = 0.0554 bits

Bit error rate in day six BER6 = 594/9900 = 0.06 bits

Bit error rate in day seven BER7 = 602/9900 = 0.0608

Bit error rate in day eight BER8 = 578/9900 = 0.0584bits

Table3: Bit Error rate for the Characterized network

Total packet loss for eight days	Congestion experienced for the eight days	Bit error rate
452	0.07681	0.0457bits
595	0.06695	0.0601bits
576	0.2111	0.0582bits
734	0.06027	0.0741bits
548	0.06976	0.0554 bits
594	0.21116	0.06 bits
602	0.066555	0.0608bits
578	0.06793	0.0584bits

4. To determine the shortest route from the characterized network.

In graph theory, the shortest path problem is the problem of finding a path between two vertices (or nodes) in a graph such that the sum of the weights of its constituent edges is minimized.

The problem of finding the shortest path between two intersections on a road map (the graph's vertices correspond to intersections and the edges correspond to road segments, each weighted by the length of its road segment) may be modeled by a special case of the shortest path problem in graphs.



Fig.1 Network for shortest distance

Figure 1 Network for shortest distance. All links have a capacity of 10 units.

Traffic is routed through the middle link (4, 6), congestion occurs.

If, instead, paths (1 --> 3 --> 6) and (2 --> 5 --> 6) are used, the average delay is small. equal 10. Thus, the total throughput can be no more than 15 units.

The shortest distance gotten is 4 that is the distance when bit error rate reduces thereby minimizing congestion in improving cross layer design for multimedia applications over distributed radio network using adaptive equalizer.

5. To design a Simulink model that will reduce interference and congestion in improving cross layer design for multimedia applications over distributed radio network without using adaptive equalizer

The equalizer is a device that attempts to reverse the distortion incurred by a signal transmitted through a

channel. In digital communication its purpose is to reduce inter symbol interference to allow recovery of the transmit symbols. It can be a simple linear filter or a complex algorithm. The types of commonly used equalizers in digital communications are:

- Linear Equalizer: It processes the incoming signal with a linear filter.
- MSME equalizer: It designs the filter to minimize, where $E[|e|]$, where e is the error signal that is the filter output minus the transmitted signal.
- Zero forcing Equalizer: It approximates the inverse of the channel with a linear filter
- Decision feedback equalizer: It augments a linear equalizer by adding a filtered version of previous symbol estimates to the original filter output filter.
- Blind Equalizer: It estimates that the transmitted signal without knowledge of the channel statistics and uses only knowledge of the transmitted signal's statistics.

- vi. Adaptive Equalizer: It is typically a linear equalizer or a DFE, which updates the equalizer parameters (such as the filter coefficients) as it processes the data. It uses the MSE cost function and it assumes that it makes the correct symbol decisions and uses its estimate of the symbols to compute e which is defined above.
 - vii. Viterbi Equalizer: It Finds the optimal solution to the equalization problem. It is having a goal to minimize the probability of making an error over the entire sequence.
 - viii. BCJR Equalizer: It uses the BCJR algorithm whose goal is to minimize the probability that a given bit was incorrectly estimated.
 - ix. Turbo Equalizer: It applies turbo decoding while treating the channel as a convolutional code.
- The equalizer used in this work is an adaptive equalizer because it uses the MSE cost function and it assumes that it makes the correct symbol decisions.

The equalizer used in this work is an adaptive equalizer because it uses the MSE cost function and it assumes that it makes the correct symbol decisions.

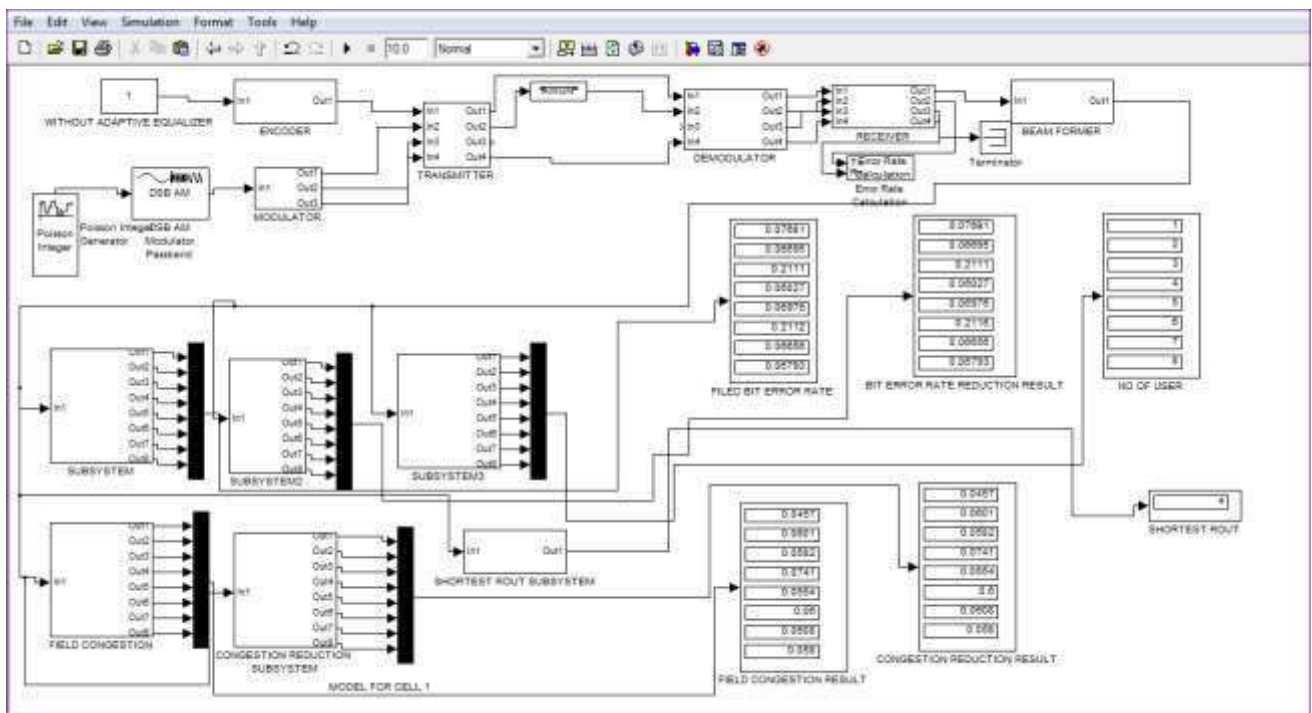


Fig.2: Designed Simulink Model in Improving Cross Layer Design for Multimedia Applications Over Distributed Radio Network Without Using Adaptive Equalizer

Figure 2 shows designed Simulink model in improving cross layer design for multimedia applications over distributed radio network without using adaptive equalizer.

The detailed result is as shown in tables 4, 5 and figures 4 and 5 respectively.

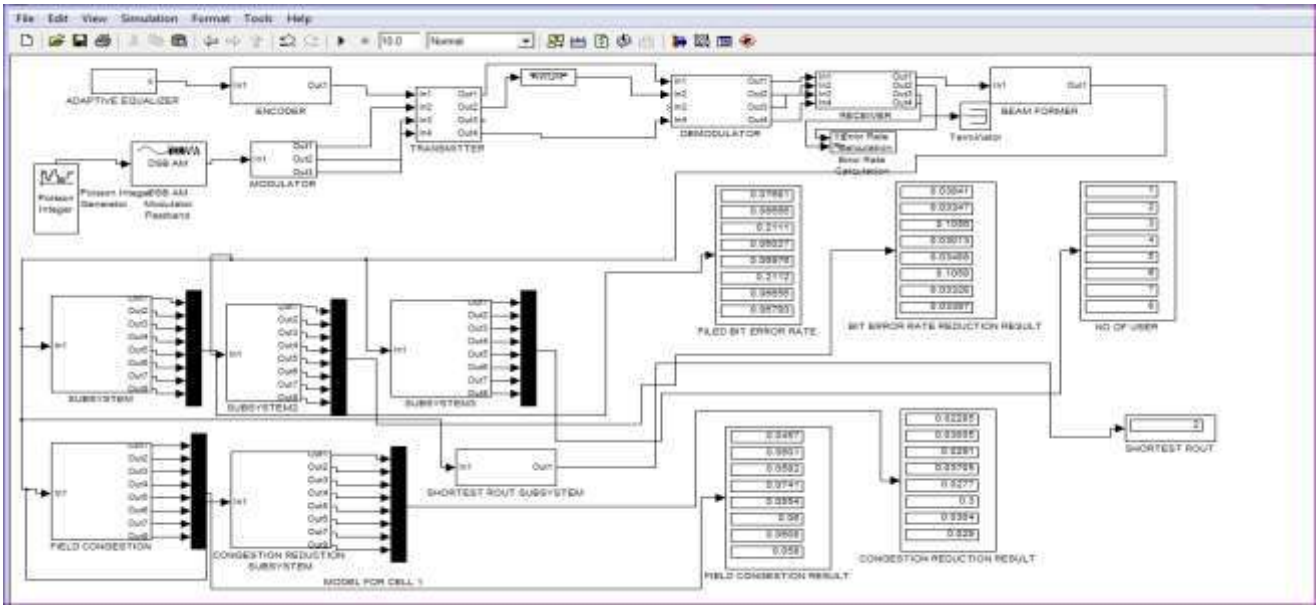


Fig.3: Designed Simulink Model That Will Reduce Interference and Congestion in Improving Cross Layer Design for Multimedia Applications Over Distributed Radio Network Using Adaptive Equalizer

Figure 3 shows designed Simulink model that will reduce interference and congestion in improving cross layer design for multimedia applications over distributed radio

network using adaptive equalizer. Meanwhile the simulated results are shown in tables 6 and 7, figures 6 and 7 respectively.

III. RESULT ANALYSIS

Table 4: Conventional bit error rate in improving cross layer design for multimedia applications over distributed radio network without using adaptive equalizer

CONVENTIONAL BIT ERROR RATE	TIME (S)
0.07681	1
0.06695	2
0.2111	3
0.06027	4
0.06976	5
0.21116	6
0.066555	7
0.06793	8

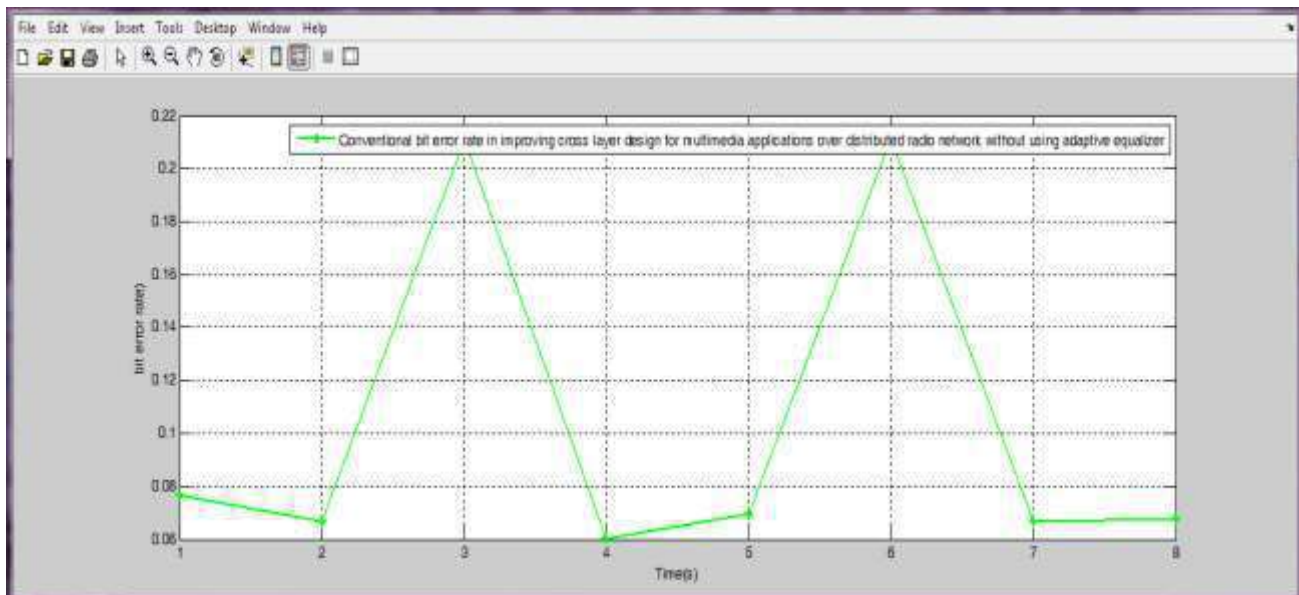


Fig.4: Result for conventional bit error rate in improving cross layer design for multimedia applications over distributed radio network without using adaptive equalizer

Figure 4 shows result for conventional bit error rate in improving cross layer design for multimedia applications over distributed radio network without using adaptive equalizer. Figure4 shows that the highest bit error rate

occurred at bit error rate and time coordination of (0.2116, 6) at this bit error rate the transmission of data from sender to receiver will become apparently impossible.

Table 5: Conventional congestion in improving cross layer design for multimedia applications over distributed radio network without using adaptive equalizer

Conventional congestion	Time(s)
0.0457	1
0.0601	2
0.0582	3
0.0741	4
0.0554	5
0.06	6
0.0608	7
0.058	8

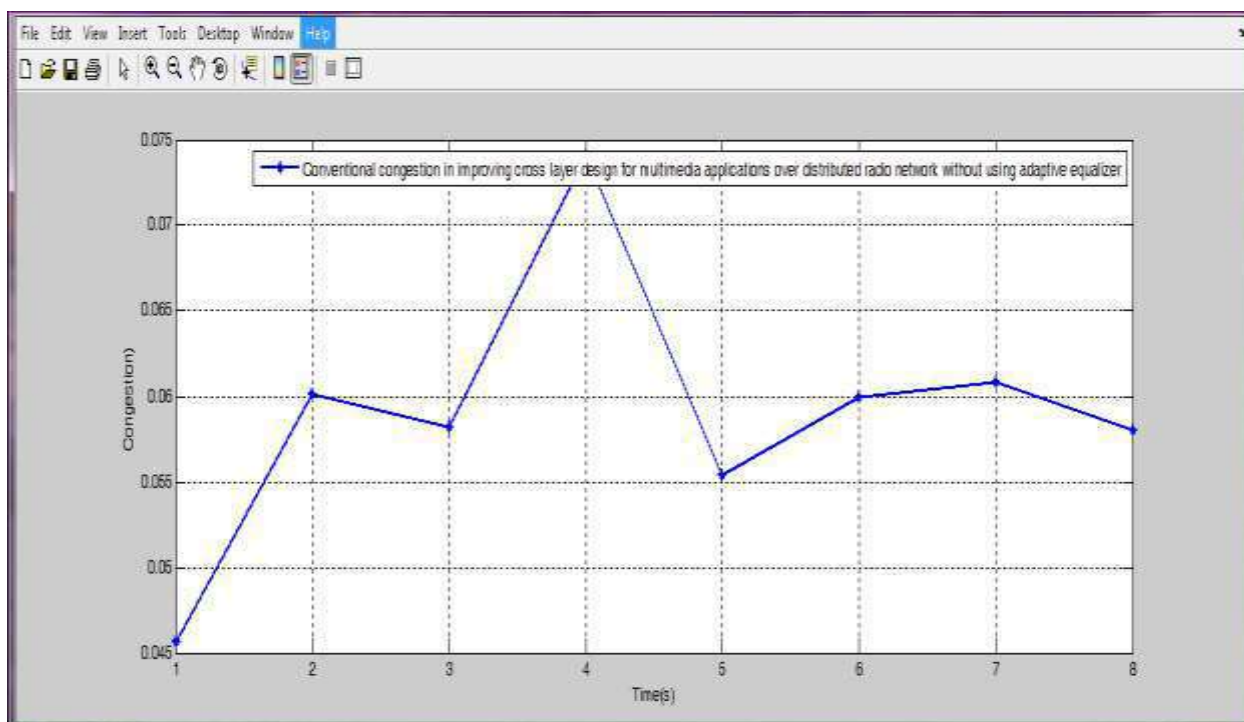


Fig.5: Result for conventional congestion in improving cross layer design for multimedia applications over distributed radio network without using adaptive equalizer

Figure5 shows result for conventional congestion in improving cross layer design for multimedia applications over distributed radio network without using adaptive equalizer. In figure5, the highest congestion occurred at

coordination of congestion and time of (0.0741, 4). At this congestion stage data will be delayed to reach its destination in time.

Table 6: Bit error rate in improving cross layer design for multimedia applications over distributed radio network using adaptive equalizer

Bit error rate when adaptive equalizer is used	Time(s)
0.03841	1
0.03347	2
0.1056	3
0.03013	4
0.03488	5
0.1058	6
0.03328	7
0.03397	8

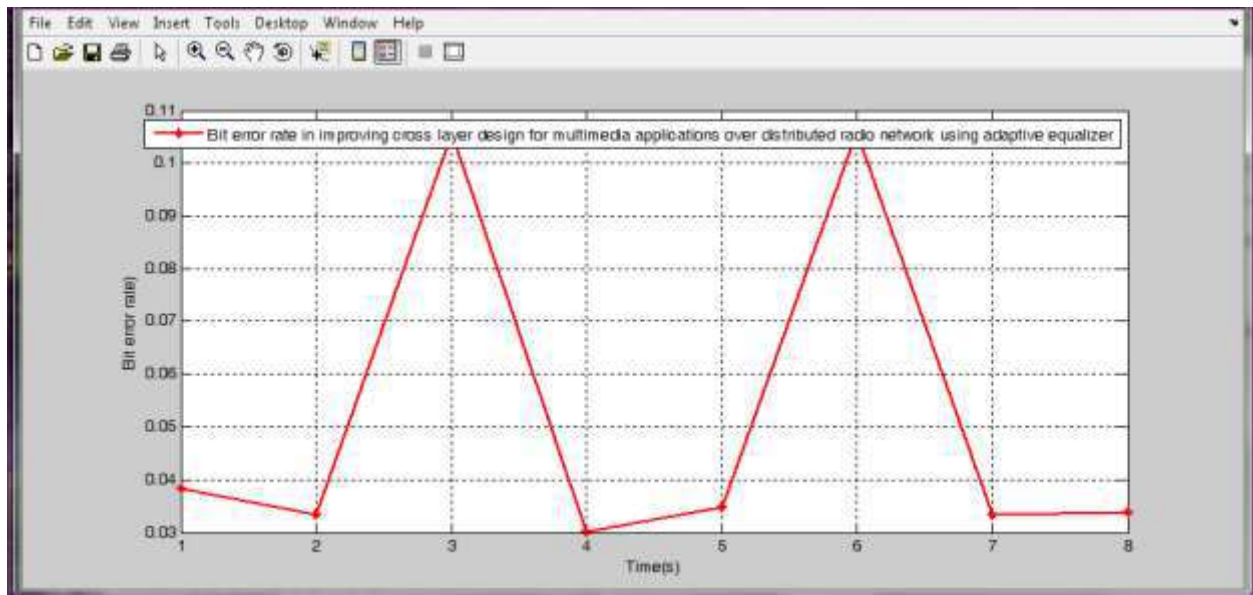


Fig.6: Result for bit error rate in improving cross layer design for multimedia applications over distributed radio network using adaptive equalizer

Figure 6 shows result for bit error rate in improving cross layer design for multimedia applications over distributed radio network using adaptive equalizer. Figure 6 shows

that the highest bit error rate to time coordination occurred at (0.1058,6). At this point the passage of data from sender to receiver is fast.

Table 7 congestion in improving cross layer design for multimedia applications over distributed radio network using adaptive equalizer

Congestion when adaptive equalizer is incorporated	Time(s)
0.02285	1
0.03005	2
0.0291	3
0.03705	4
0.0277	5
0.03	6
0.0304	7
0.029	8

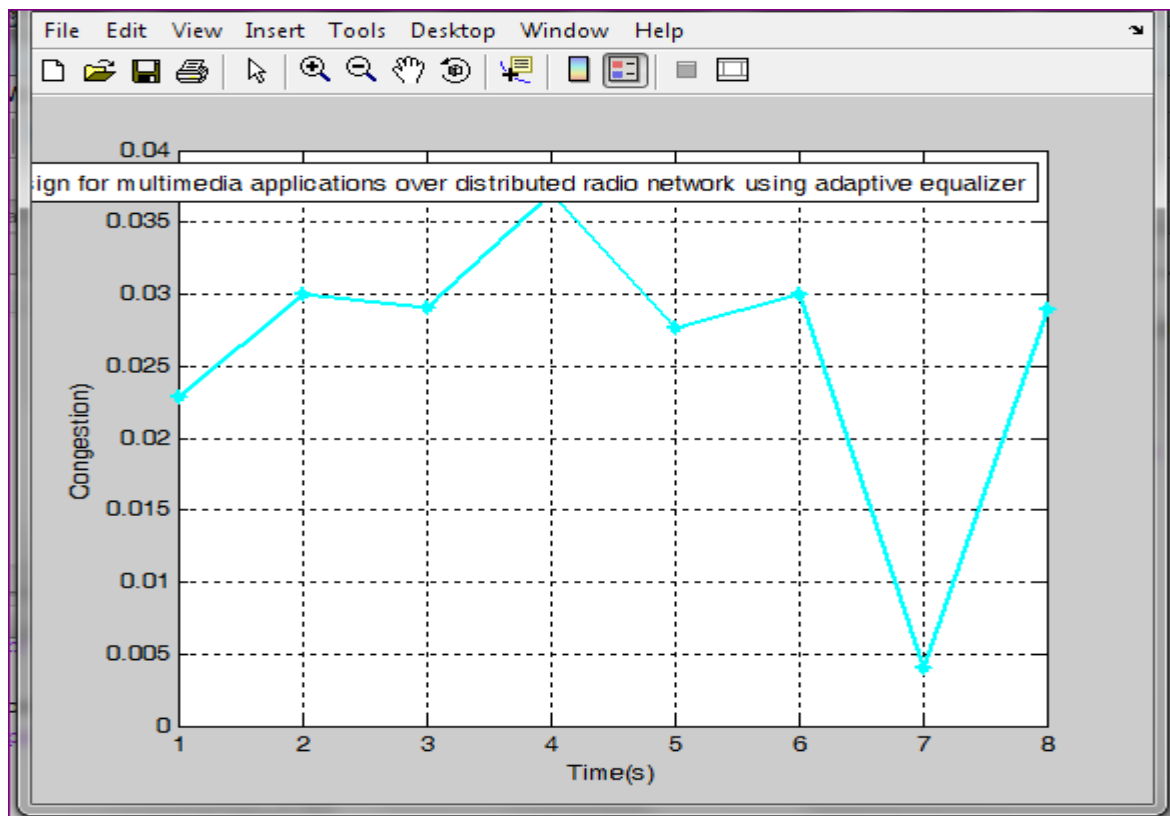


Fig.7: Congestion in improving cross layer design for multimedia applications over distributed radio network using adaptive equalizer

Figure7 shows that the lowest congestion verse time coordination is at (0.0228, 1). This shows that the passage of piece of information from source to sink in cross layer

design for multimedia applications over distributed radio network using adaptive equalizer is fast and reliable.

Table 8: Comparing conventional bit error rate with bit error rate when adaptive equalizer is used

Conventional Bit Error Rate	Bit error rate when adaptive equalizer is used	Time(s)
0.07681	0.03841	1
0.06695	0.03347	2
0.2111	0.1056	3
0.06027	0.03013	4
0.06976	0.03488	5
0.021116	0.1058	6
0.066555	0.03328	7
0.06793	0.03397	8

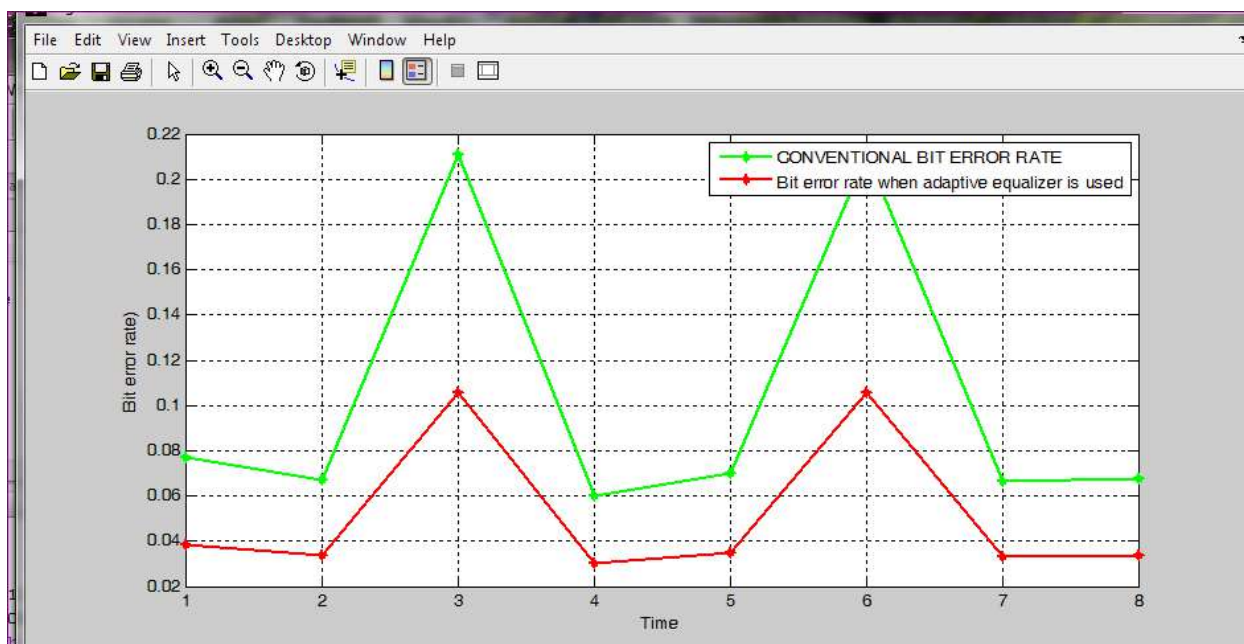


Fig.8: Comparing the result of conventional bit error rate with bit error rate when adaptive equalizer is used

Figure 8 shows that the highest bit error rate verse time without using and using adaptive equalizer (0.07681, 1). On the other hand, the highest bit error rate coordination with time using adaptive equalizer falls at (0.03841, 1). With these results, it shows that without having adaptive

equalizer has high bit error rate which equally means that it has an interference that make it not to transfer data from source to sink. While the one that adaptive equalizer was incorporated in it has reduced bit error rate that does not contain interference thereby passes data conveniently.

Table 9: Comparing conventional congestion with congestion when adaptive equalizer is used

Conventional congestion	Congestion when adaptive equalizer is used	Time(s)
0.0457	0.02285	1
0.0601	0.03005	2
0.0582	0.0291	3
0.0741	0.03705	4
0.0554	0.0277	5
0.06	0.03	6
0.0608	0.0304	7
0.058	0.029	8

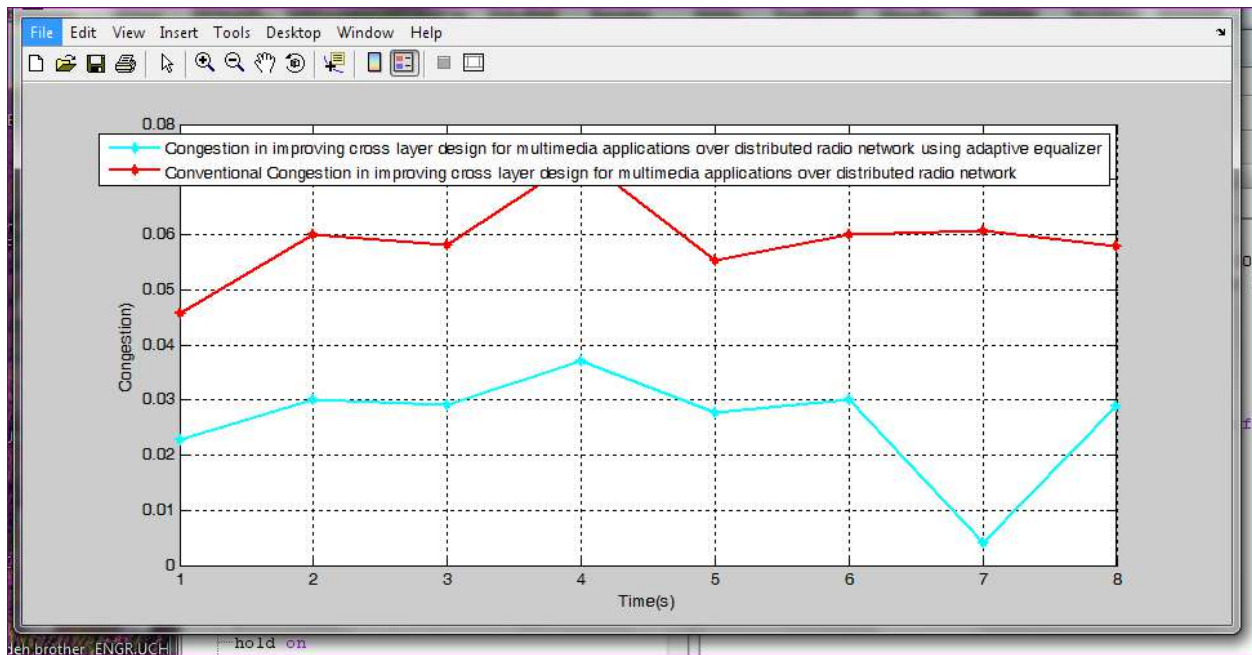


Fig.9: Comparing conventional congestion with congestion when adaptive equalizer is used

Figure 9 shows the comparing conventional congestion with congestion when adaptive equalizer is used. It shows that in the congestion verse time coordinate the highest congestion when adaptive equalizer is used occurred at (0.0741, 4) while that when adaptive equalizer is used occurred at (0.03705, 4). With these results it shows that with congestion in improving cross layer design for multimedia applications over distributed radionetwork without using adaptive equalizer the transmitting of data from one point to the other become practically impossible while when adaptive equalizer is used the congestion is reduced with quick transmission of information.

IV. CONCLUSION

The difficulty of transmitting data from one point to the other or passing piece of information from source to sink is caused by high bit error rate which constitutes interference and congestion in the communication network. The difficulty of passing piece of information in communication network is overcome by improving cross layer design for multimedia applications over distributed radio network using adaptive equalizer. This is done in this manner, by characterizing the network under study, determining the bit error rate and congestion from the characterized network that could cause the passage of information from sender to receiver difficult, determining the shortest route from the characterized network, designing a Simulink model that will reduce interference and congestion in improving cross layer design for multimedia applications over distributed radio network

using adaptive equalizer and Comparing conventional and optimized adaptive equalizer

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Agricultural Suitability of a Sandy Soil in an Agrarian Reform Settlement

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Received: 03 Dec 2020;

Received in revised form:

07 Feb 2021;

Accepted: 28 Feb 2021;

Available online: 28 Mar 2021

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Keywords— Soil degradation, Family
agriculture, Entisol.

Abstract— The soil classification is the systematic arrangement of soils into groups or categories based on attributes and diagnostic horizons. They can be structures that enable the conservation of soil, allowing infer through them the best use and management for a particular soil class. The aim of this work was to perform the taxonomic classification of a soil, through the Brazilian Soil Classification System (SiBCS), in an agrarian reform settlement in the city of Baliza - GO. It was also carry, for the purpose of soil conservation, the interpretation of its attributes for the soil classification within the Soil Agricultural Aptitude Assessment System. The soil of this study was classify as typical Orthic Quartzarenic Neosol, with severe limitations to agricultural use and that the current soil management is causing its erosion.

I. INTRODUCTION

Soil classification deals with the systematic arranging of soils into groups or categories based on attributes and diagnostic horizons (OLIVEIRA, 2008). The objective of classifying the soil is to organize our knowledge about it, so that its properties can be recollect, and its relationships understood more easily.

Classifications are structures with compartments logically delimited and organized, in order to allow the grouping of similar individuals, according to determined criteria. There are, therefore, taxonomic classifications, which group soils based on similar genetic processes, however, without aiming at a practical objective, and the technical or interpretative classifications, which have a practical objective and can be obtained through the

interpretation of the results of the taxonomic classification (FREIRE, 2006).

Soil classification can be natural/taxonomic or technical/interpretive, being able to infer the limitations, potentials, and feasibility and (better use) of the land. The agricultural aptitude system have been use in the interpretation of pedological surveys, with different levels (from exploratory level to detailed level) (PEREIRA and LOMBARDI NETO, 2004). This tool enables the evaluation of the potential of Brazilian soils and subsidizes projects and programs concerned with sustainable development.

In Brazil, the most used interpretative classifications are the Soil Agricultural Aptitude Assessment System (RAMALHO FILHO and BEEK, 1995) and the Capacity of Use System (LEPSCH et al., 1991). The Agricultural

Aptitude Assessment System is based on the qualities of the land, its type of use and the management levels considered. Guides proper land use, avoiding sub- or over-use of the soil. Suitable for assessing aptitude of large tracts of land (regional and/or national planning). It consists of an interpretative process, of ephemeral character, which varies with technological evolution (RAMALHO FILHO and BEEK, 1995).

Its favorable aspects are: i) it is the most used system in Brazil because it considers, in its structure, different levels of management; ii) allows modifications or incorporation of other parameters and limitation factors, following technological advances or the requirement of the level of study; iii) accepts adaptations and applications at different mapping scales; iv) considers the viability of reducing limitations, by the use of capital and technology, distinguishing the high-level technological farmer from the low technological level (PEREIRA and LOMBARDI NETO, 2004). Its unfavorable aspects are the scarcity of socioeconomic variables (IBGE, 2007).

Soil classifications can therefore be tools that enable soil conservation, which allow inferring the best uses and managements for a given soil class. Thus, the objective of this work was to perform the taxonomic classification of a soil, by the Brazilian Soil Classification System (SiBCS) (EMBRAPA, 2006), in a plot of an agrarian reform settlement in the municipality of Baliza - GO. For the conservationist purpose of the soil, the interpretation of its attributes for classification within the Soil Agricultural Aptitude Assessment System (RAMALHO FILHO and BEEK, 1995) was also carried out.

II. MATERIAL AND METHODS

The study site is a plot of an agrarian reform settlement (P.A. Oziel Alves Pereira) located in the municipality of Baliza - GO, with coordinates 160 30'36.38" S and 520 22'33.15" W. The total area of the settlement is 46.595,65 ha, consisting of Alic Dark Red Latosols (21,48%); Alic Red-Yellow Latosols (32%); Quartzarenic Neosols (7,30%) Cambisols (31,53%); Humic Gley and Low Humic Gley (7,46%) and Litholics (0,23%). The average altitude of the lot is 577 m, with mild local relief, Aw type (Köppen), rainy tropical climate, with concentrated rains in the summer, from October to April, and dry period from May to September with average annual precipitation 1450 mm.

Erosive grooves and gullies are frequent throughout the settlement region, including the occurrence of a gully at the study site. The owner of this lot uses the soil with pasture formed by *Brachiaria brizantha* in consortium with *Stylosanthes guianensis*, of which is degraded. There is a

frequent presence of erosive grooves in this pasture, originated by the cattle walking through the pasture, forming depressions, called 'trilheiros', which provide the concentration of water from surface runoff along the slope.

For soil classification purposes, a morphological description of a profile was performed, with the collection of samples and soil probes to determine if there were soil variations in the studied area. The morphological description of the profile was performed on the talude of a gully located within the lot where the study was carried out. A 1 m portion of soil was scraped towards its interior, to avoid describing and collecting a pedon that had been altered by exposure to insolation and oxidation. The morphological description in the field, with the delimitation and identification of horizons, determination of color, texture, structure and consistency followed the methodology described by SANTOS et al. (2005).

In the profile described, soil samples with deformed and not deformable structure were collected for all identified horizons. The deformed samples were used for the determination of texture, fertility, particle density, and sulfuric attack to determine the Ki and Kr indexes and for mineralogical analysis of the soil. Not deformed samples were collected through monoliths, for analysis of aggregate stability by a wet sieving. Volumetric rings were used to determine soil density, total pore volume, macro and microporosity, calculation of available water in the soil and saturated hydraulic conductivity. Based on morphological description and analytical results, the taxonomic classification of this soil was carried out according to the Brazilian Soil Classification System (EMBRAPA, 2006), as well as its classification in the Soil Agricultural Aptitude Assessment System (RAMALHO FILHO and BEEK, 1995), according to the following limiting factors: fertility deficiency, susceptibility to erosion, water deficiency, oxygen deficiency (excess water) and impediments to mechanization.

The granulometric analyses were performed by the Bouyoucos densimeter method, described in EMBRAPA (1997), using NaOH 0,1 N and water as dispersant to determine natural clay and degree of flocculation, calculated using equation (1):

$$GF = \left(\frac{(AT - AN)}{AT} \right) * 100 \quad (1)$$

Where, AT = total clay (dispersed in NaOH), AN = natural clay (dispersed in water).

The soil was separated into very coarse sand (2 - 1 mm), coarse sand (1 - 0,5 mm), medium sand (0,5 - 0,25 mm), fine sand (0,25 - 0,1 mm), very fine sand (0,1 - 0,05 mm), silt (0,05-0,002 mm) and clay (> 0,002 mm), the sand fraction being separated by manual dry sizing. The particle density was obtain using the volumetric flask method, using ethyl alcohol to measure the particle volume (EMBRAPA, 1997).

To determine the percentage of aggregates and to calculate DMP (weighted average diameter) and DMG (geometric mean diameter), the monoliths were carefully loosened, sieved in a 4 mm and 2 mm sieve, and the aggregates that were retained in this last sieve were used for analysis. For wet sieving, the Yoder oscillation apparatus was used, with sieves with diameters of 2; 1; 0,5; 0,25 and 0,103 mm of opening. The samples of ten grams of soil were moisten for 10 minutes and oscillated in the apparatus (40 rpm) for 15 minutes.

The material retained in each sieve was taken to the oven, dried and weighed, and the percentage of aggregates by diameter class, the DMP and DMG, were calculated using equations (2) and (3), respectively:

$$DMP = \sum_{i=1}^n x_i w_i \quad (2)$$

$$DMG = \exp \left[\left(\frac{\sum w_i \log w_i}{\sum w_i} \right) \right] \quad (3)$$

Where x_i is the average diameter of any size range of aggregates separated by sieving and w_i is the weight of the aggregates in that size range as a fraction of the total dry weight of the sample analyzed.

For the determination of soil density, total pore volume, macroporosity, microporosity and volumetric soil moisture content in field capacity (CC), the volumetric rings were placed on the tension table and subjected to a tension of 60 cm (or 6 kPa). For the volumetric humidity corresponding to the permanent wilting point (PMP), these rings were subject to a voltage of 1515 kPa in the Richards pressure chamber.

Still using the volumetric rings, a test was perform to obtain the saturated hydraulic conductivity for each soil horizon, adapting a constant load permeameter for each ring, with a ring of diameter and height similar to the ring containing the soil sample, embedded, and sealed at the last.

The analysis of soil fertility, as well as obtaining the molecular relationships K_i , K_r and Al_2O_3 / Fe_2O_3 followed the methodology recommended by Embrapa (1997).

The determination of erodibility (K), used to determine the susceptibility of the soil to erosion, was performed for each horizon of the soil profile, using the model proposed by WISCHMEIER et al. (1971), described by equation (4):

$$K = \left\{ \frac{[2,1(10^{-4})(1,2 - MO)M^{1,14} + 3,25(EST - 2) + 2,5(PER - 3)]}{100} \right\} \times 0,1317 \quad (4)$$

Where: K = soil erodibility, $Mg \ h \ MJ^{-1} \ mm^{-1}$; M = sum of the % of silt and very fine sand, multiplied by 100 minus the % of clay; MO = % of organic matter; EST = codes corresponding to structure (1 = very small granular, 2 = small granular, 3 = medium to large granular and 4 = blocks, laminar or mass); PER = codes corresponding to soil permeability (1 = fast, 2 = moderate to fast, 3 = moderate, 4 = moderate to slow and 5 = slow).

III. RESULTS AND DISCUSSION

1. Taxonomic Classification

By adopting the Brazilian Soil Classification System (SiBCS), this soil was classify at the fourth categorical level (subgroup) as a typical Orthic Quartzarenic Neosol (RQo). Neossolos are young soils, whose Greek radical neo, means new, giving a connotation of young soil, in the process of formation due to little action of the pedogenetic processes or for the characteristics inherent to the original material.

According to SiBCS, this soil class has as a criterion for its distinction the absence of subsurface diagnostic horizons, a low differentiation of horizons, with horizon A followed by C or R and with a predominance of characteristics inherited from the original material, which in the case of this soil is the product of the micaceous feldspar sandstone weathering of the Furnas Formation. The absence of a subsurface diagnostic horizon was corroborate by the morphological examination of the soil profile, as shown in Table 1. In the subsurface, there was no great differentiation of pedogenetic attributes such as color, texture, and structure, which would indicate the existence of horizon B.

The lack of a subsurface diagnostic horizon indicates the great resistance of the source material to undergo the decomposition process. Therefore, there is a preponderance of the sand fraction to the detriment of the other granulometric fractions.

Table 1. Morphological description of the profile described.

Horizon	Description
A	0 - 30 cm, bruno - dark reddish (5YR 3/2, wet), gray - dark reddish (5YR 4/2, dry); sand; weak, small, simple grain; soft, very friable, slightly plastic and non-sticky; smooth and clear transition.
AC	30 - 50/57 cm, bruno - yellowish (10YR 5/4, damp), bruno - light yellowish (10YR 6/4, dry); sand; weak, small, simple grain; loose, loose, non-plastic and non-sticky; wavy and clear transition.
C	50/57 + cm, brown - yellowish (10YR 5/8, wet), yellow - browned (10YR 6/6, dry); sand; weak, small, simple grains; loose, loose, non-plastic and non-sticky; wavy and gradual transition.

ROOTS: abundant on horizon A, being of the fasciculate type belonging to pasture; Below horizon A, infrequent occurrence of pivoting roots, and belonging to tree species.

The studied soil had its horizons classified in the sandy-sand textural classes, for the A and AC horizons, and the sandy-clay-sand horizons, for the C horizon (Table 2). In this way, these textural classes are insert in the medium textural group (Embrapa, 2006; Santos et al., 2005).

The typical value of the soil density (DS) of sandy soils is 1,6 kg dm⁻³. However, the DS values of the soil horizons are lower than the value found in the literature, which may indicate greater porosity of this soil. According to FAO (2006), which recommends pore percentage values above 40% as high porosity, this soil presented high porosity in all horizons.

Table 2. Average values of soil physical characteristics.

Horizon	A	AC	C	Measurement unit
Clay	160,00	195,00	210,00	g kg ⁻¹
Silt	60,00	60,00	65,00	
Sand	780,00	745,00	725,00	
AMG	5,33	7,50	10,60	
AG	20,66	24,71	20,84	
AM	251,05	230,26	199,62	
AF	447,70	437,15	423,63	

AMF	55,27	45,38	70,31	g cm ⁻³
Dp	2,61	2,60	2,59	
DS	1,47	1,46	1,48	
VTP	43,59	44,08	42,86	%

AMG = very coarse sand; AG = coarse sand; AM=medium sand; AF = fine sand; AMF = very fine sand; Dp = particle density; DS = soil density; VTP = total pore volume.

The texture, besides being a stable characteristic of the soil, influences the physical behavior of the soil and its fertility. Sandy soils, which contain more than 70% sand, are loose, friable, have no plasticity, or stickiness. Retain little water, have good permeability and aeration. The fertility of these soils is, however, low (FREIRE, 2006).

It is noteworthy that the textural evaluation in the field indicated a sandy texture, due to the tactile sensation of roughness, friction and the tiny plasticity and stickiness of this soil, but in the mechanical analysis, it presented a higher proportion of clay than expected. Such discrepancies may arise not only due to the subjective nature of the field examination, but also due to the action of clay minerals, exchangeable cations, organic matter and cementing agents that influence the texture estimate in the field by the touch method (MARSHALL et al., 1999). Field texture descriptions reflect soil behavior. The sensation that the soil offers to the touch is an inherent characteristic of the soil and serves as a criterion to differentiate it in the field, so the textural class estimated in the morphological description should not be corrected based on mechanical analysis (SCHNEIDER et al., 2007).

In the mechanical analysis with dispersant, there was an increment of clay in depth, with horizon C presenting the highest amount of this textural fraction. The sand content followed the opposite trend to that of clay, with a decrease in depth. The textural ratio of this soil was low, for example, the AC / A ratio, for clay, equivalent to 1,22, which indicates the absence of an abrupt textural gradient.

For the mechanical analysis in water, there was a reduction in the clay and sand content in depth, and an increase in the silt fraction with the increase in depth (Table 3). This fact evidences the importance of chemical dispersion (addition of sodium hydroxide) in the determination of more exact amounts of each textural fraction of a soil. When there was no addition of sodium hydroxide in the mechanical analysis, the clay behaved as silt, as it was not properly deflocculated.

Table 3. Average values of total clay (AT), natural clay (AN) and degree of soil flocculation (GF).

Horizon	Texture with dispersant (g kg ⁻¹)			Texture in water (g kg ⁻¹)			GF (%)
	AT	Silt	Sand	AN	Silt	Sand	
A	160	60	780	70	55	875	56,25
AC	195	60	745	50	80	870	74,36
C	210	65	725	35	130	835	83,33

Natural clay, dispersed in water, represents the portion of the total clay that is naturally dispersed in the presence of water. Thus, it can be used to indicate: i) erodibility, as it is related to the stability of stable aggregates in water, ii) the activity of the clay fraction, assuming that the more active the clay fraction, the greater the adsorption of water and, therefore, of clay dispersed in water (FERREIRA, 2010).

Analyzing the natural clay contents of this soil it is perceive its decrease in depth and an increase in the degree of in-depth flocculation. This means that the reduction of clay dispersion in depth can have a positive impact on the stability of aggregates in subsurface, as well as a reduction in the activity of this fraction in depth.

Ferreira (2010) points out that in a given soil profile, surface horizons have higher levels of natural clay when compared to subsurface horizons. However, contradicting this statement, the reduction of clay dispersion in depth had no positive impact on the stability of subsurface aggregates in the present study, in which a reduction in subsurface aggregate sizes was verified (Table 4). This indicates that the surface aggregates were more stable in relation to the subsurface aggregates, with a decrease in the percentage of stable aggregates in water with increasing depth. This trend can have a negative impact in cases of the occurrence of linear erosive processes such as ravines and gullies because such erosive features when reaching the subsurface horizons will progress more rapidly, potentiating the erosive process.

Table 4. Average values of the percentage of stable aggregates per diameter class.

Horizon	A	AC	C
Depth (cm)	0-30	30-57	57-100+
% Aggregates			
4-2 mm	86,48	79,77	77,12
2-1 mm	5,65	7,42	3,98

1-0.5 mm	0,95	2,12	2,18
0.5-0.25 mm	2,50	4,57	6,86
0.2-0.1 mm	2,10	3,67	7,29
DMG (mm)			
-	2,54	2,26	2,02
DMP (mm)			
-	2,70	2,54	2,43

DMG = Geometric average diameter, DMP = Pondered average diameter.

The values of the Ki index of this RQo ranged from 0,96 (horizon AC) to 1,02 (horizons A and C), with an average value equal to 1,00, which reflects the high silicon content in its composition (Table 5). This fact shows the origin of this soil, derived from the sandstone weathering product (Furnas Formation) rich in quartz, mineral rich in silicon and which presents high resistance to chemical weathering, that is, it is difficult to decompose its mineral structure. Therefore, there is a large participation of SiO₂ in this soil, making its Ki ratio low.

Table 5. Average values of silicon oxides (SiO₂) iron (Fe₂O₃) and aluminum (Al₂O₃).

Horizons	A	AC	C
Attribute	(%)		
SiO ₂	3,60	4,00	4,80
Fe ₂ O ₃	0,60	0,64	0,70
Al ₂ O ₃	6,00	7,10	8,00
TiO ₂	0,14	0,20	0,21
Ki	1,02	0,96	1,02
Kr	0,96	0,91	0,97
Al ₂ O ₃ /Fe ₂ O ₃	15,96	17,4	17,93

It is noteworthy that the Brazilian Soil Classification System (SiBCS) uses the Ki index as a characteristic attribute of the subsurface diagnostic horizon B Latossolic. According to the system, the Latossolic B horizon must have a molecular ratio Ki equal to or less than 2,2, being normally less than 2,0.

In this study, the Ki indices found are lower than the values recommended by the SiBCS (Embrapa, 2006) for the classification of Latosols. However, the interpretation of low values for the Ki index of the RQo's should not denote a high degree of weathering, as occurs for the interpretation of Ki indexes below 2,0 for the Latosols. The reduced Ki values for this RQo indicate a relevant

presence of Si in this soil, a fact that occurs not by the high degree of weathering, but by the high Si content that this RQo inherited from its source material and associated with the high degree of resistance to decomposition. The Ki index, which for the Latosols indicate maturity or senility, for Quartzarenic Neosols, young soils, do not.

The Kr relationship, since it involves the levels of the oxides of Si, Fe and Al, is indicative of kaolinite soils ($Kr > 0,75$) and oxidic soils ($Kr < 0,75$) (Embrapa, 2006; IBGE, 2007). Adopting these Kr values, we would classify this Neosol as a kaolinite soil. However, it is necessary to consider the origin of this soil, which is rich in quartz, a material that is difficult to weather, before concluding about its mineralogy. Thus, this index is inconclusive in the determination of mineralogy of this soil. Therefore, this Kr index, as well as the Ki index, are indicative of the prevalence of Si in this soil.

The ratio Al_2O_3/Fe_2O_3 is considered high for values greater than 3,15, expressing the small presence of iron in the soil (IBGE, 2007). Considering the values of the ratio Al_2O_3/Fe_2O_3 for the soil under study, there were high values of this ratio for all horizons, demonstrating the prevalence of Al oxide over Fe oxide for this soil.

Neosols occupy an area of 1.246.898,89 km², or 14,57% of the Brazilian territory. Of this area, 54% is of occurrence of Litholic Neosols, 42% of Quartzarenics and 2% for Fluvic and Regolithics (IBGE, 2001). Quartzarenic Neosols have a significant occurrence in the Midwest region of Brazil, encompassing approximately 15% of its total area. This soil class presents serious limitations to agricultural use, due to its excessively sandy texture, low fertility, low water retention capacity and high erodibility with severe linear erosion processes (Coelho et al., 2002).

2. Technical Classification

2.1 Type of Use and Level of Management adopted in the land

The type of land use in this lot is with planted pasture, which is under extensive management system, without any form of grazing rotation, no type of fertilization or reform. Thus, it constitutes a type of soil exploration that is almost extractive, in which nutrients are exported via grazing and are not replaced by fertilization. Furthermore, aggravating this scenario, excessive grazing, caused by lack of cattle management, creates conditions for soil compaction and erosion. Thus, it is perceived that the level of management adopted in this plot of agrarian reform is level A, considered primitive and characterized by the reduced technological level used in soil cultivation and conservation practices.

At the management level A there is no type of soil improvement compatible with this technological condition: the soil is used according to its natural conditions, without any alteration or improvement, which is worrisome when soils of low natural fertility and high erodibility are managed. Therefore, it is expected, in this scenario, a reduced production, productivity and high rate of soil erosion.

It should also be noted that the Soil Agricultural Aptitude Assessment System relates the use of planted pasture, which is the current use of this lot, with the management level B (poorly developed). Management level B is characterized by presenting an intermediate technological level that makes use of such practices: liming and fertilization with NPK and some mechanized practice. Therefore, the current level of management under which the soil is being used falls short of the need for its use. For this specific type of use (planted pasture), it would be necessary to raise the technological level and capital spent on the management of this soil.

2.2 Agricultural Condition of the Land

2.2.1 Fertility Deficiency

According to the analytical results, this soil can be classified as dystrophic, with base saturation (V) below 50%, or even subtrophic ($V < 35\%$) and mesoalic, with the content of $Al > 0,4 \text{ cmolc/dm}^3$ and aluminum saturation (m) higher than 50% (Table 6). The soil reaction class is extremely acidic, with pH below 4,3 (EMBRAPA, 2006; Prado, 2008). Reduced pH and 'V', and elevated 'm' characterize the acid reaction of this soil. 'V' varies inversely with the pH and the H^+ and Al^{3+} ions are responsible for the acidity, as they replace the K^+ , Ca^{2+} , Mg^{2+} bases of the soil exchange complex.

The most suitable soil pH, 'V' and 'm' for most crops is between 5,5 and 6,5; 40 to 70; and 10 to 20, respectively (Malavolta, 2006). It is noticed, therefore, that this soil presents values much lower than those recommended by the literature, with averages for the parameters pH, 'V' and 'm' of 4,03, 10,69% and 58,89%, respectively. Thus, this soil falls into the degree of strong limitation for the agricultural fertility deficiency condition.

Table 6. Soil fertility - average values.

Horizons	A	AC	C	Measurement unit
MO	1,40	0,65	0,50	%
pH	4,00	4,00	4,05	CaCl ₂
P(Mehl)	0,30	0,30	0,30	mg/dm ³
K	39,50	35,50	34,00	

Ca	0,30	0,30	0,30	cmolc/dm ³
Mg	0,10	0,10	0,10	
H+Al	5,90	4,55	3,30	
Al	0,85	0,70	0,60	
CTC	6,40	5,05	3,80	%
m	62,85	58,80	55,20	
V	7,80	9,75	12,90	

2.2.2 Susceptibility to erosion

Soil erosion is a function of rainfall erosivity, soil erodibility, relief, and vegetation cover. The average erodibility of the soil profile was generally low (Tables 7 and 8). By associating the average values of erodibility with the local relief, this soil can be classified as having a slight degree of susceptibility to erosion. However, it is emphasized the local condition of degraded pasture, with reduced vegetation cover of the soil, associated with a topography characterized by long and flat ramps that provide an increase in volume and speed of runoff, which potentiate soil erosion. Therefore, the erodibility value of a soil is not absolute and much less constant over time to predict its susceptibility to erosion. Soil management and use are key parameters in determining how much soil is susceptible to being eroded.

Adopting only the parameters erodibility and relief in the determination of the degree of susceptibility to erosion, this soil presents a slight degree of limitation for this agricultural factor. However, considering also that this soil is under a degraded pasture, which provides reduced protection against rain and runoff, the degree of soil limitation becomes strong for susceptibility to erosion.

Table 7. Soil erodibility (model of Wischmeier et al., 1971).

Horizon	Erodibility (Mg h MJ ⁻¹ mm ⁻¹)
A	0,0018
AC	0,0024
C	0,0060

Table 8. Erodibility value for each degree of limitation (Adapted from Giboshi (1999) apud Pereira and Lombardi Neto, 2004).

Degree of limitation	Erodibility (Mg h MJ ⁻¹ mm ⁻¹)
Null	<0,01

Slight	0,01 a 0,02
Moderate	0,02 a 0,03
Strong	0,03 a 0,04
Very Strong	>0,04

2.2.3 Water Deficiency

The volume of water that the soil can retain depends on its edaphic properties, such as texture, porosity, organic matter content. Thus, the preponderance of sand fraction, large volume of macropores and reduced organic matter content, condition a limited water retention capacity in the soil, reflected by the reduced amount of water available to plants. This amount is determined by the difference in the water content in the soil between the moisture in the field capacity (CC) and the permanent wilting point (PMP) (Table 9). By relating the physical characteristics of this soil to the climate in which it is inserted, with two distinct seasons of rainy summer and dry winter, a moderate degree of limitation was obtained for water deficiency.

Table 9. Volumetric humidity and water available for each soil horizon.

Horizon	A	AC	C	Measurement unit
Depth	0-30	30-57	57-100+	cm
Volumetric Humidity				
Saturated	0,39	0,39	0,41	cm ³ /cm ³
CC	0,25	0,23	0,24	
PMP	0,11	0,08	0,07	
Available Water				
CC	7,65	6,20	5,93	mm
PMP	3,30	2,17	1,86	
AD				
-	4,35	4,03	4,06	

CC = field capacity, PMP = permanent wilting point and
AD = available water

CC = field capacity, PMP = permanent wilting point and AD = available water

2.2.4 Excess Water (Oxygen Deficiency)

The position of this soil in the local relief is in the middle of the slope, that is, away from watercourses, which restricts the occurrence of floods, since it is a typical Orthic Quartzarenic Neosol, a soil class that is not formed by alluvial and hydromorphic processes. If this soil was influenced by such processes, this Neosol would be classified, at a second categorical level, as Fluvic. This soil

was classified as excessively drained, with values of fast saturated hydraulic conductivity in all horizons of its profile (Table 10). Thus, its degree of limitation for excess water is Null.

Table 10. Saturated hydraulic conductivity values (K_o).

Horizon	K_o (cm h^{-1})	Classification (Forsythe, 1975)	
		Classes	K_o (cm h^{-1})
A	22,44	Slow	< 0,13 - 0,5
		Moderately Slow	0,5 - 2
AC	23,77	Moderate	2 – 6,3
		Moderately Fast	6,3 – 12,7
C	16,09	Fast	12,7 – 25,4
		Very fast	> 25,4

2.2.5 Impediments to Mechanization

This agricultural factor is more relevant in the management level C, which is based on mechanized systems, than for the other management levels. The absence of pebbles and boulders on both the surface and subsurface, as well as the non-occurrence of rocky outcrops and boulders, characterize this soil as non-stony and non-rocky. In addition to the absence of stony / rocky soil, its smooth relief, with long ramps, favors mechanization, as well as its depth, classified as very deep, with fragmentary lithic or lithic contact below 2m. For being a soil with a sandy texture, good drainage and absence of hydromorphic conditions, favor mechanization. Thus, this soil presents a slight degree of limitation for the impediment to mechanization. However, the occurrence of ravines and gullies can negatively influence soil mechanization.

2.3 Viability of Improvements in Agricultural Land Condition

The soil of the present study went through a gully recovery / stabilization process using vegetative, edaphic and mechanical soil conservation techniques. The degradation was triggered by the lack of soil conservation practices. The recovery of this environmental liability was characterized as a type of intervention in the land of technological level and of capital contribution far beyond the capacity of the settlers in that area. It is demonstrated, therefore, that these settlers would not be able to recover this environmental liability with the level of management they adopt and that this same management is leading to soil depletion and its consequent degradation. If there was

no intervention by the government in the recovery of this liability, the erosive process would have become worse.

The viability of land improvement is conditioned to the levels of management B and C. The current level of management (level A) under which the land is exploited, does not foresee any possibility of improvement in the management and conservation of this soil. Thus, for this soil to be explored in a sustainable way, it is necessary to increase the contribution of technology and capital, that is, that the management of this soil migrates from level A to at least level B.

Among the agricultural factors that most affects the agricultural condition of the land are fertility deficiency and water deficiency. When considering fertility at the current level of soil management, it is assume that there is no possibility of improvement of this factor. Therefore, the farmer depends on the reduced natural fertility of the soil, which in this case, requires the improvement of this agricultural factor.

By adopting improvement class 1 (RAMALHO FILHO and BEEK, 1995), which relates to management level B, the following techniques could be adopted to overcome the deficiency of fertility of this soil. Liming and plaster to reduce acidity on the surface, subsurface and 'm', as well as raising CTC and 'V'; green, organic fertilization (use of manure) to raise organic matter; maintenance fertilization with formulated fertilizers; crop rotation, with crop-livestock integration, adoption of agroforestry systems and grazing rotation systems.

To improve water deficiency, disregarding irrigation practices that are not within the scope of the Agricultural Aptitude System, practices that recommend the supply of organic matter in the soil, as well as providing its coverage and retaining water are indicated, such as: level planting, cords of permanent vegetation, addition of organic matter, dead cover and direct planting. The use of a level terrace as a water conservation mechanism is a practice of management level C, therefore, above the capacity of technology, investment and maintenance of these settlers.

Even if the Agricultural Aptitude Assessment System has indicated reduced susceptibility to erosion by this soil, care is needed to prevent it from being eroded. The RQo, because they are soils of high sand content, have low aggregation, which predisposes them to erosion. In addition to this fact, the local relief consists of flat relief with long ramps, which enhances the speed of surface runoff. As the soil is under degraded pasture, with frequent grooves and reduced vegetation cover, the risk of erosion is increased. Thus, in addition to the aforementioned conservation practices, the following practices can be used to reduce or control erosion: reduced soil tillage, strip

cultivation, contour cultivation, bands of permanent vegetation, controlled grazing (paddocks with water tanks).

2.4 Agricultural Aptitude Class

The soil was in subgroup 4p (Table 11), which characterizes as land with regular aptitude for planted pastures. However, if the way in which the soil has been managed continues, the process of degradation and erosion will continue. In this way, this soil may have its classification changed to a class with more restricted use, because with the increase of degradation, the use restrictions will also increase, and it can be reclassified to the class restricted to planted pasture (4 (p)) or become unfit for agricultural use.

Table 11. Soil Agricultural Aptitude Class.

Group	4
Subgroup	4p
Class	Regular
Fertility deficiency	Strong
Water Deficiency	Moderate
Excess water	Null
Susceptibility to erosion	Strong
Impediment to mechanization	Slight
Indicated use	Planted pasture

Just as the classification of this soil may change due to the increase in its degradation, it may also be altered if the soil undergoes management and investment of technology and capital that allows the improvement of its edaphic conditions. Thus, with the reduction of its restrictions, this soil may have a classification changed to a good fitness class for planted pasture (4P), or even to a restricted fitness class (3 (abc)) for crops in the three management levels considered by the Agricultural Aptitude Assessment System.

IV. CONCLUSION

1. Soil classification, mainly technical / interpretive, is an important tool in determining the limitations of a soil for its agricultural use, as well as in determining its best use and management.

2. The soil classified as a typical Orthic Quartzarenic Neosol presented severe limitations for agricultural use under low technological level management.

3. The erosive and degradation processes that this soil goes through are more influenced by its use and management than by its physical-chemical properties,

indicating that the current exploration is not sustainable, leading to degradation.

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Natural fibers and the potential of babassu coconut in soil reinforcement: A review

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Received: 01 Dec 2020;

Received in revised form:

01 Feb 2021;

Accepted: 22 Feb 2021;

Available online: 28 Mar 2021

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Keywords— Babassu, Erosion, Soil
improvement, Sustainability.

Abstract— Improvement of the soil's properties in order to resist erosion is desirable, and soil reinforcement is one of the techniques used to achieve this. The incorporation of natural fibers into the soil to form a composite material has been widely investigated. The most common natural fibers used for soil reinforcement are green coconut, sisal, and jute fibers, which were the subject of the systematic review carried out in this study. The study also presented babassu coconut as a potential material for soil reinforcement. Using the methodology adopted, 76 publications related to the theme were selected and studied. This study made use of the Periodicals Portal virtual library and the articles selected were limited to peer-reviewed articles published between 2008 and 2019 in either Portuguese or English. The references of the selected articles were also analyzed. The data from the selected publications were analyzed and described under the following discussion topics: natural fibers in soil reinforcement (green coconut, sisal and jute), ideal fiber length and content for soil reinforcement, correlation between fiber content and ideal length, aspects of babassu, and future perspectives for the use of babassu. It was concluded that the natural fibers increase the mechanical properties of the soil and that the babassu husk fiber also has potential to improve the soil. It is necessary to investigate, among other characteristics, the ideal fiber length and content for the principal types of soil found in the northeast region, as well as to evaluate the effect of saturation and durability over time.

I. INTRODUCTION

Concern over soil erosion has reached a high level of importance in many regions of the world, due to the loss of

considerable amounts of arable land, the silting up of water bodies, and the occurrence of landslides [1, 2]. The form soil erosion takes may vary according to local climatic conditions. For example, tropical and semi-arid regions of

the Mediterranean are more impacted by water erosion due to the loss of vegetation cover [3, 4, 5].

The impact of raindrops on exposed soil and the power of water running across the surface of the soil promote the erosion process [3,6]. The presence of residue on the surface of the soil reduces the impact caused by precipitation and surface runoff, which thereby reduces soil particle disintegration and controls erosion [7]. This natural process can therefore be minimized by using techniques that create a resistant layer in the soil, preventing the easy penetration of water.

Currently, the most widely-used soil improvement technique is replacement, in which part of the soil is removed and other materials, such as recycled fibers and aggregates, are introduced. Choosing the best improvement technique depends on the environmental, geological, and hydrological factors peculiar to the study area. Reinforcement is therefore a mechanical method to improve soil characteristics and behavior by introducing composite materials having certain desired properties [8, 9].

The life cycle of composite material has a smaller impact on human health, the environment, and the consumption of natural resources, as well as the advantage of reduced energy consumption [10, 11]. A well-known reinforcement practice is the introduction of natural fibers into the soil matrix to form a composite material [12].

Natural fibers are abundant in tropical regions of the world and the most common are: Sisal, extracted from *Agave sisalana*, one of the first fibrous plants to be cultivated specifically for fiber extraction [10]; Jute (*Corchorus capsularis*), a fiber from a woody herb of the *Tilioidae* family; and coconut fibers, resulting from the processing of coconut bark that is generally discarded by the industry [13, 14].

The main objective of this study was to carry out a systematic review of the incorporation of the natural fibers sisal, jute, and green coconut into the soil matrix, in order to investigate the mechanical properties of the reinforced soils. The specific objectives were: (1) to discuss how the reuse of fibrous coconut residue contributes to cleaner production and sustainability, and (2) to present the babassu coconut as a potential soil reinforcement material by comparing its properties to those of green coconut.

This study is organized into sections. Section II presents a detailed description of the methods employed. In section III, the results obtained from the literature review are discussed, and subsections have been created in accordance with the objectives defined: natural fibers in soil reinforcement (green coconut, sisal, and jute); ideal fiber content and length in soil reinforcement; correlation

between ideal length and content of natural fibers; aspects of babassu coconut; and future perspectives for the use of babassu. Finally, section IV presents the conclusions of the study on the use of natural fibers in soil reinforcement for civil construction.

II. METHODOLOGY

This review followed the PRISMA ("Preferred Reporting Items for Systematic Reviews and Meta-Analysis") model [15]. The systematic review model uses systematic and explicit methods to critically identify, select, and evaluate relevant research, and to collect and analyze data from those studies that are included in the review. The meta-analysis refers to the use of statistical techniques in a systematic review to integrate the results of included studies [16].

The search tool was the CAPES Periodicals Portal, a Brazilian virtual library in which high-level articles, books, and periodicals can be consulted, such as Scopus and SciDirect. The searches were carried out using the keywords "reforço de solo e fibra de juta" ("soil reinforcement and jute fiber"), "reforço de solo e fibra de coco" ("soil reinforcement and coconut fiber"), "reforço de solo e fibra de sisal" ("soil reinforcement and sisal fiber"), "reforço de solo e materiais não convencionais" ("reinforcement of soil and unconventional materials"), "reforço de solo e erosão" ("Soil reinforcement and erosion"), "propriedades mecânicas e fibras naturais" ("mechanical properties and natural fibers"), and "coco e babaçu" ("coconut and babassu"), where 2,041 publications were found.

The choice of criteria was motivated by the need for technical reliability of the subject, current information and analysis of the research developed in Brazil and in other countries, respectively.

The selection of publications was performed according to the following criteria: (1) considering only peer-reviewed articles; (2) considering only articles published between 2008 and 2019; (3) considering only articles in Portuguese and English; (4) excluding duplicates. Further on, the articles were excluded if didn't consider mechanical properties of coconuts and its application in the reinforcement of soils. This selection was first made through the screening of titles, and then the screening of abstracts from the remained articles. Finally, after thoroughly screening the selected full articles, they were excluded if not in accordance with the objective of this study (Fig. 1).

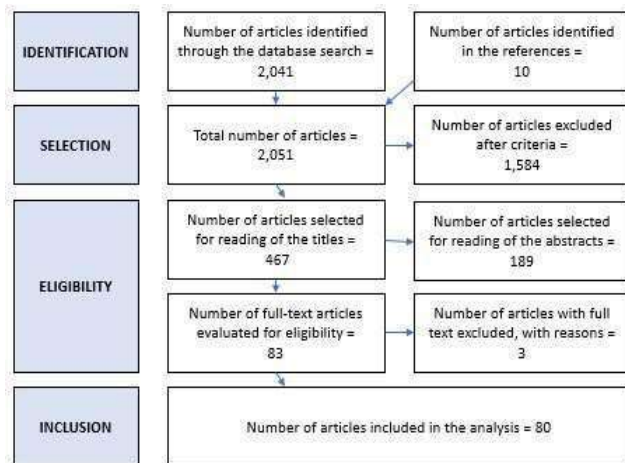


Fig. 1: Search Flowchart (adapted from [15])

The literature selection was then performed in stages. The steps were eliminatory, in the following order: (1) reading of the titles, (2) reading of the abstracts, (3) reading the articles in full. The references of review publications identified through the database search were consulted to find other sources pertinent to the study topic.

The objective of this study was to focus on the advantages of using natural fibers for soil reinforcement and how such use favors sustainability and clean production. In addition, it sought to characterize the babassu coconut to make its incorporation into the soil matrix viable in future studies. The selection resulted in a final list of 80 articles that were studied in depth.

III. RESULTS AND DISCUSSION

• Natural fibers in soil reinforcement (green coconut, sisal, and jute)

The use of natural fibers as building material is indicated mainly for regions where raw fiber materials are locally available [17]. Sisal and jute are species cultivated specifically for fiber extraction, while coconut fibers are extracted from the shell of the coconut fruit, a waste residue of the productive process [10].

The extractivism of the green coconut is aimed at the consumption of coconut water, and when mature (the “dry coconut phase”), for the production of industrialized products. The babassu coconut is exploited to remove the almond, which is destined for the production of oil. Babassu almond is the second most sold non-timber forest product in Brazil, at around 120 thousand tons annually, reaching a value of almost R\$ 150 million [18].

In 2010, approximately 481 thousand tons of dry green coconut husk and 99 thousand tons of babassu coconut husks were produced [19]. Fig. 2 shows the coefficient of

waste generation during the production of green coconut, babassu coconut, sisal, and jute, for each ton produced. It can be seen that coconut crops generate the least amount of waste, considering the technical coefficients (t waste / t product) of 0.85 for green coconut and 0.93 for babassu coconut [19].

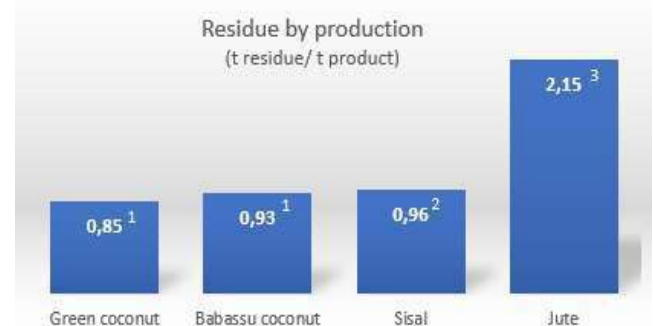


Fig. 2: Coefficients of waste generation for green coconut, babassu coconut, sisal, and jute (created from data presented by [19]¹, [20]², and [21]³)

The use of coconut shell fibers is an important step forward in making use of agricultural waste residue, and has several advantages, such as: adding value to coconut by-products; being an easy-to-use material; having better durability compared to other natural fibers; being moth-proof, fungus-proof, and moisture-proof; and, when incorporated into the soil structure, providing strength and durability [22, 23, 24].

The incorporation of fibers into the soil is known as a reinforcement technique. In general, synthetic and natural fibers can both be used for this purpose. However, due to the increasing focus on maintaining the environment, the use of natural fibers is advised. For this reason, natural fibers must have a low biodegradation potential, that is, a slow degradation rate, a characteristic of fibers containing a high lignin content, such as sisal, jute, and coconut fibers [23, 25].

The mechanical and physical properties of natural fibers differ among species, but generally have superior specific resistance, lower weight, and more eco-friendly characteristics [26]. [20] analyzed the environmental performance of the production of natural sisal fiber and compared it to synthetic glass fiber, discovering that sisal fiber production has around 75% to 95% lower greenhouse gas emissions.

Soil improvement through the addition of randomly distributed fibers has the potential to be applied to reinforce the subsoil under heavy loads and excessive deformations, superficial foundations such as in landfills on weak soil, and other earthworks [27]. It allows the use of clay as a structural element that can be subjected to

bending or pulling forces [28]. In clay soils, for example, fiber addition improves the stress-strain response [29].

Studies have indicated that the inclusion of natural fibers in the soil matrix can lead to the prevention of visible cracks [30]; the reduction of composite mass up to 110°C, due to the water loss from the fibers, because they are a natural hydrophilic material [31]; other results are shown in Table 1.

Table.1: Results of the inclusion of natural fibers in the soil matrix

Properties	Increase	References
Compressive strength	37%	[32]
Penetration resistance	56%	[33]
Tensile strength	30%	[34]
Cohesion and peak soil tension	20%	[35]

The inclusion of natural fibers in the soil matrix causes increased permeability promoted by the presence of pore structures in the fibers and due to the water flowing along the soil-fiber interface along with the flow through the soil pores [36, 37].

The natural fiber reinforced composites may have mechanical properties comparable to non-composites used for the same purpose, having the advantage of reduced energy consumption [11, 35]. [10] studied the life cycle of a composite and concluded that they have a smaller impact on human health, the environment, and consumption of natural resources throughout the cycle.

The special challenges for the use of natural fibers are concern for adhesion, fiber quality, low impact strength, long-term storage problem, hydrophilic fibers, compatibility problems, fiber degradation during processing, orientation and distribution of fibers as well as moisture [38]. Natural fibers are not very stable at elevated temperatures and could absorb moisture and subsequent swelling and degradation, which restricts them to applications in moist environments [39, 40].

• Ideal fiber content and length in soil reinforcement

The amount of natural fiber incorporated into the soil is a variable that can compromise its benefits as a reinforcement. [41, 42, 43] concluded that the best experimental yield was found for samples incorporating a higher content of smaller length fibers. The compressive, shear, and tensile strength tend to decrease with excessive fiber content. The tensile strength and modulus of elasticity of the composite increase with the addition of

fibers up to a certain point, that is, until they reach the optimum content, and decrease afterwards [44, 45]

In the publications consulted, different fiber contents were determined to improve the physical and mechanical properties of the soils. The fiber lengths and contents incorporated to reinforce the different types of soil are shown in Table 2, organized by fiber type. For each fiber, the data were subdivided according to the soil studied.

The coconut fiber content to reinforce sandy soil varied between 0.2% and 1.5% of the dry sample weight with lengths between 5 mm and 50 mm. It was noticed that lower content was associated with longer length, except in the study by [25]. For coconut fiber-reinforced clay, the content was between 0.5% and 2%. The three studies consulted tested the introduction of fiber in 0.5% increments and no relationship was observed with regard to length. In silty and clayey soils with low compressibility, the contents were between 1% and 2% and between 0.4% and 1.6%, respectively. In addition, [46] indicated the use of fibers with a length of 25 mm for reinforcement of clayey soil with low compressibility.

Green coconut fibers were found reinforcing other types of soils, such as: termite clay, strong clay, marine clay, cohesive soil, red soil, expansive soil and soft soil. For these soils, the fiber contents varied between 0.5% and 2% and lengths between 15 mm and 50 mm. It should be noted that the preparation of samples with fiber content greater than 2% had a greater incidence of fiber agglomeration and the formation of weak planes within the sample [47]. An increase in the tendency of fiber to agglomerate also can occur with the use of longer fibers [48]. Thus, to achieve strong composites, well-separated fibers are required [49].

In the studies that used jute fiber, smaller amounts of fiber were incorporated when compared to the coconut fibers. For low-compressibility silty soils, the recommended fiber content was between 0.75% and 1%, without specifying length. For sand reinforced with jute, the content varies from 1% to 1.5% and, according to [50], the ideal length is 5 mm. For the fine-grained silty clay and the expansive soil, the ideal jute fiber content was the same, 6% of the dry sample weight. However, the expansive soil requires a longer fiber length, minimum 12 mm, compared to a length of 6 mm for fine-grained silty clay.

In the studies that looked at sisal fiber, the relationship between fiber content and length was also noticed. For the silty clay soil, when the fiber content is 1%, a fiber length of 10 mm is recommended, while for a 0.1% fiber content, the length should be 70 mm. The same is observed with sisal-reinforced clay, where fiber contents of 0.3% to 0.5%

are correlated to a length of 30 mm, while for 6% content, the recommended length is 10 mm.

Studies developed by [51] and Sotomayor and [52] indicated the introduction of 0.5% of green coconut fibers in Brazilian soils, clay sand and sand, respectively, with lengths of 20 mm and 50 mm. [53] found that for a sand reinforced with sisal fibers, the 0.5% content also presented better mechanical results, where there was an increase in the resistance peak of 87% to 118%.

Two studies with the use of babassu fibers were found to improve the characteristics of sand, both to produce soil blocks. [54] used the content of 40% and random length for the fibers and [55] used content of 0.3% and lengths of 15 mm and 20 mm. Due to the non-relationship between the variables of the cited studies, the correlation between content and length for babassu coconut fibers was not analyzed.

Table 2: Characteristics of the studies included

Reference s	Soil	Fibers	Fiber content (%)	Fiber length (mm)	Unconfined compressive strength (kPa)	Undrained Triaxial compression (kPa)	Tensile strength (kPa)	Shear stress (kPa)
[25]	Sand	Green coconut	1	25 - 50	-	-	-	-
[56]	Sand	Green coconut	0.2	30	-	-	-	43 (50 kPa) 90 (100 kPa) 138 (150 kPa)
[22]	Sand	Green coconut	0.8	15	2260 ⁽¹⁾	-	170	-
[57]	Sand	Green coconut	< 1	-	-	-	-	-
[58]	Sand	Green coconut	0.5	50	-	-	-	-
[27]	Sand	Green coconut	0.5 - 1	-	-	-	-	-
[50]	Sand	Green coconut	1.5	5	-	-	-	-
[23]	Clay	Green coconut	0.5	20 - 30	770	-	108	-
[59]	Clay	Green coconut	1	-	780	-	90	-
[17]	Clay	Green coconut	0.5 - 1	-	-	350-400 (100 kPa)	-	-
[29]	Clay	Green coconut	0.5 - 2	15	-	-	-	-
[51]	Clay sand	Green coconut	0.5	20	597	-	29.8	40 (50 kPa) 80 (100 kPa) 90 (150 kPa) 125 (200 kPa)

Reference s	Soil	Fibers	Fiber content (%)	Fiber length (mm)	Unconfined compressive strength (kPa)	Undrained Triaxial compression (kPa)	Tensile strength (kPa)	Shear stress (kPa)
[47]	Low compressibility silt	Green coconut	1.5 - 2	15	470	420-500 (50 kPa) 500-570 (100 kPa) 610-790 (150 kPa)	-	-
[46]	Low compressibility clay	Green coconut	0.8	15 - 25	190.82 - 200.86	-	-	-
[24]	Low compressibility clay	Green coconut	0.4 – 1.,6	15	79.67 - 114.77	-	-	-
[60]	Termite mound clay	Green coconut	1 – 2	6	460 - 530 ⁽¹⁾	-	-	-
[61]	Cohesive soil	Green coconut	0.8	20	215	-	-	-
[62]	Marine clay	Green coconut	0.6	-	-	-	-	-
[23]	Expansive soil	Green coconut	1	10 - 50	-	-	-	-
[63]	High clayey	Green coconut	0.5	50	-	-	-	-
[64]	Red soil	Green coconut	1 - 2	15	-	-	-	-
[54]	Sand	Babassu coconut	40	-	1180 ⁽¹⁾	-	-	-
[55]	Sand	Babassu coconut	0.3	15 - 20	8390 ⁽¹⁾	-	-	-
[65]	Low compressibility silt	Jute	1	14	-	-	-	-
[66]	Low compressibility silt	Jute	0.75	20 – 40	1000	-	-	-
[50]	Sand	Jute	1.5	5	-	-	-	-
[43]	Soil of coastal area	Jute	0.2 – 0.25	25	290 – 310	-	-	-
[41]	Fine grained silty clay	Jute	0.6	6	-	-	-	205 (100 kPa)

Reference s	Soil	Fibers	Fiber content (%)	Fiber length (mm)	Unconfined compressive strength (kPa)	Undrained Triaxial compression (kPa)	Tensile strength (kPa)	Shear stress (kPa)
								210 (200 kPa) 225 (300 kPa) 250 (400kPa)
[67]	lateritic	Jute	0.75	35	450	-	-	-
[68]	Expansive soil	Jute	0.6	12 – 18	445	480 (250 kPa)	-	271 (300kPa)
[53]	Sand	Sisal	0.5	25	-	254.67 (50 kPa) 513.41 (100 kPa) 789.39 (150 kPa)	-	-
[69]	Silty clay	Sisal	0.1	70	3500 ⁽¹⁾	-	-	-
[70]	Silty clay	Sisal	1	10	-	-	-	-
[71]	Clay	Sisal	0.6	10	410	-	8.3	245 (50 KPa) 490 (100 kPa) 637 (kPa)
[72]	Clay	Sisal	0.3 – 0.5	30	-	190-220 (50 kPa) 160-270 (100 kPa) 210-330 (150 kPa)	-	-
[73]	Low compressibility clay	Sisal	0.75	25	3500	-	-	-

- **Correlation between ideal length and content of natural fibers**

In order to prove the existence of a relationship between the random variables "fiber content" and "fiber length", this study used the data presented in Fig. 3 and applied the statistical method of correlation. The behavior of each fiber was identified in isolation. All values recommended by fiber type were associated, regardless of soil characteristics.

Correlation is any relationship that involves dependence between two variables [74]. To find the correlation, it is necessary to calculate the correlation

coefficient (ρ), which is the covariance divided by the product of its respective standard deviations, shown in Eq. 1. In turn, covariance (COV) is a non-standardized measure, from which it is therefore relatively difficult to draw conclusions about the relationship between two variables. The covariance calculation is important to find the correlation value, determined by Eq. 2 [75].

$$\rho_{XY} = \frac{COV_{XY}}{\sigma_x \sigma_y} \quad \text{Eq. 1}$$

$$COV_{XY} = E[XY] - \mu_x \mu_y \quad \text{Eq. 2}$$

Where μ_x and μ_y are the means of the x and y values, σ_x and σ_y are the standard deviations of the x and y values; $E[XY]$ is the mean of the product of two independent random variables. In Fig. 3, it is possible to graphically observe the relationship between the study variables. It should be noted that the studies that did not determine a value for ideal content and/or length were excluded from the statistical analysis and, whenever a study presented a range of values, the minimum, maximum, and mean values were used.

The closer the individual points are to the linear regression line, the stronger the relationship between the

variables. It can be seen that there is a tendency for the points to cluster near the regression lines for the three fibers (coconut, jute, and sisal), but the correlation appears to be weak. Regarding the regression line for sisal fiber, the points are less dispersed than those for the other fibers. While it is not possible to accurately determine the relationship between fiber content and length, a trend can be perceived. Other statistical analyses would need to be carried out to look at this in more depth.

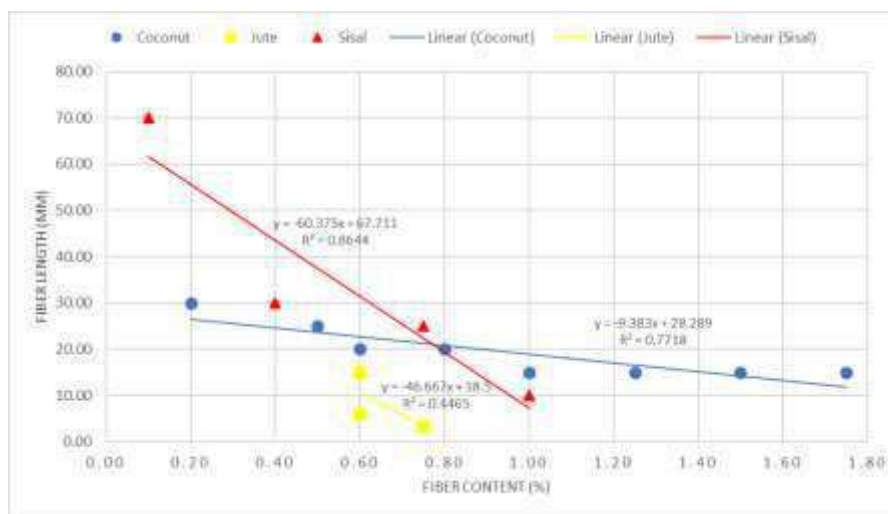


Fig. 3: Relationship between content and length for natural fibers (green coconut, jute, and sisal)

Once the correlation is characterized, it can be described in mathematical form through an equation. The measurement of the degree, the correlation sign, and the variation ratio is made by analyzing the COV values, ρ , and coefficient of determination (R^2) between the two random variables. The R^2 varies between 0 and 1, and the closer the value is to 1, the more explanatory the model is. Its value gives the ratio of the variable Y explained by the variable X through an adjusted function [75], according to Table 3.

Table.3: Covariance values, correlation coefficient, and coefficient of determination for the variables "ideal fiber content" and "ideal fiber length"

Relationship between variables	COV	P	R^2
Coconut	-2.81	-0.552	0.3042
Jute	-0.68	-0.406	0.1645
Sisal	-5.78	-0.859	0.7375

Correlation measures the strength and direction of the linear relationship between two variables. Negative values of covariance indicate that values above mean of one variable are associated with mean values below the other variable. Thus, it is observed the inversely relationship between "ideal fiber content" and "ideal fiber length".

In the analysis associated with the jute and coconut fibers, the COV, ρ , and R^2 values show that the variables have a very weak relation and the proposed equation is not sufficiently explanatory, because COV and R^2 values close to zero indicate that the two variables are not related [76]. However, the relationship between the random variables for sisal fibers was closer, that is, 73.75% of the variation in fiber length can be explained by the fiber content.

• Aspects of babassu

The fruit (coconut) of the babassu palm can be divided into layers: the epicarp, the hard and fibrous outer layer; the mesocarp, the starch-rich layer that lies below the epicarp; the endocarp, the most resistant layer, as shown in

Fig.4. The shell is made up of these three layers together, which make up 93% of the total weight of the coconut. The other 7% corresponds to the weight of the almond [19].

The babassu coconut fibers are concentrated in the epicarp. Analysis of dry epicarp samples at 75°C and 90°C showed 59% and 61% crude fiber content [77]. In green coconuts, the fibers are found in the husk, which corresponds to about 80% of their gross weight [78]. Visually analysis of the babassu coconut and the green coconut show that the babassu coconut has a length and diameter much smaller than the green, however, both have a high percentage of fiber.

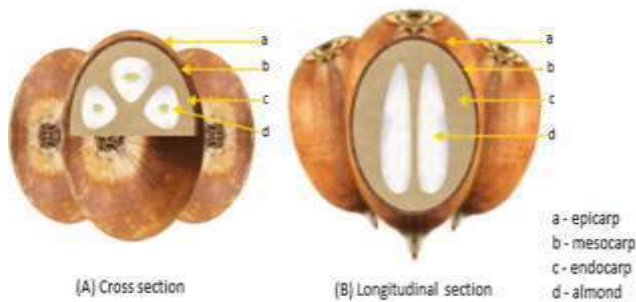


Fig 4: Sections of babassu coconut [79]

Generally, natural fibers are composed mostly of cellulose, lignin, and hemicellulose. Lignin is responsible for resistance and cellulose/hemicellulose is responsible for stiffness [12, 23]. The analysis of the chemical composition of the natural fibers is fundamental, as this can determine the applicability of the fibers for use as composite reinforcement material. The chemical compositions of the most conventional fibers (green coconut, jute, and sisal) and babassu coconut fibers are shown in Table 4

Table 4: Chemical composition of natural fibers (% by weight)

References	Fibers	Lignin (%)	Cellulose (%)	Hemicellulose (%)
[12]	Green coconut	40-45	32-43	21
[80]	Babassu coconut	17.8	62	13
[81]	Jute	12-13	61-71.5	13.6-20.6
[81]	Sisal	8-11	67-78	10-14.2

Among the conventional fibers, those extracted from green coconut have the lowest percentage of cellulose, but the highest amount of lignin [13, 82]. Furthermore, among all of the natural fibers, (green) coconut fiber has a better tear strength and maintains this property, to some extent, even in humid conditions [29].

Analysis of the chemical composition of the coconut species show that the babassu has a higher percentage of cellulose, which characterizes the material as stiffer than the green coconut, and this percentage is close to that of jute and sisal. However, the amount of lignin present in babassu coconut fibers, though greater than that found in jute or sisal, is about half that found in green coconut fibers.

[83] report that the physical and mechanical properties of the fibers are also determinants of the behavior of the composite. These properties are associated with the chemical compositions of the fibers [12]. The physical and mechanical properties of natural fibers related to soil reinforcement are summarized in Table 5.

In relation to density, the babassu coconut fibers present less value than the fibers of green coconut, jute and sisal. [54] concluded that the presence of babassu fiber in the production of adobe blocks decreases the weight of the block as the fiber concentration increases.

The Young module divides the materials into flexible and rigid, approximately. For this reason, a rigid material is one that has a high Young's modulus [84]. Thus, it is found that green coconut fibers and babassu coconut are the most flexible.

[85] observed that as babassu coconut fibers increase in the polyester composite matrix, there is an increase in the modulus of elasticity of the composite because the fibers have higher stiffness than the matrix.

The fiber's property of absorbing water is known as mucilage, a complex structure gelatinous substance that when reacted with water increased the volume, causing dimensional deformation in the composite, in addition to the mass increase. This may impair the mechanical performance of the material [55, 86].

The coconut babassu fibers have low water absorption, consequently, their incorporation into the soil composites causes little volumetric increase of the material. It is therefore possible to consider that babassu coconut has characteristics favorable for use as a composite reinforcement material.

Table 5: Physical and mechanical composition of natural fibers

References	Fibers	Density (g/cm ³)	Tensile strength (Mpa)	Young's modulus (GPa)	Ultimate elongation (%)	Moisture absorption (%)
[48, 67, 68]	Jute	1.3 - 1.5	393 - 800	10 - 55	1.5 - 1.8	340
[43, 70]	Sisal	1.4	526	18.3	6	203.2
[12, 24, 46, 50]	Green coconut	1.4	128	2.1	41.7	130 - 180
[55]	Babassu coconut	0.91	183.8	8.5	-	2

• Future perspectives for the use of babassu

Normally, following the extraction of the almonds, the remains of the babassu coconut are discarded or destined for the production of charcoal. It is estimated that 450-550 g of carbon dioxide (CO₂), 450-650 g of carbon monoxide (CO), 700 g of methane (CH₄), and 10-700 g of hydrocarbons are emitted for each kilogram of non-methane charcoal produced [87], these being the most powerful greenhouse gases [88].

In a survey conducted to estimate the commercial value of babassu products, it was verified that the mesocarp can be traded at R\$ 0.50 kg and the endocarp (fibrous layer destined for charcoal production) at R\$ 0.75 kg [89]. The commercialization of waste from babassu coconut production can generate direct and indirect jobs, promote clean production, and generate economic gains of approximately R\$ 53,260,000.00 per year. To calculate this value, it was considered that the mesocarp represents 20.4% of the coconut and the endocarp 58.4% [18]. Production data from 2010 was used, in which 98,631 thousand tons of waste from this type of coconut were generated in Brazil [19]. These facts agree with the statement of [90]: Natural fibers have the advantage of being renewable resources and marketing appeal.

Northeastern Brazil, where babassu palm tree cultivation is concentrated, is a region that has suffered greatly throughout its history due to economic and social inequalities, such as lack of infrastructure and education, as well as flagrant poverty. This study proposal can help reduce the disposal of babassu coconut residue in the environment, provide a new source of income for local communities that export babassu oil, and reduce the cost of soil reinforcement in the region.

IV. CONCLUSION

The present study focused on a review of the use of natural fibers as soil reinforcement and showed that babassu coconut is also a material with great potential for this use. The proposal is focused on the reuse of the fibrous husk of the babassu coconut, a waste product generated by the extraction of coconut oil, grown principally in the state of Maranhão, Brazil, and which can also be used to produce charcoal through an extremely polluting process. For the region where the major babassu coconut producers are concentrated, this study proposes a sustainable method that can be integrated into the grain size stabilization technique. The main conclusions of the study are:

- (1) In the green coconut industry, the processing of fibers for marketing is common and has appropriate technologies for reuse. However, this scenario is not yet seen in the babassu coconut industry.
- (2) The use of natural fibers in soil reinforcement is beneficial mainly in places where the raw material is available and helps the environment because its production process is cleaner than that for synthetic fibers.
- (3) The production of green coconut and babassu coconut presents low coefficient of waste generation.
- (4) The incorporation of natural fibers into the soil matrix increases permeability as well as tensile, compression, penetration, and shear strength.
- (5) For reinforcement of soils with natural fibers, the fiber content may not exceed 2% of the dry sample weight and length should not exceed 50 mm, as both tend to agglomerate the fibers and form weak planes of interaction with the soil.
- (6) The study statistically analyzed the relationship between the random variables "fiber content" and "fiber length" and noticed the existence of a trend with, inversely proportional, a weak relationship.

- (7) Babassu coconut has a high fibrous content and its fibers have a high percentage of cellulose, with this characteristic being associated with the rigidity of the material.
- (8) The fibers of green coconut and babassu are very flexible.
- (9) Babassu coconut fibers has lower density value and lower moisture absorption rate than the fibers of green coconut, jute and sisal.
- (10) The production process of babassu coconut treats the husk (epicarp, mesocarp, and endocarp) as waste. This waste can be used to make charcoal, which produces greenhouse gases.
- (11) The use of the babassu husk helps to ensure production standards, sustainable consumption, and the promotion of a less wasteful use of the fruit. It also strengthens the cultivation of the species and guarantees the maintenance of the social system linked to its extraction.

V. LIMITATION OF THE USE OF BABASSU COCONUT FIBERS

The principal barriers to the development of solutions that fully use babassu are due in large part to the conservative stance of the industry and the lack of technologies that facilitate processing. For the construction sector, the use of babassu coconut fibers as a construction material would provide direct reductions in the consumption of natural resources and, consequently, would minimize the generation of construction waste.

VI. SUGGESTION FOR FUTURE STUDIES

For future studies, it is highly recommended that the surface of the natural fibers be treated to improve their bonding with the soil matrix. Also, it is recommended to perform tests with strengthened or nano-modified fibers for use as soil reinforcement. In addition, the saturation effect and the long-term durability of the composite soil/fiber mixture needs further analysis.

ACKNOWLEDGEMENTS

The authors thank the Coordination of Improvement of Higher Education Personnel - CAPES for the scholarship, and the Polytechnic School of Engineering (POLI) and University of Pernambuco (UPE) for their sponsorship.

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The information technology Students' cognitive determinants and its relationship to academic performance

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Received: 25 Nov 2020;

Received in revised form:

07 Feb 2021;

Accepted: 19 Feb 2021;

Available online: 28 Mar 2021

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**Keywords— Academic Performance,
Academic Competence, Strategic Study
Habit, Test Competence, Time Management**

Abstract— This study aimed at assessing the cognitive determinants of the BSIT students during the second semester of the academic year 2019-2020. A total of three hundred ninety-four (394) respondents participated in this study to understand the relationship of the cognitive determinants to their academic performance in a major programming course. Results revealed that the number of male students was more significant than the number of female students, there was a small gap between the number of students who graduated from public and private secondary academic institutions, and technical-vocational strand and academic strand were the two senior high school strand that the IT students had taken. In terms of the cognitive determinants, academic competence were very evident to the students with mean ratings of 3.826. However, test competence, time management and strategic study habits need to be improved based on the mean ratings of 3.208, 3.115 and 3.414, respectively. In assessing the relationship between the variables, the academic performance has a significant relationship with cognitive determinants ($r = 0.443$, $p < 0.05$). This study suggests that teachers must incessantly create more meaningful learning experiences to continuously improve academic performance and explore new ways to improve the teaching and learning process.

I. INTRODUCTION

The teaching and learning process has evolved due to constant changes brought by different advancements in society's different sectors. Teaching pedagogies were reviewed and revisited to identify suitable means and methods to facilitate the teaching and learning process effectively. 21st-century teaching and learning pose new challenges and opportunities for teachers and learners. 21st-century teaching and learning require 21st-century that includes learning and innovation skills, information, media, and technology skills, and life and career skills (Stauffer, 2000; Trilling and Fabel, 2009).

Learning and innovation skills include critical thinking and problem solving, communication and collaboration, and creativity and innovation. These skills are essential for learners to develop the relevant and necessary skills needed for 21st-century work. Since the global economy requires a higher level of imagination, creativity, and innovation, teachers are encouraged to develop these essential skills. Apart from the learning and innovation skills, learners must be able to develop their information, media, and technology skills. This set of skills requires information literacy, media literacy, and information and communication technology literacy. Learners must be able to access, analyze, evaluate, and construct valid and appropriate judgments critically and

competently concerning the contents published over the internet to draw valuable insights that may significantly impact the community and their surroundings. The last set of skills required in the 21st century focuses on the life and career skills. This skill set enables the learners to survive, thrive, and succeed in the global arena (Stauffer, 2000; Trilling and Fabel, 2009).

Globalization plays an essential role in today's modern world; thus, learners must successfully develop this skill set. Life and career skills are also crucial in the workplace because of the diverse group of people working together.

The mentioned sets of 21st-century skills needed by learners are developed, enhanced, and further improved through the teaching and learning process. The learning process must be conducted and performed using the appropriate tools, techniques, methodologies, strategies, and procedures to achieve the ultimate education goal. In the process of learning, teachers must be able to recognize the importance of learning domains. Learning domains include cognitive, affective, and psychomotor domains (Hoque, M.E., 2016). The cognitive domain contains learning skills principally focused on cognitive thinking. Learning processes in the cognitive domain include a hierarchy of skills starting from processing information, constructing understanding based on the information at hand, applying essential knowledge, solving problems, and the ability to conduct research.

On the other hand, learning is not only focused on the cognitive aspect but also includes the affective side. The affective domain includes the process of learning attitudes and behaviors essential for learners to develop holistically. The affective domain focuses on the development of emotions and character. Lastly, the psychomotor domain focuses on learning through physical functions, reflex actions, and interpretive movements. The psychomotor domain of learning involves the physical components such as actions and the body itself to express and learn new insights. In general, the learning process includes these domains to establish a concrete and effective teaching and learning process.

Learners need to exert efforts in order to develop, enhance, and improve these domains holistically. Apart from teachers' efforts as facilitators of learning, learners must take into account the importance of regarding these domains for their overall improvement. The cognitive learning domain is typically the domain in which students struggle. According to Plessis S. (2015), cognitive skills determine learning ability; however, learners experience difficulty and struggle cognitively because of the following cognitive factors. Factors include the lack of

concentration, lack of experience, or low perception about things and events, memory, and logical thinking.

This study focuses on learners' cognitive aspects concerning academic performance, including assessing their academic competence, test competence, time management, and strategic study habits. Bangirana et al. (2013) explain that cognitive ability is strongly associated with academic performance. Nesaya et al. (2019) also assert that academic performance has a significant relationship to cognitive profile. Self-Efficacy can be directly affected by cognitive factors such as academic competence, test competence, time management, and strategic study habits. Different studies were conducted in the past about the relationship between the learners' cognitive determinants to their academic performance. However, the present researchers seek to contribute further to the body of knowledge relating to understanding these aspects and look at the variables' relationship in a more contextualized manner. That is, in the case of BSIT students in a higher education institution in Nueva Ecija, Philippines. Integrating the 21st century skills developed during the Senior High School years of the learners, the researchers wanted to assess the cognitive determinants composed of the following factors: academic competence, test competence, time management, and strategic study habits of the students and its relationship to their academic performance.

1.1. Statement of the Problem

- 1.1.1. How may the demographic profile of the BSIT students be described in terms of
 - 1.1.1.1. Sex;
 - 1.1.1.2. Age;
 - 1.1.1.3. Type of School Graduated From; and
 - 1.1.1.4. Senior High School Strand?
- 1.1.2. How may the cognitive determinants be described in terms of
 - 1.1.2.1. Academic Competence;
 - 1.1.2.2. Test Competence;
 - 1.1.2.3. Time Management;
 - 1.1.2.4. Strategic Study Habits
- 1.1.3. Is there a significant relationship between the cognitive determinants and academic performance of the BSIT students?

1.2. Scope and Limitations

The study was conducted in a higher education institution in Nueva Ecija, Philippines, during the Academic Year 2019-2020, involving the second year Bachelor of Science in Information Technology students enrolled in a major programming course. The academic performance was based on the final grade. Incomplete,

unofficial, and officially dropped students were not included in this study as respondents.

II. METHODOLOGY

2.1. Research Method and Design

This study utilized a quantitative research methodology. The quantitative method was used to assess the cognitive determinants of the BSIT students. When data are gathered numerically, it is easier to quantify and measure them using appropriate statistical treatment. In this study, the researchers employed a descriptive-correlational approach to identify and describe the relationship between the respondents' cognitive determinants and academic performance without establishing a causal connection between the variables. The descriptive-correlational design is applicable to measure the degree of relationship among variables. Correlations may be positive, negative, or zero correlation.

2.2. Research Local, Respondents, and Sampling Technique

The locale of this study was a higher education institution offering a BSIT program in Nueva Ecija. The researchers chose the academic institution to provide new insights and recommendations for the college to enhance instruction further. The total number of students enrolled in the major programming course was 411 students. The researchers computed the sample size using the Slovene's formula assigning a confidence level of 95% and a margin of error of 0.5. The suggested number of samples from the population was 199. However, the researchers collected 394 responses resulting in a 1.01 confidence interval. This implies that the results presented in this study were almost representative of the entire population.

In getting the samples for this study, the researchers initially planned to include the entire population of second-year students. However, due to the pandemic, some students were not reached and included in the data gathering. Total population sampling provides more accurate, precise, and objective results. However, some instances have to be considered when employing the total population sampling technique like unforeseen events such as the pandemic, availability of the respondents, and the accessibility of data gathering tools for them.

2.3. Data Gathering Procedure and Data Analysis

In the first semester of the academic year 2019-2020, the researchers started to conduct the study. The researchers carried off activities such as reviewing related literature and studies to gather essential information that served as a foundation for this study. The views and insights gained through the review of related studies and

literature clarified preconceived thoughts and knowledge about the topic and provided new relevant details that aid the researchers in pursuing this study. After that, the researchers adopted an instrument and revised it accordingly to suit the study's needs. The 20-item Study Management and Academic Results Test (SMART) was adopted from Ubaka et al. (2015) to measure the cognitive determinants of the BSIT students. SMART Questionnaire contains four constructs for cognitive determinants: academic competence, test competence, time management, and strategic study habits. When the instrument was adequately revised, the data gathering took place during the second semester of 2019-2020. The researchers explained the goal of the research and the contents of the instrument to the respondents. Clarifications were given to them, and relevant information was expressed. The researchers ensured the respondents that the data that were collected were treated with utmost confidentiality and security.

Tables 1 show the scoring rubric used for this study to properly treat the gathered data.

Table 1: Scoring Rubric for Cognitive Determinants

Range	Verbal Interpretation	Verbal Description
4.60 – 5.00	Strongly Agree	The BSIT students show very good competencies to different cognitive determinants.
3.60 – 4.59	Agree	The BSIT students show good competencies to different cognitive determinants.
2.60 – 3.59	Neutral	The BSIT students show either good or bad competencies to different cognitive determinants.
1.60 – 2.59	Disagree	The BSIT students show bad competencies to different cognitive determinants.
1.00 – 1.59	Strongly Disagree	The BSIT students show worse competencies to different cognitive determinants.

To ensure that the instrument used were valid and reliable, the researchers performed content and face validity checks and reliability analyses to ensure that the

data gathered were valid and reliable. Table 2 shows the result of the reliability analysis using SPSS.

Table 2: Reliability Analysis

Instrument	Cronbach's Alpha	No. of Items
Cognitive Determinants Questionnaire	0.839	20

III. RESULTS AND DISCUSSION

3.1. The Demographic Profile of the Respondents

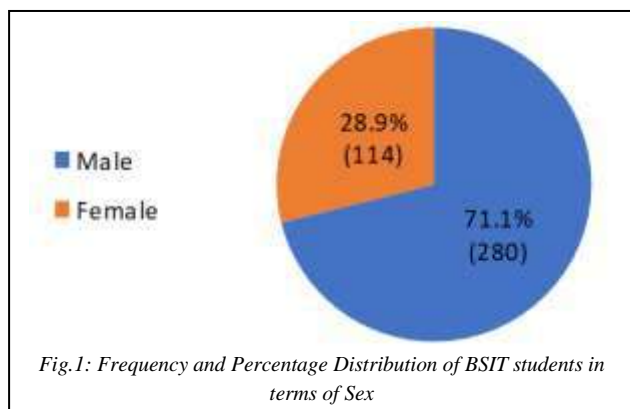


Fig. 1 presents the frequency and percentage distribution of BSIT students in terms of sex. As presented, 280 of 394 respondents, or 71.1 percent, were male while 114 respondents, or 28.9 percent, were female. A 42.2 percent difference between males and females exists, indicating that male-dominated students in the program. A study conducted by Chan et al. (2000) composed of 7,411 respondents revealed that more males have a higher interest in Information Technology careers, making them pursue IT-related programs. Results of this study about the gender gap between male and female also affirm the studies of Fried (2013) and Margolis (2013) that females are still underrepresented in the field of computing, posing an opportunity for academic institutions to provide more avenues for women to be empowered in the field of computing.

In a study conducted by Luciano and Bantug (2019) and Olipas and Luciano (2020), results suggest that more male students were enrolled in the college compared to female, posing an opportunity for the college to devise other programs that would encourage more females to engage in computing and enroll in IT program. As the global landscape continuously evolves, diversity is essential, and the gender gap in computing must be narrow down.

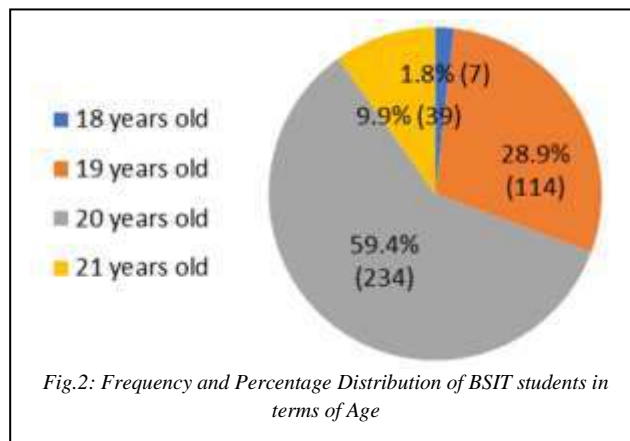
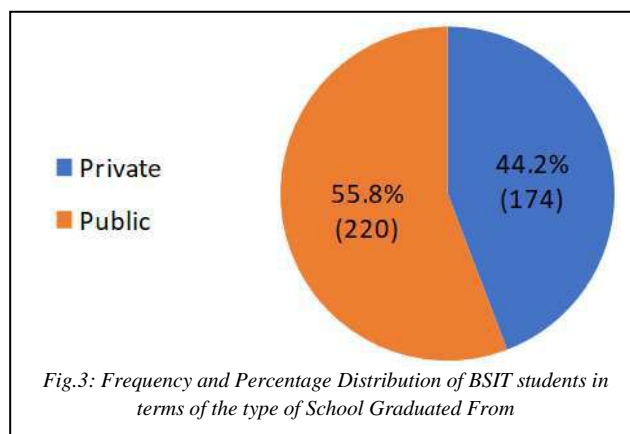


Fig. 2 presents the frequency and percentage distribution of BSIT students in terms of Age. Of the 394 respondents, seven were 18 years old, constituting 1.8 percent, 114 were 19 years old or equivalent to 28.9 percent, 234 or 59.4 percent belonged to the 20 years old bracket, and 39 respondents 9.9 percent belongs to the 21 years old category. This study's respondents were sophomore students during the Academic Year 2019-2020, and most of them fall under the 19 and 20 years old age category. Before the implementation of the RA 10533 or the Enhanced Basic Education Act of 2012, students in the tertiary levels mostly fall from the age bracket of 16 to 20 years old, but because of its implementation, an additional two years were added in the secondary level, making the Age of college entry adjust (Official Gazette, 2013).



As shown in Fig. 3, 220 or 55.8 percent of the respondents came from public secondary schools, while 174 or 44.2 percent graduated from private secondary schools. There is a close gap between the numbers of students from private and public schools because of the equal access to quality tertiary education. In 2017, the Philippine Congress passed into law "An Act Promoting Universal Access to Quality Tertiary Education" or the RA 10931 giving every student an equal opportunity to study in college. Results revealed that the university provides

equal opportunities for all to access quality tertiary education (Official Gazette, 2017).

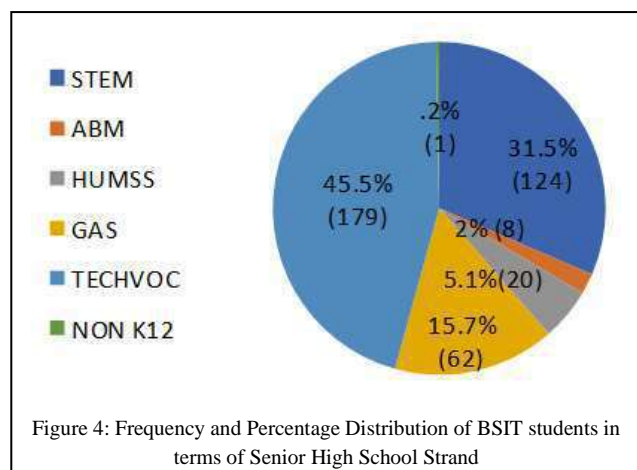


Fig. 4 shows the frequency and percentage distribution of BSIT students in terms of the Senior High School strands they have taken in their secondary education. One hundred seventy-nine or 45.5 percent of the total number of respondents took Technical-Vocational Strand, 124 or 31.5 percent took Science, Technology, and Engineering Track, 62 or 15.7 came from the General Academic Track, 20 or 5.1 percent from Humanities and Social Sciences, 8 or 2 percent from the Accountancy, Business, and Management, while there was one who was not a K12 graduate. In general, most students took SHS strands aligned in the Information Technology program, making them more prepared and oriented.

3.2. The Cognitive Determinants of BSIT Students

Cognitive determinants are composed of BSIT students' competencies to describe their over-all academic self-efficacy, including academic competency, test competency, time management, and strategic study habits.

DiPerna and Elliott (2000; 2002) define academic competence as "a multidimensional construct consisting of the skills, attitudes, and behaviors of learners that contribute to success in the classrooms" (p. 294). Students must develop significantly in higher education to prepare them for the world of work. Presented in Table 3 is the weighted mean and verbal interpretation for assessing the level of BSIT students' academic competence - one of the cognitive determinants.

Table 3: Academic Competence of IT Students

Items	Weighted Mean (WM)	Verbal Interpretation
I have been able to manage the academic course load	3.533	Neutral
I easily understand course material taught.	3.396	Neutral
I find the courses interesting.	3.944	Agree
I enjoy courses offered in the IT curriculum	3.893	Agree
I always do my best to understand course material.	4.363	Strongly Agree
Academic Competence Overall Grand Mean	3.826	
Verbal Interpretation		Agree

Results show a grand mean of 3.826, indicating that students demonstrate "very good" academic competence in the college. Specifically, students were able to manage the academic course load in the college (WM=3.533, SD=0.791), they quickly understood the course material being taught (WM=3.396, SD=0.879), they find the courses being taught in the college exciting (WM=3.944, SD=0.808), they enjoy the courses being offered as part of the curriculum (WM=3.893, SD=0.784), and they strive to do their best to understand all the course material being provided in the college (WM=4.363, SD=0.740).

However, Mah and Ifenthaler (2018), in the case of first-year students in Germany, assert that students often enter higher education unprepared and with unrealistic perceptions about academic competencies. One reason can be attributed to the lack of generic skills, often called 21st-century skills. Since the Philippines have changed the basic education curriculum in 2012 and included additional two-years in the secondary level, the students' generic skills have been further developed. Results indicate that the "very good" academic competence of the IT students can be attributed to their preparation at their high school level. Furthermore, the activities being conducted in the college have contributed to the holistic development of the students as reported in the study of Olipas and Leona in 2020.

Table 4: Test Competence of IT Students

Items	Weighted Mean (WM)	Verbal Interpretation
I can easily manage the amount of course material used for an examination.	3.297	Neutral
I do not find it difficult to prepare for an examination	3.051	Neutral
I can easily cope with examination tension	3.132	Neutral
I usually don't expect complex questions on an examination	2.977	Neutral
I have great difficulty managing the amount of study material for an examination	3.581	Neutral
Test Competence Overall Grand Mean	3.208	
Verbal Interpretation		Neutral

In Table 4, results show the weighted mean and verbal interpretation for assessing the level of BSIT students' test competence. In terms of test competence, students got a "neutral" result indicating that students may or may not have enough test competence as reflected in the overall mean score of 3.208. This may be due to students having difficulty managing the number of study materials in preparation for the examination (WM=3.581, SD=0.838), the contents of the course materials for the exam (WM=3.297, SD=0.654), the tension they feel caused by the examination (WM=3.132, SD=0.586), the actual preparation they conduct for the examination (WM=3.051, SD=0.780), and the ability to foresee complex questions resulting to complacency for the actual examination (WM=2.977, SD=0.540).

Pressley et al. (1997) explain why students are having a hard time taking tests, resulting in declining test competency. The reasons include inconsiderate text in the tests, the inadequate teaching of teachers, and the students' not-so-good information processing. However, the students in the college attributed the primary factor of low test competency to difficulty in managing their time considering their active life as students engaged in different learning experiences and activities. In the study of Olipas and Leona (2020), IT students were identified as

participative and engaged in different learning activities in the college; thus, it may have affected their time management relating to testing preparation

Table 5: Time Management of IT Students

Items	Weighted Mean (WM)	Verbal Interpretation
I find it very difficult to balance study and leisure time	2.876	Neutral
I find it difficult to study regularly	3.348	Neutral
I usually end up cramming for examinations	2.774	Neutral
I can organize my study material and leisure time easily	3.414	Neutral
I always start preparing for an examination well in advance	3.162	Neutral
Time Management Overall Grand Mean	3.115	
Verbal Interpretation		Neutral

Table 5 presents the weighted mean and verbal interpretation for assessing the level of BSIT students' ability to manage their time. In general, results show that students are "neutral" in time management. This means that some students can adequately manage their time, while other students cannot due to different factors, as reflected in the overall mean rating of 3.115. Due to lack of time management in taking examinations or tests, some students tend to end up cramming (WM=2.774, SD=0.898) and experience difficulties in balancing their study and leisure time (WM=2.876, SD=1.109). On the other hand, more students tend to start to prepare for an examination in advance (WM=3.162, SD=1.152), do not always find it difficult to study (WM=3.348, SD=1.001), and can organize study materials and leisure time easily (WM=3.414, SD=0.978) as reflected in the more loose distribution of data shown in the value of standard deviation.

Based on the assessment results relating to time management, it can be viewed that time management is a challenge for IT students. Results revealed that some could manage their time effectively, while others are having a

hard time. Students usually find it hard to regulate and manage their time for school and other activities, resulting in time mismanagement, poor sleep patterns, and increased stress levels (Van der Meer and Torenbeek, 2010; Hardly, 2003). Adams and Blair (2019) explain that effective time management is correlated to more excellent academic performance and lower levels of anxiety in students; yet, it was found out that many students find it hard to find a balance between their studies and day-to-day lives. This is in parallel with this study's results; thus, IT students have to manage their time effectively.

Table 6: Strategic Study Habits of IT Students

Items	Weighted Mean (WM)	Verbal Interpretation
While I am studying, I regularly try to find out what questions' lecturers may ask and they ask examination questions.	3.680	Agree
Planning well in advance is the best way to handle study material.	3.850	Agree
I discuss course materials with my classmates while studying for an examination	3.157	Neutral
I test my knowledge before taking an examination by answering past examination questions and questions from fellow students	3.246	Neutral
While studying, I regularly summarize course materials in my own words	3.437	Neutral
Strategic Study Habits Overall Grand Mean	3.474	
Verbal Interpretation		Neutral

Table 6 shows the weighted mean and verbal interpretation for assessing the strategic study habits of the BSIT students. Generally, more students demonstrate good strategic study habits compared to other aspects as reflected in the overall grand mean of 3.474 interpreted as "neutral." More specifically, results show that more students tend to not summarize course materials in their

own words ($\mu=3.437$, $SD=1.334$), more students do not test their knowledge before taking examinations by answering past examination questions and questions from fellow students ($\mu=3.246$, $SD=1.184$), and more students do not usually discuss course materials to their classmates while studying for examination ($\mu=3.157$, $SD=1.112$). On the other hand, results revealed that students find it very beneficial that planning is the best way to handle study materials ($\mu=3.850$, $SD=0.814$) and that regularly trying to find out what questions may be asked by their instructors and professors in the examination would help them very well ($\mu=3.680$, $SD=0.919$).

While the results suggest a "neutral" practice between positive and negative strategic study habits, IT students are more inclined to demonstrate positive habits. IT students must effectively develop strategic study habits because developing good study skills and learning strategies would keep high motivation and enable them to achieve their goals easily and efficiently. Further, good strategic study habits would help them improve life-long skills, increase their confidence and self-esteem, and lead to better academic performance (Student Wellness Center, 2017).

3.3. The Relationship Between Cognitive Determinants and Academic Performance

Table 7: Correlation between Cognitive Determinants and Academic Performance

Variables	Cognitive Determinants	Verbal Interpretation
Academic Performance	$r = 0.443$	Significant Relationship
	$p\text{-value} = 0.000$	

*Correlation is significant at the 0.05 level (2-tailed)

In Table 7, the test of the relationship between academic performance and cognitive determinants has been presented, indicating that based on the computed value ($p = 0.000$), a significant relationship exists. The correlation coefficient or the computed r is equal to 0.443, indicating a low positive correlation between the variables. Ubaka et al. (2015) support the result of this study, indicating that cognitive determinants have significant relationships to students' high and low academic performance.

IV. CONCLUSION

Results revealed that in terms of the demographic profile of the BSIT students, the number of male students was more significant than the number of female students. There was a small gap between the number of students

who graduated from public and private secondary academic institutions; and technical-vocational track and academic track, specifically science, technology, engineering, and mathematics, are the two senior high school tracks IT students had taken. In assessing the cognitive determinants, academic competence and test competence are very evident to them, with mean ratings of 3.826 and 3.208, respectively. However, time management and strategic study habits need to be improved based on the mean ratings of 3.115 and 3.414, respectively.

In assessing the relationship between the variables, it was found out that academic performance has a significant relationship with cognitive determinants ($r = 0.443$, $p < .05$).

V. RECOMMENDATIONS

Based on the results, the following recommendations were made by the researchers:

1. To lessen the gender gap between male and female enrolled in computing courses, the college may strengthen information dissemination to improve the number of females engaging in computing courses;
2. Academic competence and test competence may be continuously strengthened by incessantly improving the quality of teaching-and-learning in the college to maintain very evident competencies among students;
3. Time management and strategic study habit training may be given to students to improve this area; and
4. Devise new inclusive learning strategies in Information Technology to increase the student's academic performance.

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Continuous social practice learning of college teachers: Taking the practice of accounting as an example

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Received: 23 Nov 2020;

Received in revised form:

15 Feb 2021;

Accepted: 05 Mar 2021;

Available online: 28 Mar 2021

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Keywords— Continuous Learning, College
Teachers, Social Practice, Accounting Major,
LG Company.

Abstract— Based on the “double-qualified” talents training in colleges and universities, we found that social practice has become an effective way for college teachers to improve their practical knowledge. College teachers should hold a “continuous learning or continuous learning,” actively participate in practical wisdom, and improve their comprehensive quality. Firstly, this paper expounds on the connotation and characteristics of “the continuous learning,” then expounds on the practical significance and basic principles of social practice learning, and finally takes LG company practice as an example to explain how to face the social training of college teachers with continuous education.

To improve the quality of talent training, highlight the cultivation of practical ability and reform the mode of talent training, colleges and universities have advocated the social practice of college teachers. Every college teacher should take a “continuous learning, “actively participate socially, practice the guiding principle of combining theory with the approach, exercise practical ability in practice, correct theoretical errors in the way, better understand oneself, improve oneself and improve oneself, and finally make use of it. Through deep reflection and comprehensive promotion of practical learning, we should carry out in-depth teaching reform, explore new teaching ideas, breakthrough traditional teaching models and teaching methods, and further improve our teaching and scientific research level.

I. CONNOTATION, CHARACTERISTICS AND SIGNIFICANCE OF THE CONTINUOUS LEARNING

1.1 The connotation and characteristics of the continuous learning

The continuous learning is a kind of mentality and expression that takes education and self-perfection as the ultimate goal, everything as the object of study holds an open and tolerant attitude and the enthusiasm of beginners to explore, observe and discover the essence of things truthfully and then reflect on and learn from them. Its characteristics are: first, an open heart, that is, a fearless attitude, not afraid of setbacks and difficulties, willing to open the door, with a positive and optimistic attitude to face and deal with problems; second, a humble heart, that

is, a kind heart. Fourth, the heart of reflection, that is, often to reflect on things and self, through in-depth and continuous learning of things, and then reflect on their advantages and disadvantages and improve, so-called “absorb the essence, eliminate dross. “Those who are good at reflection will grow faster.

1.2 The significance of having the continuous learning

1. breakthrough psychological barriers and seize opportunities for learning and development

In one's life, one will encounter many opportunities to improve one's quality and ability, but many people miss or give up because of their worries or lack of confidence. But people with a “continuous learning” come only for learning, not for other purposes, and their attitude is that they can not learn from zero. It eliminates some unnecessary challenging assumptions that many people may set out psychologically, strengthens people's self-confidence, and seize opportunities conducive to their learning and development.

II. COURAGE TO FACE, DARE TO OPEN UP, MAINTAIN A POSITIVE AND OPTIMISTIC ATTITUDE

In the face of practical problems and difficulties, many people will choose to escape and retreat. People with a “continuous learning” mentality is open; they will not give up because of fear of failure because failure is also a kind of learning; they will face problems bravely, accept problems, and find ways to solve problems. For new things, they will hold a positive and optimistic attitude, dare to take responsibility, dare to challenge, so they are often innovators.

III. GOOD AT THE MENTION, KNOW HOW TO PUT DOWN, LIVE A LIFE OF OPEN-MINDED WISDOM

People who have “the continuous learning” will regard the whole life as just a process of learning. A wise man says: “the continuous learning in my heart. “Life is nothing else, but a kind of learning, that is,” only asking for hard work, not asking for harvest. “They will learn to accumulate reflection, live an open-minded and intelligent life, good at

mentioning and know how to put down.

3.1 Practical significance of social practice learning

(1) Social practice learning belongs to comprehensive learning

Social practice learning is a complex of knowledge learning, skill learning, and social life learning. First of all, knowledge learning refers to learning from practice some knowledge that books can not learn. According to statistics, one in nine of a tech worker's knowledge comes from school education, while the other eight out of school. For example, the comprehensive budget management method implemented by LG company to achieve the financial goal of getting rid of difficulties is planned by the company according to its special circumstances, which cannot be learned from the teaching materials that teach the general and general situation. Secondly, skill learning is the comprehensive promotion and flexible application of knowledge learning, which belongs to ability learning. Book knowledge is only the foundation of the knowledge system and belongs to “dead knowledge. “Only in practice, comprehensive application and flexible application according to specific conditions can it become” living knowledge “to solve practical problems. “Finally, social life learning refers to understanding and learning in a social environment different from the school environment. Such as understanding the values in the enterprise environment, such as interest and competition, individual and team cooperation, feeling the busy and orderly pace of work in the enterprise and the meticulous, scientific and cautious attitude of accounting work, learning the unified communication of interpersonal relations in the enterprise, etc. These are the activity window that we know life, understand society.

(2) Social practice learning is the living source of acquiring knowledge

First of all, book knowledge is boring, and practical learning is lively and lively learning, more vivid, interesting, and exploratory. Secondly, practical learning is a systematic and complete learning, and the cognition and mastery of knowledge are profound. Finally, practical knowledge is vital knowledge; practical learning can solve practical problems and create practical benefits. For example, learning accounting knowledge in the finance

department of LG company, the accounting system uses the new international financial management software of LAN, and the employees have their division of labor. The whole accounting process and accounting work are not as complicated and boring as textbooks. The budget management work is much more complicated than the rules and regulations in the textbook. It needs the close cooperation of the staff and the seamless communication of information. Which link has a problem will directly affect the efficiency of the whole company's budget control. And then affect the efficiency of the whole company.

3.2 Basic principles of social practice learning

(1) Learning Heart "to Face Social Practice Learning

Teachers' responsibility is to preach, teach and solve doubts, so college teachers need profound spiritual fields and extensive knowledge structure. With the development and progress of the times, the knowledge system is constantly updated and perfected, which requires college teachers to have a positive and open "continuous learning" and continuous learning ability. Social practice is a favorable opportunity and effective way for college teachers to perfect their learning system and improve their comprehensive quality. Therefore, college teachers should first abandon all kinds of concerns and improper ideas and gladly face and accept social universities. Enter the melting pot of society for study and exercise.

(2) Strive to grasp the opportunities for learning in social practice

It is rare for college teachers to have the opportunity to participate in social practice. Therefore, college teachers should strive to grasp this opportunity and effectively promote the greatest improvement of self-quality and ability. In practice, we should learn to learn with the eyes of discovery and learn some useful knowledge that textbooks cannot learn. In learning, we should be modest and harmonious, strive to do a good job of interpersonal relations, go deep into the business, master the business operation process, methods, skills, and rules, exercise our business ability, enrich our knowledge system.

(3) Reflect on social practice and learn to use it

Confucius said: learning without thinking is lost; thinking without learning is perilous. Learning is for application,

and college teachers' social practice learning should also improve and improve teaching work. Therefore, based on social practice learning, college teachers should further reflect on learning, improve teaching ideas and teaching methods, and rearrange the knowledge learned in practice, combine the knowledge of teaching materials, and integrate it. To enrich students' knowledge and promote students' learning and application ability.

(4) Learn to identify problems and improve them

In social practice, we should profoundly study and master the existing knowledge, but also teachers in colleges and universities should be good at finding out the problems existing in reality and solving them based on the integration of practical experience. This belongs to higher and more in-depth learning, that is, problem learning. Problem learning is a new way to create value. For college teachers, it is a greater harvest of practical knowledge. College teachers can do some corresponding research to improve their academic research ability.

IV. FACING THE SOCIAL PRACTICE OF COLLEGE TEACHERS WITH THE CONTINUOUS LEARNING

4.1 LG company profile

LG company is one of the national key construction projects in the "15th Five-Year Plan" period. It was completed and put into production in 1958. It is the important alumina production base in New China. The company underwent two asset restructuring and was listed on the Shanghai Stock Exchange in June 2005. LG company has a registered capital of nearly 1 billion and assets of about 3 billion. The main business is alumina, salt chemical industry, cement production, engineering supervision, real estate development, property management, medical and health care, education and training, etc. The company has been profitable, but since 2015, profit income and operating profits have declined year by year, and financial statements have been in a state of loss in recent years. LG company has a finance department, responsible for the company's daily financial accounting work. The finance section consists of the accounting section, fund section, financial budget section, assets section, tax administration section, audit section,

and agency section. This social practice is mainly studied in all departments of the Finance Department.

4.2 change of thinking and attitude, actively participate in social practice

College teachers' participation in social practice should first do the following:

(1) Elimination of mental disorders. In enterprise practice, there will generally be three concerns; one is lack of self-confidence, worry about lack of ability to lose face, the other is whether the tasks assigned by the school can be completed as scheduled, third, the interpersonal relationship in the enterprise is more complex, whether they can adapt. This is only a psychological obstacle, as long as teachers have the continuous learning, understand that to go to business practice is to learn from others, will not learn from zero; everything will be released.

(2) Clarify the objectives of practice and expectations. Sign a practical ability training agreement with the school, clarify the tasks and expected goals of the current approach to the target.

(3) Be familiar with personnel relations and enhance self-confidence. If you can go to the practice unit ahead of time, familiar with the personnel relationship of the enterprise, feel the interpersonal atmosphere of the enterprise, to enhance confidence. The most important thing is to bring a school seal agreement to remove the company's concerns about your identity (each enterprise has a trade secret) and truthfully inform the purpose and task of practical learning to be recognized and cooperated.

4.3 Study business practice and improve business skills

In the process of social practice, college teachers should do the following:

Be modest. Although college teachers already have a specific professional knowledge system and professional ability, different enterprises in different industries have other characteristics and different financial environments, and the actual operation may be different from what they have learned from books.

Make every effort to improve the existing knowledge system. College teachers can learn while practicing, take the problems encountered in practice as the starting point, inquire back and further study the book knowledge

involved in this problem, integrate the textbook knowledge, and promote the theoretical knowledge system's perfection. At the same time, with in-depth theoretical knowledge, to learn the corresponding practical experience. In this way, theory and practice merge and promote each other.

4.4 Study the learning methods of practical learning.

College teachers' enterprise practice is impossible for every post to operate in-person to keep trade secrets; important posts will not let outsiders investigate and learn. But the enterprise staff is bustling, cannot explain everything for you, so the most effective and convenient learning method is a self-made questionnaire with questions to learn. List the questions you need to know and answer them quickly, such as choosing ABCD or answering yes or no. LG company funds section belongs to the critical confidential place; the general idle person does not enter. So I first read the headquarters fund management method, then designed the questionnaire, with a short time understanding the current situation of LG company's capital management.

4.5 Reflect on the traditional teaching model and carry on the teaching reform with ability orientation

One of the purposes of social practice learning for college teachers should reflect on the traditional teaching mode, improve teaching thinking, innovate teaching methods, and enhance students' knowledge and ability based on understanding enterprises' characteristics that need talents to better adapt to and meet the needs of social work. Be a teacher with a "continuous learning" and cultivate students who actively practice learning.

The necessary qualities for the work of the financial society. First, we should have the professional quality of using accounting theory to analyze and solve problems; second, we should have the professional quality of sharp and flexible, objective and fair, scientific and prudent; third, we should have the professional spirit of keeping pace with the times and daring to innovate.

V. ANALYZE THE PROBLEMS EXISTING IN THE PRACTICE OF ENTERPRISES AND CONDUCT UNIQUE ACADEMIC RESEARCH

After a comprehensive understanding of the social

convention, college teachers should write corresponding investigation reports and scientific research topics. The emphasis of enterprise practical scientific research should be based on practice and pragmatism, mainly study the problems existing in enterprises' actual situation and put forward corresponding solutions.

5.1 Good at finding problems

To find out the existing issues in enterprises' operation, we must first clear up the ideas and clues, determine the direction, carry out comprehensive collection and investigation activities of relevant information, and carry out in-depth research based on fully understanding the current situation of enterprises. Break the original inertia thinking, reverse thinking. LG company is a wholly-owned old state-owned enterprise. Since 2005, the company has tried out comprehensive budget management. It has been ten years. It can be said that the budget management and guidance documents issued by its headquarters company have reached maturity. So if only from the system to see the surface of enterprises' operation, it seems impeccable. However, considering the pyramid organizational structure of state-owned enterprises, the daily financial supervision and assessment mainly rely on the transmission of information layer by layer, and there are inevitably no problems and deviations in its actual implementation. The company does have apparent issues in coordinating departments and personnel, budgeting methods, and budget execution control.

5.2 Study its corresponding countermeasures

After the problem is locked, it can be used as a horizontal scientific research project and enterprises' cooperation such as capital, personnel communication, collection, and relevant information provision. The enterprise can solve some practical problems for the teachers, or very recognized. It is not only our social practice but also the feedback to the enterprise and the contribution to the society.

In short, the world for everyone to provide learning opportunities is considerable, as long as the heart to learn will be inexhaustible. An excellent organization must be a learning organization; a successful person must be a learning talent; a joyous life must be a learning life. Let each of us grow up in happy learning and go to the future.

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The Memorandum of Understanding and the Jural Relation (*Vinculum juris*)

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Received: 03 Dec 2020;

Received in revised form:

20 Feb 2021;

Accepted: 09 Mar 2021;

Available online: 28 Mar 2021

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Keywords— *Memorandum of understanding, preliminary negotiations, preliminary agreement, offer and its acceptance, jural relation (vinculum juris).*

Abstract— *This paper reviews the legal framework of the document named memorandum of understanding, or letter of intent, usually employed in corporate negotiations. The interpretation of said document uses to bring about countless conflicts that are almost invariably referred to the Judiciary Branch for settlement.*

By virtue of the aforementioned, this paper intends to point out the steps to be observed when preparing a memorandum of understanding, or letter of intent. These steps are aimed at providing legal certainty to the parties thereto thus preventing controversies about its legal effects, and litigations between the parties that might potentially entail costs to the state.

I. INTRODUCTION

This paper aims to review the document entitled memorandum of understanding, or letter of intent and the situations where it may give effect to jural relation during the negotiation process. It also reviews how the Brazilian courts have ruled this matter.

Firstly, it will review the legal effects ensuing from the preliminary negotiations during the negotiation process, inherent to the agreements or discussions that usually take place in the initial phase of negotiations. It will also explain if those agreements or discussions are competent to give effect to jural relations between the parties that could be deemed as compulsory.

Thereafter, it analyzes the attributes of a preliminary agreement that is often executed by the negotiating parties following the stage of discussions. The paper shall explain what type of obligations may arise for the parties, and the elements required to characterize them.

Therefore, this paper will review the rules of procedure comprising the proposal and its acceptance, evincing the moment when the jural relation is perfected and may give effect to all the legal consequences ensuing from the establishment of the contractual legal relationship.

Hereupon, it spells out the hallmarks of a memorandum of understanding or letter of intent, and the possibility of framing it into any of the aforementioned rules of procedure as a way to evidence the existence or non-existence of jural relation obligations.

Lastly, it will show how the Brazilian courts have approached and addressed the issues ensuing from controversial understandings by parties in the event of non-compliance with the memorandum of understanding or letter of intent.

II. METHODOLOGY

This research work adopted a methodology of theoretical nature, resorting to legal theories, case laws, bibliographies in general, scientific databases, and laws such as the 2002 Brazilian Civil Code.

The study considered the review of current facts as a way to establish how the memorandum of intent or letter of intent is approached, notably by the law of obligations and the general contract law.

In fact, the memorandum of understanding or letter of intent became very customary in private law negotiations, notably those of corporate nature. Therefore, the proper legal framing is crucial, either directly to give certainty to the interests of the parties, preventing doubts and controversies about its legal effect, or indirectly to satisfy the public interest by preventing litigation between the parties that may entail legal costs to the state.

Ultimately, the paper presents actionable results about the possible interpretation of the memorandum of understanding or letter of intent, based on the Brazilian Civil Code and the Brazilian case law, as a way to fairly solve eventual controversies.

2.1. PRELIMINARY NEGOTIATIONS

Preliminary negotiations are previous understandings, surveys and discussions taking place throughout the negotiations. At this stage, that is not yet contractual, discussions do not give effect to any jural relation between the parties that could be deemed as compulsory. That is to say it is a stage that precedes the conclusion of a contract, as the convergence of intents that gives effect to the contract must follow a specific path before getting to that stage.

Hence, the parties may move on to the drafting, putting down in words some aspects of the contract content they have been agreed on, in order to include them in the contract they will further execute, even if not all aspects are endorsed. Yet, this fact does not engender any jural relation between the parties.

However, the parties must be protected in the stages previous to the legal transaction, considering that expectations and eventual damages are not exclusive to the stages after the establishment of jural relation between the parties. Therefore, the parties bear legal responsibility towards behaving according to the precepts of objective good faith throughout the negotiation process, and not behaving in a malicious or negligent way that could potentially harm the other party.

Any violation to the duties of protection, information and loyalty ensuing from the objective good faith gives effect to the breach of trust between the

prospective contracting parties. Any proved fault in the conclusion of a contract (*in contrahendo*) entitles the damaged party to claim compensation for eventual damages suffered.¹

Although article 422 of the Brazilian Civil Code does not explicitly refer to pre-contractual liability, the objective good faith unquestionably implies implicit obligations during preliminary negotiations and discussions held before the contract conclusion, as well as in the post-contractual stage.

Hence, in compliance with the precepts of objective good faith in this stage, by virtue of a malicious or negligent behavior potentially harmful to either party, gives effect to the duty to compensate all the consequent damages, pursuant to the principle of *neminem ladaere* (general duty of care) provided for in article 5, XXXV of the Brazilian Federal Constitution.

The rule of objective good faith imposes on the parties a subjective obligation that must be complied with throughout the negotiations period, from preliminary negotiations, going through the establishment and performance of legal transactions, to the contract termination.

The pre-contractual liability, also known as *culpa in contrahendo*, is comprised by the overall extra-contractual liability or Aquilian liability, ensured by article 5, XXXV of the Brazilian Federal Constitution, and articles 186, 187 and 927 of the Brazilian Civil Code.

This is the ruling of most of the Brazilian² and foreign³ legal theories. However, some legal theories consider it as contractual liability⁴ or even as a separate type of civil liability that would be neither extra-contractual nor contractual liability.⁵

Pre-contractual liability starts when contacts have been started, but the contract has not yet been concluded. The improvident breach at this stage may give effect to the duty to compensate, not for in compliance, since there is no contract, but for breaching the trust, for in compliance with the duties of loyalty, transparency, information and cooperation that rule all the acts of negotiation.⁶

The argument of contractual liability is grounded in the specific duty of good faith that, according to the followers of this school, if breached implies the violation of a compulsory jural relation. The start of preliminary negotiations would give effect to a duty of good faith that imposes on the parties the duty to persist, with diligence, in the trust raised on the other party, and also to protect the interests of the other party. Those interests are exposed to damage during the stage of negotiations.

However, the duty to observe good faith in the stage of negotiations does not mean the establishment of a compulsory relationship between the parties, considering that all overall duties of relationships are fulfilled through behaviors towards those one gets in contact. For example, the traffic rules are translated into specific behaviors that a driver should observe in relation to the others, but do not constitute compulsory relationships.⁷

Likewise, the mere offer to the public demands an objective good faith-based behavior, even in the absence of the offer addressee but, even so, does not give effect to a contractual liability.

As regards the argument that it would be a separate type of liability as it secures the compliance of the accessory duties, Massimo Bianca explains that the private law does not allow the establishment of a third type of civil liability other than the contractual liability and Aquilian liability, i.e., between the violation of a given compulsory relationship and the violation of one of the general obligations that support the relations of life.^{8 9}

The damage to be compensated by virtue of breach of negotiations should consider the existence of effective loss to either party. The analysis should consider the limits of negative interest and of positive interest to reach a conclusion about which of these will be best suited to provide fair compensation.

The compensation of damages on the limits of negative interest corresponds to the interest of the party of not being damaged in the exercise of its freedom to negotiate. Put another way, it is the loss suffered by a party for having uselessly trusted in the conclusion of the contract or in its validity.

The compensation of damages on the limits of the positive interest corresponds to the interest to perform the contract, substantiated in the damage derived from the loss that the party could have prevented (consequential damage), and for the economic benefit the party would obtain if the contract had been performed (lost profit).¹⁰

The unsubstantiated breach of preliminary negotiations by either party gives effect to the right to compensation within the limits of negative interest¹¹, i.e., the right to compensation for the damage corresponding to expenses incurred and loss of other favorable opportunities.

On the other hand, as regards loss of opportunity or chance, it should be noted that case laws are somewhat parsimonious in relation to the application of the theory of loss of chance, demanding the Judiciary Branch to tell apart the unlikely from the almost certain, as well as the

probability of profit chance loss to establish the applicable compensation.

2.2. THE PRELIMINARY CONTRACT

Preliminary contract is when the parties enter into a first agreement that gives effect to the duty to further conclude a second contract, deemed to be final. This situation arises when the parties are not interested in promptly establishing the contract that will engender the economic-legal effects inherent to the economic operation agreed on. It may happen for several reasons and, therefore, the parties decide to adjourn the production of such effects to a further moment. The preliminary contract essentially aims to enshrine the binding conclusion and/or complementation of the final contract, reason why the particulars of the final contract are a requirement.¹²

The preliminary contract is ruled by the Brazilian legal system. The Brazilian Civil Code prescribes it should comprise all the core requirements of the contract to be concluded, except for the format. When concluded, and in the absence of any repudiation clause, either party may demand the final contract execution.

A preliminary contract is characterized for having at least one of the compulsory categorical elements of the final contract. For example, if the final business is a purchase and sale transaction, the preliminary contract shall at least provide for the thing and the price. It is worth noticing that there is a content gradation of the preliminary contract compared to the final contract. Therefore, one can think of maximum, medium and minimal degree preliminary contracts, depending whether the basic business defines in a greater or lesser degree the terms of the final contract.¹³

A review of article 462 of the Civil Code shows that the Civil Code admits the principle of free form to the preliminary contract. There are no special requirements. Rather, these contracts are integral part of the set of requirements for contracts in general: competence of the parties; legal and attainable subject matter; consent or agreement of intentions. However, the formal requirement deserves special attention. The Brazilian courts have been discussing the theme based on controversial viewpoints, reaching different solutions. Sometimes they demanded the public form, other times waived it; sometimes they sustained that no effect was produced when the aim was to enter into a constitutive or translatative contract of actual rights in amounts higher than the legal rate; sometimes recognized the production of effects arguing that the purpose was the provision of a fact (*obligatio faciendi*), substantiated in the performance of the main contract and, as any other contract that gives effect to liabilities of that nature, is not slaved to the form; sometimes distinguished

the effects by virtue of the form. However, the provision of article 462 of the Brazilian Civil Code ceased the debate by expressly admitting the principle of free form for preliminary contracts.¹⁴

As it is evident, the Brazilian Civil Code established its discipline (arts. 462 to 466 of the Brazilian Civil Code). It is worth mentioning that the rule defined does not comprise the whole situation of negotiation. However, that is not a problem considering that the context involved in each contract type is permeated by specific arrangements.

The reason of preliminary contracts is to ensure the parties the granted introduction, or basic structure of the ruling of their interests regarding a specific subject matter by means of a second contract (final or main contract), the binding duty of conclusion or duty of complementation and conclusion granted in the preliminary contract. This arrangement in two different moments, as a way to satisfy the practical needs to implement the intended operation, justifies the two-stage negotiation procedure, through the use of the sequence of preliminary contract - final contract.¹⁵

It is thus found that the common denominator in that sequence rests on the creation of bonds that cover the basic structure, or middle part, or the smallest part of a ruling over predefined interests. In the preliminary contract, however, the bond both exists and is valid, but the production of the effects intended by the arrangement will depend on the further complementation of the agreement, while in the final contract, as a rule, the bond exists and is endowed with efficacy.¹⁶

Under those circumstances, the parties firstly set the core terms for the intended economic operation, creating a jural relation. Next, they establish the final structure of interests by executing the final contract, which comprises all rights and obligations of the parties, as well as the penalties for eventual breach of the contract.

The liability assumed in the preliminary contract stems from the conclusion of the final contract. In the final contract, the parties timely complement the business content upon the conclusion of the final contract.

The very phenomenology of preliminary contracts inherently provides that when the parties execute them, they should provide for the power to further complement the contract. Such complementation should take place through the perfection of residual agreements by the time of conclusion of the final contract, so that this last encompasses the pre-contract, closing the negotiation sequence.¹⁷

2.3. THE PROPOSAL AND ITS ACCEPTANCE

The jural relation between the parties may also be substantiated through the rules of procedure of the proposal and its acceptance, as provided for in articles 427, 431 and 435 of the Brazilian Civil Code.

The proposal and acceptance of a contract (and, in general, of the statements of intent) in principle may be expressed in any way such as written words, spoken words or even upon a conclusive behavior that needs no word. The only requirement is that the way of expression selected by the presenting party should clearly and properly convey to the addressee the intent to conclude the contract and its intended content.¹⁸

Moreover, it cannot be disregarded that discussions may approach non-business acts, or actual legal transactions, with an offer (or proposal) aimed at arranging the intended contract. In this sense, the offer would be the second to last act and, being accepted, the contract shall be concluded thus entering into the contractual stage itself. The offer (proposal) is a unilateral legal transaction that does not require an expression of assent, binding the offeror to its terms (article 427 of the Brazilian Civil Code), so that if the offer is followed by acceptance within the due term, with no addition, restriction or amendment, the contract will be concluded (article 431 of the Brazilian Civil Code), completing the preliminary negotiations stage and starting the contractual stage.¹⁹

Therefore, the acceptance of the proposal may come about during the negotiation process, depending on the existing construed circumstances, since the acceptance may be bound to the offer. Therefore, there is a very thin line between the rules of procedures that can only be asserted through the review of the specific case.

However, if it effectively occurs in the specific case, discussions are ceased and the contractual stage starts upon the effective conclusion of the contract through the consensual consent to execute the contract and the establishment of the subject matter and contract consideration, either ascertained or ascertainable. That is when the offer (or proposal) is fixed with the “binder of the agreement” - the acceptance - concluding the agreement and, thereafter, triggering the contract efficacy. It is worth noticing that the binder of the agreement may be explicit or implicit, or through silence (article 111 of the Brazilian Civil Code). Here the uses, further conclusive behavior and commercial practices are of utmost hermeneutic relevance to properly identify that moment.²⁰

Therefore, the existence of the memorandum of understanding and the existence of legal acts practiced by the parties can surely be framed as the existence of a

proposal and its acceptance, pursuant to articles 427, 431 and 435 of the Brazilian Civil Code, which also gives effect to jural relations between the parties.

2.4. THE MEMORANDUM OF UNDERSTANDING OR LETTER OF INTENT

It is natural the gradual construction of the agreement of intents between the parties during the negotiation process. It is built by means of the interaction of the prospective contracting parties in a stage named pre-contractual stage, inherent to the preliminary negotiations. Depending on the circumstances, this stage advances either to the contractual stage through the preliminary contract, or directly to the main contract or final contract.

In more complex economic operations, the parties usually execute, prior to the contract, documents that certify their intention to seek the consensus required for contracting. These documents are named memorandum of understanding or letters of intent, and precede the definition of the core elements of the contract (notably price or compensation). As such, these documents are not binding, and serve only to confirm the mutual commitment of the parties towards negotiating in good faith in support to the contract conclusion. Their main function is to enable the negotiating parties to get the required internal approvals to move the discussions forward. Therefore, these documents are often found in the stage of preliminary negotiations inherent to the pre-contractual stage.²¹

However, if the parties define the core elements of the future contract (consent, subject matter and price), the parties will no longer be in the preliminary negotiation stage. Rather, they will take on the effective liability of concluding the contract in the future. Nevertheless, if the document was named memorandum of understanding, letter of intent or any similar name, the parties will have taken the binding liability and the document will be construed by the laws as a preliminary contract.²²

Likewise, the jural relation following the execution of the memorandum of understanding or letter of intent may be characterized by the rules of procedures of the proposal and its acceptance. That is so because, considering the momentum implied by the negotiation process, the parties may move from the preliminary negotiations stage towards establishing the jural relation by means of conclusive behavior. This way, the discussions stage is concluded, and the stage of building the contract upon mutual consent commences, outlining the contract subject matter and price, either ascertained or ascertainable. That is when the offer is fixed with the binder of the agreement triggering the contract efficacy, being that the further conclusive behavior, uses and

commercial practices are of utmost hermeneutic relevance to properly understand that moment.

Article 113 of the Brazilian Civil Code suggests that the agreement should be construed according to good faith and local uses. In addition to the ethical guidelines to be followed in the negotiation process, it should also observe the further conclusive behavior, and the market commercial practices. This rule is oriented to the parties and the law enforcer. This provision is aimed both at the individual practices of the parties and at social practices known as uses of the process (uses of the banking industry, or of any other sector of the economy).²³

This provision was amended by the Law on Economic Freedom (Law 13.874/2019) that added paragraph 1, subsections I, II, III, IV and V, and paragraph 2²⁴, in order to establish in the interpretation of the legal transaction the behavior after the business conclusion. It also aims at the market uses, customs and practices regarding the type of businesses, and the objective good faith. The interpretation should be more beneficial to the party that did not draft the document. In other words, in the event of ambiguity, vagueness or inconsistency in the contract clauses, these should be construed in a way less favorable to the party that drafted them.

The statements of intent may be expressed in several ways, being the main one that of language. There is no doubt that in most cases the legal transactions are concluded by uttering the words or putting them on the records. The word, however, is only one of the possible signals used by men to communicate with each other. It should not be disregarded that the intent to conclude a legal transaction may be expressed through other types of signals, like when it is not expressed, but implicitly and operatively results from the attitude and activity of the subject, i.e., through their conclusive behavior.

These changes are of utmost relevance for the analysis by the law enforcer in the specific case, notably in corporate relationships, by virtue of their unique logic that hinders the interpreter from using the same technique as that used for civil relationships. Civil relationships are more of formalistic nature, while in corporate relationships the contract system is faster and more flexible, permeated by the freedom of forms, except if otherwise provided for in specific laws, for observing the principles of private autonomy and objective good faith in which the uses of processes, the further conclusive behavior and the commercial practices performed in the specific case are crucial to ascertain the existence of jural relation to the memorandum of understanding or letter of intent.

Therefore, in order to prevent discrepant interpretations by the parties as regards the legal effects of

the memorandum of understanding or letter of intent, the document should describe the legal effects intended by it.

The parties may include in the memorandum of understanding or letter of intent that they want to assign it the effects of the preliminary contract, as a way to undoubtedly give rise to the effects inherent to that kind of contract. Otherwise, the parties may also assign the existence of legal bond to the whole document, or only to one or more clauses therein.

III. RESULTS AND DISCUSSIONS

The study approaches the path taken by the Brazilian justice to solve issues engendered by the incompliance or discrepant interpretation by the parties regarding the legal effects of the memorandum of understanding or letter of intent.

The Brazilian Highest Justice Court understands that the memorandum of understanding, depending on the circumstances of negotiation, holds the nature of preliminary contract. This understanding is ratified in the decision issued on the special appeal number 1.222.399-SP, reported by the Minister Lázaro Guimarães (Justice Official Gazette dated 08/08/2018) confirming the sentence issued by the São Paulo State Justice Court.

The Rapporteur Minister of the Highest Justice Court for the aforementioned appeal properly presented a summary of the trial at the São Paulo State Justice Court to better understand the specific case, explaining that the memorandum of understanding fits into the category of preliminary contract, and the rebuttal should not be allowed in the negotiation procedures by virtue of the aphorism *nemo potest venire contra factum proprium*, i.e., the party shall not act out of character, by assuring that:

(i) thorough and detailed discussions were held in the form of “memorandum of understanding”;

(ii) the memorandums have nature of preliminary contract as they antecede the conclusion of contracts between the Bracce Bank and the Foundation, consisted of the Services Contract (pages 348/ 353) and the Bank Credit Bill Release Attachement (pages 3534/ 357), both dated July 04, 2015, through which the Bank Credit Bill was endorsed to the appellant therein;

(iii) the memorandum, of binding effect, is substantiated as preliminary contract;

(iv) according to the Bylaws, the president of the Foundation is entitled to formalize alone the operation with the other party, and,

(v) the application of the theory of prohibition to act out of character, with incidence of the aphorism “*nemo potest venire contra factum proprium*”.

In order to contribute with the study regarding the possibility of framing the memorandum of understanding into the category of preliminary contract, it is worth mentioning that the Brazilian justice courts also support the case laws in that sense.

The State of São Paulo Justice Court, in the trial of the civil appeal number 1090938-64.2013.8.26.0100 reported by the Judge Correia Lima (Justice Official Gazette dated Oct/06/2016), filed against the sentence issued for the dismissal of the writ of execution due to missing enforcement order to support it, filed by the purchasing company. The Court understood that the memorandum of understanding has nature of a preliminary contract. In the specific case, the purchasing company undertook to purchase from the sellers the farms listed in the memorandum of understanding until April 30, 2012, under the penalty of losing the down payment of 5 million reais in the event of unsubstantiated withdrawal. The sellers issued a promissory note on behalf of the purchasing company as guarantee of reimbursement of the down payment received as payment of the properties’ purchase price, in the event of unsubstantiated withdraw or unintentional breach of the obligations set forth in the memorandum of understanding by the sellers.

That Justice Court understood that the sellers had genuine expectations that the transaction would be concluded, and accepted assigning part of the land for free, for the purchasing company to plant and harvest a soybean crop, and guaranteed exclusive rights of negotiation to the purchasing company for a term much longer than the initial term, and did not explore the farms for nearly two years, by virtue of that negotiation. It was found that the purchasing company either never had real interest in purchasing the farms or lost that interest, acted against the conclusion of the business, consistently opposing conditions and obstacles that derailed the negotiation, clearly aiming to boost the withdrawal of the sellers to prevent the incidence of the premise of unsubstantiated withdrawal. Therefore, the purchasing company clearly violated the principle of objective good faith, as it frustrated the reliance of the sellers on the continuity of the relation.

Thus, the aforementioned Justice Court understood that the memorandum of understanding characterizes a preliminary contract. As such, the purchasing company was legally bound to act in good faith, and to conclude the property purchase and sale contract, i.e., the court understood that there was a jural

relation, and unsubstantiated withdrawal of the transaction by fault of the purchasing company. Therefore, the purchasing company is not entitled to foreclose the promissory note issued by the sellers, which could only be foreclosed in the event of withdrawal from the transaction or incompliance with the obligations provided for in the memorandum of understanding by the sellers.

The State of Espírito Santo Justice Court, in the trial of the appeal number 24151349339 reported by Judge Fernando Estevam Bravin Ruy (Justice Official Gazette of October 25, 2019) understood that, although the parties had named the instrument as memorandum of understanding, by virtue of the outcomes of the negotiation and understanding towards the establishment of a technical-commercial partnership, the parties decided to endow the instrument with effects of contract. Therefore, there was an unchallengeable characterization of a compulsory relation between the parties that engendered the jural relation, by virtue of explicit manifestation of the autonomy of will of both parties, which ensures the stability of contracts.

The State of Espírito Santo Justice Court, in the trial of the appeal number 1.602.842-9 reported by Judge Robson Marques Cury (Justice Official Gazette of June 28, 2017) held the same opinion. It ascertained that the memorandum of understanding for the leasing of equipment to develop port activities signed by the parties has nature of preliminary contract, being competent to give rise to the duty to execute the main contract.

In this specific case, the plaintiff company filed a suit claiming the effects of the non-executed final contract, and the trial court and the respective Justice Court understood that the plaintiff company was only entitled to claim the execution of the main contract, defining that the memorandum of understanding fits into the category of preliminary contract. As such, the plaintiff company should have first filed a suit regarding the duty of doing, aiming at the execution of the final contract, and further obtain the effects of that final contract.

The State of Goiás Justice Court, in the trial of the interlocutory appeal number 5375332-85.2020.8.09.0000 reported by Judge Marcus da Costa Ferreira (Justice Official Gazette dated Oct/ 14/ 2020) understood that the memorandum of understanding executed by the parties characterized the jural relation both for its rules of procedure of preliminary contract, and for the rules of procedure of the proposal and its acceptance, due to the further conclusive behavior of the parties.

The respective Court of Justice alleged bilaterality of the memorandum of understanding elaborated by the parties, which contained all the elements of the contract to

be further executed such as consent of parties, the thing and the price, in full compliance with the provisions of article 462 of the Brazilian Civil Code. The Court asserted the unchallengeable characterization of preliminary contract embodied in the memorandum of understanding, complemented by the letter VDL dated April 17, 2020, and the letter VDR 171-20, which gave rise to the preliminary contract by virtue of explicit manifestation of will of the parties.

The Court added that the documentary evidence proved the bilaterality in the drafting of such documents, and that Mercedes-Benz authorized the transfer of concession when the transaction between the parties was concluded, by means of execution of the termination contract with the defendant company and new concession with the plaintiff company. Therefore, the memorandum of understanding, added by the manifestation of the defendant companies regarding the sale of the concession, and by Mercedes-Benz authorizing the transaction, represents bilateral documentation competent to give effect to the jural relation between the parties, as well as by virtue of an outcome of the negotiation through the submission of the final draft proposed and accepted by the parties, which also gives effect to jural relation pursuant to the rules of procedures of the proposal and its acceptance.

IV. CONCLUSION

Considering the customary use of memorandum of understanding or letters of intent in private law negotiations, notably in those of corporate nature, it is advisable to properly complete its content, mainly the legal frame description, in order to provide certainty to the interests of the parties, preventing doubts and controversies about its legal effects and to indirectly satisfy the public interest, by preventing litigations between the parties that could potentially engender law costs to the state.

It is observed that, if the parties define the core elements of the future contract (consent, subject matter and price), they will no longer be in the preliminary negotiations stage. Rather, they will take on the effective liability of concluding the contract in the future. Nevertheless, if the document was named memorandum of understanding or letter of intent, the parties will have taken the binding liability and the document will be construed by the laws as a preliminary contract.

The jural relation following the execution of the memorandum of understanding or letter of intent may also be characterized by the rules of procedures of the proposal and its acceptance. That is so because, considering the momentum implied by the negotiation process, the parties

may move from the preliminary negotiations stage towards establishing the jural relation by means of conclusive behavior. This way, the discussion stage is concluded, and starts the stage of building the contract upon mutual consent, and outlining the contract subject matter and price, either ascertained or ascertainable.

Hence, to prevent discrepant interpretations by the parties regarding the memorandum of understanding or letter of intent, the parties should describe on the document the effects of its characterization as preliminary contract, as a way to indisputably give rise to the effects of that kind of contract, or the assignment of contractual efficacy to the entire document or only to one of more clauses therein.

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The Influence of New Technologies in the Realization of the Fundamental Right of Access to Justice in Brazil

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Received: 29 Nov 2020;

Received in revised form:

09 Feb 2021;

Accepted: 06 Mar 2021;

Available online: 29 Mar 2021

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Keywords— *fundamental right, access
to justice, new technologies.*

Abstract— *In spite of having already conquered their space in society, the new information and communication instruments remain a novelty for Law and its institutions, which to a large extent still use traditional means. Thus, the incorporation of technological tools by the legal universe constitutes an urgent need for modernity, reflecting on the promotion of access to justice. The main objective of this article is to analyze the influence of new technologies in the realization of the fundamental right of access to justice, since the Law must accompany the development of the society in which it is inserted. Therefore, the work will be based on doctrinal studies, through research in bibliographic and information sources. Finally, the chapters will address, respectively, access to justice as a fundamental right, advancing to the relationship between law and new technologies and ending with an analysis of the influence of new technologies in the realization of the fundamental right of access to justice.*

I. INTRODUCTION

Human rights, which are responsible for ensuring that individuals respect their dignity, are accompanied by a constant need for recognition and effectiveness before their recipients. For Rojas, these rights refer to the “guarantee of the dignity of the human being through certain minimum rights that are recognized to individuals only by their condition as human beings”. For that, “the original idea of individual rights is reinforced and becomes a special category of subjective rights, with protection not only national, but international”.

In domestic law, the Federal Constitution of 1988 accepted Human Rights in its article 5, welcoming them under the name of Fundamental Rights. Thus, it can be said that fundamental rights and human rights represent norms of the same content, differing mainly due to the

legal plan in which they were confirmed, since both terminologies refer to fundamental rights and guarantees for every human being.

Among the rights listed in the aforementioned provision, there is the fundamental right of access to justice, as provided for in article 5, item XXXV: “the law will not exclude injury or threat to law from the Judiciary's assessment”. This guarantee has sparked several doctrinal debates regarding the meaning of access to justice or its effectiveness in the legal-social sphere.

In this context, the technologies made available in the information age play an important role in affirming individual rights and guarantees, in particular in providing justice that qualitatively serves all sectors of a society, because, in addition to making the legal system more efficient, technological tools allow it to be made available

to social strata removed from the centers of power, both socioeconomically and geographically.

The primary objective of this article is to analyze the influence of the new technologies developed and their contribution to the provision of a more accessible and more efficient justice to individuals, considering that the Law must accompany the development of the society in which it is inserted.

To achieve this purpose, the work will be based on doctrinal studies, through research in bibliographic and information sources, using deductive and comparative methods. In turn, the chapters will address, respectively, access to justice as a fundamental right, advancing to the relationship between Law and new technologies and ending with an analysis of the influence of new technologies in the realization of the fundamental right of access to justice.

II. ACCESS TO JUSTICE AS A FUNDAMENTAL RIGHT

In view of the need to ensure that individuals have the minimum conditions to safeguard their dignity before the State and their peers, the Law has been showing significant progress since the emergence of the first fundamental guarantees to modernity. In this context, history shows that, in terms of human rights, the guarantees to be recognized should not be considered finite and their discovery process requires constant search.

Although there is no unified understanding of the origin of human rights, many authors claim that their ground zero is positioned in the events that occurred after the French Revolution and, later, after the end of the Second World War, considering that these are moments historical events related to great changes, conflicts and tragedies, with great philosophical movements being triggered in favor of the recognition of fundamental rights and guarantees.

As an example of a fundamental right, the right of access to justice has historically been one of the most relevant, although often a superficial understanding of its concept has had a negative impact on the level of its effectiveness, in the face of the legal abstraction that surrounds the expression "access to justice". Notwithstanding this, its application is of great importance, since it provides for the recognition of other rights.

Its emergence is linked to the moment when the State claimed for itself the authority to resolve the conflicts of society, ending up becoming directly responsible for the application of justice and social peace desired by those

who act on it. Thus, in a society in which litigation is common and natural, it is reasonable to have rules to discipline the most diverse disputes involving its individuals and even the State itself.

Since then, access to justice has become an essentially instrumental right, since it is related to the way the State will try to reestablish social harmony, since, in the words of Cappelletti and Garth, "the ownership of rights is stripped of senses in the absence of mechanisms for its effective claim".

Thus, while human rights in general ensure guarantees inherent to human beings, the right of access to justice provides individuals with a legitimate means of fighting for such guarantees. In short, it can be said that the right of access to justice functions as a "gateway" for the affirmation of other fundamental rights.

It must be said that the understanding of access to justice has evolved considerably if compared to the conception that had its origin, when its concept was limited to the purely formal aspect. According to the list by the author Vinícius Gonçalves,

[...] at first, with the appearance of the Liberal State at the end of the 18th century and the beginning of the 19th century, the right to access to judicial protection essentially meant the formal right of the aggravated individual to propose or contest an action. Thus, in that period, access to justice was nothing more than a mere formal right, the State having the simple function of making it positive in the ordering, as it remained inert in the face of the inequalities observed at the empirical level.

In other words, the right of access to justice was considered a natural right, a prerequisite for every individual, a fact that exempted the State from the obligation to enforce it. Due to this positioning, the fact is that only a small portion of society was really able to access the judiciary, with the percentage of those who received a concrete answer even less.

The concept of access to justice, in turn, is difficult to define. From the perspective of international law, Article 8, 1, of the Inter-American Convention on Human Rights provides that:

Everyone has the right to be heard, with due guarantees and within a reasonable time, by a competent, independent and impartial judge or court, previously established by law, in the investigation of any criminal charge against him, or to determine his rights, rights or obligations of a civil, labor, tax or any nature.

Therefore, access to justice must necessarily meet objective formal requirements before reaching the potential to offer a qualitatively fair and equitable decision, without favoring some over others. And, in this way, it will fulfill its function as a mechanism that allows the search for recognition of other rights, making the use of violence or any other form of private revenge unnecessary.

At the national level, the right of access to justice is contained in the Political Charter of 1988, both in item XXXV and in LXXIV of its article 5, which list respectively that “the law will not exclude injury or threat to the right from the Judiciary's assessment” and that “the State will provide full and free legal assistance to those who prove insufficient resources”. This time, the Constitution also guarantees the right to those who supposedly would not be able to exercise it.

The 1988 Constitution also contains, in its 1st article, the foundations of the Federative Republic, namely: sovereignty, citizenship, political pluralism, the social values of work and free enterprise and the dignity of the human person. The latter, in turn, functions as a principle whose essence is present in the other provisions of the Brazilian legal system. Dignity is, therefore, taken as a reference for norms, from those that refer to the constitution of the Democratic Rule of Law to those that deal with the protection of individuals through fundamental rights and guarantees.

The dignity of the human person, according to a constitutional approach, includes the awareness that every individual is a dignified being simply because of his condition as a human being, and because he has the prerogative to fight and enjoy the rights inherent to this condition, the example of the right of access to justice.

Critically speaking about his moral theory, Kant maintained that due to his dignity "man exists with an end in himself, and cannot be a means for the arbitrary use of this or that will". Based on this, among the principles contained in the legal system that have the purpose of enforcing this right, there are the publicity of judicial acts, the obligation as to the reasoning of decisions, due legal process, contradictory and broad defense, among others.

It cannot be overlooked that access to justice has an instrumental function as regards the enforcement of other rights, and that therefore it is not limited to access to the judiciary. The sense of justice, in turn, forks as explained by the words of the author Kazuo Watanabe:

The issue of access to justice cannot be studied within the narrow limits of access to existing judicial bodies. It is not just a matter of enabling

access to Justice, as a state institution, but of enabling access to the just legal order.

In this context, if the objective of fundamental rights is to ensure the dignity of the human person, the provision of qualitative justice through a just legal order reinforces this guarantee, since access to justice is intrinsically related to the concept of fundamental right, and must be taken into account when analyzing the applicability and effectiveness of the other rules of the Brazilian legal system.

In summary, it should be noted that, even when dealing with an abstract theme in matters of constitutional law, the concern surrounding the right of access to justice has already been established as a parameter in the formulation and application of several legal norms, especially for the purpose to ensure the fulfillment of this fundamental right in the most comprehensive way possible, as the lack of access to justice is confused with the impossibility of realizing justice itself.

III. THE RELATIONSHIP BETWEEN LAW AND NEW TECHNOLOGIES

With the technological development of the last decades, societies in general have witnessed a significant change in their lifestyle. In this context, as a phenomenon not only inherent in civilization, but dependent on it, the Law perceives the effects of these transformations, both in relation to the process of creating legal norms and in terms of the way in which they are applied. On the topic, Manuel Castells states that:

Our world has been in the process of structural transformation for two decades. It is a multidimensional process, but it is associated with the emergence of a new technological paradigm, based on communication and information technologies, which began to take shape in the 1960s and which spread unevenly throughout the world. Society shapes technology according to the needs, values and interests of the people who use the technologies. In addition, communication and information technologies are particularly sensitive to the effects of the social uses of the technology itself.

Regarding the history of the relationship between law and new technologies, Boaventura Santos (2005, p. 82-109) points out that two aspects can be observed that communicate as parts of a whole and, although distinct, require a joint analysis for your understanding. They are: “the impact of new communication and information technologies on the management of courts and access to information, on the one hand, and the impact of social

communication on the relationship between courts and society, on the other”.

Thus, from the incorporation by the jurisdictional environment of the new computing tools, most of the procedural systems are currently interconnected by information networks, through which data processing and process monitoring are carried out. This reality has already proved successful in the sense of enabling an improvement in the efficiency and quality of judicial proceedings and, therefore, of the jurisdictional activity as a whole.

When investigating the aspect of legal computerization, it is observed that technological modernity has been reaching the Superior Courts, as well as the National Council of Justice and the Regional Courts. In these bodies, resources can already be filed and their respective processes monitored by means of electronic programs. In addition, the digitization of processes provides for a faster processing of procedures, while allowing the reduction of expenses on paper and mail. These changes make the Brazilian legal system less bureaucratic and Justice, in turn, more viable.

In addition to this instrumental aspect, technological devices have become a material object of legal norms with regard to the regularization of their use, with a view to eliminating gaps in the ordering involving situations that were previously not possible, so that there was no need for legal provision.

With regard to technologies with a wide social reach, Wolkmer (2002, p. 9-32) suggests that, “in the face of the continuous and progressive evolution of information technology, it is essential to define legislation that will regulate, control and protect providers and users of electronic mass media”. As an example, we can mention the Marco Civil da Internet, sanctioned in 2014, whose rules govern the use of the world wide web in national territory.

Through a historical analysis, it can be seen that the search for guarantees consists of a continuous process of effecting the legal rules by their addressees, especially those with a fundamental right character. It is only fair, therefore, that a constant verification of the system of rules and principles be carried out with a view to incorporating mechanisms that assist and improve the exercise of these guarantees.

In this context, it can be said that the mass propagation of instruments from the digital age are of paramount importance for those who seek to recognize and enforce their rights. Through the need to increase the flow of information and communication, the internet and the devices that surround it are able to provide better visibility

and even reinforce the capacity of marginalized sectors of society to protect their rights and defend their interests.

When discussing the potential for interference from new technologies on groups and individuals in a society, it is concluded that “today digital networks are social institutions, integrated into contemporary day-to-day life”. In view of this, “when a citizen does not have access to Information and Communication Technologies, it is not a matter of him simply not having access to a technology, but to a social institution, resulting, therefore, in social exclusion”.

Although information and communication technologies have spread rapidly on a global scale, in Brazil there are still many who do not have a minimum of digital access, as a technological advance does not automatically reflect in the inclusion of new communication spaces, as in the hard-hitting democratic structures. conquered historically. This advance, at least in the field of human rights, must be synchronized with social achievements. But the fact is that many are excluded from the modernization process, either due to the lack of economic and financial conditions or the simple geographical distance from the centers of power.

With the current need for connection and exchange of information, the concern around these excluded populations has been the subject of studies and research about the possibility of including digital access itself in the list of human rights. Thus, it can be said that the eventual framing of access to new technologies as a fundamental guarantee would ratify the role of law as a regulator and mediator of the relations between technology and society.

For Wolkmer (2002, p. 9-32), who understands these information technologies, cyberspace and virtual reality in general as belonging to a kind of “fifth generation” of human rights, the idea “is to consider the ‘new’ rights as an affirmation of historical needs in relativity and in the plurality of social agents that hegemonize a given societal formation”. Thus, it can be concluded that the definition of a fundamental right depends on the “essential needs of each era, which are in permanent redefinition and creation”, inserted in a context of legal norms of a dynamic and changeable character inherent to a society in process constantly evolving.

Some authors also point to the need to formulate new categories or branches of rights, consistent with the current reality. According to the understanding of Daniele Blepper (1998, p. 121), it would be the case of creating

(...) a Civil Law of Informatics and a Criminal Law of Informatics. The first would encompass private relationships that involve the use of information technology, such as programs, systems, copyrights, commercial transactions, among others.

The second, the Criminal Law of Informatics (...), concerns preventive and repressive forms, aimed at the good and regular use of informatics in everyday life.

From this panorama, it is possible to affirm that the information age provided an approximation between Law and new technologies, affecting both existing and constitutionally guaranteed rights and new ones, which arose from the discussion on the development and interference of communication technologies. in society, such as the rights related to digital inclusion and the regularization of internet access.

Regarding access to information, Maria Eduarda Gonçalves is aware of the duty to "recognize true fundamental rights of citizens, in the social, economic and cultural spheres, opposed to both States and economic actors". The author defends the need for a minimum regulation of the forms of access to the network, allowing a broader social reach of information of relevant public interest, such as health, politics, environment and education.

Another aspect of the relationship between law and new technologies consists of using them to implement the constitutional principle of human dignity, which constitutes not only the foundation of the Federative Republic but also the starting point for the realization of other rights, such as the right of access to justice. Thus, if it is possible to provide a minimum internet access to the least favored parts of society, such digital inclusion would already mean a big step in the process of social inclusion, through the approximation between Law and society.

Finally, it is necessary that the new technologies, through the media, give rise to the construction of a different panorama in the context of the relationship between justice and the information society. In the words of the Portuguese Orlando Afonso:

(...) justice is a public service without a doubt, but with a fundamental symbolic function. Now, the symbol acts only at a respectful distance (...). Now, the media abolish three basic essential distances in justice: the delimitation of a protected space, the deferred time of the process and the official quality of the actors in the socio-judicial drama. Social communication displaces the judicial space, paralyzes time and disqualifies authority (...).

Thus, the role of journalism, especially in reporting cases of relevant public interest, whether in the economic, social or political spheres, can generate in the population the desire for urgent justice and according to common sense, which does not correspond to the way in which justice is processed in the jurisdictional scope, causing a

disreputable image of the institutions in the face of the social concept.

That said, the Law must adjust to technological and, consequently, social changes, which range from the computerization of jurisdictional systems to the relations between institutions and society. In the midst of the reality of digital exclusion, there is an urgent need to democratize access to new technologies based on the positivization of rights that expand the use and reach of networks, providing greater realization of rights and guarantees, as well as the satisfaction of social longing for information and connectivity.

IV. THE INFLUENCE OF NEW TECHNOLOGIES ON THE EFFECTIVENESS OF THE FUNDAMENTAL RIGHT OF ACCESS TO JUSTICE

Among the characteristics of a civilization deeply immersed in science and modern technologies, we highlight the amount and speed with which information reaches its individuals, albeit regardless of their wishes and actions, as it is the reality in which they are inserted. Thus, according to the Latin drill "ubi societas ibi jus", according to which Law accompanies society, it is possible to see a significant interference of new technologies with regard to the creation and enforcement of rights, especially the fundamental right of access the Justice.

The fact of living in a highly complex society from the point of view of technologies and means of communication suggests that its individuals have greater and better access to information and that, therefore, they will be able to use it for their own benefit through social movements. and politicians who aspire to the recognition and realization of their rights, or even a reinterpretation of those that have already been positivized. According to authors Cappelletti and Garth,

The term "access to justice" serves to determine two basic purposes of the legal system - the system by which people can claim their rights and / or resolve their disputes, under the auspices of the state. First, the system must be equally accessible to everyone; second, it must produce results that are individually and socially just.

In this context, an approximation between Law and society is reflected in the incorporation by the legal world of tools from the new information and communication technologies. However, although they allow greater integration of the individuals connected to them, the new technologies do not obey a parameter of social inclusion, causing an increase in inequality due to limitations in

access and use of information. In this way, social exclusion is projected onto the plane of virtual reality, which is called by Pierre Lévy as “cyberspace”. The philosopher explains the concept as being

(...) the new means of communication that arises from the worldwide interconnection of computers. The term specifies not only the material infrastructure of digital communication, but also the oceanic universe of information that it houses, as well as the human beings who navigate and feed this universe.

The digital exclusion process, mainly due to the restriction of information, presupposes a decrease in access to justice, making it necessary to create a right that guarantees the availability of the Internet and means of communication in a broad and equitable way. Thus, the fact that the citizen is aware of the existence of a benefit that is legally guaranteed constitutes the first step towards effective access to justice. According to Eduardo Bittar (2004, p. 125),

Information technology, mainly via the World Wide Web - Internet, allows, from an instrumental point of view, access to a range of information [...]. However, such a notable advance, capable of eliminating the borders between people, is already proving, perhaps, the greatest abyss of human exclusion: it presupposes someone with the capacity to handle the referred instrument, who has the access or ownership of the necessary equipment and with the possibility of adding a plus of knowledge, given the monumental range of information available.

Despite the contradiction between their potential to integrate and cause social exclusion, it is possible to make new technologies an instrument to challenge inequalities and reinforce the legitimacy of the search for new rights and guarantees. An example is the movements that use social networks to present their claims to society when the traditional means are insufficient to do so. Through mass dissemination in these media, the population in general becomes aware of the most urgent demands and, using politics, is able to elect representatives who defend their interests.

In Brazilian regions that are still difficult to access, such as interiors in the North and Northeast, as well as on the outskirts of large cities, individuals have great difficulties in accessing justice. Consequently, due to obstacles of an economic, social or cultural order, there is the implementation of proper methods of conflict resolution, usually accompanied by violence, as occurs in favelas or in regions of intense agrarian conflict.

Thus, in cases where the State is under-sufficient, private entities with resources to act provide legal assistance to citizens who do not have sufficient information or conditions to demand it, which is fundamental for guaranteeing access to justice. Whether they are totally independent or beneficiaries of state support, these institutions have proven to be efficient in producing solutions to disputes that bring satisfaction to both parties, usually free of charge or at low cost.

In these situations, the entities seek to establish aid through modern information and communication tools, being even able to expose the conflict to the social and political environment. Furthermore, they activate the judicial machinery and defend the interests of their representatives before the State. After all legal procedures, it remains to ensure that decisions are enforced and publicly disclosed, when there is a relevant public interest.

Regarding the democratization of the right of access to justice, the author Boaventura Santos (2005, p. 82-109) notes that the new information and communication technologies.

(...) they allow more circulation of more information and, therefore, a closer and more transparent right and justice. For example, they facilitate access to legal databases, essential information for the exercise of rights, and enable the easy exercise of a set of rights and duties of citizens. Today, it is possible, through electronic networks, to submit applications, receive information, pay certain fees or taxes, or even consult processes.

The electronic process, in turn, fulfills an essential purpose to provide quality justice, that is, the reasonable duration of the process. Due to the slowness with which the procedural procedure takes place, the electronic process allows the jurisdictional tutelage to be made more agile, since “it is not enough just to guarantee access to the judiciary and the adequate means of defense, since to satisfy the jurisdiction it is necessary to the protection sought is granted within a reasonable period, under the risk of becoming totally useless”.

The instrumentality of the new technologies in the face of the fundamental right of access to justice allows for a closer approximation of the citizen in relation to the jurisdictional system. When necessary or convenient, it is allowed to petition certain organs of public administration via websites, obtain certificates directly from the pages of public agencies, as well as participate in popular consultations online, among other possibilities.

Therefore, although slowly and gradually, the adoption of new technologies by the legal environment allows the

production of a more efficient and quality justice both from the point of view of the jurisdictional entity and of the person interested in the litigation, in order to considerably reduce bureaucratization and speed up the judicial system, given that many are still reluctant to sue the judiciary at all costs, whether due to the delay or the expectation of failure in the judicial provision.

In short, access to modern technologies facilitates access to rights, many of which are considered fundamental, such as access to justice. However, technologies, by themselves, are incapable of enforcing these rights and guarantees, requiring a social and political mobilization to take place in order to be truly effective. In this sense, it is essential to make communication tools as widely available as possible to different social strata, in order to alleviate inequalities and balance the demand for justice.

V. FINAL CONSIDERATIONS

Through this study it was possible to conclude that, considering the right of access to justice as a fundamental guarantee, the insertion of new information and communication technologies in the legal world brings both positive and negative consequences for the social system and, in this sense, it is necessary to reinforce the instrumental character of technological tools in favor of achieving justice for society.

On the one hand, modern technologies enable a greater and better flow of information, becoming more and more responsible for informing and making the population aware of the facts and legal procedures. In addition, the computerization of justice through the installation of the electronic process allows for a faster and cheaper procedural process in the face of the vast number of processes in progress. Thus, in addition to bringing access closer and making it more practical, modern tools contribute to a more efficient jurisdictional provision.

However, it was also possible to verify that, being close to economically and politically hegemonic groups, new technologies - especially the world wide web - tend to significantly worsen the process of social exclusion and inequality in the country. Thus, political and social measures that guarantee the democratization of informational media are necessary, in order to prevent them from being widely employed in favor of society, reaching the least favored and providing them with the information necessary for the exercise of democracy and access to justice.

This work allowed us to add that, despite the advances that the historical, social and scientific processes have

been adding to the concept of access to justice, it is of fundamental importance the understanding that the effectiveness of this right needs to be reinforced by the State and its institutions, given that, in contrast to its ability to enhance the faculties of information and communication, the new technologies remain an obstacle to parts of society that do not have digital access at their fingertips.

In summary, it can be said that information technology, of course, has brought advances to the legal system, and should be used in favor of efficiency and the process of access to justice, since the Law should not be alien to technological modernity. However, its performance in society must be subject to control and regulation by the State, which, with a focus on the public interest and fundamental rights, especially the right of access to justice, must act to ensure maximum benefits as a way of compensating the harms that result from the modernization process of society.

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Educational technologies as a health education strategy for the prevention of Cervical Cancer: Experience report

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Received: 25 Nov 2020;

Received in revised form:

18 Feb 2021;

Accepted: 02 Mar 2021;

Available online: 29 Mar 2021

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Keywords— Women's Health, Uterine Cervical Neoplasms, Disease Prevention, Public Health, Inventions.

Abstract— Objective: To report the experience of using educational technologies as a strategy to disseminate knowledge related to cervical cancer in order to promote measures to prevent cervical cancer. **Method:** This is a descriptive study, type of experience report, carried out by nursing and medical students at a Private University in the city of Belém do Pará / Brazil about cervical cancer. Fifteen women aged between 25 and 70 years participated in the educational activity. **Results:** It was noticed that during the waiting room, the women present were at all times attentive to the information passed on by the academics, however, the knowledge related to the theme is still very limited. In addition, it was observed that there was the construction of critical knowledge about cancer involvement, favoring the teaching and learning process. **Conclusion:** It was identified that the dissemination of information through health education achievements is fundamental, and the possibility of building critical and reflective thinking about cervical cancer is extremely important to prevent this pathology. It is worth mentioning the importance of actions aimed at preventing the disease through innovative technologies.

I. INTRODUCTION

Neoplastic disorders are among the pathologies that most cause morbidity and mortality of individuals at an early stage in most countries, due to numerous factors such as increased life expectancy, life habits, and socioeconomic characteristics which influence the process of diagnosis to therapy chosen in each case (FERNANDES, NFS, et al, 2019).

Among the most prevalent neoplasms, the high number of UCC cases registered at the national level stands out, with an estimate of 16 thousand new cases, being the third main etiology among Brazilian women, according to a load carried out by the National Cancer Institute (INCA) for the year 2020. Thus, it is understood the importance of preventive measures to reduce the high levels of Cervical Cancer (CC). This neoplasm presents in various histological types and, among them, Squamous Cell Carcinoma (SCC) is the most frequent with about 80% of cases, followed by Cervical Adenocarcinoma (CA) and Adenosquamous Carcinoma (ASC), which represent 10-15% of total cases (ROZÁRIO, S, et al, 2019).

The high rate of cervical cancer is due to infection with Human Papillomavirus (HPV), an etiological agent that is transmitted, in most cases, by unprotected sexual contact, in addition to being associated with other factors indirectly, such as early sexual initiation, a large number of sexual partners, multiparity and the use of oral contraceptives, smoking, old age and poor commitment to personal hygiene (FREDRICH, EK & RENNER, JDP, 2019). These factors contribute to the increased risk of developing cancer, in addition to other aspects such as the presence of the disease among individuals in lower socioeconomic conditions, leading to its association with poverty and lower levels of education, due to low knowledge related to the purpose, the periodicity and prior care of screening and prevention measures, in addition, either out of shame or due to the lack of time to perform the exam are factors that add to the risks among individuals who mostly depend only on the Unified Health System to obtain pathology assistance (MELO, EMF, et al, 2019).

Therefore, there is a great need for guidance for early detection, from the incentive to the main strategy of screening programs for cytopathological examination (Papanicolaou Smear), or preventive examination of cervical cancer. Thus, enabling the proper management and appropriate referral of women diagnosed or suspected of having a CC for investigation or treatment at other levels of the system, as needed (BARBOSA, IR, 2017).

Measures with direct interventions to a population by means of educational technologies such as the tools used

to raise awareness and prevent various problems, including Cervical Cancer. In this sense, the use in this sense, such as the use of music and the realization of a waiting room for instructional purposes, are ways of reaching the objective of reflection and greater participation of the population (SOARES, LS, et al, 2020).

Therefore, a survey with the objective of relating the experience of using educational technologies as a teaching and learning strategy related to cervical cancer in order to promote measures to prevent cervical cancer.

II. METHODS

This is a descriptive study, an experience report, carried out by nursing and medical students from a Private Higher Education Institution in the city of Belém, Pará, Brazil. Thus, the activity was carried out at the institution's health clinic by participants in the extension project entitled "Interdisciplinary Care for Women's Health", two nursing students and one medical student, directed by a project guiding nurse.

In this sense, the educational action took place on November 26, 2020, no afternoon period during the patients' waiting for medical consultation at the institution's outpatient clinic. The activity was attended by 15 women aged between 25 and 70 years.

In this context, in order to carry out the educational activities, it was necessary to divide it into two stages: I - Situational meeting to elaborate the action and II - Realization of the waiting room on cervical cancer. Thus, in the first stage, the situational dynamics of Maguerez' Arch were used, by observing the flow of women who were seen at the outpatient clinic, thinking about possibilities for carrying out health education activities such as waiting rooms, where the need for approaches related to the CC prevention and awareness method.

In this sense, according to RUIZ SLA, et al, 2020, the problematization methodology, Arco de Maguerez, is composed of five stages, the first of which is the observation of reality, which consists of the active participation of the subjects for an attentive look at reality as well as, second stage, the identification of the key points is carried out, enabling the analysis and formulation of keywords for certain problems. Furthermore, the third stage, theorization, is the moment when the subjects start to identify the problem and make inquiries. In addition, the fourth stage, identification of hypotheses and solutions, consists of the elaboration of viable alternatives to solve the identified problems, and the last stage, application of reality being led to the construction of new knowledge to transform the observed reality.

Thus, during the second stage of educational technologies to elucidate how it occurs and the importance of early diagnosis of cervical cancer. For this purpose, anatomical pelvis and female genital mannequins, models with a playful representation of healthy and neoplastic uterine necks were used, as well as posters with figures representing a physiological and pathological female genital anatomy, in cases of carcinoma.

In addition, it was thought about the ambiance of the clinic with thematic decorations on the pink October, in view of the accommodation and the greater interaction of the participants in relation to the students during the explanation of the theme.

III. RESULTS AND DISCUSSION

During the waiting room, it was identified that the women present were at all times attentive to the information passed on by the academics, as soon after the end of the explanations it was opened for the participants to ask if there were any doubts regarding the subject addressed. These questions addressed the frequency with which the preventive exams should be carried out if this involvement could be caused by sexual intercourse and doubts if the Papanicolaou's stain was performed in the institution's outpatient clinic. Thus, these questions present the difficulties related to the subject of CC and demonstrate that, even though this is a highly prevalent affection, the knowledge related to the theme is still very limited, as well as the assistance both in relation to the diagnosis and related to the specific treatment for the disease.

In this context, it is observed that access to the exam is the initial step towards an effective strategy to prevent CC control, needing to be ensured, especially for women at high risk for the disease (BARBOSA, IR, 2017). Since health information is a practical strategy to reduce the rates of difficulties in adopting a positive and active posture for women, the prevention and control of CC. In this way, the records allowed to identify the adversities of access to the system, the circumstances of low development index, generated by the most varied, promote obstacles to the expansion of the exams. Among the visitors who perform fewer exams are women with low schooling, low family income, and younger women. The low level of education for both the disease and the exams and the fear related to the diagnosis of the pathology, in case a possible discovery of the disease occurs, causes absenteeism in campaigns for prevention and control (MITTELDORF, CATS, 2016).

It was also verified in the action, that a large part of the women present, was already in time to perform the procedure, reflecting the need for continuity of procedures

like this one for the interaction and adequate conception on the needs of self-care and routine evaluation of the health professional.

Because of this situation of low performance of examinations, it is valid to ensure adequate coverage in the screening of the population defined as a target, which is one of the most relevant factors to achieve considerable attenuation of the incidence and mortality due to CC because this measure influences the understanding of that the exam is the basic form of early screening of the pathology, making it possible to intervene and treat injuries in advance, so as not to become aggressive (TEXEIRA, LA, 2015).

In another perspective, for there to be a consequence on the scope of prevention regarding health research, health professionals must be always trained to guide scientific research; about the exam collection measures, exposing the employees and highlighting the positives of the screening; for the collection of cells, ensuring the quality of the sample and the characteristics of each woman, their beliefs and perceptions; and for support and assistance in cases of finding the disease. (BARBOSA, IR, 2017).

Thus, it was observed that there was the construction of critical knowledge about oncological involvement, favoring the teaching and learning process with the sharing of interdisciplinary information to guarantee more autonomy and mastery about the information about the pathology, demonstrating the great need for integration with the community to elucidate frequent doubts that may arise and gains in experience for students participating in the health action.

In this sense, the dissemination of information on this topic is essential because as women know what pathology is, one capable of carrying out exams periodically, the search for the exam becomes frequent, through the adoption of an active self-care posture, increase coverage of preventive exams, PCCU, by health services (MELO, EMF, et al, 2019).

Besides, it is possible to verify the importance of educational technologies for the exemplification, demonstration, and consolidation of the information passed on, allowing structures and characteristics very peculiar to the disease to be created efficiently to the participants of the action. In line with this, the setting also provided a welcome and direction to the theme in question, contributing to the interaction of the participants with the proposed dynamics.

Therefore, it should be noted that health education is shown as a fundamental promotion strategy used to expand the coverage of exams and composed with the use of

educational means. Health education contributes to an adequate understanding that the examination is a simple measure of early identification of the disease, enabling intervention and previous preventive treatment. In this way, the health surveillance measures are prepared by the important monitoring and evaluation professionals, result in a direct impact on the quality of the methods of prevention and management of the disease (RIBEIRO, JC & ANDRADE, SR, 2016).

IV. CONCLUSION

In this study, that the researchers verified a depersonalized and fragmented characteristic of health care. In this perspective, the woman, even with good quality in the specific care process, does not have an adequate screening by the Pap Smear. These innumerable barriers to accessing the Pap smear exposed the vulnerability of women related to CC since it accentuated inequalities and decreased the rate of diagnoses and treatments, in addition to providing prevention to those who do not have adequate assistance.

Thus, it was noticed that the use of conversation circles, waiting rooms and even the use of didactic mannequins allowed a continuous and effective teaching-learning in health that is directly linked to the control of several factors related to cervical cancer, enabling women to develop a critical and reflective thinking on the subject favoring a better adherence to preventive measures of the pathology.

Thus, it is concluded that it is essential to adapt assistance to an organized screening mode, instead of occasional screening, aiming not only diagnostic confirmation and the respective treatment. Thus, through the construction of new expectations and reformulation of surveillance actions, as essential measures for the effective management of CC screening strategies, ensuring health promotion and coverage of the population at higher risk, indicating means to reduce morbidity and mortality rates for this disease.

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Management of Waste and Effluents Generate in the Laboratories of a University in the city of Santo Angelo-RS

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Received: 04 Dec 2020;

Received in revised form:

14 Feb 2021;

Accepted: 07 Mar 2021;

Available online: 29 Mar 2021

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Keywords— social and environmental responsibility, management, waste, effluents.

Abstract— Sustainability has demanded the most diverse organizations to adopt a new style of management with their stakeholders, which combines the practice and dissemination of economic efficiency and social and environmental responsibility, so that they are perceived as legitimate before society. Notwithstanding this reality, there are the Teaching Institution (IE). In this sense, the objective of the study was to propose a waste and effluent management system for a University in the Missions region of Rio Grande do Sul, considering waste generated waste generated in health laboratories, as well as the costs involved treatment. The methodology is an exploratory, applied and case study. The results of the waste and effluent management system clearly show economic advantages, the reduction of physical space for the storage of waste and effluents, the reduction of concentrations and volumes of solutions and reagents, as well as the awareness of the teachers and students about the importance of managing waste and effluents generated in laboratories during practical classes, graduation work and research projects.

I. INTRODUÇÃO

Devido ao forte fomento por parte das empresas no que tange ao meio ambiente/gestão ambiental, torna-se fundamental identificar ações que demonstrem o sucesso ou o fracasso da organização diante do assunto. Desse modo, afirma-se que as mesmas, tem definido estratégias, adotando políticas e certificações, bem como, entendendo a importância de investir em projetos voltados ao meio ambiente. A gestão ambiental e a adoção de comportamentos considerados sustentáveis, tem chamado a atenção, sendo isso consequência do modo de pensar das

organizações, pois as que poluem mais e sem preocupação, perdem competitividade e arriscam a saúde econômica das mesmas (DIAS, 2016). Diante a isso, tem-se visto organizações que utilizam de suas atitudes ante a sustentabilidade, como uma estratégia para desenvolver seu marketing de produtos e implantar atividades voltadas na proteção ao meio ambiente.

Afirma-se que a responsabilidade ambiental das organizações, é resultado da interação com fatores externos às organizações (governo, órgãos de controle, movimento ambientalista) e internos (o departamento de segurança e

meio ambiente, o de pesquisa e desenvolvimento, o de qualidade e o de produção), sendo dessa forma adotada pelas organizações (International Organization for Standardization, 2013).

No que tange ao Brasil, afirma-se a existência de Leis e Decretos que regem a Gestão Ambiental (BRASIL, 1998; BRASIL, 2000), tendo ainda a ISO 14000 uma norma internacional que promove as diretrizes de um sistema de gestão ambiental eficaz, passível de integração com as demais organizações. As organizações, além de cumprir as legislações, buscam a melhoria contínua; redução de custos de implementação; certificações; melhoria e satisfação dos clientes; otimização da infra-estrutura da organização e de pessoal. Além disso, a procura e o consumo de produtos dentro das normas ambientais vêm aumentando gradativamente, o que demonstra a preocupação dos públicos com a sustentabilidade ambiental (PATTEN, 2002).

Por outro lado, ao investir na questão ambiental, além de reduzir gastos adicionais, como perdas e multas com atividades que ocasionam degradação do meio ambiente e melhorar a eficiência (KLINGER, et al., 2016; STRACKE, et al., 2017; DIEL, et al., 2020), se legitima junto aos seus públicos de interesse (PARMAR, et al., 2010) por demonstrar o cumprimento do contrato social (LINDBLOM, 1994; SUCHMAN, 1995). Diante a isso surgiu o problema da presente pesquisa: investigar a possibilidade de utilizar o efluente tratado de uma empresa de refrigerantes da região das Missões/RS através de fertirrigação em um cultivo vegetal evitando o lançamento deste efluente para os corpos hídricos.

Ou seja, este estudo dentro do sistema ambiental verificou a viabilidade da utilização do efluente tratado para a fertirrigação através dos laudos técnicos, analisando as condições e qualidade da água para reutiliza-la no cultivo vegetal, ajudando a planta no seu crescimento e desenvolvimento. O estudo foi efetuado em uma empresa, situada na cidade de Santo Ângelo do estado do rio grande do sul, que desenvolve atividade de fabricação e distribuição de bebidas abrangendo os estados do Rio Grande do Sul e de Santa Catarina.

A aplicação do efluente tratado apresenta-se vantajosa quando, com isto, é possível preservar os recursos hídricos disponíveis: contribuir para o aporte e a reciclagem de nutrientes, o que possibilita a diminuição de utilização de fertilizantes químicos, e viabilidade na preservação ambiental.

Na sequência, o artigo continua com o referencial teórico e sobre o efluente líquido industrial e os elementos minerais que dão suporte a pesquisa empírica e os procedimentos metodológicos adotados para a resolução do

problema de pesquisa. Depois, apresenta e discute os resultados da pesquisa e destaca as considerações finais.

O reuso da água na irrigação é uma alternativa que vem se mostrando viável por várias razões: em áreas onde as culturas mais necessitam de irrigação a água é, via de regra, escassa; a agricultura irrigada requer grandes volumes de água, que representam a maior demanda de água nas regiões áridas; as plantas podem ser beneficiadas não somente pela água, mas também, dentro de certos limites pelos materiais dissolvidos nos efluentes, tais como substâncias húmicas, nitrogênio, fósforo, potássio e micronutrientes (STRACKE, 2020).

A reutilização da água constitui-se uma prática de caráter benéfico que pode ser observada de várias formas. Segundo COSTA e al. (1986), a reutilização de água apresenta-se vantajosa quando, com isto, é possível preservar os recursos hídricos disponíveis: contribuir para o aporte e a reciclagem de nutrientes, o que possibilita a diminuição de utilização de fertilizantes químicos, e viabilidade na preservação ambiental.

Muito embora o nosso planeta tenha três quartos de sua superfície coberta pela água, deve-se considerar que apenas uma pequena parcela, referente à água doce, pode ser aproveitada na maior parte das atividades humanas, sem que sejam necessários grandes investimentos para adequar suas características físicas, químicas, e/ou biológicas (MAYS, 1996).

Nota-se que a disponibilidade da água em qualquer local é variável no tempo e espaço em razão das condições climáticas de cada região e período do ano, e pode ser afetada pelas atividades humanas, seja ela pela demanda excessiva ou por problemas de poluição resultantes do lançamento de esgoto doméstico e efluentes industriais.

Historicamente, a água foi uma componente primordial, já que o processo de colonização de grande parte do globo foi se desenrolando as margens dos cursos d'água, como ocorreu no Brasil, na época dos bandeirantes. Com o aumento da população e o incremento industrial, a água passou a ser cada vez mais utilizada, como se fosse um recurso abundante e infinito. O conceito abundância de água ainda é mais forte hoje principalmente no Brasil, um dos países que mais dispõem desse recurso: aqui estão aproximadamente 13% de toda água doce do planeta (WRI, 2003). Contudo, uma análise mais detalhada contempla um cenário diferente. A escassez de água é uma realidade não apenas nas áreas de climatologia desfavoráveis, mas também nas regiões altamente urbanizadas, no caso das áreas metropolitanas.

Por essa razão, é importante a criação de estratégias que compatibilizem o uso de água, sendo recursos hídricos não abundante no País. Isto significa eu os

atuais conceitos sobre o uso de água e tratamento e descarte dos efluentes gerados devem ser reformulados. Assim sendo, a racionalização do uso e reuso da água torna-se elementos essenciais de garanti à continuidade das atividades humanas, diante desse cenário de escassez (MIERZWA; HESPANHOL, 2005).

O reuso de efluentes tratados é um recurso importante para implementar gerenciamento sustentável dos recursos hídricos, entretanto, devemos considerar: uso mais eficiente da água e melhor gerenciamento dos sistemas e produção de água segura para os usos desejados.

Intimamente responsáveis pelo impacto ambiental gerado por indústrias que valem dos recursos hídricos em sua cadeia produtiva, os efluentes tem sido considerados como um dos principais poluentes com ação prolongada no meio ambiente. Prova disto é o rigor com que a legislação brasileira tem punido as empresas causadoras de desastres ambientais ligados a vazamentos e/ou inadequação das estruturas á manutenção da sanidade das águas empregadas.

Dada a grande importância da água para o desenvolvimento das diversas atividades humanas, foi indispensável criar normas que disciplinassem a utilização dos recursos hídricos pelos diversos segmentos da sociedade, principalmente pelas indústrias, companhias de saneamento e produtos rurais (BRAILE, 1979). Assim, desde sua implantação, a legislação tem como principal objetivo minimizar os problemas de poluição ambiental causados pela emissão de efluentes para os corpos receptores.

As normas incorporam o conceito conhecido como “comando e controle”, ou seja, órgãos federais e estaduais estabelecem padrões de qualidade para os recursos hídricos e para emissões de efluentes, que devem ser seguidos pelas indústrias e outras atividades relacionadas. Posteriormente, há fiscalização para verificar o cumprimento das regras.

No Brasil, existe o Conselho Nacional do Meio Ambiente – CONAMA, que por meio da Resolução nº430 de 13 de maio de 2011 (CONAMA, 2011), complementa e altera a Resolução nº 357/2005 (CONAMA, 2005). Estabelece as condições e os padrões de lançamento de efluentes. Considerando a Constituição Federal de 1988 e a Lei nº 6.938, de 31 de agosto de 1981, que visam a controlar o lançamento de poluentes no meio ambiente, proibindo aqueles que são considerados nocivos ou perigosos para os seres humanos e outras formas de vida.

A Resolução do Conama, em seu Artigo 2º cita que a disposição de efluentes no solo, mesmo tratado, não está sujeita aos parâmetros e padrões de lançamento dispostos nesta Resolução, não podendo, todavia, causar poluição ou contaminação das águas superficiais e subterrâneas.

Já no Artigo 3º determina que os efluentes de qualquer fonte poluidora somente poderão ser lançados diretamente nos corpos receptores após o devido tratamento e desde que obedeçam às condições, padrões e exigências dispostos nesta Resolução e em outras normas aplicáveis.

Vale considerar, também, as peculiaridades que variam em cada região do país, sendo que os estados podem possuir normas diferentes desde que sejam mais restritas que a Resolução que possui caracteres federal.

A entidade responsável por fontes potencial ou efetivamente poluidoras das águas deve apresentar ao órgão ambiental competente, até o dia 31 de março de cada ano, declaração de carga poluidora referente ao ano civil anterior, subscrita pelo administrador principal da empresa e pelo responsável técnico devidamente habilitado, acompanhada da respectiva Anotação de Responsabilidade técnica (ART), como determina o Artigo 28 do CONAMA.

II. METODOLOGIA

De acordo com a definição dos objetivos a serem atingidos neste estudo, a pesquisa realizada visa identificar a viabilidade de fertirrigação como método de reuso de água na fábrica, através de uma pesquisa exploratória, pois até o momento não ocorreu nenhuma pesquisa relacionada a este projeto.

Neste trabalho pretende-se avaliar os parâmetros químicos do efluente tratado para ver a viabilidade da utilização no processo de fertirrigação, através dos laudos técnicos do efluente da estação de tratamento de 2012 e 2013 que estão logo abaixo. Esta avaliação se torna viável uma vez que a empresa faz monitoramento dos parâmetros através de análise mensalmente para responder aos órgãos ambientais. A partir da avaliação destas análises poderemos quantificar os nutrientes disponíveis neste efluente e a realizar sua aplicação no solo de forma adequada considerando a sua capacidade de saturação, infiltração e respeitando os princípios ambientais.

Quadro 1: Laudo referente ao ano de 2012

PARÂMETRO	JANEIRO	FEVEREIRO	MARÇO	ABRIL	MAIO	JUNHO	JULHO	AGOSTO	SETEMBRO	OUTUBRO	NOVEMBRO	DEZEMBRO	PADRÃO LO
DQO		9,8	38	24	58	32	32	9	13	30	2,35	33	<= 300 mg/l
DBO		7,8	13	5,8	18	8	16	15			27	13	<= 80 mg/l
FÓSFORO TOTAL	2,42	2,82	2,75	2,6	4,96	4,66	1,68	3,36	15,9	0,89	2,4	3,44	<= 3 mg/l
NITROGENIO		6,8	4,06	2,64	2,85				38,1		1,31		<= 20 mg/l
SÓLIDOS SEDIMEN	7,5	20	0,3	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<= 1,0 mg/l
COLIFORMES	<0,1	<100	310	<100	<100	<100	<100	<100	<100	<100	<100	300	<= 100000 NMP/100ml
PH		7,6	7,5	7,69	7,62	7,72	7,64	7	4,7		7,81	7,86	entre 6.0 e 9.0

Quadro 2: Laudo referente ao ano de 2013

PARÂMETRO	JANEIRO	FEVEREIRO	MARÇO	ABRIL	MAIO	JUNHO	JULHO	AGOSTO	SETEMBRO	OUTUBRO	NOVEMBRO	DEZEMBRO	PADRÃO LO
DQO		9,88	19	24	49	43	32	9	38	28	6,39	5,91	<= 300 mg/l
DBO	15	3,3		8	16	14	12	27	13	12	9,72	14,7	<= 80 mg/l
FÓSFORO TOTAL	2,42	1,84		2,64	1,86	2,56	0,7	2,2	1,36	0,89	2,35	2,14	<= 3 mg/l
NITROGENIO		6,37	3,68	3,34	2,35	0,42	2,91	1,48					<= 20 mg/l
SÓLIDOS SEDIMEN	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,2	<0,1	<0,1	<0,1	<= 1,0 mg/l
COLIFORMES	1007,5	200		410	310	520	<100	200	310	<100	<100	<100	<= 100000 NMP/100ml
PH		7,88	7,78	7,81	7,81	7,92	7,76			7,73	7,81	7,75	entre 6.0 e 9.0

Estes laudos técnicos foram realizados pelo laboratório ALAC que fornece serviços terceirizado para a empresa, correspondendo assim às análises dos parâmetros solicitados pela licença de operação da fábrica.

Quadro 3: Método utilizado pelo laboratório ALAC.

PARÂMETRO	UNIDADE	MÉTODO	
DQO	mg/l	Standard Methods 22st- Método 5220 B [PNT013-EF]	Espectrofotometria em refluxo fechado
DBO	mg/l	Standard Methods 22st- Método 5210 B [PNT017-EF]	Método da diluição e incubação (20°C, 5 dias)
FÓSFORO TOTAL	mg/l	Standard Methods 22st- Método 4500-P/B e E [PNT021-EF]	Método colorimétrico
NITROGENIO	mg/l	Standard Methods 22st- Método 4500 Norg-B e D/4500 NH3-C [PNT024-EF]	Método titulométrico
SÓLIDOS SEDIMENTÁVEIS	mg/l	Standard Methods 22st- Método 2540 F [PNT005-EF]	Método do Cone Imhoff
COLIFORMES	NMP/ml	Standard Methods 22st- Método 9223 [PNT006-EF]	Determinação de Número Mais Provável de Escherichia coli por substrato enzimático.

III. RESULTADOS E DISCUSSÕES

Através destes laudos, observamos que os resultados obtidos dos parâmetros estão dentro dos limites legais, através deles podemos verificar a viabilidade da utilização deste efluente para a fertirrigação.

O fósforo é um dos nutrientes essenciais para a planta, ele age na respiração e na produção de energia, nos laudos observamos que no ano de 2012 ele aparece alterado no mês de maio, junho, agosto e dezembro, sendo que no ano de 2013 se manteve estabilizado, em relação à fertirrigação não teremos problema, já que temos o controle

da quantidade existente e a quantidade necessária para que a planta cresça e se desenvolva apropriadamente.

O nitrogênio é essencial para planta na formação das proteínas, substâncias que fazem parte dos tecidos vegetais, nos laudos apresentados foi observado uma alteração em 2012, e como suas quantidades estão bem abaixo do padrão foi deixado de analisar por alguns meses.

Notamos também que os coliformes termotolerantes estão abaixo do limite, mesmo assim para o processo de fertirrigação é recomendado que o efluente passe pela cloração para garantir a eficácia da implementação do sistema sem prejuízos de contaminação microbiológica considerando a proximidade de lençol freático, pois temos que cuidar a não contaminação, mas sim enriquecendo pela disponibilização de nutrientes essenciais para o desenvolvimento da planta.

Comparando os laudos analíticos de 2012 com 2013, observa-se que em 2012 dois parâmetros excepcionalmente estiveram acima dos padrões e que em 2013 todos os parâmetros estão estabilizados.

Justifica-se assim que esse monitoramento mensal de todos esses parâmetros vem se aprimorando a cada ano ocasionando uma melhora de resultado das análises, de tal forma que nenhum dos parâmetros de 2013 estão fora do padrão.

Aproveitamos a deixa em que a empresa Vonpar estabelece metas a cada ano para diminuir o consumo de água evitando o desperdício e apoiando o reaproveitamento de água, no sentido de preservar os recursos hídricos em seu território de abrangência.

Nesse sentido de preservação dos recursos hídricos o presente estudo visa à formação de um ciclo hídrico ambientalmente correto, sendo que o efluente gerado tratado e posteriormente incorporado ao solo de forma adequada visa o desenvolvimento sustentável do ecossistema.

Considerando o resultado da análise e verificando a disponibilidade da área para a sua aplicação bem como também os limites de absorção de nutrientes pelas plantas realizou-se um estudo de monitoramento da vazão deste efluente conforme tabela abaixo.

Quadro 4: vazão do efluente em 2013

DIA	HORA	VAZÃO	OBSERVAÇÕES
01/10/2013	09:00	131	
02/10/2013	09:00	128	
03/10/2013	09:00	106	
04/10/2013	09:00	80	
05/10/2013	09:00	82	
06/10/2013	09:00		Fabrica parada
07/10/2013	09:00	129	
08/10/2013	09:00	130	
09/10/2013	09:00	117	
10/10/2013	09:00	100	
11/10/2013	09:00		Fabrica parada
12/10/2013	09:00		Fabrica parada
13/10/2013	09:00	128	
14/10/2013	09:00	121	
15/10/2013	09:00	116	
16/10/2013	09:00	87	
17/10/2013	09:00	86	
18/10/2013	09:00	76	
19/10/2013	09:00	80	Fabrica parada
20/10/2013	09:00		Fabrica parada

21/10/2013	09:00	132	
22/10/2013	09:00	123	
23/10/2013	09:00	125	
24/10/2013	09:00	125	
25/10/2013	09:00	115	
26/10/2013	09:00		Fabrica parada
27/10/2013	09:00		Fabrica parada
28/10/2013	09:00	124	
29/10/2013	09:00	114	
30/10/2013	09:00	130	
31/10/2013	10:00	110	

Nesta tabela pode se observar a medida da vazão do efluente em uma média de $111\text{m}^3/\text{h}$, sendo que o expediente da Estação de Tratamento de Efluente é de 16 horas diária de segunda á sábado.

O local em que vai ser realizado o trabalho é na Estação de Tratamento de Efluente da empresa Gama focado em três áreas.



Fig.1: área 1 medindo aproximadamente 1800m^2



Fig.2: Área 2 medindo aproximadamente 2400m²



Fig.3: Área 3 medindo aproximadamente 1800m²

Existe respectivamente uma plantação de gramado em toda a propriedade da empresa, um cultivo que traz muitos benefícios para o meio ambiente. Um gramado bem mantido proporciona um local confortável e seguro para diversão e prática de esportes; libera oxigênio (cerca de 230 m² de área gramada libera O₂ suficiente para quatro pessoas); refresca o ar e com isto contribui para os esforços de reduzir a tendência de aquecimento global (em um dia quente de verão um gramado apresentará uma temperatura

16,5°C e 7,8°C menor que a de um asfalto e um solo sem vegetação, respectivamente); reduz a emissão de CO₂ (absorvem grande quantidade de CO₂ para realizar fotossíntese durante o ano todo) atenuando o efeito estufa e controla a poluição do solo (a rizosfera serve com um filtro absorvendo o que passa por ela). Outro efeito favorável dos gramados para o meio ambiente é o controle da erosão do solo. Os gramados são seis vezes mais efetivos em absorver a água da chuva do que uma lavoura

de trigo e quatro vezes mais do que uma lavoura de feno (Beard, 1985).

Entretanto, para que os gramados desempenhem todos estes benefícios é necessário que ele esteja adequadamente suprido com todos nutrientes minerais essenciais, para que possa ter um bom crescimento e manter a qualidade. Como a maioria dos solos não possui os nutrientes numa quantidade suficiente para atender a demanda pelas gramas, é necessário a aplica-los através da fertirrigação.

Em uma média dos anos de 2012 e 2013 tivemos 3mg/l de fósforo e 6mg/l de nitrogênio considerando a vazão média destes anos de 111m³/dia transformando a vazão em litros vai para 111.000l/dia chegamos em um total de 333.000mg de P e 666.000 de N, aplicando estes efluentes nesta vazão em uma área de 6.000m² teremos uma aplicação de 55mg/m² de fósforo e 111mg/m² de nitrogênio.

Considerando que Estação de Tratamento de Efluente funciona 16 horas por dia em uma área de 6.000m² chegando a disponibilização de 55 mg de fósforo e 111mg de nitrogênio por 1 m² da área, sendo que estes dados serão monitorados com o objetivo de acompanhar e verificar a saturação destes nutrientes na planta e disposição de infiltração do efluente no solo.

Considerando também que para a cultura de gramínea é necessário 300mg/ha por dia de nitrogênio, sendo então que para 10.000 m² é preciso 300mg de nitrogênio, considerando a área disponível para a aplicação deste projeto é de 6.000m² poderá então ser incorporado 180mg/m² por dia, considerando que a disponibilidade do nitrogênio deste efluente esta abaixo da necessidade da cultura, faz com que o controle de aplicação deste nutriente seja mais tranquilo e conforme o monitoramento visual da gramínea realizado através da coloração verificaremos a saturação ou a deficiência de nitrogênio e fósforo que poderá estar ocorrendo na planta.

Nesta verificação percebemos que a quantidade disponível de nitrogênio é maior que a do fosforo, favorecendo o cultivo já que o nitrogênio é o nutriente mais importante na nutrição de gramas e exigido em quantidades muito maior que qualquer outro nutriente. Além disso, é um nutriente que apresenta uma dinâmica muito complexa nos solo, podendo ser perdido através da lixiviação (água percola no perfil do solo levando o N), ou na forma de gás (por desnitrificação ou volatilização), ficar indisponível para as plantas, por um período, devido estar sendo utilizado na estrutura de microrganismos do solo (imobilização) ou ser liberado no solo através da mineralização de materiais orgânicos.

Conhecendo os dois principais efeitos do nitrogênio na nutrição das gramas fica mais simples de entender os dois principais sintomas da deficiência de nitrogênio nos gramados. O primeiro é a redução no crescimento da parte vegetativa, principalmente, das folhas. Um dos métodos de perceber a redução no crescimento pela falta de nitrogênio é a redução na quantidade de aparas recolhida de uma área conhecida, após o corte, o segundo sintoma da deficiência de nitrogênio é o amarelecimento das folhas, devido à redução na concentração de clorofila. Além destes dois principais sintomas da deficiência de nitrogênio os gramados podem apresentar um excessivo florescimento com a falta de N disponível (Christians, 1998).

Um excesso de nitrogênio aplicado pode causar um crescimento excessivo da parte aérea (folhas) com redução no crescimento das raízes, outro problema do excesso de é tornar as gramas mais susceptíveis ao ataque de patógenos (microorganismos causadores de doença) e pragas, devido ao maior crescimento das folhas que ficam com uma cutícula mais fina.

Outro nutriente observado é o fósforo, sendo fundamental para o crescimento de raízes e gramas desenvolvidas em solos deficientes em fósforo são incapazes de produzir sistema radicular bem desenvolvido (Christians, 1998).

O fósforo é pouco móvel em nossos solos devido à fixação em óxidos de Fe e Al, principalmente, ficando indisponível a planta. Logo, para que o fósforo seja absorvido de modo eficiente o fertilizante deve ser colocado o mais próximo possível das raízes e uma dose mais alta para compensar o fósforo que será fixado pelos óxidos visando sobrar para a grama.

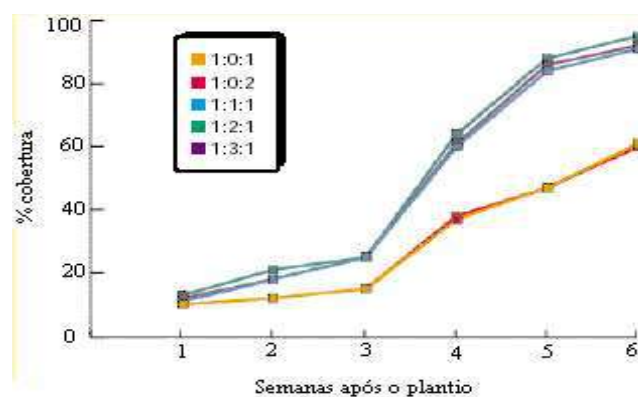


Fig.4: Porcentagem de cobertura do solo pela grama bermuda TifEagle em função da relação NPK do fertilizante até seis semanas após o plantio dos estolões.

(Adaptado de Rodriguez et al., 2000).

Nos gramados já estabelecidos, o sistema radicular já se encontra bem desenvolvido ocupando boa parte do solo sob a parte vegetativa do gramado até uma profundidade de 10 a 15cm. Esta característica torna o gramado eficiente na utilização do fósforo disponível no solo e do fertilizante, uma vez que, onde quer que o fertilizante seja aplicado este estará próximo das raízes para ser absorvido.

Além do sistema radicular menos desenvolvido, um dos sintomas da deficiência de fósforo é uma coloração verde escura das folhas mais velhas evoluindo para uma cor púrpura nas margens (Turner, 1993). No entanto, é muito raro se observar este sintoma em gramados e este pode ser confundido com o efeito de baixas temperaturas e luminosidade no inverno, em algumas gramas de verão.

Pelo presente trabalho podemos perceber que a fertirrigação com efluente industrial é viável, pois é um efluente que contém bastante nutrientes que podem ajudar muito no processo de crescimento da planta, tornando mais resistente, trazendo benefícios econômicos e aumentado a qualidade da grama, concluindo que é viável desde que seja estabelecido o manejo adequado na implementação deste projeto.

IV. CONSIDERAÇÕES FINAIS

Considerando o reuso da água neste trabalho investigou a utilização do efluente atrás do sistema de fertirrigação em uma área disponível da empresa constituído basicamente por gramíneas.

Os laudos técnicos deste efluente atestaram a viabilidade de sua incorporação ao solo agrícola, proporcionando o seu retorno ao ciclo da água deste ambiente.

Neste trabalho investigou-se que as concentrações de nitrogênio e de fósforo deste efluente que foram respectivamente de 111mg/m² e 55mg/m² são inferiores aos limites diários destes dois nutrientes sendo que para a cultura de gramíneas necessitam de 300mg por dia de cada nutriente.

Considerando a concentração deste efluente comparado com a quantidade necessária para o desenvolvimento das gramíneas pode se concluir que para uma vazão diária de 111m³/dia em uma área de 6000m² pode-se viabilizar perfeitamente o sistema de fertirrigação modesto, necessitando somente um monitoramento.

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Internationalization of Higher Education: The influencing factors in the Decision Making Process of International Students at UFPI

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Received: 25 Nov 2020;

Received in revised form:

11 Feb 2021;

Accepted: 03 Mar 2021;

Available online: 31 Mar 2021

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Keywords— *International students; PEC-G; Push and Pull Factors; Internationalization; Public Higher Education Institutions.*

Abstract— *The Internationalization aspects of a Higher Education Institution can be evidenced through the decision-making process and the factors that attract (pull) students to a certain Federal Higher Education Institution and the factors that compel (push) students to leave their home countries (or provenance) according to educational aspirations. This study, in this sense, sought to verify which factors influenced former international students from the Federal University of Piauí (UFPI) linked to the Students-Graduate Agreement Program (PEC-G), also describing their impressions regarding the experience at UFPI. Data were collected through individual interviews and qualitatively interpreted through content analysis. The documentary analysis of the Institutional Development Plan (PDI) of UFPI was also used for the period between 2015 and 2019. The study of the decision-making process elucidated new notions regarding the impact of five factors (Effect of Country of Provenance, Effect of Host Country, Effect Institution of Destination, Image of the City, and Personal Reasons) in the choice of international students at UFPI, thus contributing to a better understanding: of the institutionalization of activities related to internationalization, of the internationalization background that influence the decision-making process, and of the expectations of international students from UFPI.*

I. INTRODUÇÃO

A observação, sistematização e explicação da internacionalização das universidades públicas federais brasileiras é o leme que direciona o objetivo principal desta pesquisa, que é: *analisar os antecedentes de internacionalização que impactam no processo decisório e impressões de alunos internacionais da Universidade*

Federal do Piauí vinculados ao PEC-G.E, em relação aos objetivos específicos da pesquisa, eles são:

- Identificar quais fatores influenciam estudantes internacionais a frequentar a UFPI;
- Identificar o processo decisório dos estudantes vinculados ao PEC-G;

c) Descrever as impressões dos estudantes internacionais vinculados ao PEC-G em relação à vivência na UFPI.

Buscou-se explorar questões que surgiram ao longo do levantamento teórico dentro do contexto de um caso único, ou seja, de uma IES que está em processo de desenvolvimento e amadurecimento da sua estratégia internacional e utilizou-se os entendimentos dos ex-alunos do PEC-G – e o que esteve envolvido em seus processos decisórios – para criar uma ponte entre os dois lados da internacionalização (a acadêmica e a institucional).

II. REFERENCIAL TEÓRICO

Abrangeu-se a fundamentação teórica através da revisão da literatura e versou-se sobre os modelos adotados no tocante a temas relevantes, (COOPER, 1998). Incluiu-se também considerações relativas ao: processo decisório estudantil, às Instituições de Ensino Superior (IES) públicas do Brasil; à Internacionalização das IES, ao Programa de Estudantes-Convênio de Graduação (PEC-G); e, ao Plano de Desenvolvimento Institucional (PDI) da Universidade Federal do Piauí (UFPI). Essas construções teóricas (além das relações entre elas) consolidaram-se, por conseguinte, como “medidas” do que era conhecido e desconhecido no corpo do trabalho, permitindo um passo em direção à transparência e lisura do estudo.

2.1 INTERNACIONALIZAÇÃO: O ASPECTO INSTITUCIONAL

A internacionalização é uma integração, infusão, um processo dinâmico – e não um conjunto isolado de atividades – que contribui para que a sustentabilidade das atividades de

ensino, pesquisa e extensão atinjam uma dimensão intercultural (De Wit, 2002). Três grandes razões justificam a internacionalização da educação superior: a) interesse em segurança global; b) manutenção da competitividade econômica; e c) compreensão entre nações (Qiang, 2003).

2.2 INTERNACIONALIZAÇÃO: O PROCESSO DECISÓRIO

Pesquisas com alunos internacionais mostraram que a mobilidade estudantil pode criar em seus participantes uma consciência de engajamento global que envolve cinco dimensões distintas: i) engajamento cívico; ii) produção de conhecimento; iii) filantropia; iv) empreendedorismo social; e v) vida simples (minimalismo) (PAIGE; FRY, 2005). Além das posteriores escolhas educacionais e de carreiras, existem impactos pessoais gerados pela experiência de migração, entre eles: maior independência, habilidades relacionadas ao pensamento crítico, e potencial para liderança (Earnest, 2003). Estudantes migrantes buscam incorporar de maneira seletiva os aspectos da cultura do país anfitrião que eles apreciam (Obst et al. 2007) e possuem maior interesse em entender o mundo; tentam formar uma identidade global, e tendem a não rejeitar uma cultura em detrimento de outra (Obst et al. 2007, 2007).

McMahon (1992) conduziu uma pesquisa utilizando dados de 1960 a 1970 e constatou que são *push factors*: o nível de prosperidade econômica do país de proveniência, o envolvimento político global do país de proveniência, e as oportunidades educacionais disponíveis no mesmo. E que são *pull factors*: a cooperação econômica entre o país anfitrião e o país de proveniência. Outros fatores podem ser identificados na Figura 1 que sumariza as constatações de Mazzarol et al. (2002).

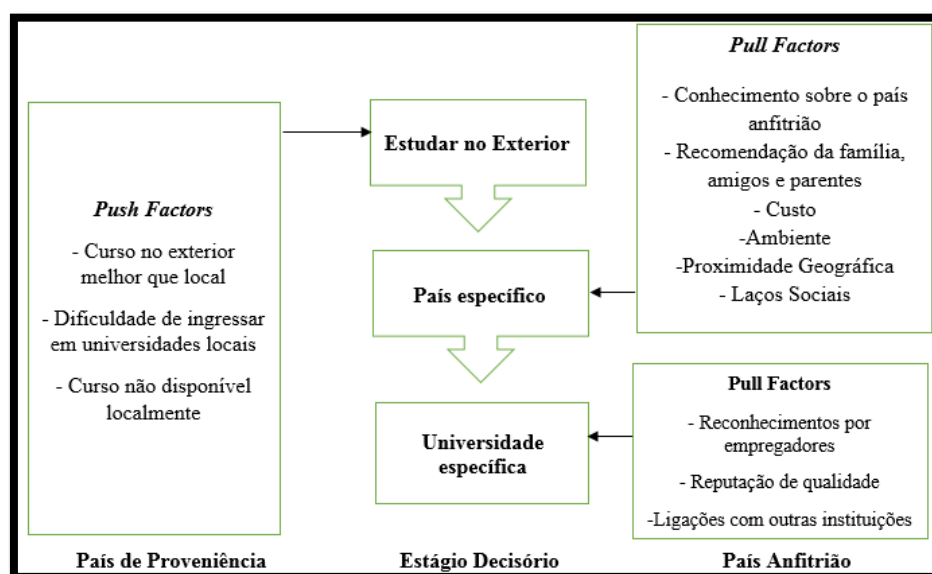


Fig.1 – Push Factors e Pull Factors

Fonte: Adaptado de Mazzarol et. al. (2002)

Em resumo, o comportamento favorável à internacionalização afeta o conjunto de relacionamentos organizacionais internos e externos, gera *feedback* institucional e, ao longo do tempo, influencia o desempenho da IES (Oviatt et al., 2005).

2.3 EFEITO PAÍS DE PROVENIÊNCIA

Mazzarol et al. (2002) desenvolveram uma pesquisa com quase dois mil e quinhentos estudantes de diferentes países asiáticos que cursaram pós-graduação na Austrália. A partir da análise dos dados coletados, os pesquisadores compilaram uma série de *push factors* – relacionados ao país de proveniência (ou país de origem) dos estudantes – e também *pull factors* relacionados ao país anfitrião (no caso, a Austrália) e sua atratividade.

Eles apontaram que laços políticos e econômicos entre os países de proveniência e o país anfitrião são importantes, pois ajudam na familiaridade com o país estrangeiro (Mazzarol et al., 2002). Peacock et al. (2009), por sua vez, apontaram que estereótipos (ideias pré-concebidas) de alunos locais e alunos internacionais causam impressões erradas e desencorajam tentativas de amizades entre eles. Além disso, observaram que, quando alunos locais e internacionais não desenvolvem amizades entre si,

eles passam menos tempo juntos e isso prejudicava o processo de trocas culturais como um todo (Peacock et al., 2009).

2.4. EFEITO PAÍS ANFITRIÃO

O Efeito País Anfitrião – equivalente à expressão inglesa *Country of Origin Effect* – no entanto, não é equivalente à concepção de *Imagem País*. Ele é abordado academicamente como variável que afeta as decisões de estrangeiros que possuem interesse em praticar qualquer forma de atividade no país anfitrião, desde lazer até investimentos (Silva, 2014) e, no contexto dessa pesquisa, não se relaciona aos níveis de percepção de qualidade de uma marca (Pappu, 2006) e sim à percepção de um lugar (o que está ligado à ideia de *Soft Power*).

Hard Power e *Soft Power* têm um ponto de conexão: ambos envolvem a habilidade de atingir objetivos afetando o comportamento dos outros (NYE JR, 2005). No entanto, a diferença entre os dois conceitos está, principalmente, na natureza do comportamento e na tangibilidade dos recursos utilizados para esse fim: *Soft Power* envolve a habilidade de moldar o que os outros querem e contrapõe-se ao poder de comando (*Hard Power*) por não implicar indução ou coerção (Figura 2)(Nye Jr, 2005).

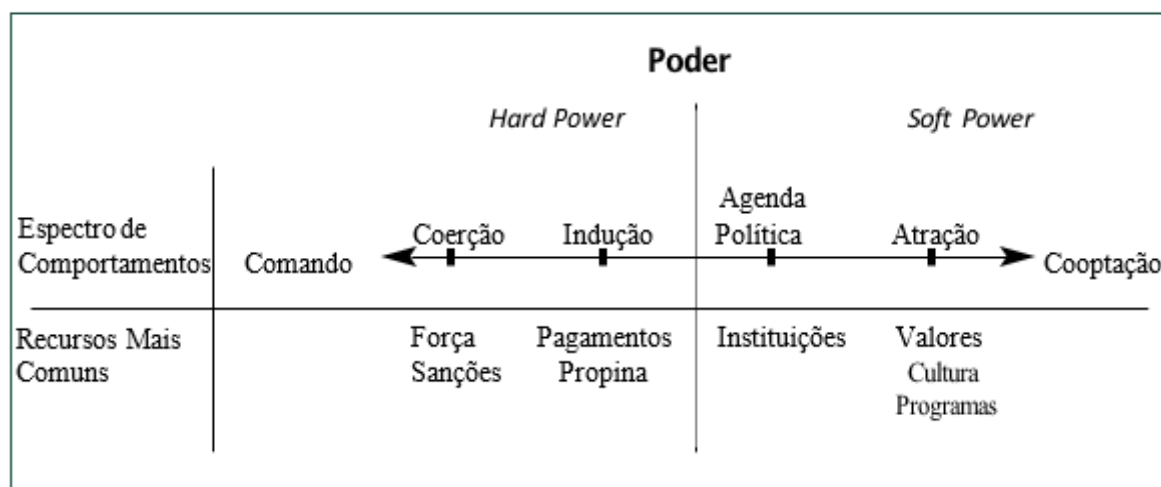


Fig.2 – Soft Power e Hard Power

Fonte: Adaptado de Nye Jr. (2005)

2.5 EFEITO INSTITUIÇÃO DE DESTINO E IMAGEM DA CIDADE

A maioria dos mecanismos de agências que ranqueiam universidades – como os da *Times Higher Education* e da *Quacquarelli Symonds (QS)* – são concebidos para essa realidade do “primeiro mundo”, que conta com sistemas educacionais construídos sobre os ombros de séculos de patrimônio científico (Kelleher,

1995). Assim, nem todos os indicadores são “justos” quando aplicados para avaliar universidades com raízes em países em desenvolvimento. É necessário, portanto, que haja instrumentos próprios – como a iniciativa introduzida pela Folha de São Paulo no ano de 2012 (Ranking Universitário Folha, RUF) – que incluam apenas critérios, indicadores e IES nacionais. O RUF observa apenas cinco indicadores: pesquisa, inovação, ensino, mercado e, é claro, grau de internacionalização.

Esse fator (imagem da cidade), no entanto, não foi tão enfatizado neste estudo devido à ausência, por parte dos estudantes, de informação suficiente para gerar padrões de análise e comparação de Teresina no momento da escolha pelo PEC-G.

2.6 RAZÕES PESSOAIS

As indagações levantadas nesta pesquisa, ao recorrer a indivíduos que já passaram pela fase de prospecção e foram estudantes com interesse em ingressar em uma IES brasileira, abordaram também variáveis de cunho pessoal. O processo de tomada de decisão dos estudantes em análise foi, portanto, visto como uma seleção individual, influenciada por opiniões pessoais, que não envolveu consenso, mas que reconheceu e precisou os papéis dos sujeitos que ajudaram a motivar a decisão (Rowley, 1997).

2.7 PROGRAMA DE ESTUDANTES-CONVÊNIO DE GRADUAÇÃO (PEC-G)

Em 1964, o Programa de Estudantes-Convênio de Graduação (PEC-G) foi constituído com o objetivo de cooperação internacional educacional e também teve como alvo preferencial outros países em desenvolvimento. A criação desse programa surgiu como consequência do *boom* da imigração estudantil estrangeira no Brasil a partir da década de 60. O intuito era suprir a indispensabilidade de “unificar as condições de intercâmbio estudantil”, garantindo tratamento semelhante aos estudantes internacionais por parte de todas as universidades brasileiras dispostas a recebê-los (Miyamoto, 2009).

O objetivo do programa é formar e qualificar estudantes estrangeiros, ofertando vagas gratuitas em IES brasileiras (que disponibilizam vagas para suprir essa demanda extraordinária) e a responsabilidade pela implementação do Programa é conjunta: abrangendo tanto o Ministério das Relações Exteriores quanto o Ministério da Educação (Brasil, 2013). O Ministério das Relações Exteriores, nesse cenário, é responsável por “coordenar os procedimentos relativos à implementação do PEC-G junto a governos estrangeiros por intermédio das missões diplomáticas e repartições consulares brasileiras” (Brasil, 2013) e ao Ministério da Educação compete “coordenar os procedimentos referentes à adesão das IES ao PEC-G, oferta das vagas, seleção e matrícula dos candidatos e acompanhamento do programa” (Brasil, 2013, p. 1). É o próprio órgão (MEC) que estabelece, por exemplo, o número total de vagas ofertadas anualmente.

As IES, no entanto, possuem autonomia para determinar os cursos de graduação que serão disponibilizados e o Ministério da Educação não está autorizado a interferir em questões de natureza acadêmica – uma vez que essa prerrogativa recai somente sobre a

Instituição de Ensino que integra o Programa e não a nenhum dos Ministérios (Brasil, 2013).

O governo brasileiro resolveu financiar e regular amplamente a educação superior não só para os alunos nacionais, mas também para alguns estrangeiros – oferecendo, através do PEC-G, educação de qualidade a um custo razoável. Esse fator financeiro (gratuidade quase que completa das universidades públicas aliada a um custo de vida baixo de algumas cidades) é também o que atrai os estudantes de países cuja disponibilidade de recursos é escassa e de onde nem os mais favorecidos conseguem superar as dificuldades relativas à instabilidade política e econômica local (Tan, 2014).

2.8 A UNIVERSIDADE FEDERAL DO PIAUÍ E O PLANO DE DESENVOLVIMENTO INSTITUCIONAL 2015-2019

A UFPI possui, atualmente, sete convênios para intercâmbio com instituições estrangeiras. No entanto, seus principais empreendimentos de internacionalização – de iniciativa própria ou promovidos pela CAPES – são parcerias internacionais ou interinstitucionais que foram celebradas objetivando o envio de alunos locais a universidades de países não periféricos.

As metas relacionadas à internacionalização para o quinquênio 2015-2019, nesse contexto, são: a) estimular a realização de convênios internacionais de cooperação técnico-científica; b) consolidar o centro de línguas estrangeiras e criar laboratórios de ensino de línguas nos diferentes Campi; c) ampliar o processo de mobilidade local, nacional e internacional; e d) ampliar as ações de internacionalização em outros Campi fora de sede (PDI/UFPI, 2015, p. 241). E a consolidação fática dos instrumentos de cooperação institucional voltados à internacionalização vem ocorrendo desde 2005, com a criação da Assessoria Internacional (ASSINTER), órgão encarregado de: a) estabelecer parcerias com outras universidades e/ou instituições de interesse acadêmico internacional, especialmente aquelas localizadas fora do país; b) divulgar editais com oportunidades para que alunos, professores e funcionários administrativos participem de atividades, cursos, projetos, pesquisas e programas no exterior; c) apoiar e facilitar o acolhimento de alunos beneficiários de acordos de natureza internacional (PDI/UFPI, 2015).

III. METODOLOGIA DA PESQUISA

Esta pesquisa teve como paradigma a investigação qualitativa e foi delineada a partir da utilização dos preceitos do estudo exploratório. Este estudo tentou seguir os ensinamentos de Burns (1989) – o qual difundiu padrões formais para avaliar a validade da pesquisa qualitativa

(Burns, 1989) – que proporcionam legitimidade à abordagem de pesquisa e são relacionados a cinco pontos específicos: i) relevância heurística (analisar se o estudo tem ou não significado e relevância para aqueles que o leem); ii) precisão analítica (abstrações desenvolvidas ao longo da pesquisa se encaixam umas nas outras e são realmente plausíveis); iii) conectividade teórica (estudo claramente exposto, logicamente consistente, refletindo dados, e compatível com a base de conhecimento já existente); iv) vivacidade descritiva (leitores cientes de tudo o que cerca ou interage com o fenômeno em estudo, incluindo a voz do pesquisador); e v) congruência metodológica (BURNS, 1989). A congruência metodológica, nesse contexto, incluiu quatro dimensões: rigor na documentação; rigor processual; rigor ético; e auditabilidade (Burns, 1989).

3.1 ESTRATÉGIAS DE COLETA DE DADOS

Foram coletados dados primários (produto de entrevistas individuais e/ou por via telefônica) e utilizados dados secundários (artigos científicos, teses, dissertações e documentos). Foi selecionada a metodologia qualitativa e o desenho de pesquisa alinhado ao estudo exploratório. A

unidade de análise foi uma IES piauiense que está em processo de desenvolvimento de sua estratégia de internacionalização. E os sujeitos foram indivíduos que cursaram graduação (em qualquer área de formação) na Instituição Federal Pública em análise, concluindo o curso antes ou durante o ano de 2015 (ano em que o Plano de Desenvolvimento Institucional atual entrou em vigor).

Os métodos de amostragem selecionado foi a amostragem não-probabilística do tipo *Snowball* (ou bola de neve) (Robson, 2011) – em razão de se estudar uma população de baixíssima incidência.

As respostas foram categorizadas nos moldes dos fatores de influência estudados no referencial teórico e, para efeito de organização dos dados coletados, as perspectivas dos respondentes foram apresentadas, via de regra, em ordem cronológica crescente relativa ao ano de conclusão. Tornou-se mais viável, desse modo, diagnosticar possíveis mudanças ou evoluções em relação às políticas da universidade.

O Quadro 1 abaixo foi desenvolvido para esquematizar os dados dos respondentes:

Quadro 1 – Perfil dos Entrevistados

Código	Idade	Sexo	País de Proveniência	Curso	Ano de Conclusão (Graduação)
E1	35	F	Cabo Verde	Serviço Social	2005
E2	32	M	Guiné-Bissau	Ciências Sociais	2006
E3	30	F	Cabo Verde	Nutrição	2011
E4	30	M	Cabo Verde	Ciência da Computação	2012
E5	28	M	Cabo Verde	Medicina	2014
E6	31	M	Camarões	Medicina	2015
E7	28	M	Guiné-Bissau	Ciência da Computação	2017

Fonte: Elaborado pela autora com base nos resultados da pesquisa (2018)

3.3 ESTRATÉGIAS DE ANÁLISE DE DADOS

Quanto à análise de dados, nesta pesquisa, optou-se pela utilização de técnicas de análise de conteúdo (Bardin, 2011), uma vez que buscou-se entender a realidade operacional da Universidade Federal do Piauí partindo da perspectiva de estudantes que já haviam enfrentado o processo de escolha da instituição e já haviam assimilado como funciona o processo de aclimação com a universidade (Knight, 2004).

Os dados obtidos através dos instrumentos propostos foram sistematizados qualitativamente por meio da análise de conteúdo categorial por temática (Bardin, 2011) – que teve como foco a identificação dos principais fatores de influência evidenciados a partir das falas dos

entrevistados, reinterpretando e ressignificando categorias já apresentadas na literatura. Utilizou-se a análise de conteúdo, nos moldes propostos por Bardin (2011) e, portanto, seguiu-se uma ordem de procedimentos. As inferências e as interpretações foram utilizadas para tratar os resultados e agrupá-los em 6 categorias analíticas (que foram devidamente abordadas na seção de fundamentação teórica deste estudo): a) Efeito País de Proveniência; b) Efeito País Anfitrião; c) Efeito Instituição de Destino; d) Imagem da Cidade; e) Razões Pessoais.

Além da avaliação dos objetivos, os achados da pesquisa foram discutidos e comparados com a literatura apresentada, constituindo o arcabouço para a construção de algumas sugestões e recomendações que tem potencial para

gerar aprimoramentos no processo de recrutamento da UFPI.

IV. ANÁLISE E DISCUSSÃO DOS RESULTADOS DA PESQUISA

4.1 EFEITO PAÍS DE PROVENIÊNCIA

Observou-se, quanto ao Efeito País de Proveniência (Peacock et al., 2009) na escolha da UFPI pelos estudantes do PEC-G, convergência entre o que foi constatado nas pesquisas de Peacock et al. (2009) e os depoimentos coletados. Segundo os autores, os fatores políticos, sociais e econômicos do país de proveniência são importantes no momento de decidir pela não permanência no país natal, de acordo com os ex-alunos da UFPI.

Outros fatores ligados à nação de origem dos entrevistados (*Push Factors*) também foram apresentados nas falas como relevantes para a decisão de estudar no exterior. Assim, os resultados advindos deste estudo convergiram com as respostas obtidas por Tan (2014) em sua análise do processo decisório estudantil internacional. Segundo ele, a indisponibilidade de ensino superior; a valorização da graduação estrangeira; a capacidade financeira; a instabilidade política; e melhores oportunidades de emprego ao retornar são alguns dos fatores que impulsionam os estudantes. e nesta pesquisa constatou-se que:

“Não tinha Faculdade de Medicina no meu país.” (E5)

“Decidi estudar no Brasil uma vez que Cabo Verde não possuía Curso Superior de Serviço Social.” (E1)

Os achados, nesse sentido, corroboraram a tese de Maringe et al. (2007) que apontaram a relevância de laços históricos entre países como fator de influência no movimento de estudantes em determinada direção. E apontaram que países pouco desenvolvidos ou em desenvolvimento que foram colônias de países desenvolvidos tendem a gerar um fluxo migratório estudantil em direção aos países mais desenvolvidos (Maringe et al., 2007).

“O meu país é bem menos desenvolvido do que o Brasil e isso significa mais oportunidade de crescimento científico e financeiro, então a escolha não foi difícil. (E6)

4.2 EFEITO PAÍS ANFITRIÃO

Os discursos dos ex-estudantes evidenciaram também as características do país de destino que os

atraíram, corroborando os estudos de Mazzarol (1998) e a conceituação descrita na literatura referente aos fatores de atração e repulsão (Agarwal et al., 1985; Mazzarol et al., 2001). Segundo os entrevistados:

“As características do Brasil que me atraíram foram novela, carnaval, futebol e a possibilidade de interação melhor em termos de relações interpessoais [...] os guineenses têm boa impressão do Brasil, existe facilidade na comunicação linguística [...] o PEG-G da oportunidade aos guineenses.” (E2)

Entre as peculiaridades dos serviços de educação oferecidos internacionalmente está o fato de que o país de destino – local onde o serviço é oferecido – não é o lugar onde a aquisição do serviço é realizada (geralmente, no país anfitrião) (Cubillo et al, 2006).

4.3 RAZÕES PESSOAIS

Segundo Pimpa (2003), o processo decisório de aquisição de serviços profissionais (por exemplo, educação, turismo e seguros) é mais fortemente influenciado por “grupos de referência” (como família, amigos) que acabam informando o processo:

“Amigos influenciaram minha decisão de estudar no Brasil. Eu tenho amigos brasileiros que residiam em Cabo Verde e que me influenciaram a estudar no Brasil. Em Teresina, eu tinha um amigo também de Cabo Verde que era estudante.” (E1)

Para Mazzarol et al. (2002), resumidamente, os estudantes consideram e comparam as oportunidades e benefícios encontrados em cada local, mas também ponderam as indicações das pessoas que os rodeiam e os laços sociais que podem vir a ter no local que escolheram (amigos ou parentes que vivem ou viveram no país anfitrião). Assim, o segundo entrevistado destacou que:

“[Foi um] amigo do meu pai influenciou minha decisão de estudar no Brasil[...] Durante a inscrição do processo seletivo na Guiné-Bissau, um amigo do meu pai que é brasileiro e funcionário da embaixada do Brasil na Guiné-Bissau me

indicou Teresina por ter custo de vida muito baixo e universidade de alta qualidade em relação aos outros Estados.” (E2)

Os achados, portanto, corroboraram a pesquisa de Rowley (1997), a qual afirmou que o fator razões pessoais possui utilidade na previsão do comportamento de alunos que se encontram na fase de prospecção (Rowley, 1997).

4.4 IMAGEM DA CIDADE

Em relação à Imagem da Cidade, é possível apontar que, para alguns entrevistados, esse aspecto não foi um fator gerador de significações, uma vez que a cidade de Teresina não possuía grande apelo internacional ou atratividade em certos países de origem dos respondentes. Percebeu-se, em última instância, que o papel da cidade nas escolhas é relativo e ocorre em graus diferentes dependendo do nível de divulgação, de potencial turístico e de reconhecimento internacional da cidade (Cubillo et al., 2006). Isso ficou evidente nas seguintes afirmações:

“Nunca tinha ouvido falar em Teresina.” (E4)

“Não conhecia Teresina antes do curso.” (E5)

Porém, outros fatores como o custo de vida, clima, imagem e tamanho da cidade também poderiam ter influenciado a decisão de estudantes (Bodycott, 2009) se Teresina fosse uma cidade com reputação internacional mais amplamente difundida nos países participantes do PEC-G.

4.5 EFEITO INSTITUIÇÃO DE DESTINO

Oviatt et al. (2005) – ao desenvolver um modelo sobre as forças que influenciam a velocidade de internacionalização – constataram que a velocidade de internacionalização de uma IES é influenciada pela tecnologia, motivada por concorrência e moderada pelas *redes internacionais e pela intensidade de conhecimento da oportunidade*. As instituições públicas de ensino brasileiras, nesse contexto, encontram-se totalmente alinhadas à essa visão, pois, através do MEC, elas têm investido com abundância em programas internacionalizantes que oferecem oportunidades a alunos estrangeiros e difundem a sua existência. Não obstante, a seleção ou determinação da instituição de destino não foi o principal fator de atração dos estudantes, porque, em alguns casos, não foram sequer oferecidas a eles opções de instituições:

“A UFPI foi a única instituição que calhou, porque tinha duas instituições que escolhi, mas no fim me deram na UFPI [...] foi a única opção que me foi

dada [...] porque queria o curso de Nutrição, queria fazer um curso na área da saúde.” (E3)

Constatou-se que, durante o processo decisório dos estudantes entrevistados, também foram determinantes para a seleção da UFPI: a qualidade do ensino, os cursos ofertados, e a localização da universidade em uma cidade onde o custo de vida é baixo (McMahon, 1992). Os trechos extraídos das entrevistas respaldam:

“Acredito que, no meu caso, [...] universidade de boa qualidade foi fundamental pela minha escolha.” (E2)

“Construí uma imagem [de Teresina] já aqui no Brasil, pois passei 9 meses em Recife estudando português. Só se ouvi coisas negativas, referente a pobreza e condições climáticas desagradável (sic). [...] vim pra Teresina mesmo assim porque sempre ouvi coisas boas a respeito do curso e da faculdade de medicina da UFPI”. (E6)

4.6 SUMARIZAÇÃO

Em parâmetros gerais, os entrevistados abordaram concisamente os fatores em estudo e refletiram bem acerca do “efeito país de proveniência”, do “efeito país anfitrião” e do “efeito Instituição de destino”, além de serem claros acerca dos elementos “imagem da cidade” e “razões pessoais”. Dessa forma, os *push and pull factors* e os demais fatores de influência compilados durante a análise do acervo bibliográfico e identificados no processo decisório dos estudantes do PEC-G da UFPI entrevistados parecem bem esclarecidos no que se refere às experiências investigadas.

V. CONSIDERAÇÕES FINAIS

Este estudo partiu do pressuposto que o processo de internacionalização (assim como o de democratização) de uma IES é sempre incompleto e ativo (Giroux, 2004) e que pequenos passos devem ser dados em direção a um futuro universitário mais democrático. Ofereceu-se, assim, uma abordagem diferenciada e focalizada da internacionalização; uma abordagem que deu voz a diferentes sujeitos e examinou-se a internacionalização a partir de um contexto específico (processo decisório), utilizando um objeto próprio (uma Instituição Federal de Ensino Superior brasileira) e adotando a perspectiva de um grupo particular de estudantes (os

vinculados ao PEC-G). Buscou-se sintetizar fatores que, de acordo com a literatura, tendem a influenciar a internacionalização de universidades e relacionou-os às expectativas e experiências de alunos estrangeiros participantes do Programa de Estudantes-Convênio de Graduação (PEC-G).

Neste estudo, não se tentou controlar a multiplicidade de fatores envolvidos no fenômeno sob investigação e sim explorar a complexidade de categorias envolvidas no processo decisório, e aproveitou-se uma estrutura útil (categorização) para organizar dados o que facilitou a sistematização das conclusões.

Em se tratando do alinhamento dos achados de pesquisa aos objetivos estabelecidos houve coerência, pois: a) os fatores que influenciaram a decisão dos estudantes internacionais entrevistados de frequentar a UFPI foram identificados e expostos na seção anterior, com destaque à influência do Efeito País de Proveniência, do Efeito País Anfitrião e das Razões Pessoais nas escolhas dos estudantes internacionais da UFPI vinculados ao PEC-G; b) o processo decisório dos estudantes vinculados ao PEC-G foi devidamente esclarecido quando os entrevistados responderam às perguntas P5 a P8, trazendo à tona a importância de cada fator ou categoria de análise estudada (Efeito País de Proveniência, Efeito País Anfitrião, Efeito Instituição de Destino, Imagem da Cidade, e Razões Pessoais); e c) as impressões dos estudantes internacionais vinculados ao PEC-G em relação à vivência na UFPI.

Verificou-se, nesse contexto, que grandes ações ou projetos que tenham potencial para impactar no processo decisório dos alunos vinculados ao PEC-G ainda estão por surgir, pois as políticas institucionais, de modo geral, não incluem muitas medidas para atração e/ou melhor acolhimento de alunos advindos de países em desenvolvimento (conforme PDI UFPI 2015-2019). Os ex-alunos PEC-G participantes da pesquisa, por exemplo, mencionaram pouquíssimos fatores que diferenciam a UFPI (apenas sua localização e da qualidade de determinados cursos).

Existe a necessidade de responder aos questionamentos – implícitos ou subconscientes – do meio acadêmico quanto ao mérito e ao direito de os estudantes PEC-G estarem ocupando determinada vaga. Faz-se necessário, assim, que as pró-reitorias, coordenadorias e departamentos se empenhem na divulgação do programa – razões de existência, métodos de seleção, concessão de vagas, situação financeira dos alunos, e realidade dos países participantes – para os discentes e na capacitação dos docentes e técnicos que lidam com os estudantes-convênio direta ou indiretamente. Pois, além de atenuar o desconhecimento sobre os mecanismos de funcionamento do PEC-G reduzir-se-á a ignorância, o

preconceito local, e o sentimento de não pertencimento por parte dos alunos vinculados ao PEC-G.

As próprias salas de aula – locais ideais para se experimentar os benefícios da diversidade (Hurtado, 2005) – poderiam facilitar as interações entre alunos “diferentes”, pois os alunos entrevistados sentiram falta de processos (gerenciais e de ensino/aprendizagem) direcionados a ajudar os locais a se engajarem em uma reflexão crítica sobre condições sociopolíticas desumanas a que seus colegas estrangeiros são submetidos em seus países de origem. As IES, nesse sentido, poderiam facilitar a socialização intercultural e evitar momentos traumáticos que afetam profundamente a experiência na universidade. Assim, ações podem ser tomadas para que certas desventuras estudantis (resultantes do preconceito e da falta de suporte) deixem de existir.

É preciso que os estudantes vinculados ao PEC-G desfrutem de acompanhamento pedagógico especializado e aconselhamento ou orientação profissional de um psicólogo (para seja possível diagnosticar as situações que dificultam o aprendizado e a convivência dos mesmos dentro e fora sala de aula).

Tratando-se de impressões positivas, tanto a cidade quanto a IES em análise também deixaram marcas nos estudantes relacionadas a características identitárias (culturais, humanas, linguísticas), adquirindo cada vez mais importância para os mesmos durante os anos de curso, apesar de nem sempre terem sido fatores determinantes durante o processo decisório dos mesmos (Cubillo et al., 2006). Percebeu-se, assim, que mesmo aqueles que não haviam declarado preferência por Teresina ou pela UFPI antes de serem alunos acabaram desenvolvendo conexões e laços afetivos com a cidade.

A Imagem da Cidade, apesar de não ter influenciado fortemente a decisão final dos alunos na fase de prospecção, foi destacada como ponto alto dos tempos de universidade. Ela não só afetou a experiência, como também foi guardada como lembrança boa dos anos de graduação.

A ampliação da ASSINTER e a lotação de servidores nela colaboraria não só para o melhor acompanhamento dos alunos intercambistas, mas também para transformar a assistência aos alunos do PEC-G em uma tarefa especializada, desafogando também os setores atualmente encarregados.

O posicionamento atual (do PDI) reflete ainda a priorização de apenas um aspecto da internacionalização: aquele voltado para extensão, pós-graduação e fluxos Norte-Sul. O documento favorece expressamente o intercâmbio internacional de docentes e discentes e o fomento da internacionalização dos programas de pós-graduação da instituição (PDI/UFPI, 2015, p.237-242) – reforçando a

mobilidade que visa o envio de estudantes locais e não o acolhimento de estudantes internacionais.

A instituição precisará melhorar seus processos para que os estudantes internacionais que frequentem seus *campi*; e terá que diversificar, refinar, robustecer e acelerar seu processo de internacionalização para permitir a exposição de seus alunos a ambientes culturalmente diversos.

O que identificamos na UFPI, através do discurso de seus ex-alunos e da análise do seu PDI 2015-2019, foi uma instituição que está se preparando para agregar um conjunto de características inegavelmente positivas sob a ótica do que está sendo estudado. Reconhece-se, em âmbito estratégico, que o futuro da internacionalização depende do grau de investimento, cooperação, parcerias internacionais e compartilhamento de conhecimento com vista a ganhos no longo prazo e, de modo geral, isso já reflete uma postura proativa.

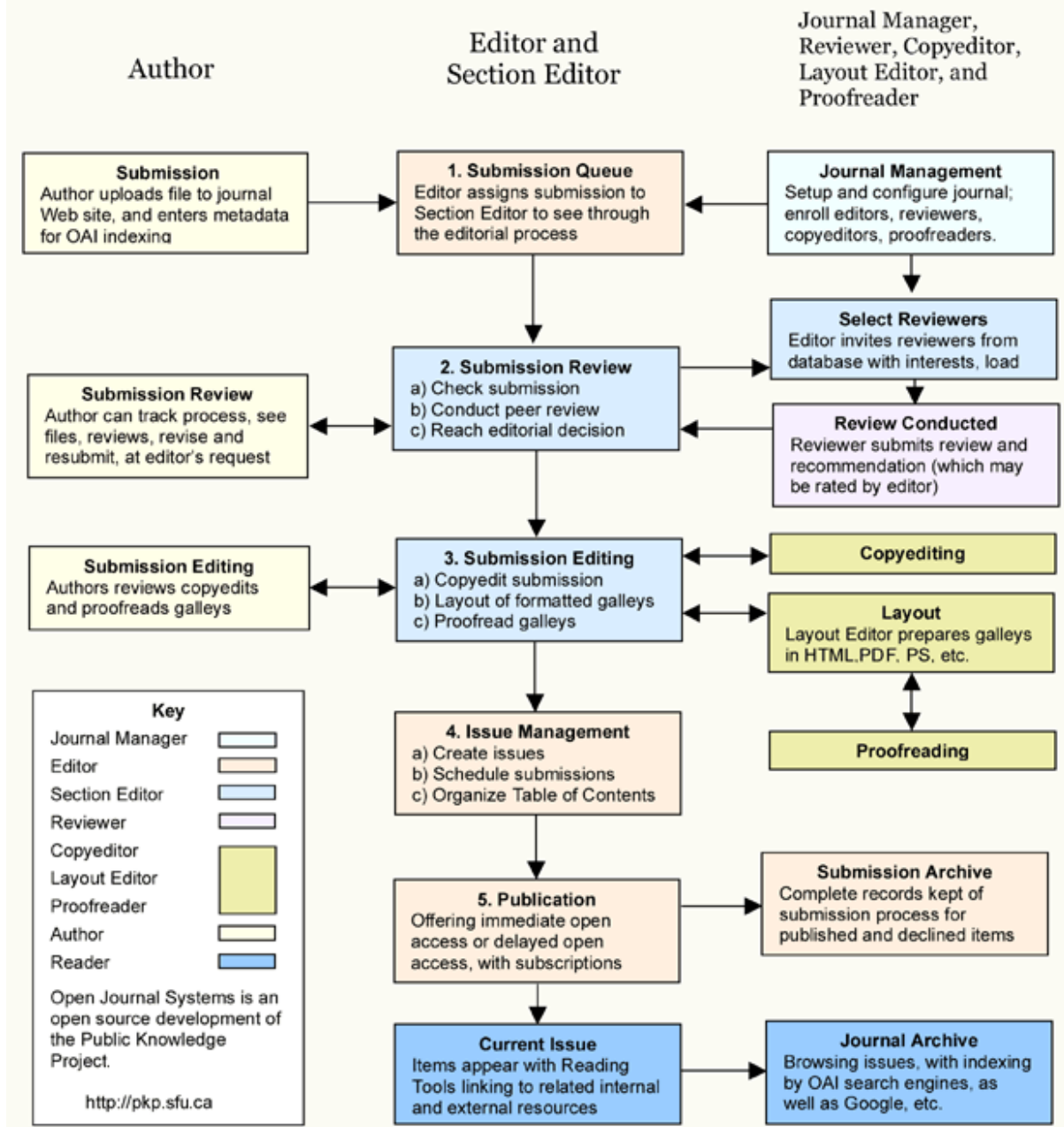
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