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FOREWORD

I am pleased to put into the hands of readers Volume-7; Issue-8: 2020 (Aug, 2020) of **“International Journal of Advanced Engineering Research and Science (IJAERS) (ISSN: 2349-6495(P) | 2456-1908(O)”** , an international journal which publishes peer-reviewed quality research papers on a wide variety of topics related to Science, Technology, Management and Humanities. Looking to the keen interest shown by the authors and readers, the editorial board has decided to release print issue also, but this decision the journal issue will be available in various library also in print and online version. This will motivate authors for quick publication of their research papers. Even with these changes our objective remains the same, that is, to encourage young researchers and academicians to think innovatively and share their research findings with others for the betterment of mankind. This journal has DOI (Digital Object Identifier) also, this will improve citation of research papers. Now journal has also been indexed in **Qualis (Interdisciplinary Area) (Brazilian system for the evaluation of periodicals, maintained by CAPES)**.

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

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

With warm regards.

Dr. Swapnesh Taterh

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Expressions of Human Sexuality in the Genital Phase: Reports of a Field Observation in Adolescents and Young People from Porto Velho, Brazil

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Abstract— This work aims to discuss about the psychosocial development in adolescence proposed by Erick Erickson, focusing on human sexuality, and analyze what influences experienced by each in this period. The study was part of the Human Sexuality discipline of the Psychology Course at the Federal University of Rondônia in the second semester of 2017 and reports an observation made with four young people and adolescents of both sexes in the age group of 16 to 20 years, emphasizing the genital phase but, as said, under the focus offered by Erick Erickson in the well-known phase of identity and confusion of identity. Study procedures included semi-structured interviews. Adolescence is a phase of many personal and social conflicts and the literature shows that adolescents are always in constant development and because of this, it is considered that they do not yet have sufficient autonomy to constitute themselves as fully capable of being aware for their actions. Thus, it was found that the lack of direction generates a negative outcome in the self-knowledge of young people who currently reflect realities of which they have barely overcome the identity crisis.

Keywords— Adolescence, Development, Conflicts, Sexuality.

I. ADOLESCENCE: SOME POINTS

Adolescence is the target of research in many sciences, especially in psychology, which has sought explanations for this stage of life since the beginning of the 20th century. To better understand this concept, it will be necessary to analyze the term and its meaning. The term adolescence, according to the etymological dictionary, comes from the present participle of the Latin verb *adolescere*, to grow. The past participle, *adultus*, gave rise to the word "adult". In Portuguese, the words would be equivalent to "crescent and" "crescent ", respectively. Although we consider the adolescence phase to be a relatively recent "sociological invention ", the word adolescent is about a hundred years older than the word adult. (HENDRICKSON 2008).

Therefore, it can be seen that the meanings carried by that word indicate growth, transformation and that is why we know these phases as a transition, because literally, their meaning explains this idea.

Because of this term, many authors have addressed the topic. Stanley Hall a psychoanalyst exponent had adolescence as his object of study, he conceives the phenomenon as a stage of disturbances, anguish and sexual flourishing.

Urribarri (2002, p.1) enumerated the aspects that cause the mismatches produced by the pubescent clash, such as: "The conflict around the dependence on external objects. The reactivation and the establishment of identity conflicts, which also call into question your identity. The reactivation of the body's representations, and questions about its scheme based on physical change and, in particular, on the news that genital eroticism produces".

According to Bock (2007, p.64) the main responsible for the institutionalization of adolescence, was Erick Erickson. He presented it based on the concept of a moratorium and characterized it as a special phase in the development process, in which the confusion of roles, the difficulties in establishing his own identity marked it as "[...] a way of life between childhood and adult life" (Erickson, 1976, p.128).

In Brazil, we had authors who wrote about adolescence, such as IçamiTiba, popularly known for his books, but who, like the others, also understood adolescence as a maturational phenomenon, a period of personal and social conflicts.

Oliveira (2007) presents in his work the definition used by IçamiTiba for adolescence, as being second childbirth. For him, the experience of pregnancy lived by the mother and accompanied at a distance by the father, are factors similar

to what happens in this age group. The son and daughter seek their own identity, trying to understand what is happening to their body.

Kimbanda (2006) observed that in primitive tribes sexual initiation as well as the division of tasks within a clan began in adolescence, in an age group of approximately 14 years.

In Angola, for example, initiation is practiced by several groups: Ganguela, Tshokwe, Nhaneka-Humbe, Ambó. The girl must be initiated when her first period appears. In some groups, they start them before and in others, after two years or more; they also associate it with the marriage contract. (KIMBANDA, 2006, p.118)

Fiori and Davis (1982) wrote about the development of adolescence and cultural intervention in emotions.

In tribal groups, or historically differentiated from Western culture, there is no long period that separates children's activities from the full integration of the subject into the productive and reproductive group. The child is considered as such until maturation and biological changes start puberty and characterize their transition to the adult group. Usually in these groups there is a passage ritual, sometimes preceded by a period of recollection, which will characterize the entry into adult relationships. (FIORI and DAVIS, 1982, p.11).

For years, it has been found that in different cultures adolescence is defined by historical requirements. Leontiev's contributions make such facts evident, "We can say that each individual learns to be a man. What nature gives you when you are born is not enough for you to live in society. It is still necessary for him to acquire what was achieved in the course of historical development by human society." (Leontiev, 1978, p.267).

Today we have access to different forms of information, and this has contributed to the transformation of adolescents and their role in society. However, even with all this advancement that technology allows, many young people still believe that this moment in life is an obstacle that needs great challenges. All of this makes it difficult not only to understand them when facing the demands of life, but also for their parents who cannot find practical measures, justifying certain attitudes.

We understand, therefore, that adolescence, like any other phase of human development, has its dynamics permeated by the environment. It is up to us to keep updated to deal with these changes, otherwise we will incur misconceptions and misjudgments. (MAFFEI, 2008, p.167).

In view of this variety of understandings of adolescence, in this article we have adopted the Psychosocial perspective of development that presents significant contributions to understanding this stage from the perspective of Erick Erickson. In the course of it, we seek to consider the psycho-social context that rewards the relationships of the young people who were interviewed, also considering the maturational and biological view in the making of the interview script, since there is a junction of this overlapping element in Erickson's Psychosocial theory.

II. ADOLESCENCE AS A DEVELOPMENT PHASE: MAIN CONTRIBUTIONS TO PSYCHOSOCIAL THEORY

The psychosocial development defended by Erick Erickson stems from the understanding of human behavior beyond the biological and instinctive integrating functions, it seeks to include socio-historical variables in an attempt to break the importance given by Freud of childhood as defining the constitution of the individual's ego.

According to Rabello (2011), Erickson's theory describes the psychosocial development of the human being through eight stages in which the individual grows from the internal demands of the ego, but is also influenced by the people and environment in which they live, being essential to identify the culture and society in which the subject is inserted to understand the characteristics of each phase.

At each stage, there is a crisis that will result in an outcome, whether positive (ritualization) or negative (ritualism). Both experiences are essences for the construction of the ego, since crises can strengthen or weaken the ego to the extent that it is not adequately overcome. The more well lived the previous crises, that is, when Basic Trust, Autonomy, Initiative and Diligence have positive outcomes, the easier it becomes to overcome the Identity Crisis. Loyalty and loyalty to yourself are characteristics of the positive outcome of this stage. (RABELLO apud ERICKSON, 2007).

From this perspective, Erickson (1976) addresses the *identity and identity confusion* phase, in which he describes psychological situations common in adolescents. And at that moment, the term crisis will not have an unpleasant connotation, but designate a moment of decision and direction that adolescents go through to grow, differentiate themselves from others, as well as make commitments through meaningful choices. During this phase, there will be constant psychological conflicts regarding the formation of an identity that is not yet well integrated. Based on this, the author writes:

It is a period of life when the body changes radically in proportions, genital puberty changes the body and the imagination with all kinds of impulses, intimacy with the other sex begins and the immediate future puts you in front of an excessive number of possibilities and conflicting choices [...] he must make a series of increasingly specific selections of personal, occupational, sexual and ideological commitments. (ERIKSON, 1976, p. 132-245).

This phase yielded more work, being an entire chapter of his book on identity crisis, in addition to the works *Youth and crisis*; *The complete life cycle*. This period marks the moment when the personality gains mold as we recognize ourselves through the other and the self-knowledge "Who I am", "What are my plans", showing the emergence of the identity that according to (Myers, 1999, p.86) is the gradual reformulation of a self-definition that unifies the various "selves" in a coherent and concrete feeling of who you are.

The acquisition of new skills is relegated to crises experienced during adolescence that will support the accumulation of knowledge to be inserted in adult life. This phenomenon Erickson (1976) called a "psychosocial moratorium" that defines fixed periods through which everyone will go through life until they reach adulthood. In the phase in question, each society will stipulate the appropriate experiences to consider the young person apt to exercise adult life. In Western society, we have the advent of professional choice and ideological definition, as described by Erickson: "*Social institutions support with vigor and the distinction of the nascent functional identity, offering to those who are still learning and experiencing a certain status of learning, a moratorium characterized by definitive obligations and sanctioned competitions, as well as by a special tolerance*". (1976, p.157).

Soon, Erickson (1976) will go over how identity is configured in this stage, dividing it into areas that he considered basic to understand every phenomenon. For Parrot (2003), sexual identity will be responsible for the inclusion of young people in certain patterns and groups of which they correspond representative of the same characteristics that they have. As well, learning to relate differences and conflicts as outside oneself, at this stage the behavior and physical differences of the others do not interfere in the individual's perception, as he already understands that there is an exclusivity of attributes in each human being.

Professional identity is responsible for the feeling of belonging and appreciation attributed by the young person.

When he chooses a profession, he feels independent, confident to leverage the next phases proposed by the author. "Producing and building outside is for adolescents a compensating element for their failures" (Parrot, 2003, p. 31).

On the other hand, ideology identity implies continuous internal restructuring, because as the adolescent positions himself before the world, he is able to assimilate knowledge and introduce political, religious and spiritual ideologies of the social group of which he is part.

What the literature demonstrates about the theory is that the adolescent will always be in constant development and because of that, he does not have enough autonomy to constitute a being capable of being aware of his actions. Therefore, there is much criticism of this point of view, According to Pereira (2007, p.4), we understand that when understanding the young person as someone who "is not yet" we are denying his historical condition. Every young person has a life story that began to be built in childhood and that results in his unique personality.

Based on this assumption, other leading authors of psychoanalysis shared the theoretical position defended by Ericsson regarding adolescence, such as Anna Freud, G. Stanley Hall. For Pereira (2007) this model has been criticized in the maturational era of understanding the human being, even though it considers social aspects as influencers, it still has deterministic conceptions about human development.

In general, Erickson brought a new look within psychoanalysis on human development, focusing on adolescence and not so much on childhood. He noted that all phases have barriers to be faced in order to have a healthy ego, so he proposed an understanding of the daily conflicts in each age group and how this is absorbed and permeated through the human capacity to plan the future, a specific factor of the phase from which the article portrays.

III. METHODOLOGICAL PROCEDURES FOR STUDY

This study had a descriptive nature, with the collection of both quantitative and qualitative data in order to seek the knowledge, experience and opinions of each subject and thus corroborate the theme of the development of human sexuality in the genital phase, in adolescence and youth.

3.1 The Subjects

The sample universe consisted of four adolescents and young people of both sexes and aged 16 to 20 years.

3.2 Instruments and data analysis

A non-standardized interview was used, in which the interviewees reported their experiences and conceptions about the different contexts of sexuality. The data collected were analyzed through content analysis, in which it aims to know the speeches of each person in order to categorize them and gives meaning to their speeches.

IV. RESULTS

According to the website "The mind is wonderful", they published an article with the following theme: Do you know what sexuality is? (2015) portrays that the human being has his biopsychosocial unit that has three fundamental aspects of sexuality that must be analyzed together. The first factor is sexuality from the biological, it is not specifically the sexual organ or only reproduction, it is the most comprehensive concept. The scheme of the body is integrated as a whole and in this way, we are sexual beings from childhood, adolescence, adulthood and old age. The second factor is the social view of sexuality, according to the acquisition of customs and the learned behavior of the individual in the historical context that is inserted, the beliefs are modified and in relation to sexuality is no different. We are influenced from all sides,

Therefore, the socialization process to live sexuality is different for each individual, because the knowledge that is internalized helps us to adapt from our experiences and the maturation of each person's personality. Finally, the third factor is sexuality from the psychological point of view, characterized by thoughts, fantasies, attitudes and tendencies. In other words, it is related to beliefs, pleasure, the result of experiences, the acquisition of knowledge and the feelings we feel about ourselves and others. Thus, it appears that each human being has its uniqueness and our feelings and emotions are felt in a certain way, despite the situation being the same. Therefore, what can be pleasurable for some may cause disgust for others.

Adolescence is a period of change, it is the transition from childhood to adulthood, a time of many changes being biological, social and psychological, adolescence is considered a very difficult phase to deal with, as there are several conflicts experienced in it.

Adolescent pregnancy is considered a serious public health problem and therefore requires guidance, preparation and monitoring programs during pregnancy and childbirth, as it is a problem that offers risks to the child's development, as well as risks to the pregnant woman herself, so most of the time it is unplanned.

When pregnancy occurs during adolescence, biopsychosocial transformations can be recognized as a

problem for adolescents, where a family starts early on that will affect youth and the possible possibility of achieving a stable life project. Pregnancy, whether it is desired or not, causes a set of communicative impasses at the social, family and personal level (ARAÚJO FILHO, 2011).

Studies show that unstructured families, children or adolescents who are mistreated or abused in the family environment, contribute greatly to the increase in the statistics of teenage pregnancy.

Through an interview with M, a 16-year-old teenager who is five months pregnant. It was possible to observe that even today with the advancement of technology and access to information, there are still many young people and adolescents who are unaware of ways to prevent unexpected sexual consequences. At the moment of euphoria, you forget about prevention, even though you have free access to contraceptive methods. One of the questions asked the teenager was about access to sexual orientation information, she replied that she had already attended lectures at school and that her parents had also spoken about the subject.

Teenage pregnancy can have a difficult impact on the education of pregnant women, as many stop studying because of the pregnancy, many need to take care of the child because they usually have no one to take care of and often end up leaving to study to be able to take care of the child.

Teenager M, stopped studying said that she became very ill during pregnancy and that she had to miss several times and then she thought it was better to stop studying. But she intends to continue her studies because in the future she wants to be a doctor.

According to some studies, a teenage pregnancy is characterized as a high-risk pregnancy, due to the high rates of maternal-fetal morbidity. Bringing several biological implications, which are, anemia, overweight malnutrition, hypertension, pre-eclampsia and postpartum depression. The psychological is also affected by the fact that pregnancy at this time in life reduces opportunities and makes it impossible to take advantage of the experiences that adolescence/youth could provide you (TEIXEIRA, 2010).

In recent years, the teenage pregnancy rate has grown considerably, not only in Brazil, but worldwide (DADOORIAN, 2003). And the question asked is how does this continue to occur if access to information is becoming more and more comprehensive.

AL, the 19-year-old interviewee who became pregnant for the first time at the age of 14, mentions that she obtained information related to sexuality from friends at school, remembering that the term sexuality is not only linked to the sexual act but also to other factors such as puberty, for example. The mother's absence, according to the interviewee, was a very important factor for her development, the conversations, the clarification of doubts, could not be taken away, reported, due to this lack that had to be supplied by the father, who also did not talk, he informed about the changes that would occur and the best way to deal with them, or at least clear up doubts.

Sexual maturity, which occurs with puberty during adolescence, results in pregnancy simply because having sex without any contraceptive method during a given period results in fertilization. Freud (1905) mentions that these transformations and organic changes generate a very large hormonal pressure, even impelling the adolescent to use his reproductive system to relieve this pressure, in this way the interest in sex begins and as a consequence of an active sexual life, pregnancy.

A study by Doering (1989) with pregnant teenagers showed that those who fell into the middle class and were seen in private clinics rejected pregnancy, saying that this would hinder their plans, projects and so on. The low-class adolescents, seen in public hospitals, claimed that they liked children, showing a much greater acceptance of motherhood. Which shows that the majority of middle class adolescents do not see motherhood as a priority, which often happens with low class adolescents, which is the case of the interviewee AL who reports that she has no prospect of the future, who just wants to be a good mother, who watches over the health of her children, showing that she sees motherhood as a life perspective. The research also addressed the fact that pregnancy,

According to Blos (1998) apud Oliveira, et al., (2003) in the final phase of adolescence, professionalization is the most striking process for the consolidation of ego interests. Moreira, 2001 also states that all curiosity, creativity and spontaneity are necessary to channel a creative professional option. The particular vision of the professional choice of each young person expresses the way in which he evaluated the past, present and thus, creating means for the projections of the future.

The interviewee AS who is 20 years old, female, single, low class and is currently unemployed. When asked about life projects for the future, she reports the following:

“Studying and passing medicine. I intend when, during the course, to enter scientific initiation to discover something that helps humanity. When I finish graduation I want to go to these countries in need and help voluntarily. also contributing cash to NGOs, people in need, clothing, food and also to pay for a medical course for someone who is hardworking and cannot afford to pay. Because I wanted someone to do this for me, so if I can afford it I will do it for someone [...]”

Given the analysis of this excerpt from the interview, we can see that the young woman is in the process of searching for occupational identity, which according to Bohoslavsky and Moreira (1998; 2001) apud Oliveira et al. (2003) has the same difficulties in the construction of personal identity. For the occupation is what the individual wants to be and not what one wants to do, it is the fruit of the socio-historical-cultural context in the connection with oneself. According to their interests and aptitudes, these issues are generated by the interaction of a range of variables such as the social environment, the family environment and personal identifications. (OLIVEIRA, et al. 2003).

Finally, according to Oliveira et al, (2003) in a study with 48 adolescents from different social insertions in Brasília, the results showed that young people want to enter higher education, enter the job market through exercises that bring personal satisfaction. Despite the fact that the socioeconomic situation is a great difficulty for low-income people, at any given moment, regardless of their social class, they have feelings of anguish and indecision for the future, only as a result of the growing maturity of their identity that can to know more about the issues that will help in making the decision for the individual's occupational identity.

We are faced with the ideas of Stanley Hall a great psychologist, who identifies adolescence being marked by torments and disturbances linked to the emergence of sexuality.

In conversation with V. at the age of 19, he brought the context of sexuality and its definition within the parameters of society and his perspective. He believes that it is the way we express ourselves sexually, with or without the interference of social, biological, political, religious factors, etc.

With this, Erikson (1976) highlights that it is in this period when human beings are “concerned with what they may appear in the eyes of others, in comparison with what they themselves believe to be, and with the question of how to

associate roles and skills cultivated before the ideal prototypes of the day ”. In the case of the adolescent interviewed, it is clear that he is deciding on the direction of his life, with great concern for what society will think about him. So much so that this formation of identity does not begin or end with adolescence, but it is where construction takes place.

He believes that our society to a great interference of religions, with a historical construction that determined what is "right" would be the heterosexual relationship between "male" and "female" with the sole objective of reproduction.

Also believing that our society has stood out with advances for all sides, even with sexuality, it has become aware of its complexity.

So much so that V. presents is in constant search for freedom from the dogmas of society about his sexuality. He states that it is not being an easy process and requires a lot of personal construction, because while trying to understand what his desires are and trying not to label himself, he deals with people constantly trying to minimize his situation.

For Hall (1904), adolescence would be an experience compared to a second birth, in which the human being would have the opportunity to go through all the previous stages and, thus, obtain the apex of their development, in addition, this would be a chaotic and difficult phase due to the speed with which the transformations take place. This statement will be reinforced in the psychoanalytic theory that brings adolescence as a stage of confusion, stress and grief also caused by the sexual impulses that it manifests in this phase of development.

So we understand that we are in a generation that is quite reluctant on the issues of taboos regarding sexuality and we understand that each person has their uniqueness that are very far from the questions of normative heterosexuality that has been imposed in many societies throughout human history. Currently, we are able to approach homosexuality, bisexuality, asexuality or pansexuality with adequate naturalness. Gradually, the idea that diversity is freedom and enrichment is beginning to spread, something that encourages everyone to define their particular form of affective-sexual orientation.

Thus it is reinforced again during the conversation about sexuality, that the young person is constantly in search of true identity, even though they identify themselves as homosexual and still find themselves discovering more aspects about their desires, believing that the human being

has the tendency to classify people, precisely as a way of seeking to understand yourself.

According to Outeiral (1994), the cultural issue of being / being a teenager comes up in this search for a definition. The author, despite stressing the fact that adolescence is a psychosocial phenomenon, and does not have a well-defined end, divides adolescence into three phases, the first being characterized by body changes (puberty); the second, the search for sexual definition; and the third approaching what would be the end of adolescence, highlights the acquisition of maturity and social responsibility. And when observing another adolescent interviewed, we still face this search for sexual definition, which is a phase that should be part of the individual's whole life, being a process that undergoes constant changes.

So much so that he tries to live his life to the fullest, likes to listen to music and watch movies that give him certain pleasure and learning in his day-to-day life. And on questions about sex, he believes it is overrated and even though it is a biological necessity for most people, always being reinforced as an intrinsic desire of all human beings, however, there is a minority of people who do not consider the role of sex. so important for people's well-being and happiness, because there are other things that he considers more fundamental than that, such as love, partnership and complicity.

This factor is very interesting, the interviewee brings about being asexual in adolescence, since in all books and other readings we are faced with the statement that the teenager is looking for sexual impulses and that it is at this stage that the boy and girl will develop and have the first contacts with other individuals and their relationships. So, what we highlight about what he brought, is about the lack of sexual interest. Being often contextualized from a culture in which it was created, being one of the main influences in its decisions. An example of this would be a country that stimulates sexuality, while in another country it can curb it strongly. But the central point of all this is what we can understand if there is still the presence or absence of psychological distress and, based on psychodynamic theories,

Thus, it is clear that the interviewee has some suffering regarding this asexuality. But not on his part, but on what society thinks and how difficult it is to relate to another person who has an active sex life, and everything becomes even more complex.

V. CONCLUSION

The interviews with four adolescents and young people brought to light the experiences and life expectations for the future according to their perspectives. We elect people between 16 to 20 years of age, since its objective is to observe the development of human sexuality in the genital phase in adolescence and youth, so we can assess the vision of each one in different social contexts.

In view of the data analysis, we can see that teenage pregnancy is a very delicate moment in a woman's life, as it causes several problems both in the family, in the studies of the teenager, sometimes in physical health and especially in the psychological aspect if she is not prepared to assume the commitment of motherhood and all the responsibilities that pregnancy carries. After the birth of the child, we can see that generally the woman lives or wants to live for him, he has no plans for his future as a person and his desires and desires are left aside. However, it was verified in the face of a young woman's vision that her life goals are well established, that she is in search of occupational identity and that she is also in search of her autonomy, it is a decisive and desired phase for the realization of herself. Finally, analyzing the last interviewee, we can highlight the search for his personal identity, he is in the process of discovering his own sexuality, which considers asexuality as his sexual orientation. Due to a very sexualized society it is a difficult and even painful passage, especially when looking for partners who have the same sexual orientation.

Thus, we conclude that there is a great need for projects in the scope of sexuality in general, both in the biological, as well as personal and psychological. For teenagers and young people in schools, projects that really clarify students' doubts and that provide an open and welcoming place for their positions, without judgments. In addition to the fact that the family is a support for these individuals, thus being able to create a wide space for dialogue between them and, in this way, being able to guide in the best possible way in this turbulent and decisive period in their lives.

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Analysis of the influence of different kinematic instrumentation in extrusion of apical debris

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Abstract— Endodontic instrumentation systems can cause extrusion of debris. Apical extrusion has been reported as the main cause of pain after completion of endodontic treatment. The purpose of this study was to compare canal preparation time and apical extrusion of debris during instrumentation with the ProTaper Next (PTN), WaveOne Gold (WOG), and Reciproc Blue (RCB) systems. Forty-five roots of extracted mandibular first molars, with curved mesiobuccal canals (10–20°) and independent foramina, were distributed across 3 experimental groups (n=15 each) according to the instrumentation system used. Roots were secured in Eppendorf tubes, the canals were irrigated with double-distilled water, and the instrumentation time was recorded. After instrumentation, the roots were removed from the device and the amount of extruded debris was calculated by subtracting the initial weight from the final weight. Descriptive analyses were performed, followed by the Kruskal–Wallis test with a post-hoc Dunn's test. The PTN system was associated with significantly ($p < 0.05$) greater amounts of extruded debris and longer instrumentation time. There was no significant difference between the WOG and RCB groups ($p > 0.05$) between the amount of debris extruded and instrumentation time. Conclusion: The RCB and WOG were associated with less debris extrusion and shorter instrumentation time when compared to the PTN system.

Keywords— Endodontics, flare-up, reciprocation motion, rotary systems, debris extrusion.

I. INTRODUCTION

One of the main objectives of the instrumentation of the root canal system is the elimination of irritating etiological factors on the one hand, and the maintenance of healthy periapical tissues, on the other, some of these irritating agents, such as contaminated dentin debris, microorganisms and pulp tissue remains, can, during instrumentation, extrude through the apical foramen to the periapical space. This extruded material when in contact with the periapical tissues also works as an irritating factor, providing, among other occurrences, the painful symptoms to the patient known as flare-up [1, 2, 3, 4].

Some studies have been carried out in order to evaluate the amount of material extruded for the periapical tissues including a variety of factors: kinematics, apical diameter, working length, quantity and type of irrigating substance, irrigation systems, instrument design [5,6,7], but few studies have been carried out to better evaluate this extrusion when using reciprocating systems [8,9].

The extrusion of debris through the apical foramen occurs more frequently in cases of apical periodontitis, due to the presence of pathologies involving this region or apical resorption [6]. On the contrary, normal periapical tissues exert a natural barrier, thus contributing to the control of apical extrusion of debris, but not in all cases

preventing the passage of this substrate through the foramen [10].

New endodontic instruments have been idealized and manufactured in order to make endodontic treatment more effective, with quality and faster. Thus, using a root canal instrumentation technique that minimizes apical extrusion of debris would be advantageous, providing a better postoperative and, consequently, more effective repair of periapical tissues [11,12].

Regarding the instrumentation time, since reciprocating systems employ a "single file" philosophy for the preparation of the root canal system and, therefore, probably need a shorter clinical time, possibly resulting in a lesser amount of debris formed that could be extruded through the apical foramen. For this reason, it is opportune to analyze different endodontic instrumentation systems regarding the condition of apical extrusion.

The aim of the study was to evaluate the apical extrusion of debris after different kinematics of endodontic instrumentation: WaveOne Gold and Reciproc Blue reciprocating systems and Protaper Next rotary system in curved mesial root canals of mandibular molars.

II. MATERIALS AND METHODS

Specimen selection and preparation:

Once approval from the Human Research Ethics Committee of the Pontifical Catholic University of Campinas had been obtained (no. 2,379,268), 45 mandibular first molars that had been extracted for various reasons were included in the present study. Teeth with fully formed roots showing independent foramina, curvature angles of 10–20°, absence of calcifications, or resorption, and with an initial apical canal diameter corresponding to that of a #15 K-file (Maillefer Corp, Ballaigues, Switzerland) were selected and disinfected by soaking in 1% chloramine-T trihydrate solution for ten days.

All teeth were de-coronated perpendicular to the long axis of the tooth with a diamond disc (Horico Dental Hpf; Ringleb, Berlin, Germany) coupled to a slow-speed handpiece powered by a micromotor, under constant refrigeration, standardizing roots segments of 13 mm in length. An evaluation under microscopy to analyze possible existing cracks was performed.

The initial diameter of the mesiobuccal canal was established by advancement of a #15 K-file (Dentsply Maillefer, Ballaigues, Switzerland) until it fit snugly within the canal and its tip was just visible in the apical foramen under an operating microscope at 12.5x magnification

(Stemi 508; Carl Zeiss, Jena, Germany). The same procedure was used to determine the working lengths of the specimens. Canals that did not meet this criterion were excluded from the study and replaced with new specimens. Two #10 K-files were introduced into each mesial root canal, in a clockwise/ counterclockwise motion with slight apical pressure, to confirm the presence of independent foramina under 8x magnification (Stemi 508; Carl Zeiss, Jena, Germany).

Group allocation:

The samples were randomly allocated into three 3 groups using a computer algorithm (www.random.org). Each group represented an endodontic instrumentation system used for instrumentation of the mesiobuccal canals. The mesiolingual canals were not exposed to any type of instrumentation or irrigation at any point in the experiment.

Instrumentation of sample groups:

PTN group: X1 (17.04) PTN file (Dentsply Maillefer, Ballaigues, Switzerland) was used in rotary motion (300 rpm, 2 N·cm). Three in-and-out movements (pecks), with a stroke amplitude of 3 mm, were performed until the WL was reached (1 mm short of the apical foramen). The exact same sequence was then followed with an X2 (25.06) instrument.

RCB group: R25 (25.08) RCB file (VDW, Ballaigues, Switzerland) was used in reciprocating motion. Three in-and-out movements with amplitude of 3 mm were performed in each third of the canal until the WL was reached (1 mm short of the apical foramen).

WOG group: The primary file of the WOG system (25.07) was used in a manner similar to that described for the RCB group.

The same operator performed all instrumentation with the X-Smart Plus motor (Dentsply Maillefer, Ballaigues, Switzerland), adjusted for each system. Each file was used for the preparation of only one canal, and later discarded.

During the instrumentation, the specimens were irrigated with 3 mL of double-distilled water per root third, through a 30G NaviTip needle (Ultradent Products Inc, South Jordan, UT). In all groups, after each cycle of instrumentation and irrigation, foramen patency was controlled with a #10 K-file advanced 1 mm beyond the foramen. At the end of the instrumentation, a final irrigation with 1 mL of the same irrigant used throughout was performed, never exceeding the total amount of irrigant standardized for all specimens (10 mL). Canals were dry with the aid of capillary tips (Ultradent, South Jordan, UT) and the paper points provided with the respective systems.

The present study followed the methodological parameters proposed by Myers and Montgomery [5]. and modified by other authors [13,14]. (Fig. 1) to quantify the amount of debris extruded through the apical foramen.



Fig. 1: Device for weighing extruded debris

The initial weight of each Eppendorf tube (Eppendorf do Brasil, São Paulo, SP, Brazil) was determined by weighing three consecutive times on a precision balance (Ohaus Corporation, Parsippany, NJ, USA) with a precision of 10^{-5} g. The root was pushed through this hole and a rubber dam (Madeitex, São Paulo, SP, Brazil) was placed for isolation, simulating a clinical procedure. To equalize the air pressure levels, a 27G short disposable anesthetic needle (Unoject DFL Ltda, Rio de Janeiro, RJ, Brazil) was inserted through the rubber dam and stopper. Each Eppendorf/root assembly was then placed into an opaque vial to prevent the operator from having any visual or manual contact with the tubes. Instrumentation was then performed, and any apically extruded debris was thus collected inside the Eppendorf tube.

To collect any residual debris still adherent to the outer root surface, 1 mL of double-distilled water in a 10-mL hypodermic syringe (BD Plastipak, Curitiba, Brazil) was used to rinse the root; any debris thus removed was caught in the Eppendorf tube after specimens instrumentation. In order to allow complete evaporation of water from the Eppendorf tubes and subsequent weighing of the extruded debris, the tubes incubated for 6 consecutive days at a constant temperature of 68°C (Model EL-14, Odontobrás, São Paulo, Brazil). In all experimental groups, each Eppendorf tube was weighed using the same procedure described above. The mean of the three weights was recorded as the final value. The weight of the extruded debris in grams was obtained by subtracting the mean final weight from the mean initial weight of each Eppendorf tube.

The time spent on instrumentation was timed (Seiko, Japan). The timer was started only when the instrument was activated and introduced into the root canal and

stopped whenever the instrument was removed, thus yielding the actual instrumentation time.

Statistical analysis:

Data on debris weight and instrumentation time were entered into BioEstat 5.0 for analysis. The D'Agostino test rejected the assumption of normality for both variables analyzed (amount of extruded debris and instrumentation time).

Descriptive analyses were performed and the nonparametric Kruskal–Wallis test (with Dunn's post-hoc test) was used, at a significance level of 5%.

III. RESULTS

Regardless of the instrumentation system used, debris extrusion levels were observed (Fig. 2).



Fig. 2: Debris extruded and collected in the eppendorf after drying.

Table 1 represents the amount of debris extruded and Table 2 the actual instrumentation time (in seconds) for all groups. PTN system was associated with the greatest amount of extrusion ($p < 0.05$) than the WOG and RCB systems. There was no significant difference between the WOG and RCB groups ($p > 0.05$).

Regarding instrumentation time, PTN system was associated with significantly longer time ($p < 0.05$) than the RCB or WOG systems. Again, there was no significant difference between the WOG and RCB groups ($p > 0.05$).

There was no instrument fracture and no preparation iatrogenesis during instrumentation of the root canals.

Table.1: Amount of debris extruded during instrumentation with each system

Abbreviations: MD, Median; IQD, interquartile deviation; MA, Mean; SD, standard deviation.

	WOG	PTN	RCB
Minimum	0,001	0,0052	0,0001
Maximum	0,0031	0,0086	0,0116
MA(SD)	0,0021 (0,0008) ^A	0,0068 (0,0012) ^B	0,0025 (0,0035) ^A
MD (IQD)	0,0019 (0,0007) ^A	0,007 (0,0001) ^B	0,0012 (0,0025) ^A
(p-kw)	p = 0,0000		

Table.2: Instrumentation time of each system

	WOG	PTN	RCB
Minimum	16,74	80,25	17,87
Maximum	39,44	135,02	41,22
MA(SD)	24,54 (7,11) ^A	103,02 (16,39) ^B	27,19 (7,09) ^A
MD (IQD)	22,28 (5,36) ^A	100,86 (12,67) ^B	26,47 (5,76) ^A
(p - kw)	p = 0,0000		

Abbreviations: MD, Median; IQD, interquartile deviation; MA, Mean; SD, standard deviation.

IV. DISCUSSION

Biomechanical preparation is a very important phase in endodontic treatment and requires attention from the clinician and / or specialist, avoiding unpleasant consequences such as accumulation of dentin residues and the extrusion of dentin that is often contaminated to the periapical region. It is known that this extrusion of residues, in addition to often reassessing a periapical process, causes postoperative pain and can also hinder the repair of periapical tissues [9,15]. Therefore, due to this frequent occurrence of apical extrusion during endodontic treatment, this work was designed with the aim of possibly identifying the type of instrumentation technique most related to this complication.

As also found in the present study, the extrusion of debris by the apical foramen was present regardless of the technique, instrument and kinematics employed, which

confirms the findings of several researches [9,16,17]. Thus, with the advent of new instruments with different kinematics, in this case the reciprocating ones, it is important to compare preparation systems with the objective of proving some technique that promotes the minimum extrusion of debris beyond the foramen and, clinically provides less pain after endodontic treatment [11,18,19]. In addition, preparation systems that spend less clinical time to be performed minimize fatigue not only for the patient but also for the professional who performs it [20].

The method used to collect debris extruded by the foramen was very similar and with few modifications to that indicated by Myers & Montgomery (1991) [5], which are widely used and cited in the most recent studies [5,8,9,11,15,18,19,21,22,23,24].

In order to simulate irrigation during endodontic preparation and not to influence possible subsequent weighing results, double-distilled water was used in the study as is also recommended in other researches [21,22].

The reciprocating movement has been related by some recent studies as a kinematics that promotes greater extrusion of contaminated debris [8,11], however the reason for such a discrepancy in results with the current study, may be linked to the lack of segmented preparation in the crown-down direction by root thirds, since these works do not clearly discriminate the protocol for the use of reciprocating files.

The crown-down preparation sequence and, further, its execution by root thirds was used in the present study and is cited in the literature as an important factor in reducing debris extrusion, as mentioned by Yeter et al. (2013) [25] and Garlapati et al. (2013) [26].

Another factor that may have contributed to this favorable result for reciprocating instruments in the present analysis is that the performance of the glide path was used in each preparation cycle by a third, which was also not idealized in other studies by Burklein & Schäfer (2012, 2014) [8,11]. The glide path maneuver not only facilitates the maintenance of the spatial center of the root canal during its preparation, but also promotes a greater facility for the instrument to reach that working length [7], thus, the apical preparation file it should need less force to reach its objective, which probably results in less extrusion of debris and microorganisms through the apical foramen [20,22,27].

During the reciprocal movement there is a greater amplitude of rotation in the counterclockwise direction, responsible for cutting the instrument, followed by a movement with less amplitude in the clockwise direction,

which aims to unscrew the dentin and also a greater centralization of the preparation, in this way it is probably explained the lower pressure in the apical direction by these instruments when compared to the rotating systems [28], this can also explain the lesser extrusion of debris by these instruments in this study compared to the rotating group represented by the Protaper Next.

The results of the present study are in agreement with those found by De Deus et al. (2014) [22], who also performed analysis on mandibular molars, as by Xavier et al. (2014) [15], who used a very similar methodology. Both studies concluded that the tested reciprocating systems promoted less debris extrusion compared to rotary systems. All authors defend the principle that the instrument performing the reciprocating kinematics in a greater control of the debris extrusion, as it is a type of balanced force movement with less apical pressure compared to the rotational system [28], in addition to use a single file even with greater cutting power than probably the files of the tested rotary system.

Another important point that must be taken into account is the number of instruments used to prepare the root canals. As the reciprocating systems use a single file to prepare the root canal over its entire length, this instrument, even being used for a few cycles until reaching the working length, results in less time spent for the entire series of instruments needed to complete the preparation of the instrument same root canal when using rotary systems. This can result in a greater amount of debris formed during instrumentation by the rotating systems and therefore explain the result obtained in this study [9,21,29,30,31].

Capar et al. (2014) [21] reported in their study that the Protaper system, as it presents a greater number of instruments used until the end of the apical preparation, demanded a longer working time than the other tested systems and this factor may explain the greater amount of debris formed during instrumentation and, therefore, extruded through the apical foramen. This fact can be extrapolated to the results obtained in the present study, since reciprocating systems use the same file during the preparation of the entire length of the root canal and due to the shorter working time, possibly promoting a lesser amount of debris to be extracted by the apical foramen. . Other studies also agree with these findings [15,22].

Thus, the study evidenced by the results obtained, a consequent interrelation between the number of instruments and probably the kinematics of their movement in relation to the extrusion of debris, which is in agreement with the conclusions of other authors [15,20,22,32].

In addition to the kinematics, the design and cross-section of the instrument can influence the extrusion of debris through the foramen as mentioned by Elmsallati et al. (2009) [18]. This was not observed among the reciprocating systems evaluated in the present study, since no statistically significant difference was found between these systems of similar movement, even recognizing their differences regarding the respective designs.

The effective instrumentation time obtained as a result at work was proportionally shorter in the groups that obtained coincidentally shorter debris extrusion results. This correlation makes sense, since if an instrument acting in the preparation of the channel up to the working length spends a shorter interval of time, it probably promotes less debris, and thus less probability of extrusion may occur [21].

As noted, the reciprocating systems tested in the study (WaveOne Gold and Reciproc Blue) demonstrated safe instrumentation in the scope of apical extrusion and, still, spending less time to prepare the root canal.

V. CONCLUSION

According to the methodology employed, it was possible to conclude that the reciprocating systems represented by WaveOne Gold and Reciproc Blue extruded less debris through the apical foramen during instrumentation, as well as being faster in the question of instrumentation of curved mesial root canals of mandibular molars compared to Protaper Next rotary system.

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Forms of Enslavement in Mamfe Area from 1900-2010

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Abstract— On the plain of Mamfe is found a group of people who practice slavery and slave trade from 1900 to 2010. Examining the atmosphere and heritage, much could be seen to have control and contributed to the legacy. Decent of slaves remain victims of harmful prejudices. For instance, a man of a slave origin cannot marry nor have as spouse a girl from the free family. It is therefore interesting to know how people became slave in that area or in the society of Mamfe. This paper actually describes the circumstances in which free people lost their freedom and become slaves. Also, this paper explains methods that can be use to combats enslavement. From archives, oral and documents sources, we attempt to clearly identify the various forms of enslavement or the process through which free persons became slaves.

Keywords— Mamfe, Slavery, Slave-trade, Legacy, Forms, enslavement, Slaves.

I. INTRODUCTION

In the document, “Translocal Culture: The slave and cultural Transfer in the cross River Region.” (Roschenthaler, 2006, p.84.) The author made mention of associations and cult agencies that were not sold and spread widely but only within the group of local persons whose biography was known and who were considered to be among the first or real owners of the land on which they settled. But later, were sold due to Progress and advances in Science, Geography, Religion Trade and other developments in Europe and the extension to the Americas via sailors like Christopher Columbus, let to the search for slaves who could supply labour in the several plantations in America and the West Indies. (F K Buah, 1967, pp.23, 28-58)

Some religious men spoke out ...persuaded the owners of the mines and plantations to look elsewhere for men and women to replace the American Indians...the Portuguese traders had taken slaves from West Africa back to Portugal. These men were found to be very strong. Therefore when the European adventurer miners and farmers decided to look elsewhere for workers they decided to use the people of Africa.

Following the above author, it fosters the act of enslavement in Mamfe Area. This has been noticed as disgusting since 1900 to 2010. Among the several

Researchers who made mention of enslavements are Paul E Lovejoy in his Transformation in Slavery in Africa. He said, “...enslavement was the ultimate sanction...payment often being in slaves...this strife resulted in the enslavement of many people without pushing back the enslavement frontier...The enslavement of people was easy...and communities always feared the dangers of war, kidnapping, and raids.”(Paul E Lovejoy, 2000:pp.86, 87) and E S D Fomin in Slave Settlements in the Banyang Country; Slaves were enslaved in Settlements, “The two types of Banyang slave settlements referred to in this study are types A and B...Mbenjong was the main slave quarter of Tali 1...private slave quarters in Banyang country were kesem Tata Biatung in Asom.”(V J Ngoh and E S D Fomin, 1998: pp, 22, 23 and, 27) Furthermore, Sehou Ahmadou said, as he quoted Catherine VerEeeke, slaves were enslaved and sent to a place known as slaves settlements *dumde*, “...the major title-holders...owned each between fifty and two-hundred slaves and between two and four *dumde*,...personal farms ...as many as 1000 slaves,5 *dumde* ...”which some were transported to the America to work in the Plantations. Enslavement will mean to make a slave completely dependent on the Master, that they cannot manage without or alone. According to (Fomin and Chem-langhee, 1990:pp.197-221) the legacy of slavery and slave trade in Mamfe Area, remain a reality. There are many and varied forms in which a man or a

woman can be enslaved by another person. The slaves were kept in places now quarters. These slaves referred to those who before and after the slave trade reached the coastal region after a long trekking from the Grassfield in the Cameroon to the Mamfe plain. Some slaves originated in the Mamfe Area. Not all the slaves that arrived were sold to the Europeans Merchants, and did not reach the Atlantic Ports. Some of these slaves stayed in Mamfe area which anchored several of them in settlements now slave villages or quarters. Most of these slaves who passed through the forest originated in the mountainous grassfield areas, the Bamileke and the Bamenda, and were traded by the Middlemen during the 19th centuries of the transatlantic slave trade. This trade took place from village to village that prevailed in the vast forest between the grassfield and the Atlantic coast thus Mamfe is an “*entrepot*.” (V J Ngoh and ESD Fomin 1998, p.7)¹ To examine this, it will be necessary to throw light on other Cross Section of Cameroon. Therefore, the question that needs an answer is what are the various forms or ways that the people of Mamfe area faced Enslavement in the Modern and Contemporary times? Here, it will be interesting for us to examine the following aspects: A General View of Mamfe Area, The Origin of Enslavement in Mamfe Area, Forms of Enslavement in Mamfe Area and lastly, Strategies to combat Enslavement in Mamfe Area.

II. A GENERAL VIEW OF MAMFE AREA

Mamfe is found in the South West Region of Cameroon. Mamfe falls between Longitude 5°00 and 8°00 north of the equator and between Latitude 10°00 and 5°00 south of the Equator. (George Philip, 1968, pp.66-61) The Climatic Condition of this region is favourable and conducive for the keeping of slaves.² Mamfe covers a total land area of less than 23.008km square. It is a lowland plateau. The Mamfe Depression forms a distinct zone located some 150 kilometres away from the coast. It is almost encircled by a range of mountains except to the West where its lowland stretch out into Nigeria for smooth movement of slaves and intermediaries to trade very easy with the hinterland trader on slaves. The depression receives numerous streams which

flow down from the surrounding mountains and join to form the Cross River which links Cameroon to Nigeria.³ Slaves were transported through these rivers in to the seas and Atlantic Ocean.⁴ The vegetation of the Mamfe Area is characterised by huge rich palm oil belt of the equatorial jungle type. Oil palm is the richest plant. Mamfe has a population in 1967 to be 11, 729, (Neba Aaron, 1987, p.75).⁵ Mamfe is the central town but consists of villages, the Banyang, Ejagham, Anyang, Amassi, Boki, Manta, Messaga, Achabe, Menka, Biteku, Abbella, Eyumodjock, and Besongabang. Manyu Division shares boundaries with the Mezam Division, Menchum Division in the North, in the East, with Lebialem and distance Meme Division and in the South, Ndian Division and Rio del-rey. Slaves were used to work in palm Bushes. They were very good at palm climbing to harvest palm nuts for palm oil. The wildly grown palms like the other equatorial trees compete for sunlight in a sea of great evergreen canopy. Moreso, Mamfe has an evergreen ecosystem that, joint with the mangrove, cash and tall trees in this region. These tall trees were used to construct boats for slaves transportation and construction of Baracoons.⁶

III. THE ORIGIN OF ENSLAVEMENT IN MAMFE AREA

Before the white men came, Africa has already had her system of organisation. Slaves serve for the development of her territories. Anthropologists and historians rarely conceded slaves a culture in the sense of a body of permanent institutions and established practices. Slaves were rather perceived as Translocal individuals of different origin without a common culture and history. (Roschenthaler, 2006:p.71.) The early African slave enjoyed a great deal of freedom. He was regarded as part of the household and was allowed to own property and he was often given his freedom. (F K Buah, 1967, p.57) But, event took place in North as Arabs conquered North Africa, they used slaves to serve in their household and to work in the salt mines. Slaves were forced to do this in the hot season. Eventually, due to European demand for slaves merchant anchor with large

¹ UTE Roschenthaler, “Translocal Culture: The slave and cultural Transfer in the cross River Region”. In <http://www.google.fr>. Search 3h1=80q=slavery and slave trade in South Eastern Nigeria and Mamfe in Cameroon. 1800+1957. 8btnG= recherche 8 Meta.2006.

² George Philip, *The Modern College Atlas for Africa*, Ninth edition, The London Geographical institution, London, 1968. pp. 66-61.

³ Ibid. P, 14.

⁴ Ibid.

⁵ Neba Aaron S, *Modern Geography of the Republic of Cameroon*, Second edition, Neba Publishers, Camndem, NJ. 08101, 1987.p, 75.

⁶ Georges Couarde, *Atlas Régional Oust I*, Office de la Recherche Scientifique et Technique outré mer, République Unie du Cameroun. P, 46-47.

boats and ships demanding for slaves at the coastal regions. This huge demand for slave led to the trans-Saharan slave trade and transatlantic slave trade.⁷

Furthermore, the enslavement never ended in North Africa but extended to Mamfe area. Mamfe accepted war captives and refugees into their societies but allow them in separated settlements.⁸ Slaves in Mamfe itself that is, that not coming from outside were also integrated into this area, they join the incoming slaves in their settlements.⁹ These slaves population leaving in their settlements in 1916, specifically at Ossidinge in Mamfe which the Banyang occupied a greater amount, the number of adult male slaves was 419. This number could be more than 600, hence the total number of slaves including children and woman was 2600. The number of persons considered as slaves was stated to be 428 thus 80 percent of the total. In 1918, Anyang had 24 slaves, Banyang 185, Boki 40, Ekoi 11, Keaka 148 and Obang had 20. By 1926, there were still a large number of slaves in the Mamfe Area.¹⁰ Some 1360 persons faced enslavement. Leaving in separation explains the onset of enslavement in the Mamfe Area.¹¹ As time and events continued to evolve the number increased drastically as propagated by the German administration.¹² From the above statistics, it proves that the exact number of slaves that faced enslavement in the various settlements was for domestic use and external exportation. This proves and marked the origin of slave trade in the Mamfe Area.¹³ The way or forms of enslavement in the Mamfe area are several and varied.

IV. FORMS OF ENSLAVEMENT IN MAMFE AREA

Those who became slaves, their crimes were hardly justify. Reasons being, actually they do not deserve either the penalties or sanctions. While few actually deserve it, the majority were forcefully accused and rejected from the

Mamfe community. Most of them later found themselves in the settlements hence for the Transatlantic Slave trade. It should be noted that some came from outside the Mamfe society.

3.1.1. Forceful Labour Supply and Tribute Payment

To supply forceful labour to the rich freeborn and pay tributes to them in the form of slaves, constituted just an aspect, some other aspects were for prestige due to the fact that a chief, king and head of quarter was well acknowledged and respected due to his number of slaves found in his backyard in the case of Mamfe as a case study.¹⁴ Some were later enslaved for transatlantic slave trade to forcefully work in the plantations.

Kopytoff and Miers, talk of "Chattel Slavery". An old form "law or old-fashion", something that belongs to you: Women are now considered as equal partners, not as chattels or housekeepers, goods were equal to women because they were bought and forcefully sold in marriage at child birth, as they grew up they were automatically titled towards their husband. Another situation denotes the circumstances that a man uses money in the name of bride price via the parent or relatives in the name of diary but with the primordial intension for the young girl (maid) to work for him.¹⁵ Promiscuity has engulfed greater percentage of the youth population in Mamfe. Selling of one in the various forms of prostitutions: Sex for money and dancing Naked in Night Clubs. Most parents enslave their female children, in such act thus enslaving them to sell themselves for money by having rampant sex, sex without control. Some could embrace all these in one way or the other as social enslavement of some people. Furthermore, it is on this act that they made completely dependent on which they cannot manage without it, hence enslavement.¹⁶ This action in the 19th and 20th century, Mamfe has been able to influence neighbouring societies.¹⁷

3.1.2- Victims of Witch-craft practice

Those who practice Witch craft were Witches and Wizard known to be and look upon as evils doers in the society. This was because they were believed to be devil incarnates with extra ordinary powers. Victims to this act

⁷ Mathew A Seino, *A History of Cameroon*, Bamenda, Unique Press, 1989, p, 24.

⁸ V G Fanson, *Cameroon History for Secondary Schools and Colleges, Vol 1. From prehistoric times to the nineteenth Century*, MacMillan, Cameroon, 1989, p, 67.

⁹ V J Ngoh and E S D Fomin, *Slave Settlements in the Banyang Country 1800-1950*. Buea, Publications, 1998. P, 22.

¹⁰ Ibid. p, 23.

¹¹ Ibid.

¹² Onwubiko KBC, *History of West Africa, 1800-present day*. Book two. Africana-FEP Publishers limited. Nigeria, 1986.p, 86.

¹³ V J Ngoh and E S D Fomin, *Slave Settlement in the Banyang ...* p, 14.

¹⁴ Jean-Pierre Warnier, « Traite Sans raids au Cameroun. » In *Cahier d'etudes Africains* 113, xxix-I, Vol 29 No 113.p, 25.

¹⁵ S Miers. and A Kopytoff, *Slavery in Africa*, Madison, University of Wisconsin Press. 1977. P, 3-81.

¹⁶ Interview with Chenyere Ignes Uche at Mamfe, November 11, 2008.

¹⁷ Interview with Udoh Thomas at Mamfe, November 11, 2008.

were victimised or punished in to enslavement. This act was usually attributed more to the Keaka people. Furthermore, the people of Mamfe area belief in key institutions like the *Obasinjom*, *Ekpe* and *Nfam Nyankpe*.¹⁸ It is believed to be borrowed from the Ejagham.¹⁹ They are used to protect the community (*Etok*) and individuals against the civil activities of witches and wizards which gained more prominent position in the era of slave dealing.²⁰ Ferdinand de Jong commented globally which analysing this fact, historical documents described public divination, demonstrates how persons were transformed into slave through the notion of the belief and conviction as witches and wizards hence such victims became prey to guard the people using their supernatural powers. Profiting from the conviction of witches and wizard by the leaders or quarter heads, hence these forms of enslavement was also attributed to the entire Mamfe region such as the Kembong, Ejagham (Keaka), Bakebe. This form of enslavements intertwined with one and other villages that made up Mamfe. This witchcraft is more popular with the Ejagham society who speaks the Keaka language and other neighbouring villages have embraced this practice. This was a belief which enslaved many people. This was life, enslavement. The Anyang, Banyang, Kenyang (Lower and Upper Banyang) and others have borrowed these spirits to victimise those in witch-craft practices as forms of enslavement. (Mary Agbor, Kumba, 2008.)

3.1.3- Disrespect for observances traditional rites

Occult imagination constituted harrowing tales in the era of the slave trade. Mamfe is a place that provided its slaves. Freeman used traditional observances and associations such as Ekpe to subjugate their slaves (Roschenthaler, 2006:p71). These demonstrate how the memories of the slave trade structure the Agency of colonial and postcolonial subjects as they experience the capacity of the slave modern state. Present memories fuse can be understood in the light of the past, the slave trade and the complicity of Mamfe intermediaries is here remembered as a trade of which the moral ambiguities are encrypted in an occult imaginary of witches and Leopard men. This group of people are admired. Informants situated that immorality in their occult imagination let to enslavement, 'burden of blackness' as far as today's, leopard men-politicians gain status. Those elderly men who became members escaped enslavement while those

elders who hated the occult societies were regarded as slaves.²¹ Baum's shrines of the slave trade published in 1999 reiterates on the above that, the Leopard society men only becomes renowned and participate in decision making in the Mamfe area, if they joint this occult groups amongst which is the Leopard men hence they could contribute to make decisions as such gain titles. They are known as elders of the village.²²

In the Mamfe area, the judiciary body known as *kwifons* a traditional group known for their masquerades as well as for their elaborate hierarchies headed by kings (*fons*), these curtly societies are marked by stark concentration of Wealth among the leaders or Heads in the form of wives of which the Heads could posses up to hundred.²³ In the Mamfe society, the *Ndong* dance was for the enslaved because of failure to respect laws of the societies. The slaves were indulged in to this group as a means of punishment. This has been one aspect of continued enslavement; this dance is only by those enslaved while the *Etogobi Beti*, a midnight dance is reserved for the freeborn such as the *Obasinjom*, *Ekpe*, *Beteneh*, and *Eblagha*. The *Obasinjom* was collectively operated by the community. It was indeed a community cult agency.²⁴ This juju is also considered as the messenger of god, traditionally called *Obasi*. He sorts and point out the wicked witches and wizards as well as their hiding places and hidden or unknown deeds during it display. He even sees distance and emerging problems and events and procrastinate or give solutions. In case of disrespect of it laws or norms their punishment was enslavement.²⁵ The dance usually start with an unknown act of screaming and shouting of a member of the cult, the "powers" held the member still bound which he moved toward the masked, lift it up, through on his body by wearing and players accompanied him. He reveals by pointing much evils and devilish actions and deeds and asked for their immediate destructions.²⁶ The *Ekpe* or *Ngbe* and *ekpe* mean Leopard in the *Ejagham* and *Efik* languages respectively, according to U T E Roschenthaler in Translocal cultures. The slave trade and cultural transfer in the cross river region, among the several juju was the *Ekpe*, the most

²¹ Ferdinand de Jong, "Silences that speak to the slave trade." In *Cahier d'études africaines*. L (1), 197, 2010.p, 325.

²² Ibid.

²³ Interview of, Mary Agbor at Mamfe on the 8th February, 2008.

²⁴ V J Ngoh and E S D Fomin, *Slave Settlement in the Banyang Country 1800-1950*, Buea, University of Buea, Publication, 1998. P, 45.

²⁵ V J Noh and E S D Fomin, *Slave Settlement ...* p, 45.

²⁶ Ibid.

¹⁸ Ibid.

¹⁹ Ibid.

²⁰ Ferdinand de Jong, "Silences that speak to the slave trade." In *Cahier d'études africaines*. L (1), 197,2010p, 325.

well known of these associations. Many areas in Mamfe claimed to be the original inventors which they spread it into the interior or hinterland and further into the Calabar and Cross-river-areas at different levels, grade and posts.

. In later period *Ekpe* became transportable and transformed into a dance association which was later accompanied with songs, rhythms, marks and dances diffused disconnectedly and by imitation, and in turn were integrated into local performances. The *Ekpe* was the most effective society because it renders services such as staging dances in festivities and acted as court and collected debt for members. Crime committers became slaves in this group, and those who do not abide to the norms of this society were enslaved.²⁷ Other association of men with secret knowledge were *Abiankpo* (stilt dance), *Angbu* (drive away ghosts) and *abhon* (a minor form of *Ekpe*) all for younger men. Among the societies for women were *Ekpe Atu* (women's right ritual and *njom Ekpe* a graded society with a secret voice and a sculpted headdress for performances, and always goes out of the village to perform. Also, the existed the women dance called *Moniki* that deals with the display of mirrors while initiating nature being of some creatures.²⁸ The *Mfam* could not be left out for its vital functions. Not being loyal to the above group leads to enslavement.²⁹

3.1.4- Disrespect of Rituals Performances

Rituals are forms in which masses in the Mamfe area used to enslave. The family in Kembong found in Eastern Ejagham confirmed that the *Ndong* of the slaves was made up of villagers. *Ndong* involved the slaves. The settlement society was widely known as *Ndong*. Away from Kembong Eastern Ejagham, the chief of Babi Village in Western Ejagham or Ekwe close to the Nigerian border explained that the slaves danced with skin-covered masks, which were also called *Ndong*, they performed rituals during funeral of their

members which the villagers would not attend. They used a broom stick to magically cut the neck of a fowl in one stroke. Slave women took part in the day performance only. Refusal to perform the rituals in the villages allowed room for more slaves enslavements. The slaves perform their own dances in order not to annoy them because they could not participate in *Oruua Neebe* ritual as the society that excluded the slaves was called *Babi*. Some unbearable slaves or stubborn ones were meant for the transatlantic Middle Passage.³⁰ It should be noted that in all the cult Agencies the grades or level differed from one another and before a member grade is added, a ritual initiation often took place to differentiate this change of grade which in some libation and the killing of animals and birds like goats and fowls. Before a red feather is given to an elder in Mamfe area, a ritual is also performed.³¹ The elders summon and speak words of honour and powers from the ancestors calling on them to accept their nomination of a new person elder in their midst shaking their brooms in the air while touching him evoking the spirit of the gods and ancestors. Palm wine is also used and collar-nut. Some individuals they called "Medicine men" have shrines either behind their houses or inside their houses which they usually carry out rituals, killing animals as means of cleaning the village. Some of these men who refuse to respect these ritual practices became slaves.³²

Related cultural practices connect the social memories of slaves, traders and those who managed to avoid enslavement and deportation, were exposed to embrace close kin which today falls under the forms of enslavement because turning left nor right more substantial will come hence force to stay within the realms of endless enslavement.³³ Ending, occult, cult and rituals led to forms of enslavement, Nicolas Argenti and UTE Rosenthaler said, "There is a person, or country, or both, far on the other side of Qua, called Mbafum ... many of them are brought here as slaves" taken from Anderson letter to Hutchison, old Kalabar, 22 July 1856, quoted in Hutchison (1907 "1861": 322").³⁴

²⁷ Ibid. p, 76.

²⁸ Ibid. other cult Agencies involve, moninjom, Njom called Agbanyang Kembong Cult Agency Okebhone

²⁹ *Mfam* was cult agency, meant also to checkmate the witchcraft of the slaves. That is, they are enslaved to and constantly check the slaves. They are also foreign provenance. The *Mfam* was prepared by special witch doctors from various parts of plants, animals and often human beings. It was a famous Banyang Cult Agency against pervasive witchcraft. The Banyang Cult brought it from the Keaka people around 1880s. *Mfam* was serious and genuine dreaded by witches, wizards and diabolical individuals. People usually swear by *Mfam* to prove their innocence if not they were sold as slaves due to their guilt as they believe. All these safe as forms of enslavement in the Mamfe areas because many are victims to fall into such cult societies which this enslaved many.

³⁰ UT E. Rosenthaler, « Translocal Culture ... » p, 83.

³¹ Interview with Eneke Gideon at Mamfe, 2008.

³² Ibid. it should be noted here that the Translocal healers usually give to some sons of the soil full feathers and descendant of half feathers. The feathers are qualified, not the same to the groups.

³³ Nicolas Argenti and UTE Rosenthaler, "Introduction: Between Cameroon and Cuba: Youth, Slave Trade and Translocal Memory capes." In *Social Anthropology. European Association of Social Anthropologists*. United Kingdom. 2006. P, 40.

³⁴ Ibid

Here, those as *Bankoh* (strangers) arrived Mamfe from the grassfield Areas which they have no brother (*motaicha*) or relatives (*Bate bochi*) which they continue to stay as (*nsem*) one bought and kept in servitude. They usually engulf them in cult Agencies and rituals.³⁵ Some became “sacrificial ram” for conduction of sacrifices-rituals. During the typical slaves days slaves were used for the protection of the village and market in Mamfe hence all entrances to quarters, houses, palaces boundaries and farm-roads. The enslaved were in charged and duty conscious of these activities. The *Mbokondem*, *Nsibiri*, *Ejo* and *Ndem* for women often exercise cultural functions. Enslavement is look upon as a cultural prestige, and some of these families were *Abane*, *akasa*, *Ako nchenge*, *Asingbong*, *Atu Agortarko*, *Atu Enow*, *Mbengn* *Atu Kachang* and others. A name such as *Nsem* means slave, “*Nyengkap*” (chattel), and *Mbeasik* (descendant of slave).³⁶ Out of traditional observances and rituals, the also existed other forms of enslavement in the Mamfe area. But, before elaborating on this form of enslavement it shall be necessary to lay emphasis on the conduct mechanism of this enslavement to the Mamfe areas. Due to the aforementioned traditional forms of enslavement, the also survived translocal frontiers manifestation.³⁷

3.1.5-Marriage Barriers

Marriages in the Mamfe area between the free born and the slaves population are facing serious problems. It has been a bone of contention. The enslaved continuously faced enslavement while the freeborn remain freed. An interviewed person exclaimed.³⁸

“I can never get married to a slave class. God forbid, what has a freeborn got to do with a slave, two ends of different subject, no! They are parallel and must move separately. It can't just meet. No matter what, nothing can change it.”³⁹

³⁵ This became grotesque realism that incorporate violence in the exercise that suggested the performances remember violence as Argenti goes on to argue that such performances are not memorizing histories. The masked dances are not organized according to the king time but according to the king time but according to time of the people that is non-sequential and “ghostly” in its recurrent returns in the present. It involves Mimetic of Violence, transformation presenting in the bodies of the people.

³⁶ V J Ngoh and E S D Fomin, *Slave Settlement* ... p, 21 and 83.

³⁷ UTE. Rosenthaler, “Tranlocal Culture ...”p, 71 and Nicolas Argenti and UTE Rosenthaler; “Introduction between ...” p, 76.

³⁸ Interview with Mary Agbor at Mamfe.2008.

³⁹ Interview with Mary Agbor at Mamfe.2008.

Due to the fact that slaves formed the lower class of the Mamfe people hardly do they interact with the freeborn. This could be one of the reasons for the engagement in much prostitution hence they can only be married with strangers and foreigners out from the Mamfe area. These modalities of marriage restriction before someone is married in Mamfe, he or she must examine the other family lineage to avoid falling into a slave family. If accidentally married the whole married family automatically becomes enslaved and have very little say in the community affairs thus a means of enslavement. For instance, the Atlantic trade, the legitimate trade, the dissemination of Islam and Christianity... For instance ... marriage has historically constituted a protective practice against the dangers of the slave trade, yet it simultaneously rendered married women into potential channels of the wife as ... remembers the slave trade. Men, to this day, defend themselves, afraid of the darkness that renders women unknowable. If gender can thus be understood as memory of the slave trade, memory is also gendered.

Marriage has been examine as a protective practice against the danger of the slave trade, this is so in historical perspective in the Mamfe area because the secrecy of women powers in line to the slaves that were known to be witches and wizard from within and outside thus renders women unknowable which in the Mamfe areas enclose it to be enslavement. This has been detected to be understood as memory of enslavement as memory itself is also gendered as is the case with the Mamfe area in Cameroon.

3.1.6-Wars

Wars as denoted by Meillassoux, Miers, Kopytoff and Northrup (1981) were a means of enslavement out of the “sorcellerie” witches, “*Kong*” of Douala and “*famla*” of the Bamileke region. Warnier in, *la Traite Sans Raids au Cameroon* gives us the means and purposes of wars on a global perspective.⁴⁰

It is crystal clear that slaves were used mostly in wars of honours to create and expand chiefdoms, therefore villages, clans and ethnic groups. This war was not only to capture and kill people but was also to enslave people captured to use them to work, enlarging their kingdoms or territories. But, it has been generally noted that, the wars of capture of slaves actually took place in the Mamfe area but its main purpose or goal was to enslave. It should be noted that forms of enslavement by wars, by using arms, slaves threat or population and different parented depend on region

⁴⁰ J P Warnier, « Traite sans raid au Cameroon ... » p, 23.

without macro-sociology of African enslavement as viewed in a number of years founded now on the study of micro-sociology and regional domain as explain as those hereditary. Therefore, in the Mamfe region a man or woman whose ancestors were slaves, the children and grand children, great grand children also became slaves hence those lineages never comes out of enslavement and marriage with the free-born and slaves are restricted.

3.1.7-Voluntary Slavery.

Another glaring form of enslavement is “voluntary slavery”. According to the League of Nations Report on slavery in the Mamfe Division dated 18th December, 1936 states in article 5:

It is not difficult to understand why these persons are content to remain in a position of voluntary slavery. They have been in their present surroundings for generations. They are now under no obligations whatever to their “Master” they are treated as ordinary human being.⁴¹

According to the above quotation it is glaringly clear that, some of these slaves have willingly decided to stay in their initial normal and neglecting positions of slavery which they could openly ask for their liberation by making themselves known in the society. If they are incapable, others could make them come out in their present malice as their offspring will be, protected. Zingraphs tour in this region noted that the exist abundance of association and cult agencies, prevailed in this vast forest between the Grassfield and the Atlantic coast, he said,

“The slaves are in their numbers and very muscular than their masters, they could easily beat them and get free themselves”⁴²

Nicolas Argenti and U T E Roschenthaler seeks here to explain the fact that they have the capabilities to let themselves free but some love their state and will like to continue leaving in such a situation which they fine enough for them in all conditions as also stipulated above in the article.⁴³

⁴¹ NAB, Slave Dealing. The Provincial Court Holden at Mamfe on the 4th day of February 1924.

⁴² Nicolas Argenti and U T E Roschenthaler, Introduction: Between Cameroon and Cuba: Youth, Slave Trade and Translocal Memory capes. In *Social Anthropology. European Association of Social Anthropologists*. United Kingdom, 2006. P, 40.

⁴³ Ibid.

3.1.8-Other Related Forms of Enslavements in the Mamfe Area.

3.2.1-Pawning

In the Mamfe Division, Pawn became legal and it was indiscriminate, a man or a woman can pawn a man, woman, child without others concern thus debts and their recovery.⁴⁴ The general notion was that, only maternal relations can pawn others, a father cannot pawn his own child born of a free woman but the mother of the child can pawn the child born of the maternal relatives of the child, a father can pawn his own child born of the slave woman who he has made his wife, a more common form of pawn of adult is for the person pawned to live in his own house and to render service to the lender of days work every five days (that is, every “week”). This slave tradition renders humanity a product, which was not good and demanded no encouragement.⁴⁵

3.2.2-Stealing

By stealing, seizing, selling and buying, (Suh Hillary S, 2009, P. 120.) The act of stealing could be best explained in the Mamfe area where children were missing, even nowadays children are stolen every day. This situation started long ago as explained by this sentence confirmation in, case no 94/1925, in a Provincial Court held at Obonye on the 3rd of December 1925 under SDO Rutherford hence Rex versus (1) Mbwayina (2) Tabe Ndbaw of Obonye and case no 37, 1926 held at Mamfe on the 6th day of June 1926 before Mr. L L Cantel Acting District Officer holding power, Rex versus Aba Mbaane of Obonye 1 were all charge for child stealing. According to the case, they were judged and found guilty of stealing a child.

3.2.3-Seizing

Furthermore, seizing and treating of a child was usually on debt cases. For example, a slave Abandi (f) of Ntakwo between September, 1923 and January, 1924 was stolen by the accused Anji of Amasi which he admitted seizing the young girl Abandi in justification that he requested a slave

⁴⁴ NAB-Annual Report Downing Street, Sa 1923/16 of 12 December. 1922 Confidential copy, Nigeria from S/D Devonshire to Sir Hugh Clifford GC, MG, Compilation by Mr. Hargrove.

⁴⁵ According to a report from Downing Street dated 12th December 1892, a copy Nigeria in a confidential letter from Senior divisional Officer; Devonshire to Governor, Sir Hugh Clifford, G c M. stipulated in part 1, chapter 10, Pages 1436-1438 impact of slavery and slave Trade on debt and their recovery.

which he paid for but no slave was given him, so he had to seize and treat the girl Abandi as slave.⁴⁶

3.2.4-Selling

Also, selling and buying was another dimension to enslave someone, hence Anji substantiated that he gave money to one man named Ekiri of Abandi's country to buy him a slave, he took the money for himself and did not repay him, so he decided to seized their child to recoup himself, which he kept "here" for five months until police aid, that came and release the girl thus means of enslavement.⁴⁷

3.2.5-Buying

Buying, according to (Martin A. Klein, 2001) and (J P Warnier, 1995) explained that the coastal slave dealers still came up to the Mamfe area with head loads of goods, stayed there for two months and went down again with an average of 20-25 slaves carrying goods. In the decentralization societies of the forest regions slaves were rarely sold in market places but rather by private arrangement and in the darkness of night. By this time, the slave trade was more hidden and organized by net-works shrine or secret societies such as Ekpe. Not all the slaves abducted in the grassfield reached as far as the slave ship. Many remained dislocated on the continent like Children under captivity.

V. STRATEGIES TO COMBAT ENSLAVEMENT IN MAMFE AREA

According to and in the Supplementary Convention on the Abolition of slavery and Slave trade and Institutions and Practices similar to slavery adopted by a Conference of plenipotentiaries convened on 30th April 1956 at Geneva, on 7th September 1956 that went into full force or operational on 30th April 1957 stipulated in section one article one that, "...to bring about progressively and as soon as possible the complete abolition or not they are covered by the definition of slavery...signed at Geneva on 25th September 1926...

(c)Any institution or practice whereby:

(i)A woman, without the right to refuse, is promised or given in marriage on payment of a consideration in money or in kind to her parents, guardian, family or any other person or group; or

(ii)The husband of a woman, his family, or his clan, has the right to transfer her to another person for value received or otherwise; or

(iii)A woman on the death of her husband is liable to be inherited by another person;" all these falls under the act of Slavery and slave trade in case of it disrespect or practically enforcement.(U N O , S C S S T I P S S , PP.1-2)

Here, a freeborn or a slave should have the right to select or chose the one he or she love indiscriminately either from the Freeborn or the slave class. Before the eighteen century, there is no evidence to prove that slavery came under serious attack or was combated especially in the Mamfe area. According to the panoramic view on patterns of Emancipation" Christ insisted on the equality of all before God and Christianity experience much of its early success among the disenfranchised of the Roman Empire". Churches should extend their tentacles and reach this area in more "vague" and preach to humanity the commandments of God. Church "Priest" should accept or embrace the institutions of states and societies hence needed framework for putting in order by controlling sin and allowing the religious institutions to perform its sacramental functions that will enable the people to reason as one and embrace each destiny.⁴⁸ Furthermore, Martin A Klein quoted Hunwich as means to show respect for humanity in Muslim point of view or light.⁴⁹

"Fear God in the matter of your slaves. Feed them with what you eat and cloth the slave with what you wear and do not give them work beyond their capacity. Those whom you like refrain, and those whom you dislike sell. Do not cause pain to God's creation. He caused you to own them and had them. He so wished, he would have caused them to own you"⁵⁰

Here, justification for the enslavement of people in the various forms should be wantonly rebuffed because it's the existing world of exploitation and suffering in the Mamfe region. This hell can also be refused by bringing to effect, putting in place the Muslim act under the code 25 of 1917 that dealt with children liberation under fifteen years old and the system of holding persons for debt which presently is still

⁴⁶ NAB, Political Sa/1926/3 file, No 119/1926. Mamfe Criminal case 37/1926.

⁴⁷ NAB, Slave Dealing. The Provincial Court Holden at Mamfe on the 4th day of February 1924.

⁴⁸ Martin A. Klein, "Introduction; Modern European Expansion and Traditional Servitude in Africa and Asia." In *Breaking the Chains, Slavery, Bondage, and Emancipation in Modern Africa and Asia*. 1993. P, 14.

⁴⁹ Ibid. p, 2.

⁵⁰ Hunwich, 1988. P, 10 and Martin Klein; "Introduction: Modern European ..."p, 14.

existing as a man will allow her daughter to get married to a rich man because he was and may be indebted to him, an indirect means to pay his debt. This is included under the code (369) in Nigeria hence “slave dealing”.⁵¹

Furthermore, another glaring mood of eradicating slavery and slave trade or related forms of enslavement in the Mamfe area is to establish more abolition movements like that of the abolition of England slavery that was illegal and became abolished in 1772 and by the end of the century Upper Canada and most of the Northern United States had taken action against slavery. The renovation in France in 1794 was geared toward the abolition of colonial slavery. The American constitution provided for the end of slave imports in 1808 while the Danes abolished the colonial slave trade in 1803, Britain in 1807, the Dutch in 1814. In Cameroon 1923 and series of convention under the League of Nations Report via convention, the United Nations Penitentiary convention on slavery and slave trade and other related forms of slavery. If all these abolition application is resented in the Mamfe area, the forms of enslavement will gradually disappear or come to an end. Due to the fact that slavery was immoral, as a single movement was equation to bondage and backwardness.⁵²

Additionally, usually poverty and famine has been the backbone in precipitation of the rampant means of enforcing enslavement in our various communities worldwide and in Mamfe.⁵³ Multi-national investment should be focus on development and on individual families, revealed to be a slave or decadence of slaves. More so, if so well instituted those under this “cage forum” will come out for their ameliorations. This could help to reduce the poverty rate and create employment to those living in bondage that the government agreed unofficially to allow slavery to be re-established for the new arrival, while in public it stuck to its contract, labour which envisage paying the owners of the slaves freed in 1875, instead measures should be taken to punish slaves owners as a means of discouraging the slavery.

⁵¹ NAB, South West Province, Memo-Slavery (forced labour and c.s.a 1918/2, disposal of Freed Slave Children.

⁵² (...) There was a moment between 1775 and 1783 when parliament was called upon to consider one element of the slave system relative independent of its policy toward the United States. ... with every other quarter of the globe. Seymour Drescher, *Abolition; A History of slavery and Anti-slavery* Cambridge University Press, New York, 2009.p, 119.

⁵³ (...) Debates over slavery varied in different parts of the empire. P,19. In Britain, the interest aroused by the Somerset case and Colonial agitation for slave trade abolition after 1772 were adversely affected by the outbreak of hostilities.

Workers salaries in plantations in and around this region should be added not to their proprietors, directors, and managers auspices but directly, from the donors to the slaves. Experts should guard them from masters-servants relations and make special laws that will control over their payment “money”. Their children will be better taken care of, so well done. The donor society could even extend her assistance in seeking nice decent jobs with good salary and even use them to continue crusading against forms of enslavement. All the above could reduce our attachment to sort slaves to better their gloomy past and present conditions.⁵⁴

Even though slave trade was a clandestine importation of labour from about 1900, organized by Canoe owners who had for centuries been deeply involved in the slave trade of the oil rivers and the Crosse rivers, slavery was entirely absent from the Kamerun plantation zones. Whether this ever was done is not clear, but it is certain that many of the workers known were actually slaves subcontracted by the Bali and other chiefs to the planters. The Germans checked only external not internal slavery. Comey and dash were given and could still be added so that persons of slave statute should be compensated or well paid to come out of slavery.⁵⁵

Slaves should be sent back and their masters should not confiscate their merge salaries. It is possible that survivors can returned for further contracts in the plantations. Modern methods of slave raiding, especially at the expense of the dense populations of the Grassfield should come to an end. The Bali and others pacification and it's Corollary, base on ending the slave raiding.⁵⁶

Important slave routes should be traced across territories and improve. Slave should be all free if they entered into some territories. Settlement “Free Zones” many should be created “Free Zones” well constructed. They will come out in their number and receive better conditions in nice and comfortable houses. More agreement pact and treaties should be signed with chiefs and head of states and put in practice indicating end of enslavement. The existing slaves should be paid by donors while they continue to work domestically

⁵⁴ Martin A Klein, discussion with student of masters and Ph D University of Dschang. West Province Cameroon on the 21st of December 2011 at 9 AM to 1.30 PM. Opinion, evaluation on the means or methods to solve slaves problems.

⁵⁵ William Gervase Clarence-smith, “cocoa plantations coerced labour in the Gulf of Guinea, 187-1914,” In *Breaking the Chains Slavery, Bondage and Emancipation in modern Africa and Asia* (ed. Martin A. Klein.) The University of Winconsin Press, Madison, London. 1993. p,160.

⁵⁶ Ibid.

depending on the evolution carried out to better their conditions for some length of time. He can decide to stay where he is, if he wishes to stay at spots and give his or her loyalty. They can still trace their origin and come back for permanent stay and effectively carryout sensitization of the havoc in our societies such as that of Mamfe area in Cameroon.⁵⁷

An appropriate defensive strategy in Africa as suggested by Martin A Klein was the architecture that made it difficult for attackers to take prisoners even if they succeeded in entering a fortified village. This means has been very effective, it should be enforced.⁵⁸ Nowadays, it will be necessary and good for us to build nice comfortable flat encircle with fence and good jobs provided to trace slaves in Africa.⁵⁹

Furthermore,(John N Oriji,2004,pp.121-131), (Ismail Rashid,2004,pp.132-151), (Walter Hawthorne,2004,pp.152-169), (Joseph E. Inkori,2004,pp.170-198, 199-118), (Carolyn A. Brown,2004,pp. 219-225) and (Paul E. lovejoy and David Richardson ,2004,pp.101-118) in Fighting the slave Trade as West Africa Strategies, brought forth modalities that all boils at letting loose the slaves and revamp the standard of their living conditions. The prime intentions of William Wilberforce, Granville Sharp, Thomas Clarkson and Buxtons that was at the time remedies, solutions to the assessment of the extent problem on slavery and the slave trade could still be revised and applied. Ending of Apprenticeship, House-Helps, shop-helps, should received better payment and good working conditions in Africa and Mamfe.⁶⁰

⁵⁷ Claris Achu in CRTV News reiterated on the Comeback of some blacks Americans after having been undergone the G N A Test and result was positive. They are said to have originated in Cameroon at the Bimbia area where slavery and the slave trade was highly practiced. CRTV News 2nd of January 2011.

⁵⁸ Martin A Klein, "Defensive strategies Wasulu, Masina and the slave trade." In *Fighting the Slave Trade. West Africa Strategies*. (ed. Sylviane A. Diouf) Ohio University Press, United Kingdom, 2004.p. 62.

⁵⁹ Interview with Etah Henry, Limbe on the 28th of December 2010.

⁶⁰ Buxton's response has already been noted. The slave trade and its Remedy was the first detailed treatment of the issue by an abolitionist for many years and the most damning attack so far made by anyone on the official policy ... Buxton has been critical of the suppression policy. Others went much further. Not only, it second to them was Britain failing to check the traffic; she was actually making it worse... for economic reasons, to keep mortality to a minimum. Howard Temperly, *British Anti Slavery 1833-1870*, Longman, London 1972.p, 169. Therefore, not only the American

Another glaring process which can be use is the broader process, as a technique through propaganda, petitioning and association that will involve organizational techniques of mercantile and manufacturing lobbyists. This will serve as a means of converting public pressure into law and policy which has been neglected under the United Nations Convention on the Abolition of Slavery and the trade and other related act of forms of enslavement during slave trafficking. This could be reiterated via Colloquium, Conferences, associations, Libraries, debating societies, pamphlets, Novels, Public meetings, ongoing discussions and petitions to the national legislature since this is an act against religious norms, Religious bodies should articulate distaste and crusade on this deviance for popular mobilization.⁶¹ Thomas Clarkson was completely unaware of Granville Sharps decades' activity. Only on reacting, he discovered, small band of Evangelicals who were also to play a large role under James Ramsay who has been furnished for the cause.⁶²

VI. CONCLUSION

In the nutshell, this piece of work on the forms of enslavement in Mamfe Area 1900-2010 has been rotating on the following Axis; A General View of Mamfe Area, The Origin of Enslavement in Mamfe Area, Forms of Enslavement in Mamfe Area and the Strategies to combat Enslavement in the Mamfe Area. Decadences of slaves remain victims of prejudice. These different circumstances in which people were enslave is not good so it will be interesting if some actions be taken to erase the harsh treatment of humankind in our societies and that of Mamfe. It will be interesting if we can revamp and bring to effect once more, emancipating methods made to abolish slave trade. Furthermore, we can deduce from the attempted solution to draw best and concrete ways in which one could use as remedies to end the act of enslavement and better the lives of slaves, knowing the slaves. This will demand further research to know how we can trace the roots of slaves and solve their problems globally and individually. The slave trade led to profound changes in the Mamfe area. It actually

Continent should face this fight nowadays, the most essential British society need to react promptly.

⁶¹ Information and financial networks of the initial abolitionist movement such as Quaker Organization in Britain became more apparent anti-slave trade committee.

⁶² Seymour Drescher, *Abolition: A History of Slavery and Anti Slavery*. Cambridge University Press, New York, America 2009. P, 211. These remedies should take diverse forms to better solve the problems of enslavement.

made great changes in the political, economic and social structures as were deeply shaken. The violent brought about incessant wars, a direct result of the hunt for men, women and children. This has got negative impact on the people thus defensive and protective strategies should be applied. Presently, it will be interesting to protect the continues fight for the abolition by examining methods, strategies to assist the predecessors of the slaves, based on the rational management of their environment. The desiring compensation should geared improving the lives and vicinity of these people and those victims' offspring. This has negative impact on the people thus *defensive, protective and offensive* strategies should be applied. What measures can be use to completely end slavery in the ongoing contemporary Mamfe Area?

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Slope Instability Monitoring by Using Distributed Optical Fiber

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Abstract— Mass movements are often associated with periods of heavy rainfall that penetrate the ground causing a reduction in its shear strength parameters and generating instabilities that can lead to rupture. These instabilities when in densely populated areas can cause catastrophic occurrences with loss of human life and environmental and economic damage. This article discusses the results of ground strain measurement obtained by using a special optical cable and a Distributed Temperature and Strain Sensor (DTSS) unit. The optical cable was installed on a slope in São Paulo state, Brazil. Optical fiber technology allows instantaneous and periodic monitoring of surface strain evolution that occurs over a wide area, complementing traditional geotechnical instrumentation, made up of punctual and manual measurements, which is prone to error and requires more time for verification. The optical cable used for this study acts as an intrinsic sensor, where the cable itself acts as a sensor element, thus performing the function of receiving and transmitting information, unlike other sensors, called extrinsic, which only transmit information from a point sensor. The optical fiber sensor used are lightweight, malleable and immune to electromagnetic interference, making them ideal because they are rugged and allow for practical control and reliable results. For the optical cable analyzed for this article, the maximum strain variation and maximum strain relief values were 1528.29 microstrains and -2867.69 microstrains, respectively.

Keywords— DTSS, Geotechnical Monitoring, Optical Fibers.

I. INTRODUCTION

Slopes are often located in areas with large concentrations of people close to linear civil structures such as highways, railways and pipelines. In the case of pipelines crossing sloped regions like mountain sides there might be complications if mass movements occur. If the pipeline is damaged by the mass movement it is at risk of rupture. Then, the fluid carried by pipeline when leaking may contaminate the soil and water or cause fires and explosions. When the fluid contaminates the soil and water, with natural occurrences of rainfall, groundwater and other external factors these fluids can be carried to other nearby areas affecting not only the region of the rupture. The ambiental, economic and social impact of an accident with a pipeline could be very detrimental to the development of communities, cities and states.

Slope instabilities become apparent before rupture, signs of instability tend to start slow and gradually over time tend to intensify until rupture occurs.

When properly positioned and monitored geotechnical equipment allows the collection of data and the analysis of parameters that may indicate signs of mass movements. When risk arise, the professionals assigned to the monitoring must be able to analyze these data and with appropriate techniques control or stabilize the mass movement. However, if measures are not met in time the professionals must apply fast contingency measures.

In order to contribute to the research to improve safety of pipelines crossing slopes a complement to the traditional geotechnical equipment was installed on a site. The slope that exhibit a known instability behavior in the past was instrumented with optical fibers layered about 30 centimeters below surface. This technology has revolutionized how we monitor mass movements by monitoring mass movements in order to facilitate decisions to help minimize catastrophic occurrences.

This article presents an abstract of preliminary mass movements measurements results over time. Full results

can be seen in a dissertation publication (PAULINO, 2020). That dissertation completes the objectives from a Research and Development job, evolved by Lactec with Petrobras financial support, which purpose is evaluating the use of optical fiber technology to monitoring geotechnical behavior of slope areas crossed by pipelines.

II. OPTICAL FIBER TECHNOLOGY

Since the 1960s optical fibers have been used in various ways of communication whether it be telecommunications, computer networking or long-distance communication (KREUZER, 2006). With the development of optical fibers, various ideas and techniques have been introduced and applied to different fields of studies and projects.

Optical fiber is a transparent and flexible cord that is made of either drawing glass or plastic. The optical fiber itself is encased in 2 concentric layers made of protective coating which consist of coating and cladding layers. Each layer is made and designed with a specific job and objective for the optic fiber to transmit light and read specific data points for the given project and company (KILGALLON, 2004). The most internal layer of the optical fiber is the core, made of silica, which center section is the light-transmitting region of the fiber. The middle layer as known as the cladding layer is also made of silica and this is the first layer that surrounds the core. This layer is important in helping the optical fiber completing its main objective of transmitting a light signal through the core. By creating an optical waveguide that helps confine the light in the core of the optical fiber it helps create total reflection at the core-cladding interface (KILGALLON, 2004). The coating layer is made of polymer and the purpose of this material is to protect the cladding and the core from external environmental damage. Based on what is asked of the company using optical fibers, other layers can be used as a protective barrier of external environmental damage. For example, in 2008 the company Fiberware, Mittweida (Germany) produced an external Polyvinyl chloride (PVC) layer, Kevlar layer, and PVC jacket layer (CHENG-YU et al., 2017).

The core layer can hold either multimode or singlemode fibers. Depending on what the specific projects call for, the optical fiber can be either multimode, singlemode or a combination of both fibers. Multimode fibers have the prefix “multi” because light rays travel through multiple paths called “modes”. Singlemode fibers allows light to travel straight through the fiber, according to the smaller diameter when compared to multimode fibers. Typically, the diameter of multimode and

singlemode fiber is broken into two diameters, the first measurement is for the core layer and the second measurement is for the cladding layer. Multimode have (50/125) μm or (62,5/125) μm and singlemode have (9/125) μm .

In addition, optical cables can be manufactured according to its application, which may indicate different layers with different amounts of optical fibers in its interior. The most traditional optical cable types are tight buffered and loose tube cables. In Tight Buffered cables each fiber composed by core and cladding layers receives a thermoplastic coating layer, which keeps the fiber attached to this layer. Then, the fibers are grouped inside a traction element, like Kevlar, which protects the other layers against physical damage.

In the case of loose tube cables, the coating layer placed around the fiber have a much larger internal diameter than the fiber, that means fiber is free within optical cable subunits. Then, the space between the subunit and the fiber is filled with a gel that allows free movement of the fiber within the tube. This type of cable is widely used when it is intended to evaluate the temperature variations suffered by the fiber, because they are free, the fibers do not suffer interference from strain, for example.

For a better understanding of optical fibers, one must know the importance of bandwidth and the role it plays in singlemode and multimode fiber. Bandwidth is the data-carrying capacity of an optical fiber, it is a product of distance and frequency (KILGALLON, 2004). Because light in multimode fibers take different paths in the core of the fiber there is a risk in mixing the fibers information. This could lead to unrecoverable information at the exit of the fiber, that is why the information in these fibers must be sufficiently spaced, differently from the singlemode fibers, where the information can be closer because light propagates in just one mode.

With the growing use of optical fibers, it is beneficial to know the advantages and disadvantages of the technology. Optical fibers have increased bandwidth which allows for greater information-carrying capacity, the fiber also provides lower attenuation than copper conductors. In the process the optical fibers allow for fewer repeaters, this allows the optical fiber to transmit information over long distances. Optical fibers also have decreased sizes compared to other transmitting material. Optical fibers are lightweight and easy to transport, compared to copper its approximately 10 to 15 times lighter; it also allows for easier and faster installation (KILGALLON, 2004). In contrast, optical fibers are rather fragile and over long distances of connection optical fibers

can become more vulnerable to damage compared to copper wiring. Optical fibers can also malfunction if the pigtail connection in any way get disconnected, dirty or gets damaged, usually the pigtail is connected to a system; for example, DTSS. This system tracks and keeps a count of deformation suffered by the optical fiber.

In Brazil, Lactec, one of the largest centers of science and technology, a reference in development and innovation, conducts research and development projects in partnership with companies from different areas, focusing on proposing technological solutions to some existing problems. In the geotechnical area, regarding the main theme of this article, optical fiber technology, Lactec engineers, researchers and former students from Lactec postgraduate program has already developed and published a lot of relevant documents regarding the use and improvement of the technology in the tracking of mass movements. Among these documents, it is possible to cite dissertations from Buras (2013), Silveira (2017) and Favaro (2018).

In the dissertation of Buras (2013), the development of a mass movement areas identification system through fiber optic technology using DTSS is presented. The author performed specific experiments to simulate mass movements in the laboratory, where the unstable zone was identified through the deformation of an optical cable installed in the ground. The results obtained by Buras in the laboratory allowed the estimation of an effective theoretical model for the identification of stable and unstable areas on a slope by installing distributed optical fiber sensors in trenches excavated on the slope face, longitudinally, transversely or both ways.

Silveira (2017) in his dissertation exposes his methodology to analyze deformation monitoring data of a natural slope crossed by a pipeline. Following the rupture of a pipeline in 2001 due to mass movement, in August

2014 Lactec installed distributed optical fiber sensors on that slope, in the context of one of Lactec's numerous research and development projects developed in partnership with Petrobras and Transpetro. Data were collected between January 2015 and May 2016 with DTSS equipment and treated using MatLab, Excel and Surfer software. The results indicated that the slope suffered strain of 784 microstrains and strain relief of -515 microstrains. According to the author, the recorded values are relatively low and, being a methodology applied in experimental phase, it cannot be affirmed if such deformations correspond to displacements in the slope.

Favaro (2018) describes in his dissertation the procedures for instrumentation and monitoring strain in a slope crossed by a pipeline. In addition to soil characterization laboratory tests, an optical cable was installed on the slope face in the longitudinal and transverse direction, producing an optical fiber mesh, according to the theoretical model suggested by Buras (2013). Monitoring was performed on four different dates using the DTSS equipment. The data obtained were compiled with Matlab software and the results showed relatively small deformations with strain of 1334.04 microstrains for the longitudinal stretch and 940.62 microstrains for the transverse stretch and strain relief of -1137.74 microstrains for the longitudinal stretch and -881.21 microstrains for the transverse stretch. The author concludes that these values do not allow to affirm whether such deformations indicate movements on the slope.

In addition, were also published articles, project reports and several event participations, linked to research and development projects, which form a constant basis to further expand this knowledge and were fundamental for writing this article. A summary of those publications can be seen on TABLE 1.

Table 1: Summary of optical fiber publications

Author	Title	Objective
Buras, Silveira and Rocha, 2014	Laboratory tests for monitoring natural slopes with fiber optic technology [Testes de laboratório para o monitoramento de encostas naturais com a tecnologia de fibra óptica]	The authors developed a split metal box (shear box) and specific anchor systems in laboratory to evaluate the efficiency of distributed optical fiber sensors for mass movement monitoring after their installation on an unstable natural slope using the DTSS equipment
Marocki et al., 2015	Water level instrumentation based on fiber optic technology [Medidores de nível d'água com base na tecnologia de fibra óptica]	This research focused on the installation, field testing and monitoring of geotechnical instrumentation based on optical fiber technology for ground water level measurement
Silveira, Pretto and Buras, 2016	Technical Report 3 - R&D - ANP Project title: R&D Slope Slip Risk Analysis, Using Optical Fiber Geotechnical Instrumentation and Interactive Modeling (Process 2014 / 00442-6) [Relatório Técnico 3 - P&D - ANP Título do projeto: P&D Análise De Risco De Escorregamentos De Taludes, Utilizando Instrumentação Geotécnica De Fibra Óptica E Modelagem Interativa (Processo 2014/00442-6)]	This report, which covered the period from April 5, 2016 to August 10, 2016, presents the study areas (Parana, Santa Catarina, São Paulo and Rio de Janeiro states) covered by the project. Location data related to the areas and laboratory tests results for the soil of the slopes in question are presented. Interactive modeling and strain results for one of the selected slopes (Parana state) were also presented
Silveira, Buras and Pretto, 2017	Technical Report 4 - R&D - ANP Project title: R&D Slope Slip Risk Analysis, Using Optical Fiber Geotechnical Instrumentation and Interactive Modeling (Process 2014 / 00442-6) [Relatório Técnico 4 - P&D - ANP Título do projeto: P&D Análise De Risco De Escorregamentos De Taludes, Utilizando Instrumentação Geotécnica De Fibra Óptica E Modelagem Interativa (Processo 2014/00442-6)]	Continued from report 3, this report, from August 11, 2016 to January 25, 2017, presents data for the second selected slope (Santa Catarina state). It is possible to find the area topographic survey and the procedures for installing the optical cable on the slope, as well as the installation of the water level meter and piezometer
Buras et al., 2017a	Technical Report 5 - R&D - ANP Project title: R&D Slope Slip Risk Analysis, Using Optical Fiber Geotechnical Instrumentation and Interactive Modeling (Process 2014 / 00442-6) [Relatório Técnico 5 - P&D - ANP Título do projeto: P&D Análise De Risco De Escorregamentos De Taludes, Utilizando Instrumentação Geotécnica De Fibra Óptica E Modelagem Interativa (Processo 2014/00442-6)]	Continued from report 4, this new report, which runs from January 25, 2017 to June 19, 2017, presents the installation of the optical cable on the two remaining slopes (São Paulo and Rio de Janeiro states). The procedures for checking optical cable integrity for slope strain measurements in Santa Catarina state are presented. It is also informed that augmented reality will be used in the next steps of geotechnical monitoring of the project slopes

Author	Title	Objective
Favaro et al., 2018a	Geotechnical monitoring through fiber optic technology to assess the deformations of a hillside in Serra do Mar, Santa Catarina [Monitoramento geotécnico através da tecnologia de fibra óptica para avaliação das deformações de uma encosta da Serra do Mar catarinense]	This article presents the installation method developed and the data obtained in the strain monitoring using distributed optical fiber technology from a slope crossed by a pipeline operated by Transpetro in Santa Catarina state
Buras et al., 2018b	Technical Report 6 - R&D - ANP Project title: R&D Risk Analysis of Slope Regulations, Using Optical Fiber Geotechnical Instrumentation and Interactive Modeling (Process 2014 / 00442-6) [Relatório Técnico 6 - P&D - ANP Título do projeto: P&D Análise De Risco De Escorregamentos De Taludes, Utilizando Instrumentação Geotécnica De Fibra Óptica E Modelagem Interativa (Processo 2014/00442-6)]	Continued from report 5, this new report, from June 20, 2017 to December 22, 2017, presents the installation of geomechanical tube for water level measurements in a water level meter and piezometer (Santa Catarina state), the methodology of flow analysis and slope stability, scope and testing of augmented reality application, as well as some of obtained results

III. DISTRIBUTED SENSING SYSTEM

Distributed sensing systems monitor several different quantities using different technologies for analysis. This article will cover DTSS system.

With this equipment it is possible to monitor temperature and strain over long distances and on various surfaces. This equipment uses optical fiber as a sensor element.

The main benefit in using that equipment together with optical cables is in providing temperature and strain profiles along the entire optical cable rather than obtaining punctual information as in the inclinometer.

3.1 DTSS

Distributed Temperature and Strain Sensor (DTSS) is one technology used for determining the temperature and deformation in an optical fiber cable.

Over time and with contributions of natural disasters and occurrences, events like earthquakes and ground conditions can be monitored over time. With mass movements, the deformation of land can be plotted using a strain versus displacement graph. Using this form of measurement engineers can properly plot deformation of a landmass. If strain measurements are repeated multiple times on the graph, engineers or technicians can take the proper precautions to ensure the safety of the general public and structure.

A technology discovered by French physicist Léon Brillouin that is used in DTSS is Brillouin scattering, which is a type of light pattern shown in optical fiber. DTSS helps measure the entire Brillouin spectrum which in the process helps the DTSS make calculations and measurements. DTSS helps provide temperature and strain observations over a duration of time. This function within the DTSS provides real-time changes within a structure. After attaching the DTSS cable underground strain monitoring can be carried out for landslide and subsidence applications.

At the Korea Institute of Geoscience and Mineral Resources (KIGAM) optical fiber cables were experimented. Because the experiment at the university was tested in a small region of land, researchers had to improvise and used a pushing tool to activate a movement in the ground. Researchers would use weight and drop them on the surface of the test site to act as the abnormality that was introduced to the surface of the region being worked on. With the conclusion of the weight, experiment researchers discovered that DTSS will be an efficient, consistent and economical warning system for landslides and subsidence (KLUTH et al., 2006).

IV. STUDY AREA

The slope in question was selected by the Lactec research engineers together with Petrobras and Transpetro engineers, mainly because a containment structure in this area shows signs of past movements that were monitored and controlled in the upstream direction (Fig. 1).



Fig. 1: Containment structure with movement indications

The area is located on the side of a highway, and is shown in Fig. 2, where it is also possible to identify the representation of the optical cable path installed on the slope.

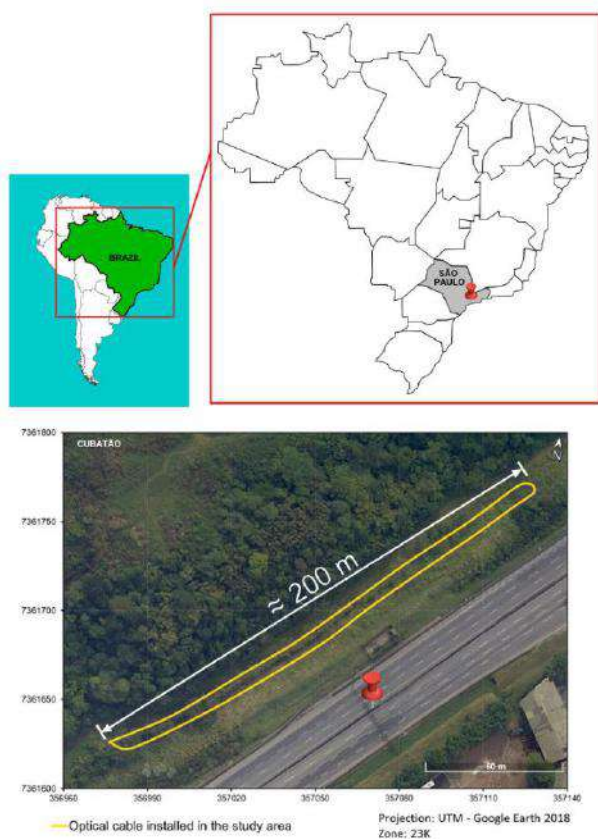


Fig. 2: Path of the optical cable in the study area

The slope was instrumented with almost 600 meters of optical cables. After the installation, a measurement was performed, which was later taken as a reference for future analysis. The equipment used on site was the DTSS from Sensornet. In subsequent campaigns, each measurement was followed by comparisons with the reference measurement values. Inside this equipment there are 407 optical sensors which when multiplied by the spatial resolution of this equipment results in 415.22 meters (407

x 1.0202) of optical cable. To this length must be added the length of the extension (50 meters) used to connect the equipment on site. All this length mentioned does not have influence in the analysis of the results. Thus, the data analysis takes place from 465.22 meters to 1028.36 meters and the preliminary results for a given length of optical cable are presented in the following item.

V. RESULTS AND DISCUSSION

Six measurement campaigns were carried out on June 11, July 12, August 9, September 13 and November 22, 2018 and March 21, 2019. As previously mentioned, on site almost 600 meters of optical cable were installed. This article presents some of the results along the optical cable.

The first campaign (June 11, 2018) was taken as a reference campaign for the other measurements. The data on this date were taken as zero as an initial slope condition and the cable pre-tensioned to allow ground compression measurements and consequently cable strain relief. Thus, the strain and stress relieve values found for the following campaigns correspond to the strain change between the deformations of the current campaign relative to the reference campaign. This way, taking the first measurement as a reference on June 11, 2018, it was possible to establish the strain variations for each campaign that followed.

Based on these variations, expressed in microstrains, six comparative images with a color scale were generated for the measurement campaigns.

In the images of Fig. 3, Fig. 4, Fig. 5, Fig. 6, Fig. 7 and Fig. 8, it is possible to see the color scale that indicates the amount of strain change between each campaign compared to the reference campaign, ranging from -5000 microstrains to +5000 microstrains, where warm tones (red) represent strain and cold tones (blue) represent strain relief. The yellow color has a value of zero, meaning that there are no variations between the strain in the analyzed campaign and the reference campaign. The longitude is informed on the horizontal axis, and the latitude on the vertical axis, both in UTM coordinates.

It should be noted that the campaign of June 11, 2018 was compared with itself, because as cited, the data on this day were taken as zero and used as a basis for calculating the strain variations in subsequent campaigns. That is why all the points in Fig. 3 are yellow, representing no strain change.

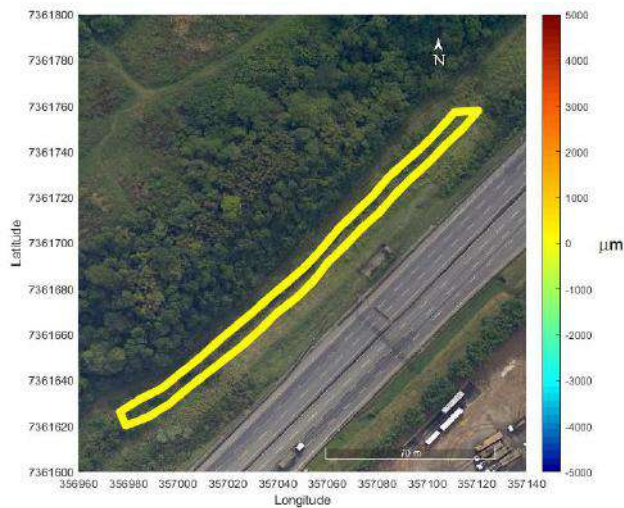


Fig. 3: Strain change between June 11, 2018 and June 11, 2018 (Reference)

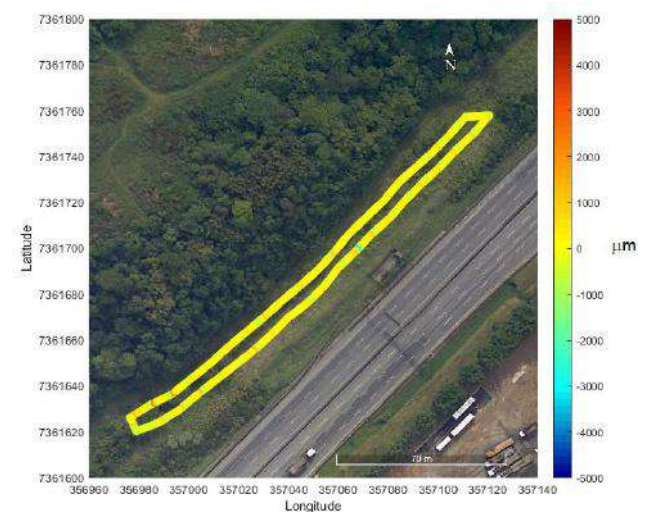


Fig. 6: Strain change between September 13, 2018 and June 11, 2018

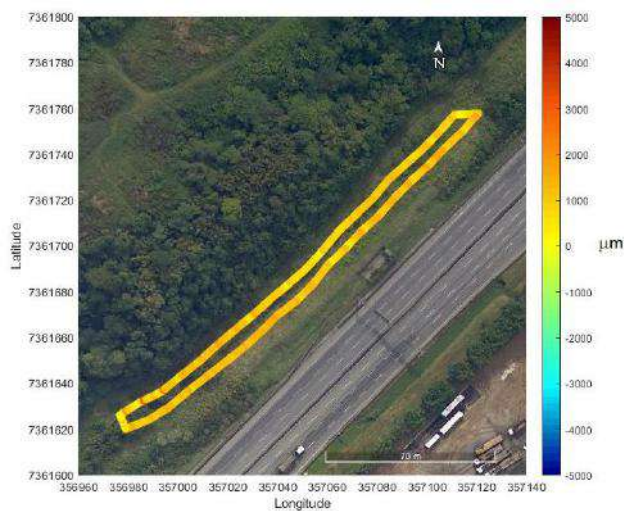


Fig. 4: Strain change between July 12, 2018 and June 11, 2018

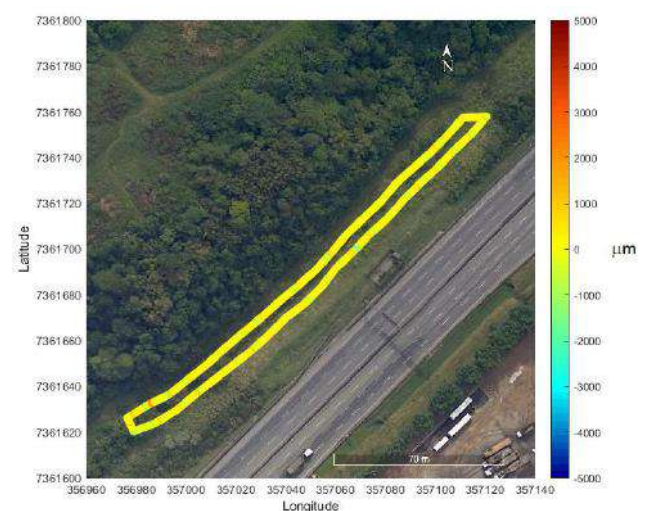


Fig. 7: Strain change between November 22, 2018 and June 11, 2018

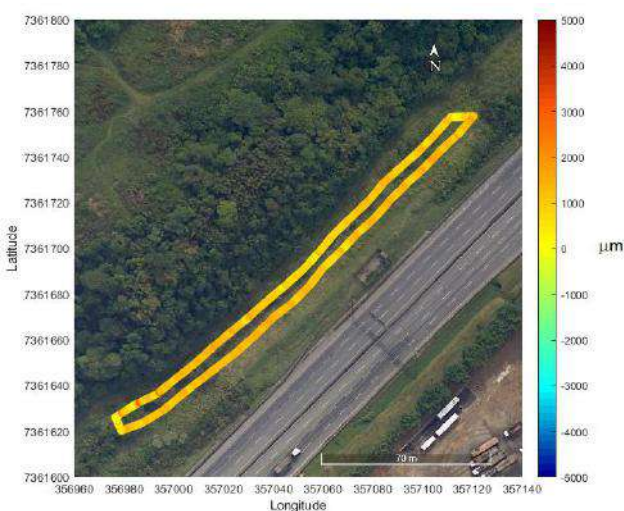


Fig. 5: Strain change between August 9, 2018 and June 11, 2018

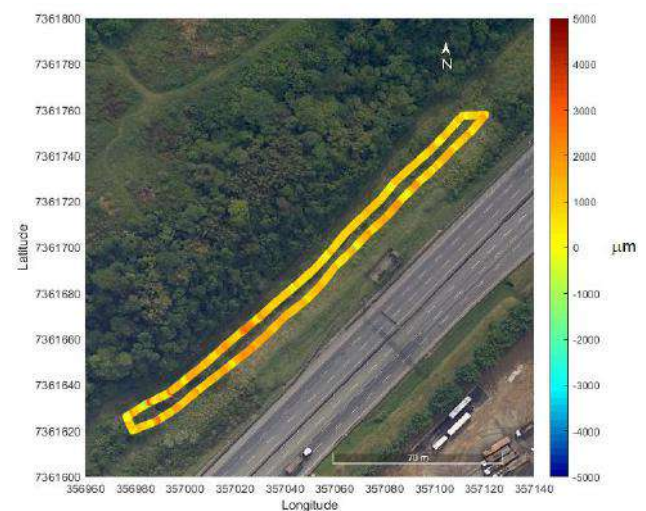


Fig. 8: Strain change between March 21, 2019 and June 11, 2018

Also, considering all the measurement campaigns, were selected four points that were responsible for the highest strain changes. The graph in Fig. 9 represents these points and the strain history suffered by them during the measurement campaigns.

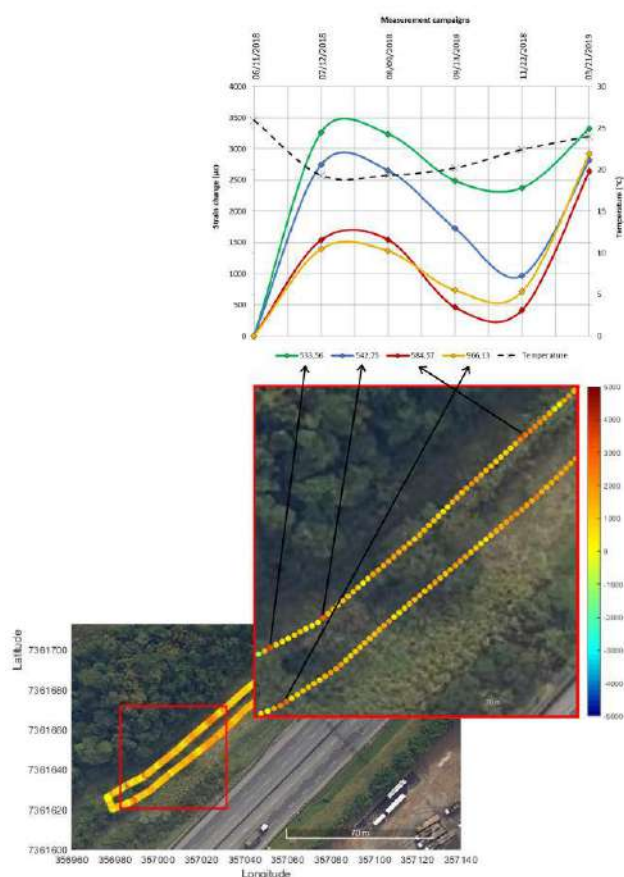


Fig. 9: Strain history for the lengths 533.56 m, 542.75 m, 584.57 m and 966.13 m

Considering the points presented and their strain history, the maximum strain was 3324.77 microstrains for the length 533.56 m. As can be seen, the same point suffered the largest strain variation in all the measurement campaigns compared to the other points according to the strain history in Fig. 9.

However, it is also important to note that the high strain variations between the first campaign (reference) and the second campaign may have occurred due to the cable re-fitting on the ground and the pre-tensioning during cable installation.

Due to these factors, it was decided to exclude the first measurement campaign and make the second measurement campaign as a reference for further strain analysis. Thus, it is possible to reduce errors arising from the re-fitting and pre-tensioning of the optical cable.

Thus, a new strain history (Fig. 10) was performed, including the points cited in the strain history of Fig. 9 in addition to another point: the one with the maximum strain relief (2867.69 microstrains) at 853.91 m.

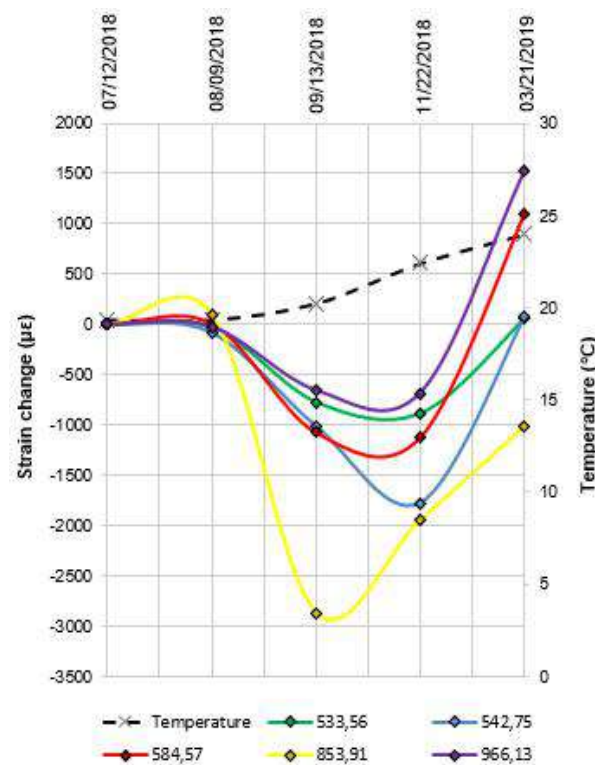


Fig. 10: Strain history for the lengths 533.56 m, 542.75 m, 584.57 m, 853.91 m and 966.13 m

As shown in Fig. 10, it is possible to notice that the strain variations between the new reference campaign and its subsequent measurement campaigns are very low, showing that the variations due to cable re-fitting and pre-tensioning were eliminated. Thus, the largest strain variation found was 1528.29 microstrains for the length of 966.13 m and the largest strain relief was -2867.69 microstrains for the length of 853.91 m.

Whereas 1000 microstrains corresponds to 0.1% strain or 1 mm/m, the maximum strain on this cable was 0.15% or 1.53 mm/m. However, although it is possible to represent such movement in mm/m, it is not possible to indicate the direction of movement.

As new measurement campaigns take place along with continuous follow-up, slope behavior will become more evident, allowing more knowledge about the performance of this geotechnical fiber optic instrumentation that will help easier decision making.

VI. CONCLUSION

This article presented the advances regarding slope geotechnical monitoring. The aim was to discuss the advantages and limitations of using optical fiber embedded in the soil to obtain internal strain profile.

From the data collected in the measurement campaigns, the data analyzed presented relatively small strain values (0.15%). The slope is moving, as visually perceived before cable installation, but so far there are no risks to the area in question as the conventional geotechnical instrumentation installed there shows. It is recommended that the slope continue to be monitored periodically by the new geotechnical fiber optic instrumentation and its data analyzed frequently.

Even with all the monitoring period and amount of data, despite the possibility of representing such movement in mm/m, it is not possible to indicate the direction of this movement and not even if the slope is really moving.

Also, the optical cable used on the slope in question allows to read strain up to 20000 microstrains. The maximum raw strain found across all the measurement campaigns was 4422.78 microstrains, reaching 22.11% of the optical cable readability.

In addition, compared to traditional geotechnical equipment, slope-mounted optical fiber technology leads to reduce installation and monitoring costs as a single cable and equipment is required to monitor a large area without the need for punctual and often difficult to access measurements.

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Ethnobotany of Medical Plants: Diversity and use in Brazilian Quilombol Communities

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Abstract— *ethnobotany has been an excellent research tool in understanding the various ways that relate physics, culture and spirituality to plants in traditional quilombol communities. Studies on medicinal plants, which demonstrate their diversity and use by quilombola communities, demonstrate their relevance, given factors such as cultural influence, ancient knowledge passed on to each generation bringing them to scientific knowledge. In this context, the present study aimed to conduct a survey on the diversity and use of medicinal plants by quilombola communities, through the review of articles from 2014 to 2019 obtained by the SciELO platform, LILACS and CAPES Magazine Portal. With the study, it is clear what is the importance or fundamental knowledge about the diversity and use of these medicinal plants, and the lack of knowledge of an important risk factor for poisoning for the residents of these communities, thus alerting the need for education and preventive activities, as well as the publication and dissemination of research with similar objectives, are those that best use above as their basic and nutritional needs.*

Keywords— *Quilombol community; Traditional knowledge; Phytotherapeutic species.*

I. INTRODUCTION

Ethnobotany can be understood as the study of human populations and their ecological, genetic, evolutionary, symbolic and cultural interactions with plants, which seeks to interrelate the two elements, the plant with structure-functions and the human being (REIS et al., 2017). In Brazil, phytotherapeutic science is a therapeutic practice encouraged by the Ministry of Health and has made considerable progress due to its proven effectiveness (SALES et al., 2015).

Brazil, in turn, a country resulting from the strong cultural influence of indigenous people mixed with African traditions, originating from three centuries of trafficking in black slaves and the European culture brought by the colonizers, brings with it a diversity of ethnic groups, many of those found in the northeast region (BARACUHY et al., 2014).

Biodiversity has been the subject of research in the ethnobiological and ethnoecological fields, in order to

assist local and regional development programs, as well as environmental conservation policies (BARACUHY et al., 2014). Many peoples associate the use of natural resources with their conservation, as they are directly dependent on these resources for their subsistence, economic and social development (LIMA et al., 2012). In this context, studies of medicinal plants in the semiarid region of Northeastern Brazil have grown progressively (REIS et al., 2017).

Medicinal plants, which are any vegetable that has substances that can be used for therapeutic purposes (Resolution CFN, 2007), have been used, for several generations, by quilombolas through the traditional knowledge transmitted by parents and grandparents, with the objective of preventing and treating common illnesses in their community, since such knowledge is inserted in their culture (GUIMARÃES et al., 2019).

The perception of the medicinal power of plants and the use of their leaves, flowers, stems, seeds and roots correspond to a set of knowledge that is transmitted orally

from generation to generation, enriching the cultural framework of traditional communities, at the same time which challenges phytogeographic, pharmaceutical, botanical studies and their methodological keys for identifying species, such as, for example, the work of Carvalho et al., (2019) and Pereira Júnior et al., (2014).

In a data survey conducted by Guimarães et al., (2019), based on quilombola reports, it was observed the importance of expanding scientific studies that prove the effectiveness of plants for certain purposes, as many plants can be potentially toxic, have medicinal properties in lower concentrations, as well as cause undesirable side effects (GUIMARÃES et al., 2019).

The World Health Organization (WHO) estimates that approximately 80% of the world population depends on home remedies prepared with traditional knowledge of the use of plants. However, the continued use of these plants may be threatened due to the interference of factors external to the group's social dynamics, such as the exposure of communities to external economic and cultural pressures. However, as the relationship between man and the territory is transformed by modernization in the countryside, the network for transmitting knowledge about plants starts to change (SALES et al., 2015).

In this way, the study on medicinal plants, which demonstrates their diversity and use by quilombola communities, demonstrates their relevance, given factors such as cultural influence, ancient knowledge passed on to each generation, bringing them to scientific knowledge. This review aims to survey the ethnobotany of medicinal plants in terms of their diversity and use, traditionally known by quilombola communities.

The use of plants, in addition to other natural products, in the prevention and cure of diseases, can be identified in different forms of social organization, constituting itself as an ancient practice associated with popular and medical knowledge and religious rituals (FERNANDES, 2004).

In Brazil, the National Policy on Medicinal Plants and Herbal Medicines, through Decree No. 5,813, of June 22, 2006 (BRAZIL, 2006), defines medicinal plant as being a plant species, cultivated or not, from which products with medicinal properties Healing materials can be obtained and used in the human species for therapeutic purposes.

In this sense, the knowledge acquired and accumulated by traditional communities over the centuries has shown a close relationship between these communities and the natural environment, proving to be

fundamental for the maintenance of biological diversity, using natural resources rationally (MING, 2009).

According to Silva (2019), quilombola communities, as well as other traditional communities, preserve valuable knowledge about medicinal plants, one of the causes of the intense relationship between these communities and the environment in which they are inserted is the provision of countless resources that nature disposes of them and that are fundamental for their survival and reproduction, contributing to the continuation of quilombos, guaranteeing the survival of this population. This knowledge has, over the years, constituted an important socioeconomic factor in rural communities, being passed on from generation to generation. In many rural communities, knowledge and use of plants represent the only option for treating illnesses, due to limited access to health programs.

In this way, studies that emphasize that ethnobotany, and at the same time of human society, past and present, and their ecological, genetic, evolutionary, symbolic and cultural interactions with plants, allow to conquer, with approach and experience, the rescue of the knowledge of popular medicine and the relationship of affinities between humans and plants.

II. MATERIALS AND METHODS

This bibliographic research was carried out from August to November 2019 and includes articles published from 2014 to 2019, with the keywords: "quilombola community", "traditional knowledge", "medicinal plants", used in the SciELO, LILACS platform and CAPES Journal Portal. 26 articles were selected, which again passed through a filter, which excluded studies in duplicates; studies with themes of works not related to the research interest and articles that related only toxic plants. Thus, 20 articles remained, which were used only those that described quilombola communities, the diversity of medicinal plants and their use.

DATA ANALYSIS

Based on the ethnobotanical data collected by most of the articles, quantitative analyzes of the information were carried out, with the objective of verifying the medicinal plants most cited in the articles and the use of quilombola peoples, which contribute to the preservation of health and quality of life, as well as maintenance of medicinal resources within these communities. The method consists of the ratio of the number of information that was cited in the articles and a given species to the number of informants that cited the species (SILVA et al., 2010).

III. RESULTS AND DISCUSSIONS

A total of seven articles were used, published between 2014 and 2019 and it was observed that ethnobotany is a knowledge of great relevance for society, especially for quilombola communities. Oliveira (2015) and Reis (2017) point out that the majority of those who know popular knowledge are women, and this information has been perpetuating over time through grandparents who passed it on to their children and so on. However, Santos (2014) warns of an increasingly growing fact, which is the lack of interest of young people in the community in wanting to learn about old knowledge, sometimes because they are attached to new treatments as well as to disbelief by medicinal plants.

In the interview conducted by Reis et al., (2017), it can be observed that the knowledge informed by the interviewees about medicinal plants, is vast and of great importance to the community, however, the absence of certain information, could also emphasize, as for example, the risks to humans that toxic plants may have. The types and quantity of medicinal plants mentioned by the study by Beltreschi (2017) differ from the research carried out by Conde (2017), since the locality and the communities are different, demonstrating that knowledge is not uniform among quilombolas.

Similar to the results of Reis et al., (2017) the numerical difference of the plants mentioned by the collaborators, was possibly associated with the fact that the knowledge is linked to a single holder of local knowledge or restricted only to a family nucleus, as well as the knowledge may have been acquired individually through contact with other quilombos and not have been shared.

When analyzing knowledge according to the age group of the interviewees, the study carried out by Reis and collaborators, analyzes age and reveals that older people (over 50 years old) have greater knowledge in relation to younger age groups. The relationship between the age of the informants and the level of knowledge has also been reported by other ethnobotanical works

(ALBUQUERQUE et al., 2010), reaffirming that older people have greater knowledge in relation to young people.

Some species of medicinal plants, shown in Table 1, are quite common in most quilombola communities mentioned in different studies analyzed. In this sense, it is important to carry out ethnobotanical surveys of medicinal plants in quilombola communities, as they have extensive knowledge in the use of these medicinal resources, as well as in their way that is directly related to the culture and beliefs of these communities, as is the case of use them for rituals and baths (THIAGO et al., 2014).

In the quilombola populations, during the interviews carried out, a common pattern was observed in the answers when questioned the reason why medicinal plants are used. In the study by Oliveira et al., (2015), he indicated for diseases of the respiratory system, diseases of the digestive system, various pains, soothing / insomnia and high blood pressure, already in the research by Reis et al., (2017) they show interest in solve diseases and symptoms of the digestive, respiratory, circulatory system and skin diseases.

In research carried out in different regions of the world (ABE; OHTANI, 2013; NGO; KIM, 2014; TETIK et al., 2013), the respiratory system and the digestive system are the most relevant for traditional communities, according to a high degree consensus among respondents. The reason for this result of diseases of the respiratory system being more common is due to the fact that its symptoms are well defined, favoring the identification of the disease. Another reason for these systems to have the highest values is the precarious socioeconomic and health conditions in which these populations live (BELTRESCHIL et al., 2018).

Table 1: Medicinal plants most cited in studies carried out in Brazilian quilombol communities between the years 2014 to 2019.

FAMILY	POPULAR NAME	SCIENTIFIC NAME	PART USED	BIOLOGICAL ACTIVITY
Lamiaceae	Anador (BELTRESCHI, 2018)	<i>Coleus barbatus</i> (Andrews) Benth. ex G. Don	Leaves	Pain
Lamiaceae	Alecrim (REIS et al., 2017; OLIVEIRA, 2015)	<i>Rosmarinus officinalis</i> L.	Whole plant	Intestinal gases, nervousness, tonic
Verbenaceae	Erva cidreira (REIS et al., 2017; OLIVEIRA, 2015)	<i>Lippia alba</i> (Mill.) N.E.Br. ex P. Wilson.	Leaves	Soothing, insomnia, nerves, colds, heart, painkiller
Apiaceae	Erva doce (OLIVEIRA, 2015)	<i>Pimpinella anisum</i> L.	Branch, leaf and seeds	Soothing, gas, pain
Fabaceae	Umburana / Amburana/ imburana de cheiro (REIS et al., 2017; OLIVEIRA, 2015)	<i>Amburana cearensis</i> (Allemão) A. C. Sm.	Trunk, seeds and bark	Digestion, flu, hepatitis, bronchitis, diarrhea, stomach and sinusitis
Anacardiaceae	Aroeira (REIS et al., 2017; BELTRESCHI, 2018)	<i>Schinus terebentifolius</i> Raddi	Leaves and bark of the trunk	Natural antibiotic; cough; anemia and tuberculosis
Rutaceae	Arruda (REIS et al., 2017; BELTRESCHI, 2018)	<i>Ruta graveolens</i> L.	Leaves	Inflammation, liver, diarrhea, colic
Lamiaceae	Manjerição/ Manjerona (REIS et al., 2017; BELTRESCHI, 2018)	<i>Ocimum basilicum</i> L.	Leaves and seeds	Cold and cough
Lamiaceae	Boldo (REIS et al., 2017; OLIVEIRA, 2015)	<i>Plectranthus barbatus</i> Andrews	Leaves	Diabetes, diuretic, cough, cramps, inflammation
Poaceae	Capim Santo (REIS et al., 2017; BELTRESCHI, 2018)	<i>Cymbopogon citratus</i> (DC.) Stapf	Leaves and bark of the trunk	Soothing, tranquilizer, repellent, allergies, sleeping pills
Asphodelaceae	Babosa (REIS et al., 2017; OLIVEIRA, 2015)	<i>Aloe vera</i> (L.) Burm. f.	Leaves	Natural healing, hemorrhoids, gases, laxative, prostate
Fabaceae	Pau de rato (REIS et al., 2017)	<i>Cenostigma bracteosum</i> (Tul.) E. Gagnon & G.P. Lewis	Leaves and bark of the trunk	Soothing and relaxing

Amaranthaceae	Mastruz (REIS et al., 2017; OLIVEIRA, 2015)	<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants	Leaves	Inflammation and injuries
Lamiaceae	Hortelã (REIS et al., 2017; OLIVEIRA, 2015)	<i>Mentha piperita</i> L.	Leaves	Colds and flu
Asteraceae	Camomila (REIS et al., 2017; BELTRESCHI, 2018)	<i>Matricaria chamomilla</i> L.	Leaves and flowers	Relaxing, soothing, nerves, soothing
Fabaceae	Angico (REIS et al., 2017)	<i>Anadenanthera colubrina</i> (Vell.) Brenan	Trunk bark	Anemia, cough, tuberculosis, insecticide, inflammation, throat, arthritis, pain, rheumatism

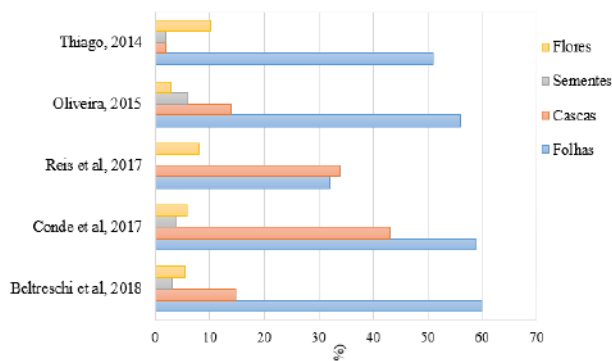


Fig.1: Parts most used in drug preparations in quilombola communities

According to a survey conducted by Beltreschi et al., (2018), the parts indicated for greater medicinal use are the leaves, followed by the bark, flowers and seeds. In the study with women from the quilombola community in Furadinho in the municipality of Vitória da Conquista in the state of Bahia, there was a predominance in the use of leaves, with 4% of the interviewees declared using the leaves together with seeds and 3% of the interviewees declared using the leaves. Leaves together with the flower (OLIVEIRA, 2015), which shows similes results in different regions of the country (Figure 1).

The National Health Surveillance Agency (ANVISA) regularly publishes the list of authorized species to be commercialized, highlighting the safety and risks for the patient (ANVISA, 2015). The list is made up of 71 plant species, for which research and investment are prioritized, with the aim of being used safely and effectively in their different forms of presentation: fresh

plant material, dry plant material, manipulated and industrialized medicines (Sales et al., 2015).

When comparing the table rewritten in the present study to ANVISA's list of medicinal plants allowed for use, the total of 16 plants cited, only 4 (*Amburana cearensis* (Allemão) A. C. Sm.; *Ocimum basilicum* L.; *Dysphania ambrosioides* (L.) Mosyakin & Clemants were not on ANVISA's list, the others present (*Coleus barbatus* (Andrews) Benth. ex G. Don., *Rosmarinus officinalis* L., *Lippia alba* (Mill.) N.E.Br. ex P. Wilson, *Pimpinella anisum* L., *Schinus terebinthifolius* Raddi, *Ruta graveolens* L., *Plectranthus barbatus* Andrews, *Cymbopogon citratus* (DC) Staupf., *Aloe vera* (L.), *Mentha piperita* L., *Matricaria chamomilla* L., *Anadenanthera colubrina* (Vell.) Brenan).

According to Ndhlala (2013), the lack of evidence of the effectiveness of some plants, which may contain toxic substances, which affect vital organs, while some can affect the main functional systems of the body, such as the central nervous system (CNS), interfering with coordination nerve functions of the body. Metabolic toxins affect organs such as kidneys, liver, heart and lungs, depending on the route of administration, stage of growth or part of the plant, amount consumed, species and susceptibility of the victim, there is a need for registration and dissemination of these plants, through booklets, lectures, educational games and other tools, in order to contribute to the passage of traditional knowledge to future generations, as well as to promote safety while using them.

Therefore, it is necessary to point out the agroecology used by these communities, whether improved, or to improve the agroecological technologies of those who use medicinal plants, as well as to learn about their diversity

and use to counter conventional production for those who are unaware of more advanced models. Sustainable and that the knowledge and experiences mentioned in these articles are strengthened by the creation of a national benefit sharing fund, aimed at the conservation of medicinal plants of agrobiodiversity and the implementation of the rights of these quilombos, in order to adopt specific laws to promote the use sustainability of agricultural biodiversity and ensure due legal space on the use and diversity in these local agroecological systems.

IV. CONCLUSION

In the sample universe of this review, it was found that less than half of the populations cited in the articles had knowledge about traditionally used medicinal plants, in this context, the old quilombolas, reveal that they have the ethnobotanical knowledge of the plants, however, the frequent report of loss of interest by young quilombolas on the topic, which causes this knowledge to be lost more and more.

Through this review, it was observed from the reports described by the authors, that public programs and policies are not always oriented towards the conservation, diversity, use of medicinal plants and the implementation of quilombola rights in specific laws. So that these laws open spaces for such programs and policies to strengthen and reframe knowledge for the new quilombol generations.

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Solid health waste management: A process analysis at the hospital area

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Abstract—This systematic review describes the scientific production about Solid Health Waste Management (SHWM) in hospitals, seeking publications in the period from 2015 to 2020, to have a synthesis of the importance of SHW management and strategies practiced in hospital facilities, analyzing the perception of health professionals about the management of these wastes. The articles obtained demonstrate that health professionals, although they have some knowledge of the legislation, are constantly living with the inadequacies in the management of SHW, resulting in risks to the health of both employees and the environment, and it is necessary to seek management measures aimed at professional training for correct management..

Keywords—Waste Management, Environmental Health, Solid Waste.

I. INTRODUCTION

With the new consumption patterns of industrial society, since the second half of the 20th century, waste production has expanded assiduously to levels exceeding the planet's absorption capacity. Also, the diversity of products with components and materials of difficult degradation and greater toxicity is growing; characterizing one of the challenges of the environmental issue, to ensure the maintenance of the quality of life of the current population and the existence of future generations (ANVISA, 2006/07; Silva, 2011).

The health industry has a significant contribution, equivalent to a value that exceeds the mark of 2.4 million tons of waste per year, in addition to being configured as a potential energy consumer. Therefore, the task of hospitals goes beyond physical limitations and must perform safe practices to promote the health not only of their patients and professionals but also of the environment where they are (Harris et al., 2009).

Although the generation of health services waste (SHW) is small about urban solid waste, it is expressive when analyzing the potential risk conferred to them, as a consequence of the existence of pathogenic organisms

and/or their toxins, chemical products of diverse nature (drugs, chemotherapy, solvents, among others), as well as radiological risks. The problem of SHW is also decreasing in other aspects, such as the combination of waste of different natures, discarded on public roads, and/or inadequate distribution in landfills, not always sanitary or controlled (Schneider & Stedile, 2015).

Thus, inadequacies in waste management in contemporary society significantly compromise the health of the population and the environment in which they live, such aspects reflect on physical health risks (infectious and degenerative diseases), mental health (anxiety crises, panic crises, depression) and social disintegration (social isolation, exacerbation of violence, among others) (Siqueira & Moraes, 2009). Improper waste management exposes the health of workers (direct hazards) and the population (indirect hazards) (Mathur et al, 2011; Babanyara, 2013).

These premises point to the inherent association between health, environmental health, environment, and health service waste (SHW), which can generate adverse reactions on the environment and organisms. From this perspective, the Ministry of Health stresses that

"environment and health are interdependent and inseparable" (Brazil, 2007).

The definition of Environmental Health associates the aspects that encompass human health and quality of life, established by physical, chemical, biological, social, and psychological elements in the environment, exposing determining factors for the maintenance of health (PAHO, 2001). Given the facts mentioned, solving the problem caused by these residues derives from the need to correct the public health policies and legislation published in the Official Gazette of the Federal Republic of Brazil, such as the RDC No. 306, of Anvisa, which provides on the Technical Regulation for the management of health service residues, and the Resolution of the National Environmental Council No. 358, of April 2005, on the treatment and final destination of health service residues and makes other provisions to achieve the sustainable development of the environment and the preservation of health as a whole.

Given the contingency, it is pertinent to analyze the impacts and characterize the process of Solid Waste Management of Hospital Health, seeking the deepening of the theme to reduce the negative impacts with the non follow up of the norms recommended by the competent agencies. Thus, the present study was designed to describe the scientific production about the Management of Solid Residues of Hospital Health in the bibliographic and documental context (legislation) published in periodicals between 2015 and 2020, indexed in the databases of LILACS, BDENF, CAPES and WORLD WIDE SCIENCE.

II. THEORETICAL FRAMEWORK

According to RDC ANVISA no. 306/04 and Resolution CONAMA no. 358/2005, all services related to human or animal health care, including home care services and fieldwork; analytical laboratories for health products are defined as generators of solid health waste (*SHW*); mortuaries, funeral homes, and services where embalming activities are performed, forensic services, drugstores and pharmacies, including those of manipulation; teaching and research establishments in the health area, zoonosis control center; distributors of pharmaceutical products, materials, and controls for in vitro diagnosis, mobile health care units; acupuncture services, tattooing services, among other similar services.

Although the direct responsibility for the *SHW* is of the health services establishments, as they are the generators, by the principle of shared responsibility, it extends to other actors: to the public power and the collection, treatment, and final disposal companies. The Federal Constitution, in

its article 30, establishes the competence of the municipalities to "organize and provide, directly or under concession or permission, public services of local interest, including public transport that is essential" (ANVISA, 2006).

The National Survey on Basic Sanitation (NSBS), conducted in 2000 by IBGE, shows that most Brazilian municipalities do not use an appropriate system to carry out the collection, treatment, and final disposal of *SHW*. From a total of 5,507 Brazilian municipalities surveyed, only 63% perform the collection of the *SHW*.

The Southeast is the region that most carries out the collection of *SHW* in Brazil, totaling about 3,130 t/day. Next comes the Northeast, with 469 t/day, then the South, with 195 t/day, the North, with 145 t/day, and finally the Center-West, with 132 t/day. Regarding the final destination, about 56% of the municipalities have their *SHW* on the ground, and 30% of this total corresponds to landfills. The remainder is deposited in controlled landfills, sanitary landfills, and special landfills (ANVISA, 2006).

By correctly classifying the residues generated in health units, it is possible to separate them according to their composition (chemical, physical or biological), state of matter, origin, place of generation, and potential for contamination (Cussiol, 2008). This separation makes it possible for the generator to properly handle its waste, also, the segregation at the time and place of generation reduces the volume of materials that need differentiated management (CONAMA, 2005), which enables cost reduction in management.

The waste management process must be part of the standards of every establishment that generates Health Services Waste, taking into account all steps, including generation, conditioning, internal storage (waste room), external storage (waste shelter), internal treatment, and final internal disposal. The internal management of waste involves the above-mentioned steps that occur within the generating establishment and shall be adequately controlled so that there is no waste of materials that can be reused or recycled, and so as to avoid improper handling of infectious waste.

However, according to the Collegiate Directorate Resolution (RDC) No. 306/044 (ANVISA, 2005), the solid health waste management plan (*SHWM*) at the time of preparation shall be compatible with the rules on collection, transportation and final disposal of the waste generated, established by the local agencies in charge, covering the management stages, which comprises the action of managing the waste in its aspects from generation to final disposal, based on the following guidelines:

- Segregation: Consists of the separation of waste at the time and place of its generation, according to its physical, chemical, and biological characteristics, its physical state, and the risks involved.
- Conditioning: Consists of the act of packing the segregated waste in bags or containers that avoid leakage and resist puncture and rupture actions. The capacity of the packaging containers must be compatible with the daily generation of each type of waste.
- Identification: Consists of the set of measures that allows the recognition of the residues contained in the bags and containers, providing information for the correct handling of the *SHW*.
- Internal Transport: It consists of the transfer of the residues from the generation points to the place destined for temporary storage or external storage with the purpose of presentation for collection.
- Temporary Storage: It consists of the temporary storage of the containers containing the residues already conditioned, in a place close to the generation points, aiming to speed up the collection within the establishment in order to optimize the displacement between the generating points and the point destined to the presentation for external collection.
- Treatment: Consists in the application of a method, technique, or process that modifies the characteristics of the risks inherent to the waste, reducing or eliminating the risk of contamination, occupational accidents, or damage to the environment.
- External Storage: Consists of the storage of the waste containers until the external collection stage, in an exclusive environment with easy access for the collecting vehicles.
- External Collection and Transportation: Consists in the removal of the *SHW* from the waste shelter (external storage) to the treatment unit or final disposal, using techniques that ensure the preservation of the conditioning conditions and the integrity of the workers, the population and the environment, and must be in accordance with the guidelines of the urban cleaning bodies.
- Final disposal: disposal of solid waste, generally in the soil previously prepared and duly licensed.
- Chemical treatment: method of disinfection using a chemical agent;
- Microwave: method of decontamination by the emission of waves at high or low frequency, with a temperature around 95 and 105 °C, in this procedure the residues need to be prepared being previously crushed and humidified;
- Incineration: a method that burns the residues, provides volume and weight reduction in addition to eliminating the risks of contamination.

III. CONTINUING EDUCATION

The continuing education program, provided for in RDC ANVISA no. 306/04, aims to guide, motivate, raise awareness, and permanently inform all those involved in the risks and appropriate management procedures, in accordance with the precepts of waste management. According to RDC ANVISA no. 306/04, the services generating *SHW* must maintain a program of continuous education, independent of the employment relationship of the professionals.

An indispensable factor for the correct management is the environmental and sustainable education of solid residues. Education must be used as a tool for individuals to reflect on the issue of changes in attitudes regarding the correct disposal of waste and the valorization of the environment (Gusmão, 2000).

Continued health education is of great importance in terms of the acquisition and renewal of knowledge of professionals. This not only encompasses those working in the area, but also the entire population and community, which in general, ends up benefiting from improved care and optimization of care, due to these educational programs developed within the various health units (Marandola et al., 2009).

Permanent education, based on the principle of significant learning, considers that the educational process is dynamic, continuous, and that besides people's knowledge, it also brings social advances. The training processes of health workers should be structured from the problematization of the work process, aiming at changing professional practices and work organization, based on the health needs of individuals and populations, institutional management, and social control in health (ANVISA, 2004).

With regard to the forms of treatment of available health service waste, Pereira (2009) quotes:

- Autoclave steam: sterilization method that consists in releasing steam at high pressure and temperature;

IV. METHOD

In this research, a systematic qualitative review of the literature was performed, which consists of a form of synthesis of the results of studies alluding to a given problem, analyzing their contributions. Classified as exploratory, it is characterized by exploring or analyzing a problem for better understanding (Andrade, 2004; Malhotra & Robert, 2005).

To achieve the proposed objective, a retrospective bibliographic survey was conducted from 2015 to 2020, using the Latin American and Caribbean Health Sciences Literature database (LILACS), Nursing Database (BDENF), Higher Education Staff Improvement Coordination (CAPES) and WorldWideScience.org, using the descriptors: "hospital health solid waste management" and "hospital waste".

In this way, publications on the subject were published during this period, which may later contribute to the evaluation and monitoring of the development of this field of study. The Regional Portal of the Virtual Health Library was adopted because it contemplates one of the largest and most important indexes of the scientific literature, which includes relevant databases in the health area, such as LILACS and BDENF.

The bibliographic survey was conducted from February to May 2020, through direct consultation on the above-mentioned online platforms. The study sources were included according to the following criteria: scientific articles published between 2015 and 2020, Portuguese

language, English, which contemplated the following topics: management of hospital health services waste, health professionals' actions in *SHWM*, nurse knowledge related to health waste, observational studies.

As exclusion criteria, we chose not to use articles that did not correspond to the study object; incomplete texts; articles that were not available in full online; that did not provide sufficient information for the subject.

After the end of the survey, the reading and categorization of the articles began, concomitantly with the elaboration of sheets, that is, the articles were read and, according to the themes developed in them, were categorized according to the following topics: year, title, author, journal, methodological approach, and theme. Therefore, the analysis of the records was carried out.

V. RESULTS AND DISCUSSION

There were 68 articles distributed in the databases: BDENF - 04 articles (5.90%), CAPES - 25 articles (36.76%), LILACS - 06 articles (8.82%), and WORLDWIDE SCIENCE - 33 articles (48.52%). After applying the inclusion criteria, the final sample totaled 09 articles (Figure 1), being later organized and characterized, according to Table 1.

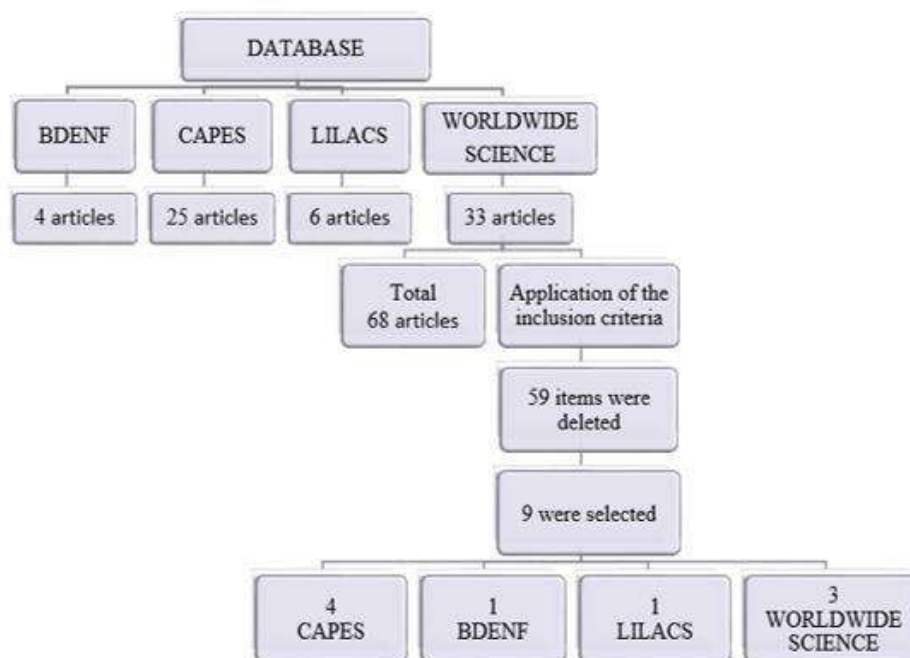


Fig.1: The selection process of the articles used in the review.

Table 1: Qualitative data from the systematic review

Author / Database / Year	Title	Methodological Approach	Overview
Mesquita, M. G. R. <i>et al.</i> BDENF 2015	Safety and Sustainability in the Management of Healthcare Waste at Hospital Units	Translational, descriptive and exploratory research	Protocol elaboration and correlation of the practice in the light of scientific evidence in the hospital scenario, through translational, descriptive and exploratory research, with the Hospital Universitário do Rio de Janeiro/RJ as scenario.
Pinheiro, L. A.; Silva, E. R. CAPES 2016	Studies on Solid Waste from Health Services and Environmental Education	Integrative Literature Review	Investigation of the national scientific production, appreciating in the reports of training and realization of the qualification of the professionals in hospital scope, for the practices of management of the residues generated in their work activities.
Soares, L. S. V.; Madureira, A. S. CAPES 2018	Scenarios that Challenge the Emergency Implementation of the National Solid Waste Policy: an Environmental and Health Issue	Analytical Cross-sectional Study	Reflection on the possible obstacles existing in the National Policy on Solid Waste that prevent the real confrontation of sustainability and the proper management of solid waste in Brazil.
Zajac, M. <i>et al.</i> CAPES 2016	Class "D" Waste Reverse Logistics in Hospital Environment: Monitoring and Evaluation of Recycling at the Children's Hospital Cândido Fontoura.	Quali-quantitative approach, characterized as a research-action	Analysis and elaboration of an evaluation model, training and measurement of common waste segregation, for adequate segregation of Health Services Waste (HSW) that depends on the training and awareness of employees involved in generating HSW.
Rizzon, F. <i>et al.</i> CAPES 2015	Challenge in Waste Management in Public Health Services	Exploratory research, characterized as action research.	Exploratory research in a small town, describing the analyzed management processes and critical points found at each stage, making a parallel with the current legislation, addressing the management challenges, appropriate processes and risks inherent to mismanagement.
Costa, T. F. <i>et al.</i> LILACS 2018	Intra-Hospital Management of Hazardous Chemical Waste Handling by Nursing	Quantitative, descriptive study	Evaluation of the management stages of hazardous chemical waste - formaldehyde and orthophthaldehyde, handled by the nursing team, from descriptive research and data collection, which provide important guidelines for the preparation of the Management Plan for Hazardous Chemical Waste from hospital care.

Kist, L. T. <i>et al.</i> WORLD WIDE SCIENCE 2018	Diagnosis of Hospital Waste Management in Vale do Rio Pardo-Rio Grande do Sul, Brazil.	Quali-quantitative research, bibliographical and field	Practical application of management tools in health units, to close gaps between practice and management of solid wasteful health care, by monitoring actions with available resources and providing adequate deadlines and dates, which result in systemic compliance with current legislation.
Negreiros, R. V. <i>et al.</i> WORLD WIDE SCIENCE 2018	Solid Health Waste Management at a University Hospital in the Northeast of Brazil.	Quantitative, descriptive and transversal research	An active policy of guidance regarding the handling of waste in health, through permanent education, promoting training and educational actions, since it deals with hazardous health waste.
Oliveira, E. L. <i>et al.</i> WORLD WIDE SCIENCE 2018	Environmental Performance in Healthcare Establishments: A Case Study of Hospital Naval Marcílio Dias, Rio de Janeiro - RJ.	Bibliographic survey, field survey, interviews and analysis of collected data.	Evaluation of the environmental performance of Hospital Naval Marcílio Dias, considering the eco-efficient measures already established in the hospital and collected data through documentary survey and interviews with employees in the environmental management sector.

Each selected article deals with the issue of waste management in health facilities from the perspective of the professional who acts directly or indirectly in the process. It is significant the articles that present application of questionnaires, as well as the search for simplified methodologies, not lagging, and continuing education practices that encourage the professional to treat the classification and conditioning of solid health waste (*SHW*) as a necessary and positive daily habit.

Mesquita *et al.* (2015) corroborate the evidence-based practice in hospital activities, constituting the sampling by professionals from the multidisciplinary team who work in waste management, based on testing and re-testing as an observational interposed technique, elucidating the respondent's world perceptions without imposing the researcher's vision.

Negreiros, *et al.* (2018) presented results of the questionnaire survey applied to the multidisciplinary team, showing that 96% of the professionals indicated knowledge of the importance of residue management and about 52% of the nursing team admitted knowledge of the current norms on *SHW* classification, with the lack of information regarding adequate management as the main difficulty found by the team, the lack of training and time (generally insufficient due to excessive work) as factors for not performing the correct management, which according to Costa *et al.* (2018) may cause several health problems in the team itself, as well as the environment.

Pinheiro & Silva (2016) in an integrative review draw attention to the lack of knowledge on the part of the administrative body regarding the form of classification and segregation of the *SHW* when compared to the health team, pointing out the lack of routines and frequency of training, and sometimes the lack of interest in participation. Zajac *et al.* (2016), when analyzing the effectiveness of training on level D solid hospital waste (those that do not offer biological, chemical or radiological risk), showed the effectiveness of monitoring, guidance, and adequacy of the hospital administrative sector to achieve significant results in reducing the volume and consequently the costs of treatment of these wastes. With this, the author reiterates the breaking of the paradigm surrounding the disposal of hospital waste, exposing the possibility of recycling non-hazardous materials, if properly managed through the solid health waste management program (*SHWM*).

Inadequate storage for long periods in containers without proper identification, as described by Rizzon *et al.* (2015), may lead to occupational accidents, due to the disposal in the wrong place of infections, or even the contact of the surrounding external community with contaminated effluents that, without prior treatment, may drain into the sewers, causing damage to health and the environment. Negreiros, *et al.* (2018) reaffirm the need to maintain solid waste management correctly, paying attention to biosafety measures during the handling of these wastes.

Soares &Madureira (2018) emphasize that to maintain adequate control of the *SHW*, it is necessary to formulate and implement public policies by analyzing the results and designing the policy itself, based on research that ensures the effectiveness of these plans. Rizzon et al. (2015) taking into account the complexity of the local social, economic, ecological, political, and cultural levels, the formulation of environmental policies is a basic step of success in the environmental management process. It is necessary to consider the elements that affect the implementation of the policy and, thus, a more complete assessment can be made when checking the structure (objectives, tools, and agents) used to adjust the existing processes.

Another important aspect, highlighted by Soares &Madureira (2018), refers to management solutions that can optimize costs, enable innovative and efficient technologies and promote long-term partnerships that can achieve the waste policies of municipalities (especially those with fewer resources). It is worth mentioning that it is necessary to adapt and reformulate from time to time to create an operating system that does not fall into discrepancy.

In this context, continuing education is necessary, Kist et al. (2017) encourage lifelong learning, so that the legal regulations regarding adequate management by health professionals can be effectively implemented to change the practices that constitute the current institutional situation. This process of change can be achieved through the action of managers, whose task is to spread knowledge and awareness of the individual and collective risks of inappropriate waste management among hospital staff.

Pinheiro & Silva (2016) observed inadequate practices even after the training for the *SHW* program, making it clear that the occurrence is not only due to lack of information from professionals, but also unidirectional training, focused on compliance with the legislation, which do not present satisfactory results. Oliveira et al. (2018) introduce the realization of training campaigns and environmental education that can involve all employees, focusing on specific environmental aspects of each department, to encourage both the team and visitors, to participate in practical and sustainable actions, disseminating the importance of following the correct management of *SHW*, so that it becomes routine.

Thus, when new improvement measures are determined, Kist et al. (2017) ensure that a new cycle is repeated frequently to complete the recommended continuous improvement process, where the use of protocols or tools such as the PDCA (Plan, Do, Check, Act), introduces a unique, effective and dynamic aspect, in

the structuring of the planning, efficient execution, monitoring of steps aimed at maintaining the quality of services and action so that the whole system does not stagnate remaining only on paper so that finally there is a narrowing of the gap that currently exists between the practice and the management of solid hospital waste.

VI. CONCLUSION

In the current context, solid waste consists of various materials capable of recovery. Therefore, it would be relevant to have strategies for the reuse of these materials, capable of generating income and work, as well as making it possible to mitigate the extraction of natural resources and save energy that is essential for safer ecological and social care.

In the reality we live with, related to solid waste management, it is imperative to act in the direction of intra-institutional policy involving a healthy environment model. There is a certain difficulty in the applicability of *SHWM*, which requires more effective proficiency of the legislation together with the rupture of dogmas in order to ensure a better quality of care and minimize the risks to health and the environment.

Among the possible strategies of impactation and effectiveness, we can mention continuing education. This has positive repercussions in the context of *SHW*, but in order to make it interesting and effective, it must be dynamic, including practical attractions, which do not become tiresome or time-consuming so as not to generate disinterest or changes in the work routine of employees. Besides having the participation of the team, it is interesting to introduce the users of the health system, because it is conducive to the integration of learning. For the effectiveness in the training, one must work on changing the behavior of the professionals involved in the *SHW* process, in order to promote the idea of reusing common waste, reducing the final volume (and consequently the costs with *SHWM*), preserving the quality of services, the integrity of the employees' health and the environment, because, with the correct adequacy in the management of these waste, the probability of leftovers coming into contact with sewage or open areas is reduced.

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Analysis of the effectiveness of the alternating water and gas injection method (WAG)

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Abstract—Being the main source of primary energy in the world, oil is an increasingly used resource, and at the same time more difficult to be explored and produced. Special recovery methods have been extensively studied to increase the oil recovery. The WAG method consists of the alternating injection of water and gas for the recovery of the residual oil in the reservoirs. The objective of the present work is to simulate the alternating injection process and to evaluate its recovery efficiency when compared to the water injection and CO₂ injection method using the MRST software (Matlab Reservoir Toolbox Simulator). In general, an increase of about 4% in oil production was found, when the WAG methods and CO₂ methods are compared. The results show that, for three scenarios analyzed, up to 12 years of production the water flooding has the same volumes of recovered oil as the WAG or CO₂ mechanisms. After that period, the WAG mechanism resulted in greater volumes of oil produced.

Keywords—Carbon dioxide, EOR, Petroleum, Reservoir engineering, WAG, MRST.

I. INTRODUCTION

The constant evolution of technology, which provides a better quality of life for society, is closely related to an increase in global energy demand. This increase in turn leads to an accelerated pace of high investments in the search for new sources of energy and/or improvement of existing ones. However, according to the IEA (International Energy Agency), fossil fuels account for about 81% of the world's primary energy. Of this total, 54% are still oil and natural gas exploring and production [1]

Both the burning of these fuels and the petroleum and gas exploration and production leads to a large amount of CO₂ emitted to the atmosphere, which has created a worldwide discussion on what to do with this gas and how to reduce its emission rate. CO₂ emissions become a challenge for the exploration and production of pre-salt reservoirs. Petroleum in the pre-salt reservoirs in Brazil has very high gas-oil ratio (GOR) with high content of carbon dioxide [2] According to [3] there are three ways to reduce the accumulation of these gases in the air: increase the

efficiency of energy production, i.e. produce a smaller amount of CO₂ per unit of energy; use of renewable energies; CO₂ capture for use in enhanced oil recovered (CO₂-EOR) and geological storage (part of the CCS technology). In the CCS technology the produced gas with high content of CO₂ is treated at the production platform or in a subsea CO₂ separation process [4].

In the CO₂-EOR process the remainder gas with CO₂ content of 70% to 80% is reinjected into the reservoirs in the initial age of the reservoirs production. Where it mixes with the oil to swell it and reduce the oil viscosity, making it lighter and detaching it from the rock surfaces. However not all the injected CO₂ is produced, as a significant fraction of the CO₂ is retained in the reservoir. Therefore, the CO₂-EOR process is essentially a closed loop for CO₂ [5]. Then, to maintain a specified injection ratio of CO₂, the recycled CO₂ is supplemented with the purchased CO₂, contributing to the reduction of CO₂ emissions from the atmosphere. However, CO₂ has a lower viscosity than oil and therefore tends to form finger, reaching the producing well before oil -in other

words the breakthrough time shorter than oil. One way to avoid this is to switch water and CO₂ injection, designated as “water-alternating-gas” or WAG floods. The amount of oil that can be recovered by a recovery method is a function of both geological and operational characteristics. Reservoir specificity such as lithology, permeability, heterogeneity, and other physical features unique to the reservoir influence efficiency as well as injection pattern (the geometrical arrangement of injector and producer wells), the distance between injectors and producers, the volume of fluid injected, and the ratio of injected water to injected CO₂ or “WAG ratio”. Numerical simulation tools could be used to take these variables in consideration and help predict the overall behavior of a recovery method, and which configuration will give better results.

There are several computational tools to solve the porous flow problem. However, most are commercial and blackbox software that are expensive and do not allow changes in the code to better suit a specific scenario. Several groups of researchers have been developing free computational tools. In this work, simulations were performed in the software developed by the Computational Geosciences group in the Department of Mathematics and Cybernetics at SINTEF Digital - MRST, an open source program that is also free. Several recovery scenarios: water injection, CO₂ injection and WAG injection were analyzed to find the best method and the results were compared with the paper of [6]. To verify the efficiency of the WAG recovery method compared to the continuous injection of CO₂ and water injection methods through free MRST software. The period evaluated in the production well were divided in 0-8 years (short), 8-24 years (medium) and 24-32 years (long). Injection methods were compared over different time periods: short / medium and long term and the permeability influence was checked. The flow injected rate used to evaluated which method production were in stb/d: 12,000; 20,000; 30,000; and 45,000.

II. THEORETICAL FOUNDATION

Petroleum reservoirs are multiphase systems composed of oil, gas, and formation water. Oil recovery is a mechanism that depends on several factors which correlate the physical properties of the rock and the fluids involved. Due to the multiphase characteristic of the system there is a discontinuity of pressure at the interface between two fluids and the fluids and porous medium, resulting in capillary pressure. In a recovery mechanism that injects water, even if all oil trapped in the reservoir is in contact with water not all oil will be recovered, mainly due to high interfacial tension (IT) between oil and water or by forces capillaries.

For an efficient recovery method, a displacement fluid with surface and interfacial properties ideal for mastering high IT and capillary must be injected into the reservoir. Thus, the recovery method should increase the overall oil displacement efficiency, which is a function of microscopic and macroscopic efficiency. The microscopic efficiency significantly depends on the relative permeability, interfacial tension, wettability, liquid viscosity, and capillary pressure. The macroscopic or volumetric sweep efficiency depends on the injection well pattern, fractures in the reservoir, position of gas-oil and oil-water contacts, reservoir thickness, heterogeneity, mobility ratio, density difference between the fluids [7].

The reservoir recovery efficiency, E_R , is given by the product between the displacement efficiency, E_d , and the volumetric sweep efficiency, E_v (Equation 1)

$$E_R = E_d \cdot E_v \quad (1)$$

The Fig. 1 shows microscopic and macroscopic efficiency on the reservoirs, E_d and E_v , respectively[8].

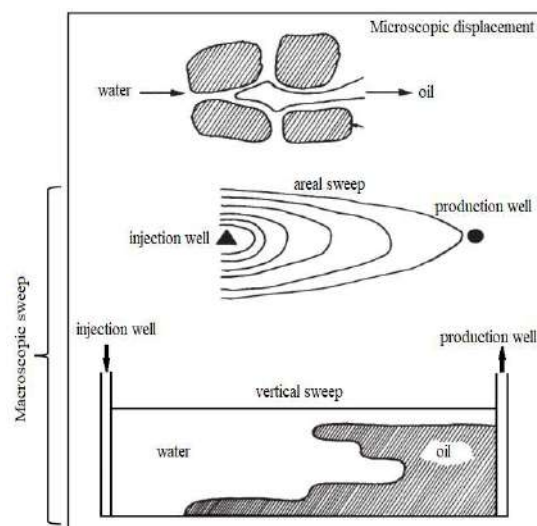


Fig. 1: Schematic representation of macroscopic vertical sweep and microscopic displacement. Adapt from [9].

Displacement efficiency, E_d , is attributed to the produced oil from the pore spaces by the displacing fluid. It measures the oil saturation reduction in the invaded region by the injected fluid, E_d (Equation 2) is given by:

$$E_d = \frac{S_{oi} - S_{or}}{S_{oi}} \quad (2)$$

Where S_{or} is the residual oil saturation at the end of the displacement fluid injection and S_{oi} is the initial oil saturation.

The volumetric sweep efficiency, E_v , corresponds to the amount of produced oil which has been in contact with the injected fluid [8]. It is a macroscopic measure between the

products of the areal and vertical sweep efficiencies, E_A and E_{VV} (Equation 3):

$$E_V = E_A E_{VV} \quad (3)$$

Water flooding is the most common method of oil recovery. Usually after water flood, significant amount of oil remains in the reservoir (S_{orw}), typical 40-60%, mainly due to high interfacial tension. Part of this remaining oil can be recovered by gas injection. Various types of gas have been used for injection in oil reservoirs including, CO_2 (mostly in USA), hydrocarbon gas (mostly in the North Sea area), nitrogen and air [10].

The injection of CO_2 as a component of an advanced oil recovery method acts at the interface between the phases, to reduce interfacial tension (IT) among them. For this, two factors influence the efficacy of this objective: the number of capillarity Ca and the ratio of mobilities M .

The capillary number Ca (Equation 4) brings the relationship between the viscous forces and the dominant capillary forces in the reservoir pores. This value is defined by Green and Willhite (1998) as:

$$Ca = \frac{v\mu}{\sigma} \quad (4)$$

where v is the Darcy velocity (m/s), μ is the viscosity of the shifting fluid (Pa*s) and σ is the interfacial tension between the phases (N/m).

The literature shows that the increase in the number of capillarity results in a lower value of residual saturation of the oil [11], that is, when it is said that the miscible methods act in the reduction of interfacial tension, the objective is the increase in the number of capillarity and consequently higher production of hydrocarbons.

The mobility ratio M (Equation 5) is the ratio between the mobility of the displacing fluid λ_d and the mobility of the displaced fluid, λ_o defined by the equation:

$$M = \frac{\lambda_d}{\lambda_o} = \frac{k_d \mu_o}{k_o \mu_d} \quad (5)$$

where k is the permeability relative to each fluid, and μ is the viscosity of each fluid. The displacing and displaced fluids (oil) are represented by the subscripts d and o respectively.

The mobility ratio demonstrates the efficiency of the injection process. This value is considered favorable when close to 1 and corresponds to a slow advancement of the displacing fluid, creating a more uniform displacement front. This process increases the sweeping efficiency of the reservoir, i.e. a greater amount of oil is produced through the injection [11].

The great difficulty encountered in the pure CO_2 injection process is the difference between the viscosity and

density of the gas and the oil. This discrepancy is clearly noted in the mobility ratio, which reaches values much greater than 1. Thus, the CO_2 forward front is not uniform (as shown in Figure 2a) and creates preferential paths through segregation and viscous fingering (Figure 2b) and arrives at the production well in an early manner. This phenomenon is called breakthrough. However, even so, according to [12] the preference in the use of CO_2 when compared to the other gases can be explained by its ease in mixing with the lighter fractions of the oil, going from C2 – C6.

To compensate for the effects caused by differences in density and viscosity, CO_2 is commonly injected into banks, characterizing the alternating water and gas injection (WAG) method (Fig. 2).

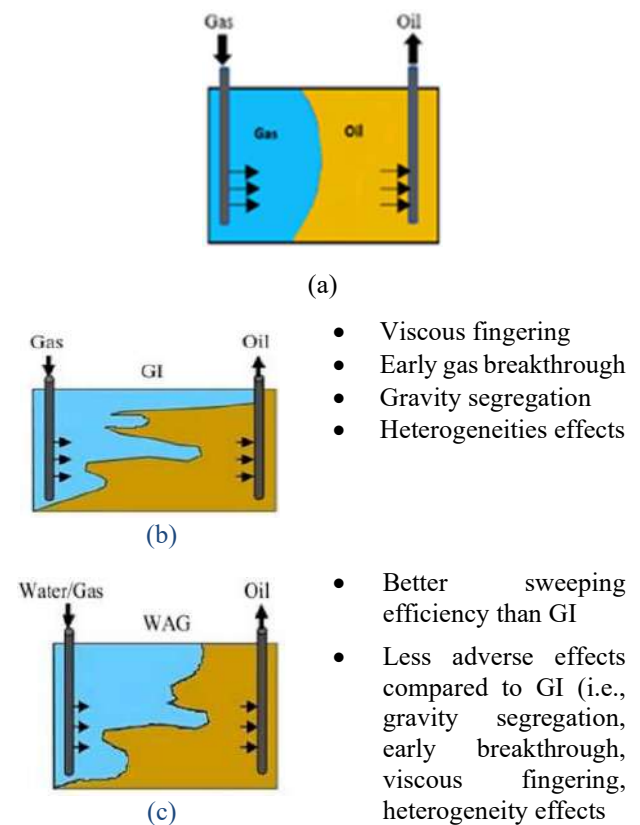


Fig. 2: Representation of three different cases for CO_2 injection. In (a) the uniform/ ideal advance of the CO_2 bank. In (b) the influence of density and viscosity on the forward front. In (c) the conventional WAG injection. Adapted from [13].

According to [13] the WAG method reduces the rate of mobility between the gas and the oil, and consequently increases the efficiency of sweeping the reservoir. While the CO_2 front contacts the residual oil by removing the heavier fractions and reducing the density difference between gas and oil, the water front reacts with the CO_2 bank increasing its viscosity. Fig. 3 shows the structure of the injection seats

showing a schematic of the injector and the producer well and the oil bank, miscible, water and CO₂ zone. Is possible to observe that the WAG scheme (water and gas injection) are carried out alternately in a reservoir for a period of time in order to provide both macroscopic sweep and microscopic efficiencies and reduce gas override consequences: viscous finger, gas breakthrough and gravity segregation [14]. However, the method has a complex three-phase flow in the porous medium.

In the miscible zone, there is a continuous mass transfer between the CO₂ and the reservoir oil, which improves the density and viscosity of the fluid in this zone. In addition, reducing interfacial tension in the miscible zone allows for better oil recovery. However, for these miscible zones to occur, the pressure at the gas / oil interface must be greater than the minimum miscibility pressure (PPM). This pressure value is a parameter that defines whether the process will be miscible or not. Therefore, maintaining the efficiency of CO₂ injection also means achieving and maintaining PPM [16]. The calculation to estimate the value of the minimum pressure for the CO₂ can be done through some correlations; as proposed by [17] which is still widely used; or more recent ones, such as that developed by [18].

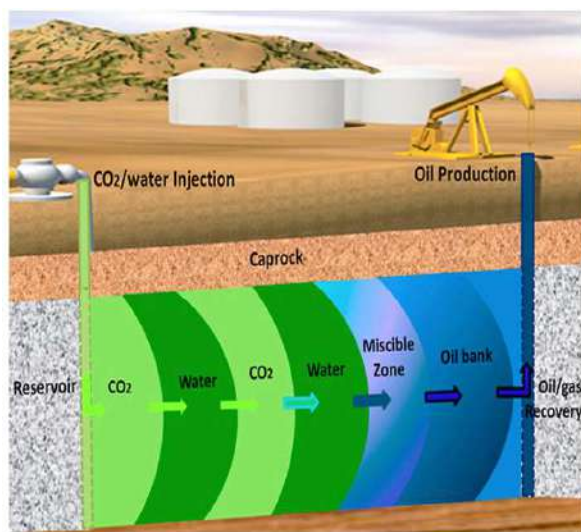


Fig. 3: Scheme of injection in banks in the WAG method [15].

There are, according to the literature, some criteria regarding the fluid and the reservoir that must be respected to obtain a CO₂ injection with high efficiency. They are: the porosity must be greater than 15%, the fluid must have a density greater than 25 ° API and viscosity lower than 12 cP; the reservoir pressure should be between 1500 and 6000 psi; being in an advanced stage of water injection or other secondary recovery method [3].

According to [19] the number of fields that have adopted miscible injection methods has increased by 41% in recent years, and since 2006, gas injection has been the main method of recovery in the United States in terms of number of projects. In addition, the miscible injection of CO₂ Water Alternating Gas is one of the ways to help offset the cost associated with CO₂ geo-sequestration processes making them economically more attractive [20].

In Brazil, according to [20] the alternating injection method is used in 8 wells, most of them in the Lula field. The results found in the production, according to the [21] are satisfactory, and the method is very promising for the pre-salt, mainly due to the high concentration of CO₂ in the reservoirs.

III. METHODOLOGY

The simulations were performed using the MRST computational tool. The oil production was evaluated during a total period of 32 years of production. Were analyzed 3 scenarios with 4 distinct cases of recovery mechanism, being: case 1 - natural flow well; case 2 - water flooding; case 3 - CO₂ injection and case 4 - WAG injection. In all cases, the upwelling production was maintained for two years.

The simulations of the first scenario were made to validate the model. The obtained results were compared with the results found by [6]. Those results obtained measure the efficiency of each recovery mechanism, by the determination of their production in all four cases. The case 1 will be used for comparison of the effectivity of the production in cases 2, 3 and 4.

For the second scenario the analyses of oil production were evaluated in different times periods: short term (0-8 years), medium term (8-24 years) and long term (24-32 years).

3.1 Proposed Issue

For the simulations, the reservoir size data and rock and fluid properties were based on the study by [22].

The reservoir is characterized as a parallelepiped, being completely horizontal. It has dimensions of 1066.8 m x 1066.8 m x 30.48 m, in the X, Y and Z axes respectively, with its first layer at the top, located at 2537.46 meters in depth. There are two wells in the reservoir, an injector, and a producer, arranged diagonally. The reservoir parameters can be found in Table 1 and Table 2.

Table 1: Reservoir conditions parameters.

Parameter	Value
Porosity, %	30
Rock compressibility, 1/Psi	5×10^{-6}
Initial pressure, Psia	4000
Temperature, K	344.261
Deep, m	2537.46
Oil saturation, %	80
Water saturation, %	20
Saturation pressure, Psia	2302.3
Distance between wells, m	4005

(Adapted from [22]).

Table 2: Layer Parameter

Layer	Vertical Permeability (mD)	Horizontal Permeability (mD)	Thickness (m)
1	50	500	6.069
2	50	50	9.144
3	25	200	15.24

(Adapted from [22]).

The analyzes of the methods were performed through simulations in the free software MRST (Matlab Reservoir Simulation Toolbox). The properties used in the study of [22] was used as input data in the simulator.

The model that will be used corresponds to the set of equations determined black oil. The name refers to the assumption that the various chemical species present in petroleum can be grouped into two components under surface conditions, a heavy hydrocarbon component called "oil"; and another with light hydrocarbons, called "gas".

Under reservoir conditions, the two components may dissolve in each other depending on the pressure and temperature conditions, forming one or two phases. In addition, the model also includes an aqueous phase, composed only of water. Despite all the interactions between the phases, the composition of the hydrocarbon remains constant.

3.2 Mathematical formulation

3.2.1 Porosity

The porosity ϕ of a medium is defined as the ratio between the empty spaces of the rock over its total volume, thus its value varies from $0 < \phi < 1$.

For a model considering the incompressible rock, the porosity can be considered as a function of the pressure, as shown in the following Equation (6).

$$\phi(p) = \phi_0 e^{c_r(p-p_0)} \quad (6)$$

where p is the total pressure of the reservoir, p_0 is the initial pressure, and c_r as the compressibility of the rock. For a simpler equation, the porosity value can be linearized by Equation (7):

$$\phi = \phi_0 [1 + c_r(p - p_0)] \quad (7)$$

3.2.2 Saturation

The saturation S_α is defined as the fraction of pore volume occupied by a given phase α . In the multi-phase model used, it is assumed that all empty space is filled by fluids (Equation 8), therefore:

$$\sum_\alpha S_\alpha = 1 \quad (8)$$

In the model presented, three phases are considered: one aqueous phase (w), one gas phase (g), and another oil phase (o). The saturation value for each of the three phases can range from 0 to 1.

3.2.3 Black-oil Model

In the Black Oil Model, the fundamental principle of mass conservation is used. For a multiphase and multi-component system, the equation for each phase is (Equation 9, 10 and 11),

$$\partial_t(\phi b_o S_o) + \nabla \cdot (b_o \vec{v}_o) - b_o q_o = 0 \quad (9)$$

$$\partial_t(\phi b_w S_w) + \nabla \cdot (b_w \vec{v}_w) - b_w q_w = 0 \quad (10)$$

$$\partial_t[\phi \cdot (b_g S_g + b_o r_{so} S_o) + \nabla \cdot (b_g \vec{v}_g + b_o r_{so} \vec{v}_o) - (b_g q_g + b_o r_{so} q_o)] = 0 \quad (11)$$

where ϕ represents the porosity, ρ the density value, S the saturation, \vec{v} is the velocity and q correspond to the flow rate and the subscript α indicates the phase being analyzed. The value of b_l, b_o, b_g which correspond to the inverse of the formation volume factor (for each phase), the ratio $r_{so} = \frac{v_g^s}{v_o^s}$ defines the solubility ratio gas-oil.

The velocity (\vec{v}_α) is calculated by Darcy's law (Equation 12):

$$\vec{v}_\alpha = \frac{-k k_{r\alpha}}{\mu_\alpha} (\nabla p_\alpha - g \rho_\alpha \nabla z) \quad (12)$$

the variable μ_α represents the viscosity of the fluid, ρ_α is density, ∇p_α is the pressure gradient, $k_{r\alpha}$ represents the relative permeability of each phase.

3.2.4 Numerical approach

Like the work of [6] the reservoir is composed of 147 cells distributed in: 7 cells in the X axis, 7 in the Y axis and 3 in the Z axis, as can be seen in Fig.4.

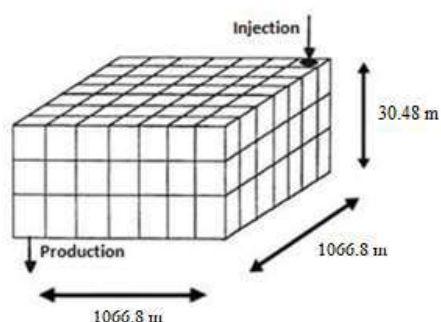


Fig.4: Discretization of the reservoir and positioning of the wells (Adapted from [6]).

The size of each cell in the X axis and Y is 152.4 meters. Already for the Z axis, the first layer is 6.096 meters, the second 9.144 meters, and the third 15.24 meters. To solve the problem, the finite difference method will be used [11].

3.2.6 Proposed Scenarios

For the validation of the MRST software the procedure of [6] will be reproduced and used for evaluating four cases:

Case 1 – Natural flow well;

Case 2 - Water flooding;

Case 3 –CO₂ injection;

Case 4 –WAG injection.

In cases 2, 3 and 4, the analyzed period was 32 years, and in the first years, no injection method was used, that is, natural flow. The values considered for the injection rate were 12,000 stb/d, 20,000 stb/d, 30,000 stb/d, 45,000 stb/d. The effectiveness of the method was determined by comparing the flow production rate.

After the model validation will be carried out an analysis of the production over the time.

IV. RESULTS AND DISCUSSIONS

4.1 First scenario: Software validation and method effectiveness

Simulations were carried out for the three recovery methods (case 2, 3 and 4) at different flow rates. The results were arranged in tables and compared with those obtained by [6].

Table 3 shows the cumulative oil production data obtained for each injection method, with their respective flow rates.

Table 3: Production data for each recovery method.

Injection Methods	Flow rate stb/d	Software's		
		MRST	Eclipse	$Relative\ Error = (\frac{Eclipse - MRST}{MRST}) * 100\%$
		Cumulative Oil Production (MMstb)		
Natural flow well – Case 1	0	12.10	11.10	8.26
Water flooding – Case 2	12,000	24.47	26.40	7.89
	20,000	25.38	26.10	2.84
	30,000	25.73	25.50	0.89
	45,000	25.74	25.40	1.32
CO ₂ injection – Case 3	12,000	33.19	30.70	7.50
	20,000	36.56	34.10	6.72
	30,000	38.54	36.10	6.33
	45,000	40.28	38.70	3.92
WAG injection – Case 4	12,000	39.05	32.50	16.77
	20,000	40.52	35.00	13.62
	30,000	41.29	37.90	8.21
	45,000	42.03	40.60	3.40

Source: (Author)

For the first case, natural flow, we observed an estimate 9% higher in the cumulative oil production than the value estimated by the eclipse software. For better visualization the data of Table 3 can be found in Fig.5.

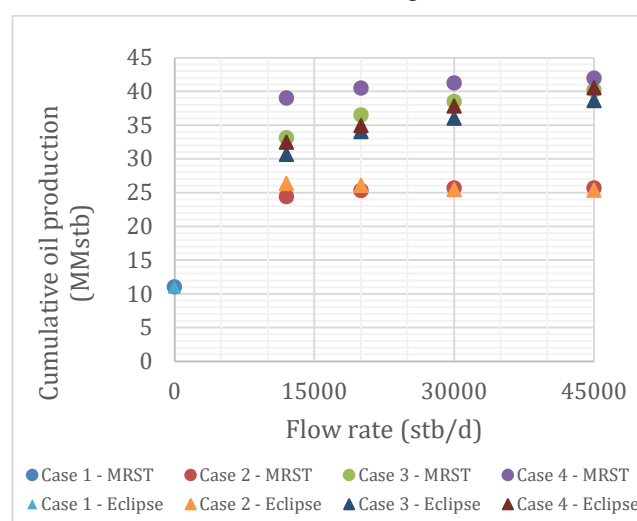


Fig.5: Cumulative oil production for case 1- natural flow; case 2 – water injection; case 3 – CO₂ injection and; case 4 – WAG injection.

Regarding the effectiveness of the method, it is possible to notice a continuum increase of cumulative oil production with the flow rate for the cases 2, 3 and 4 when compared to case 1. The use of WAG injection shown an increase of 3.47 times the production of natural well flow, proving that this method makes a better sweep of the reservoir elevating the production of the well.

For the three injection methods, it is possible to note a pattern of reduction of the relative error found, as the injection flow increases (Fig.6). This behavior is evidenced mainly in the WAG injection, where for an injection flow of 12,000 stb/d a difference of 4.63 was found, while for the 45,000 stb /d flow the deviation was only 1.01.

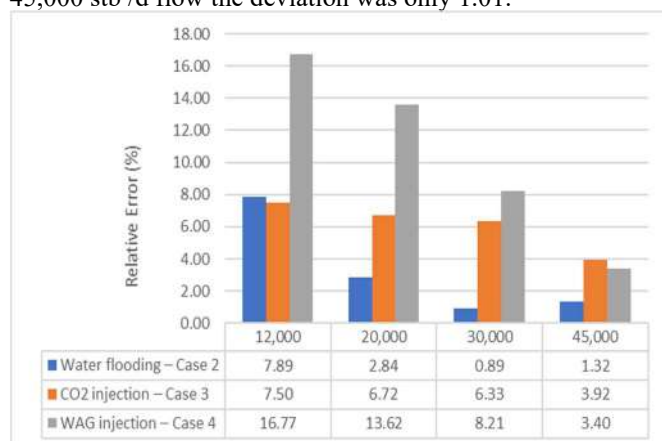


Fig.6: Behavior of the relative error with respect to the method and injection rate.

Therefore, despite less robust software, these results demonstrate the effectiveness of MRST, especially for simulations involving high fluid flows.

4.2 Second scenario: Analysis of production over time

To perform the production analysis, the injection rate of 12,000 stb/d, which generated the lowest production, for cases 2, 3 and 4.

Fig.7 shows the production for the first 8-year period. After the first two years of emergence, the CO₂ injection method has a slightly higher recovery than the others, but is soon overcome by alternating injection, when it reaches stabilization in its cycles.

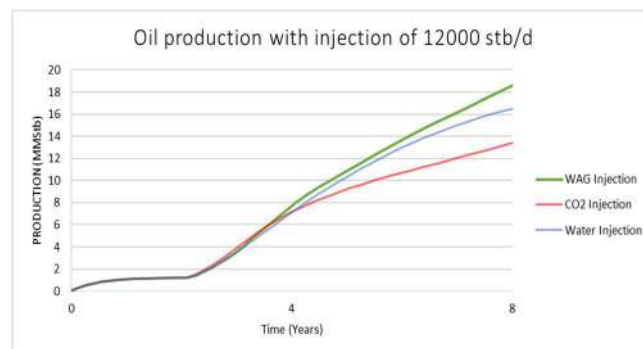


Fig.7: Oil production in the first 8 years of simulation with injection of 12,000 stb/d for the three methods.

Therefore, at the end of the period it is observed that the WAG method is more efficient in the short term, followed by the injection of water and later that of CO₂. The fact that the injection of gases has an early breakthrough in relation to the injection of fluids, explains a smaller production of the method in the first years of production.

The results found are in agreement with [13] who states that the injection of the two fluids in cycles, behaves in a way that with each water bank, the advance of the injection front is retarded, and each CO₂ bank the miscibility with the oil is increased, resulting in an increase in recovery efficiency.

Fig.8 below shows the data for medium-term production in the period from 8 to 24 years. For this time interval, as already expected, the alternating injection method still has higher production and an increasing curve in the recovered oil value.

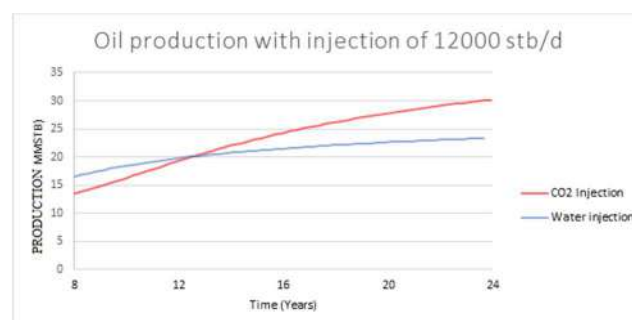


Fig.8: Oil production in the period from 8 to 24 years of simulation considering the injection of 12,000 stb/d for the three methods.

At the same time, it is possible to note the effects of miscibility between water and oil for such an injection method. During the 16 years, the production curve is tending to a certain stability, having an increasingly smaller production over time. This phenomenon can be explained by the difficulty that water has to cover the entire reservoir,

together with the inability of water to remove the volumes of oil mopped by interfacial tension.

On the other hand, CO₂ injection shows exactly the opposite. While earlier production was smaller because of earlier breakthrough, now the ability of CO₂ to blend with the oil and reduce interfacial tension between the phases brings the possibility of producing the volumes that were previously mopped. This characteristic is confirmed by the greater production of oil through the injection of CO₂ from the 12th year of production.

The long-term production analysis, from 24 to 32 years of simulation, can be visualized in Fig.9. It is possible to verify a stabilization of the production curves, which indicates that the three methods reached the maximum recovery efficiency for the if proposed.

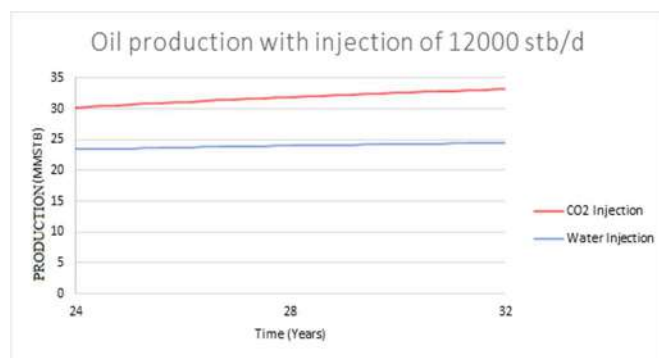


Fig.9: Oil production in the period of 24 to 32 years of simulation. Injection of 12,000 stb/d for all three methods.

The results found in the second scenario followed the same pattern as in the first scenario. However, it was possible to identify that the water injection method, for the short term, is more efficient than CO₂ injection. Thus, such behavior can be considered when choosing the injection method.

V. FINAL CONSIDERATIONS

In a general, the software has shown satisfactory results when it comes to simulation of injection methods. The 4% increase in oil production when compared to WAG-CO₂ methods was achieved. In addition, the deviations found between the values obtained through the MRST software and those of [6] were relatively low, mainly at high injection rates.

In general, an increase of about 4% in oil production was found, when the WAG-CO₂ methods are compared. In addition, the deviations found between the values obtained by the MRST software and those of [6] were a maximum of 17%, decreasing to around a maximum of 7% for the largest simulated flows.

Likewise, it was possible to evaluate the effectiveness of each method in relation to the period of time the method was used. In general, it was observed that up to 4 years of production there are no significant differences in oil production. Up to 12 years, the water injection method is more efficient. After this period, the CO₂ injection method presents greater volume of oil production. The WAG method presents the largest volumes of oil production throughout the analyzed period.

The use of the MRST software proves to be a great option for works related to reservoir engineering and recovery methods, among others. The possibility of accessing routines is a great advantage in relation to commercial software, as it allows new routines to be inserted. The software has a certain intuitiveness for its use as well as extensive documentation that can be found on the website:

<https://www.sintef.no/projectweb/mrst/documentation/>.

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Realistic simulation as a facilitating tool in the teaching-learning process in urgency and emergency: Experience report

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Abstract— *Objective: to describe the experience of professors and students of the undergraduate nursing course in the use of realistic simulation as a methodology to facilitate the teaching-learning process in the curricular component "Nursing Care in Emergency and Trauma". Method: experience report, with participatory observation of professors and students of the undergraduate nursing course at the University of the Amazon, Belem, State of Para, Brazil, regarding the use of active methodologies in the construction of teaching in Urgency and Emergency, in the period included from August 6 to December 22, 2019. Result: in this teaching-learning process, with the simulation methodology, teachers played a fundamental role, acting as facilitators, emphasizing self-directed and student-centered learning. Such experiences allowed the actors involved to see teaching in the laboratory as a privileged space, which requires constant interaction between academics and teachers when integrating theory learned in the classroom with practice. Conclusion: the use of realistic simulation as an active teaching methodology, contributes to increase the self-confidence, self-knowledge and psychomotor skills of students in practice, in addition to providing theoretical-practical dialogue aimed at the profile of the professional to be trained.*

Keywords— *Teaching. Simulation Training. Health Education. Education, Nursing, Baccalaureate.*

I. INTRODUCTION

Caring more than a simple repetition of tasks, translates into complex and dynamic work, with scientific methodology and accurate clinical reasoning. In this way, current nursing seeks to reframe the care and teaching processes for the construction of knowledge with a scientific, clinical, technical and technological basis⁽¹⁾. Clinical simulation is a method that aims to improve reasoning and critical thinking, which qualifies the

knowledge and assessment skills and decisions required in care practices⁽²⁾.

In this context, simulation teaching corroborates the recommendations of good nursing practices and the current recommendations of the Quality Committee in Health Care of America, which deals with the prevention of errors and patient safety, assuming that the team's learning be achieved through the use of simulation, based on the management of the team in an emergency and

encouragement of interdisciplinarity, adapting to the parameters established internationally for teaching, where the training of professionals must meet the demands of globalization⁽¹⁻²⁾.

The use of realistic simulation strategies has its genesis in military, aviation, aerospace and nuclear training, which have always valued the quality of service and minimizing errors⁽¹⁾.

Patient safety has become a global challenge for healthcare organizations worldwide. The report "To err is human" presented worrying data regarding the number of deaths, showing around 48,000 to 98,000 deaths per year. Estimates currently point to more than 400,000 deaths from errors in the health area, despite the measures and policies instituted worldwide⁽³⁾.

Using simulation as a teaching method is challenging, as it must be embedded in the Pedagogical Project of the Course of Higher Education Institutions, becoming a reality, based on actions that give rise to reflections about training, through investments in the composition of commissions permanent assessment and, above all, the permanent training of teachers and insertion of the academic community in research with the objective of strengthening the teaching-learning process⁽²⁾.

Realistic simulation is seen as an effective and innovative method that expands the relationship between the theory and practice of the student body in a safe environment, offering better opportunities for learning and training, contributing to the qualitative training of the professional. In its last stage, simulation allows a proposal for reflective discussion (debriefing) about the situation experienced, the learning process and the decisions taken during the simulated service, stimulating the student's critical and reflective thinking, consolidating knowledge. Simulation in the educational process of health professionals provides the opportunity for the development of varied skills and competencies necessary in a controlled and protected environment, allowing repetition, errors and professional growth, without risking patient safety⁽⁴⁾.

The simulation gives the student the ability to deal with feelings of insecurity, fear, uncertainty and motivation for questions about the procedures performed, leading to the construction of experiences that require reflection and allows the possibility of acquiring the ability to self-conduct the training process. The student is evaluated about their actions, in addition to pertinent considerations that will allow them to reformulate and reframe their conduct, contributing so that the teacher can evaluate the progress and effectiveness of their classes and qualify

undergraduate nursing education, in its theoretical and practical bases. methodological⁽²⁾.

In this context, realistic health simulation has been a strategy explored in teaching laboratories and simulation centers, aiming to provide a reflective and transformational environment for the development of skills and competencies essential to patient-centered care and achievement of the proposed objectives and results for the learning and improvement process⁽³⁾.

The use of simulation techniques favors the implementation of the National Curriculum Guidelines for the Nursing course, given that the profile of the graduate who wishes to graduate is that of a generalist and humanistic, critical and reflective professional, capable of learning to learn and have commitment to education and training⁽²⁾.

Thus, the integration of different health teaching methodological strategies that enable the articulation of theory and practice has been pointed out as an effective mechanism in higher education, capable of training more critical, reflective and prepared professionals for professional performance, provided with maturity expected by society and the labor market⁽⁴⁾.

In order to improve training results, realistic health simulation for the education and training of professionals in the field has grown as one of the strategies for the development of technical and non-technical skills. Technical skills are understood by specific procedures in each specialty, and non-technical skills involve cognitive, social and relational skills that complement the technique for the performance of professional practice with quality and safety⁽³⁾.

The benefits of simulation-based teaching are many, as they provide teachers with opportunities to assess and measure the student's ability to integrate; it also allows the chance to make mistakes and thus lead to professional growth without compromising patient safety, since the knowledge acquired is realized through programmed situations, which represent the professional reality, still allowing control of external factors, standardization and systematization of teaching beyond positive feedback to students⁽²⁾.

Recognizing the relevance of the aspects mentioned in the teaching-learning process in relation to nursing skills, this study aims to describe the experience of professors and students of the undergraduate nursing course in the use of realistic simulation as a methodology that facilitates the teaching-learning process in the curricular component "Emergency Nursing Care and Trauma".

II. METHOD

Report of experience with participatory observation of professors and students of the undergraduate nursing course at the University of the Amazon (UNAMA), Belem, State of Para, Brazil, regarding the use of active methodologies in the construction of teaching in Urgency and Emergency, in the period included from August 6 to December 22, 2019.

The descriptive method was used. For this, a critical analysis of the activities developed during the school period was carried out.

The discipline of Emergency Nursing Care and Trauma is a mandatory curricular component of the undergraduate nursing course, being taken in the seventh academic period of this higher education institution. It has a theoretical-practical character with 80 hours.

The activities were developed together with student monitors who had already taken the course. These were approved in an internal selection process instituted in the first semester with entry in the second semester of 2019 through the request of the professor in charge of the discipline, of the academic board of UNAMA in line with the coordination of the Nursing Course.

It should be noted that the selection process consisted of a written test, an interview with the judging committee, chaired by the professor responsible for the discipline and an analysis of the academic performance of the candidates. In this process, three monitors were selected, one with a scholarship and two volunteers, who were subsequently distributed in the three shifts.

The activities were developed both in the classroom and in the realistic simulation laboratory, where there was the opportunity to develop students' skills and abilities in the elaboration of the activity plan, exercise with the students, clarifying doubts about the subjects taught or remembering the practical maneuvers developed in previous semesters in line with the curriculum design, always under the supervision of the teacher responsible for the discipline.

The monitors fulfilled a mandatory workload of 20 hours per week in accordance with the selection notice, 12 hours of which are intended for student assistance in the monitoring room or in the realistic simulation laboratory, 4 hours for the study of the discipline and 4 hours for academic production. The schedules were distributed to the 3 monitors throughout the week, in the morning, afternoon and night shifts.

During the five-month period, these students met with the teacher who subsidized and consolidated the necessary information for the improvement of the group's cognitive, psychomotor, affective and attitudinal competences in face of the constructed clinical situations / scenarios. The questions that arose were promptly clarified, so that students could acquire greater confidence and security to act in the face of the formulated cases.

The period of organization of content and construction of cases and scenarios lasted one month. The last four months were devoted to the implementation, implementation and final adjustments of clinical cases. The implementation of the cases occurred in order to reproduce care experiences for the group, which require nurses to develop skills related to cognition, psychomotricity, attitudes and behaviors.

For this, initially, an environment for simulation was created inside the laboratory, where the group of students, together with the teacher, met weekly to adapt and program the scenarios of clinical cases to be applied with the class. Subsequently, the cases were implemented, using the simulation strategy to verify their scientific applicability and the achievement of the objectives proposed by the teacher in relation to the expected performance of the students.

Immediately before implementing a case, students were informed by the teacher about the clinical history of the patient with whom they would work. In a last moment, after each simulation, the students, together with the teacher, met in a private environment to carry out the debriefing. At this stage, in each scenario experienced, the best practices were discussed in relation to situations, the adequacy of behavior, attitudes and posture. Then, the teacher was offered reinforcement of successful practices to stimulate the student's scientific growth.

This experience aimed to include the simulation method, with the aim of minimizing insecurities, strengthening knowledge bases, promoting, in a safe environment, the repetition of clinical situations that would hardly be experienced in hospital practice.

With this, it was expected to reduce the existing gap until the present day between theory and practice, in addition to optimizing the technical-scientific use of the course by the student body. In this perspective, the guiding question of this report was "Can insecurity, fear and lack of practical experience limit the nurse's performance as a professional?"

To support the teaching process, in this experience, they were listed as material and methodological resources: media resource, TV, internet, simulator mannequin

(Resusci Anne - LAERDAL®), for cardiopulmonary arrest training and Automatic External Defibrillator simulator, cervical collar, long board, dorsal immobilizer vest, multiparametric monitors, infusion pumps, electrocardiograph device, laryngoscope, tubes, probes, drains, catheters, among other materials necessary for the construction of clinical scenarios.

The execution and management of the entire simulation process was carried out by academic monitors of the Nursing undergraduate course with the supervision and guidance of instructing professors linked to the discipline.

In order for the instructors (teachers and student monitors) to start the stage of practical activities, first there was an explanation (briefing) of how each stage would go, in order to guide students on how to proceed, that is, that there would be a systematic observation of the service provided by the student and registration by the instructor, but without intervention, that the instructors were there only to observe and offer some material if requested by the student. At this stage, it was reiterated that even if the student realized that he performed an incorrect action, he should follow the service as if he were in a real situation.

At the end of each simulated service, the instructor performed the summary of the service individually, a succinct explanation of the critical points, errors and successes (debriefing) allowing feedback and feedback to the participants, in addition to a group evaluation focused on collective feedback.

III. RESULTS AND DISCUSSION

It was evidenced that the simulation scenario allows the student to experience, in real time, frequent situations in the practice of care, in which the consolidation of knowledge and experiences occur safely and echoes in practice as a tool that strengthens and consolidates the theoretical aspects learned in the classroom setting.

It should be noted that the emotional difficulties found in the clinical activities reported by the students, occur due to insecurity in carrying out the procedures and unpreparedness in the execution of some techniques.

Corroborating the findings of this study, it is described that the development of care-care practices can generate anxiety, stressful factors capable of producing anguish in the student. This fact is mainly due to inexperience, insecurity, unpreparedness in the execution of the techniques, the fear of making mistakes and the clinical evaluation. In this understanding, training prior to internships in the clinical field, carried out in the classroom and in the laboratory, contributes to the construction of

these skills and the development of student safety, reducing the influence of emotional factors on their efforts. In this scenario, the need for prior practice is considered mandatory for the consolidation of higher education curricula in health, in which higher education institutions must provide laboratories for training basic psychomotor skills for the training of generalist nurses⁽⁵⁾.

It was possible to verify in this experience that the coping with the unknown and the intensity of involvement with the simulated situations were imperative factors for the expression of feelings such as stress, anxiety and insecurity that predominates among the students.

It is considered that the performance during the realistic simulation in this experiment went beyond the development of psychomotor and technical skills. The findings revealed the students' ability to interact in a more participatory and motivated way, by identifying and recognizing signs and symptoms that are known, but remain hidden and poorly systematized when exposed to an unexpected clinical situation, which sometimes culminates in a deficient skills for the identification of clinical conditions that suggest deterioration of the patient in the emergency and the correct way to provide care in these situations.

Nursing is recognized as a profession that is closely linked to technical and manual procedures, thus, the acquisition of psychomotor skills is essential to provide qualitative care to patients and their families. Considering patient safety, the development of these psychomotor skills cannot be neglected during the training process during graduation. In addition, graduation also contributes to the development of managerial and administrative skills, providing experience in carrying out nursing management activities, which are essential to guide professional practice⁽⁵⁾.

Realistic simulation is recognized today as a driving tool in the health scenario, being suggested as a planned and applied practice for the qualitative training of undergraduate and nursing professionals, benefiting the teaching and learning process both in undergraduate and in continuing education and permanent. The insertion of simulation as a training strategy, continuing education and evaluating professionals is relevant in the health scenario⁽⁶⁾.

In this context, the laboratories provide the articulation of diverse knowledge and the overcoming of the dichotomy between professional and general education of the student. This facilitates learning and generates reflection on the practices performed, more than simply guaranteeing training to exercise functions⁽⁷⁾.

The lack of technical skill is reported in some studies by many recent graduates in the field of nursing as an obstacle to be overcome when being incorporated as professionals in health services, confirming that the psychomotor skills of recent graduates, necessary for the development of technical competence the professional nurse, does not meet the requirements of the work environment during graduation⁽⁵⁾.

In this scenario, new professionals are shaped to suit the type of assistance offered. For students, self-confidence in doing professional in their first job is directly associated with academic experiences and how much they were able to learn and practice during graduation⁽⁵⁻⁷⁾.

It is known that the health environment is increasingly complex, dynamic and constantly changing. Thus, nurses must work in an efficient and collaborative way with their nursing team and multidisciplinary team. It is through collaborative practice that professionals from multidisciplinary teams are encouraged to work together, in an interdisciplinary way, and with patients and their families, in order to improve and achieve the highest quality in the results related to the care process, reducing health costs and, consequently, achieving greater organizational efficiency⁽⁶⁾.

In this context, the clinical simulation laboratory becomes an efficient means of providing skills training, mainly psychomotor, where the student can perform the same procedure repeatedly to improve the technique without putting patients at risk. However, in the context that involves training psychomotor skills, it is essential that, at a later time, students now provided with more security and knowledge, acquired in a controlled environment can experience supervised practice in a real environment. It is considered that the experiences apprehended critically and reflexively during the supervised internships are the main responsible for the personal and professional growth of the student, providing him / her with greater security at the end of the course. This experience provides the construction of a professional identity for performance, leading him to appear more and more prepared and competent⁽⁵⁾.

In this process that permeates teaching with the use of realistic simulation, aiming to meet the proposed learning objectives, teachers act as facilitators, emphasizing self-directed learning, centered on the student, in which, it can be observed that teaching in the laboratory requires constant interaction between the protagonists, academics and teachers when integrating theory with practice. The simulations humanize teaching and contribute to overcoming difficulties and to controlling students'

emotional stress, reinforcing the relevance of the interaction between teachers and students⁽⁸⁾.

Simulation is a process of cognitive and behavioral education, given the high levels of self-esteem and self-confidence that it can provide, thus expanding the possibilities of the individual to assimilate information and obtain gains in his learning process⁽⁵⁾.

Although the university setting this experience has a curricular design with a significant practical workload, the students consider the practical opportunities still insufficient, in addition to recognizing this component as essential, which must be carried out from the beginning of the course through laboratory practices.

It should be noted that the simulation laboratories are in the process of implementation and improvement in the educational institution and their incorporation into active teaching methodology should, in the medium and long term, provide positive changes in the profile of students in relation to their technical skills and, consequently, in critical reasoning.

It is possible to observe, from the students' speeches, a reduced contact with the practice of caring for critically ill patients in urgency and emergency, which we believe is directly linked to the profile of generalist education in Nursing in Brazil.

In this context, many students only contact emergency services in their final year of graduation, an opportunity not available to everyone.

However, we consider the benefits that this contact can bring to the development of nursing skills and competences undeniable. The urgencies, for providing care to patients of various specialties and varying degrees of complexity, provide the opportunity to apply the theory in the practice of a significant amount of procedures and skills, in addition to the contact of students with a wide multidisciplinary team.

We understand that the inclusion of students in these scenarios, however, presents obstacles, such as the need for adequate preparation of teacher teachers to perform supervision; restricted environment, reducing the number of students and teachers in the field; and the fact that the environment has the potential to generate anxiety due to the constant imminent risk of death and the high specialization required.

Reiterating the importance of teaching by simulation in the teaching-learning process, in this experience it was possible to observe among the students, that the contact with the dummies for simulation of cardiopulmonary resuscitation (CPR), for example, helped to work on

posture, ergonomics, control of strength and technique to be applied during this procedure and other recommendations that would be almost impossible and somewhat dangerous to teach / learn in a real setting, given that cardiopulmonary arrest is an extreme medical emergency.

Leaving for the practical field, after classes with the repetition of techniques and development of these skills in the laboratory, the students were safe in the execution of the tasks, a situation experienced in supervised practice and reported by the students, where they were faced with a cardiorespiratory arrest or the evaluation of patients in the various clinical entities, were not intimidated and afraid to interact with the multiprofessional assistant team, nor with patients and their families, showing the effectiveness of previous training in the laboratory with the use of realistic simulation.

IV. CONCLUSION

The results showed that the increase in self-confidence and satisfaction with the simulation has a protective impact on the level of anxiety of students, in addition to increasing the confidence and self-efficacy of patient care.

Surely, experiments with simulation are capable of promoting learning outcomes that are well articulated between theory and practice. Simulation stands out as a strategy that involves learners from different perspectives, making them reflect and reformulate their practice, prompting thinking and doing simultaneously.

We conclude that classes with the realistic simulation method in the laboratory facilitate the development of skills, not only from a practical point of view, but, above all, emotional and psychological, given that students can familiarize themselves previously with materials and equipment and design for a real care situation contextualized with everyday life.

We reiterate that nurses involved in the teaching and learning process of the 21st century need to develop a reflective process, in the sense of seeking strategies to innovate teaching, with simulation being an effective tool in professional education and in the modern context of teaching for qualitative health care. .

The simulation strategy aims to develop the skills needed to master competence in the areas of health, management and systematization of care. They are privileged and protected spaces that simulate scenarios of health care practice safely.

Students perform consultations on simulated patients, that is, procedures on mannequins, being accompanied by a

facilitator who will assess the performance of the skills geared to the profile of the professional to be trained. All this innovation helps the facilitators to contribute to the excellence of the teaching-learning process, increasingly focused on what the labor market requires from a nurse; thinking, critical, reflective in his doing.

At the same time, the nursing student develops a process of thinking and rethinking, to give a new meaning to his education, making it possible to see in the academy the need to build and develop his technical and scientific skills to do the best, supporting his training in scientific consensus and evidence that promotes the highest levels of quality of health care.

Simulation has been constituted as a facilitating strategy used in the disciplines of undergraduate nursing courses to teach the techniques and procedures necessary to perform care. In Brazil, experiences indicate that the simulated practices have contributed significantly to the qualitative training of students, corroborating the improvement and transition of virtual and controlled environments in laboratories to assist patients in the various scenarios and levels of complexity of the health system.

The results of this experiment suggest that the application of simulated strategies in the laboratory can be associated with computer technology, as support for classroom teaching. Teachers and students are available for innovative ways of teaching, particularly simulations.

The psychomotor and administrative skills of nursing students are often insufficient to meet the demands of health services, corroborating the idea that recent graduates may face difficulties in adapting to the practice as nurses with regard to direct assistance and execution of technical assistance procedures.

Thus, the results of this research contribute to the reflection on the teaching of nursing in all educational institutions that have similar teaching methodology; instigate those responsible for the basis of nursing education and allow them to question the actions currently developed and their effectiveness in forming the professional profile of future nurses; give rise to research, focusing on nursing skills, teaching methods and how training processes are being built in higher education institutions.

The scarcity of scientific productions directly linked to the proposed theme from this perspective was the main limitation found. From the results of this study, the need for further study on the topic by the academic community is reiterated, considering its relevance.

Despite the lack of studies at national and international levels, dedicated to investigating the teaching-learning process and the relationships that permeate the implementation and evaluation of teaching by simulation, especially in the training of nurses, with its implications for professional performance, further studies are suggested.

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Automation Mechanisms applied in the legal practice of the Brazilian Federal Public Administration

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Abstract— *The study intends to present some experiences in the use of artificial intelligence tools and automation in the management of lawsuits in defense of the Federal Executive Branch in Brazil. Therefore, through a markedly descriptive approach, basic aspects of the organization of the Brazilian State and the Judiciary are presented, as well as data from the national reality and reflecting the procedural volume faced by Brazilian public lawyers, in the defense of public property and treasures. As a theoretical basis, specialized doctrine on the subject and data accessible in the official portals of the Federal Government is adopted. It is also intended to explain the functioning of the interface used by the Attorney General's Office with the Judiciary and to list the automation tools in the lawsuits in which the Federal Public Administration is a party. Method: The method of approach is the deductive, through the bibliographic and documentary research technique, with analysis of the legislation involved.*

Keywords— *procedural legal activity; public advocacy; automation; Federal Public Administration.*

I. INTRODUCTION

In the 20th century, computer scientists believed that people could be much more effective if they had at their fingertips a computer system with good displays and good databases.¹ Now, in the 21st century, we hardly envision how to live apart from the digital and automated reality.

In the age of new technologies, the astonishing evolution of the language of orality for the use of digital codes transported artificial intelligence (AI) from the exact areas to all contemporary professions.

And at incredible speed, legal information tabulated in books and libraries is now used to transiting through an invisible field and being associated with

expressions such as "big data", NLP "natural language processing", "Python", "Dax" (data analysis expressions") and "M" (power query formula language). A direct and immediate consequence of this new scenario, the emergence of a more digital judicial defense model, began to require profound and accelerated changes in the respective instruments of work of advocacy, especially in the sphere of public advocacy.

To measure the size and complexity of such system, it should be emphasized that Brazil is the fifth country in territorial extension in the world,² currently in

¹ HAFNER, Katie. *Onde os magos nunca dormem: a história da origem da internet e dos magos por trás de sua criação*. Trad. Rio de Janeiro: Red Tapioca, 2019. p. 41.

² According to the Brazilian Institute of Geography and Statistics (IBGE), Brazil is a country of continental size, with 8,510,820,623 km², unevenly distributed among Brazilian macro regions, especially in the North, with 45.25% of the total area of the country (3,851,281,390 km²) and in central West, with 18.87% (1,606,239,030 km²). Retrieved from:

the ninth position among the largest economies in the world,³ with a population of approximately 210,147,125 inhabitants⁴ and in the fourth position in the world's most connected population, with more than 120 million people with frequent internet access.⁵

Apart from such data, it strongly highlights the existence of about 80 million lawsuits in the Brazilian Judiciary,⁶ according to the figures of the National Council of Justice (CNJ) recorded in 2018. In fact, such representative figures would certainly bring with them daily challenges to legal operators, which reinforces the urgency in the study of automation and productivity systems.

The Constitution of the Federative Republic of Brazil of 1988 (hereinafter Constitution of 1988) structured the judicial system composed of various bodies.⁷ Part of these operates within the Union and is divided into units, such as the Federal Court (common) – including the Federal Special Courts – and the Specialized Justice – composed of the Labor Court, the Electoral Justice and the Military Justice.

In this context, it matters to detach that, according to the Report already in 2019,⁸ only 16.2% of all new cases were physically entered, and only in 2019 were already recorded 20.6 million new cases in electronic format.

Numbers that show that the accelerated reality of the electronic process in Brazil is unquestionable.

Just to get an idea of the respective framework for the implementation of the electronic process in Brazil, in 10 years the Brazilian Judiciary received 108.3 million new cases in electronic format, which represents the percentage of adhesion of 83.8%.

In another relevant data, the same CNJ report of 2019 confirms that the main factor of slowness of the Brazilian Justice rests on tax executions, which represented 39% of the total number of pending cases, with a congestion of 92%.

This numerical expressiveness indicates the urgency and marked importance of AI tools applied to the legal services of public lawyers, especially at the federal level. Added to this is the fact that the Brazilian federal public sector (the federal government, its autarchies and foundations) is the largest service provider in the country and, consequently, has led, for almost ten years, the participation in ongoing legal actions.

Without disregarding the possible and even necessary questions and criticisms that may arise from this statement, which are not appropriate to be analyzed here, there is no escaping from this inexorable problem situation: how to operationalize work in millions of processes involving taxpayers, users of the public health system, social security and users of administrative infrastructure?

In an attempt to initiate the response to such a complex and multifaceted problem, it should be remembered that the organization of the Brazilian State was defined in the 1988 Constitution as a presidential federative republic, characterized by being a unity within the immense pluralistic diversity.⁹

Contrary to the US federal model, the Brazilian Federation established by the Constitution of 1891 is marked by a centrifugal movement, which formed autonomous units of power, and which is reflected in the way public services are provided.¹⁰

It is also important to highlight the qualitative trait of the Public Administration as an active subject of the legal-administrative relationship, intended broadly to satisfy the public interest,¹¹ allied to the public

https://biblioteca.ibge.gov.br/visualizacao/periodicos/2/bn_2019_v27.pdf. Accessed 27Jul. 2020.

³ Reference considering the gross domestic product (GDP) according to the IMF. Retrieved from: <https://www.imf.org/external/pubs/ft/weo/2017/01/weodata/index.aspx>. Accessed 26Jul. 2020.

⁴ Official data published in the Official Journal (OJ) on August 28, 2019, according to IBGE estimate in Resolution n° 3 of August 26, 2019.

⁵ Data extracted from the official publication at the General Secretariat of the Presidency of the Republic. Retrieved from: <https://www.gov.br/secretariageral/pt-br/noticias/porta- gov-br-vai-reunir-servicos-do-governo-federal-em-um-so-canal>. Accessed 30Jul. 2020.

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⁹BULOS, UadiLammego (2012). p.913.

¹⁰BULOS, UadiLammego (2012). p. 915.

¹¹ The debate on the concept of public interest and its centrality to contemporary Administrative Law goes beyond the limits of this study, especially in relation to the discussion on the so-called principle of supremacy of public interest and the criticism that is addressed to it. It can be said that the "concept of public interest is misinterpreted as the unavailable values guaranteed by the

administration in the sense of function of an administrative and executive nature, guided in all its biases by constitutional principles based on lawfulness, impersonality, morality, publicity and efficiency (Article 37, *caput* of the 1988 Constitution).

In this regard, it seems possible to affirm that the administrative structure has made firm efforts to enter the digital age, including with a view to complying with the constitutional principles mentioned above and advancing in the consolidation of a model of digital citizenship, participatory and continued, in order to reduce bureaucracy and improve the provision of its services through digital platforms.

In 2019, Decree nº 9,756, of April 11, 2019, established the single portal "gov.br" and provided on the rules of unification of digital channels of the Federal Government, having so far successfully migrated federal services to the new tool of the Services Portal, the *Planalto* and the Government of Brazil. These three websites receive about 13 million visitors per month. By the end of 2020, this sum should reach 1.6 thousand sites¹² of the Federal Public Administration - all will be part of "gov.br".

Among the objectives is to digitalize all the 3,293 services¹³ offered by the Federal Government, 315 of which have already been transformed and will represent about 12.5 million annual visits no longer in presence of public agencies. One that intends to facilitate the life of the citizen and provide, in the Government's estimates, an estimated annual saving of R\$ 936 million, of which R\$ 197 million for the Public Administration and R\$ 739 million for citizens.¹⁴

Constitution, under the unshakeable sign of fundamental rights and the centrality of the principle of the dignity of the human person (personalization of the constitutional order)". On this debate and the construction of the legal-administrative regime common to the paradigm of democratic Public Administration, from the structuring constitutional principles of the dignity of the human person, the democratic state of law and the republican principle, see: CRISTOVAM, Jose Sergio da Silva (2015). p. 117.

¹² In the UK, one of the world's leaders in public sector digital innovation, the Government Digital Service (GDS) completed 7 years in October 2019. In November "gov.uk" celebrated the hallmark of nearly 2,000 government websites combined into a single website, with support from nearly 14 million visitors. Retrieved from: <https://gds.blog.gov.uk/2019/11/05/transforming-gov-uk-the-future-of-digital-public-services/>; <https://gds.blog.gov.uk/about/>. Accessed 4Aug. 2020.

¹³ Data extracted from the official publication of the Government of Brazil. Retrieved from: <https://www.gov.br/pt-br/noticias/financas-impostos-e-gestao-publica/2019/08/portal-gov-br-reune-servicos-em-um-so-local>. Accessed 30Jul. 2020.

¹⁴ Data extracted from the official publication of the General Secretariat of the Presidency of the Republic. Retrieved from: <https://www.gov.br/secretariageral/pt-br/noticias/portal-gov-br>

This brief information of data and values makes it possible, albeit superficially, to situate the dynamics around which the entire judicial defense demanded by the Brazilian Federal Public Administration orbits and which is under the attribution of the Attorney General's Office (AGU). The AGU is highlighted by the 1988 Constitution as one of the essential functions of Justice in Brazil, with the responsibility of exercising activities of consultancy, representation in court and legal advice from the Federal Executive Branch.

Although since the 1988 Constitution, article 131 has provided for the AGU as the institution that, directly or through a related body, represents the Union, judicially and extrajudicially, it was only on February 10, 1993, by Supplementary Law nº 73, that it was officially created.

For its operation, the AGU is divided among the organs of the Solicitor General's Office (PGU),¹⁵ the Attorney General's Office for the Federal Agencies (PGF), the Attorney General's Office for the National Treasury (PGFN) and the Attorney General's Office for the Central Bank (PGBC). This division encompasses the Union's judicial defense of both direct and indirect administration, which justifies the volume and importance of the respective legal work.

From this introduction and from the functioning of the judicial defense of the federal public administration, it is possible to present some characteristics of the automation ecosystem and archival management in use by federal public lawyers.

II. AUTOMATION INSTRUMENTS AND ELECTRONIC PROCEDURAL MANAGEMENT IN FEDERAL PUBLIC LAW.

The effects of language evolution¹⁶ (from orality to writing and programming in a digital environment) made it possible for man to expand the functions of rationality by combining human reasoning with the machine's potential. Svein Linge states that we only use the real power of computers when we know how to program¹⁷

vai-reunir-servicos-do-governo-federal-em-um-so-canal. Accessed 30 Jul. 2020.

¹⁵ The official nomenclatures of the bodies and offices of the Attorney General's Office in the English, Spanish and French languages, were established by Ordinance n. 3, of 3rd January 2020.

¹⁶ The important debate about the theory and philosophy of language goes beyond the limits of this study. On the subject, see: WITTGENSTEIN, Ludwig (2017).

¹⁷ LINGE, Svein (2016). E-book.

them and from that we make them do exactly what we want them to. That's having digital freedom.

In Brazil, we are not presented to the language of programming as an integral part of the legal study. As a result, legal services end up hiring programmers or consulting firms for digital inclusion and optimization of work resources.

However, the reality of the legal professional necessarily encompasses the use of automation tools applicable in archival management. On the other hand, any unfamiliarity with these instruments cannot cause the feeling that belonging to the world of laws will automatically exclude it from the world of machines.

The use of artificial intelligence and automation making up an architecture necessary for large-scale legal activity, as is the case of public legal action in Brazil. About AI, although there is not only one definition of AI,¹⁸ even among experts in the field,¹⁹ concepts vary and can identify AI, for example, as a field of research, such as the autonomy of advanced systems, or to settle in comparison with human intelligence.

This way, visions such as "government as a platform" are gaining space. That expression was brought by Tim O'Reilly,²⁰ who presents a government focused on the construction of an information-based infrastructure that allows any citizen to reuse information to build new applications useful to society as a whole. In other words, the same openness that allows transparency also allows innovation and future applications initially unexpected.

Open source software, public software²¹ and digital platforms are in the same path, the first being the

starting point for the creation of SAPIENS, the system that is the central object of the analysis undertaken here.

Initially, the completion of forms of lawsuits occurred every two seconds, so that the Procedural Automation System (SAP), known as "robozinho", distributed processes and enrolled tasks in the Integrated System of Control of Union Actions (SICAU)²² in a few seconds.²³

In Brazil, these mechanisms of the digital era are the responsibility of the Ministry of Economy to implement actions to improve public services in structuring systems.²⁴ The so-called Structuring Systems are support mechanisms (auxiliary) to the activities performed by the sectoral bodies (units responsible in each body or entity), under the coordination and supervision of a central body. Part of the processes executed in these systems are centralized in information systems (structuring systems), that is, in technological platforms (software) managed by the central bodies.

In the face of such information, it is evident that state legal defense cannot depend solely on normative and theoretical knowledge; it needs to go further and look for new working instruments. It is no longer worth expecting that those intuitive experiences typical of Word, Excel, PowerPoint and Internet Explorer may be sufficient for understanding the world in the digital age and in the time of the narrow, dynamic and accelerated interconnections between the universes of law and AI.²⁵

In fact, the working facilities offered by information technology and programming have indicated a new path for the law professional, which can no longer be restricted to the legal arena. It urges its entry and constant frequency to the stages of new technologies and AI.²⁶

¹⁸ It is known that the term "artificial intelligence" was the object, more than sixty years ago, of a proposal for the "study of artificial intelligence of 2 months and 10 men" presented by John McCarthy (Dartmouth College), Marvin Minsky (Harvard University), Nathaniel Rochester (IBM) and Claude Shannon (Bell Telephone Laboratories), in a workshop, which occurred between July and August 1956 in the United States. Retrieved from: <https://www.forbes.com/sites/gilpress/2017/08/27/artificial-intelligence-ai-defined/#2a9777927661>. Accessed 18 Jul. 2020.

¹⁹ BUITEN, M. C. (2019). pp. 41-59.

²⁰ O'REILLY, Tim (2011). pp. 13-40. Retrieved from: <http://www.mitpressjournals.org/doi/abs/10.1162/inov.a.00056#.Vp1XYGwVhBc>>; Accessed 29 Jul. 2020.

²¹ On the Brazilian Public Software portal, part of the Ministry of Planning, Development and Management, 69 free software are shared, resulting in the economy of public resources and constituting a beneficial resource for the whole, the public administration and society. Brazilian Public Software is a specific type of free software that meets the modernization needs of the public administration of any of the Powers of the Union, the States, the Federal District and the Municipalities. Retrieved from:

https://softwarepublico.gov.br/social/search/software_infos?softw are_type=public_software. Accessed 4 Jul. 2020.

²² Currently, the initial system is no longer in use in the AGU, but in March 2013 the expectation was around the mark of one million records.

²³ As an illustration, in March 2013 the numbers of the first systems of the AI AGU were already representative and totaled more than 760,000 tasks, capable of entering a load of 300 Court cases in one afternoon, which previously required three days of work to achieve the same result, in addition to the demand for personnel to perform the task.

²⁴ As provided for in Decree nº 9,745, of April 8, 2019, in Article 127, item VI.

²⁵ On the theme of relations and interconnections between Law and AI, see: PEIXOTO, Fabiano Hartmann; SILVA, Roberta Zumblick Martins da (2019).

²⁶ About the Digital Government and Information and Communication Technologies (ICTs), see: CRISTOVAM, Jose Sergio da Silva; SAIKALI, Lucas Bossoni; SOUSA, Thanderson Pereira de (2020).

In the case of the AGU, the Integrated System for the Control of Federal Actions (SICAU) was initially adopted, which was discontinued in 2016 due to the entry into operation of SAPIENS, with the following definition:²⁷

SAPIENS is an Electronic Document Manager (EDM) that has advanced resources to support the production of legal content and control of administrative flows, focused on integration with the computerized systems of the Judiciary and Executive Branches. (...) SAPIENS unifies and relates the elements contained in the Administrative Processes, including judicial dossiers, placing the AGU definitively in the era of virtualization and the electronic²⁸ administrative process.²⁹ It promotes the orchestration of the various computerized systems of the public administration, in a transparent way for the User. It manages and promotes the adoption of standardized models and theses of law at the national level, in order to make the performance of Federal Public Lawyers throughout the national territory and in all instances cohesive. (...) SAPIENS is a hybrid system, that is, it supports digital and physical documents. It includes operations such as: capture of documents, application of the classification plan, version control, control over storage and destination deadlines, safe storage and procedures that ensure access and preservation in the medium and long term of reliable and authentic digital and non-digital archival documents.

The term SAPIENS also means Intelligent Attorney Support System, a system created and managed

by career members, with a first project in 2013. However, SAPIENS was born by Ordinance AGU n. 125, of April 30, 2014. According to your art. 1º, the "official system of information, documents and electronic processes within the framework of the Attorney General of the Union", of mandatory use in document management and control of workflows by the members and servers of the AGU, in the organs in which it is implemented.

According to data released in the National Congress of Federal Public Lawyers, SAPIENS worked, in November 2018, with 10 million NUPs³⁰ created by 20 thousand internal users and 40 thousand externals. The same system was also able to integrate with more than 40 systems of the judiciary and other bodies. In addition, the same data fueled the formation of a considerable legal archive with 300 million documents registered, at a growing rate of 500,000 new documents registered in the system per day. the same date, a volume of 50,000 daily subpoenas was counted, resulting in 1.5 million tasks per month and 1.8 million activities per month, according to data presented at that event.³¹

Currently, SAPIENS, with almost 10 years of use and several alterations, is the largest electronic process system in Brazil. It is a platform that seeks to deal with the challenge of a cadastral base of 30 million processes (administrative, advisory, judicial), 1 billion registered documents, plus a daily base of 10,000 new processes that bring an average of 500,000 documents, with digital components in this digital legal block. This informational volume demands archival management with classification, control and storage, in favor of an efficient documentary production. Thereby, through specific screening and distribution tasks, it is possible for the user to focus on a greater and better production in the 800 units spread over more than 400 municipalities in Brazil.

The implementation of SAPIENS began its journey through central bodies and successively through regional, state, sectional and representative offices, in a progressive process of creating routines, courses to public employees and members, correction and minimization of errors until arriving at productivity gains.

In July 2014, when the system was in the initial phase of implementation within the AGU, SAPIENS celebrated the closing of its first semester with 50 administrative processes in progress and 5,000 members

²⁷ Information extracted from the links: <https://sapiens.agu.gov.br>; <http://sapienswiki.agu.gov.br>. Accessed 3Jul. 2020.

²⁸ About the electronic administrative process, see: SCHIEFLER, Eduardo Andre Carvalho (2019).

²⁹ Decree n° 8,539, of October 8, 2015, provides for the use of electronic means to carry out the administrative process within the agencies and entities of the direct, autarchic and foundational Federal Public Administration. The National Electronic Process (PEN) consists of three major actions: The Electronic Information System (SEI), developed by the Federal Regional Court of the 4th Region (TRF4), the SEI integration bus (with other solutions for the use of electronic means) and the integrated protocol.

³⁰ Abbreviation that informs the number of each process registered in SAPIENS, whether judicial or administrative.

³¹ Retrieved from: <https://anafenacional.org.br/3o-conafe-bernardo-menicucci-grossi-e-eduardo-alexandre-lang-debatem-inteligencia-artificial-e-advocacia/>. Accessed 3Jul. 2020.

and public employees of the AGU who used the system exclusively in the administrative routine of work.³²

Moreover, on that same date, it was reported that SAPIENS was with its interface ready for petitioning with the judiciary agencies. Since the first registration, on January 21, 2014, until the beginning of July 2014, the electronic manager of tasks and activities linked 150,000 documents and had about 50,000 lawsuits been processed.

Indeed, between 2014 and 2018 there was considerable growth, a period in which SAPIENS ended up to having 60,000 users, evolving from an internal system of administrative processes to contemplate internal processes, documents and lawsuits. An extremely timely solution, developed by federal public lawyers, consisting of a complete web system to support the production of legal content and control of administrative flows, focused on integration with computerized systems of Judicial Power and the Executive Branches.³³

As a workflow control tool for the AGU's organization, SAPIENS is able to quantify the workload and the average time required to perform legal and administrative tasks throughout the country, allowing the evaluation of productivity in each unit of the federation. In addition, in judicial defense allows the standardization of legal theses and be defended in favor of the Federal Public Administration and dynamizes the consultation and research of the documentary basis of the areas of consultation and litigation.

Another highlight is the ability to incorporate tools to support text production, with suggestions for legal content, petition models and processes for the workflow, not to mention the combination of automation tools. This is possible because the system is capable of learning (machine learning) from users and applying such knowledge to the system as a whole.

The combination of this system enables SAPIENS to be divided into two modules. The administrative module, responsible for its integration with the other existing computerized systems (such as the Judiciary Systems), for the exclusive use of the Attorney General's administrative support team. This module automatically migrates the electronic subpoenas of the Justice, as well as complete information on the process and synchronization of the bases of tasks. This whole process of each insertion

in the system takes place in fractions of a second and occurs in a programmed manner during the night period in order to avoid delays in the work periods. In turn, the judicial module consists of a tool to assist the work of the public lawyer, helping in the control of deadlines and even in the production of the legal document with the direct protocol in the electronic process.

Mauro Lucio Baioneta Nogueira, member of AGU and one of the developers of SAPIENS, points out that the system works with the concept of social intelligence, in order to combine the support provided by AI tools with human feedback. SAPIENS even uses only open technologies and common domain licenses, which exempts the Public Administration from investments in these points. From the point of view of the technical language, the PHP language (Personal Home Page Tools) was chosen for the development of the system, on a joint platform Apache and MySQL.³⁴

It should be noted that these three databases (PHP, Apache and MySQL) are open source projects, in which programmers from all over the world contribute to the creation of efficient software and can be replicated all over the world without commercial purposes.³⁵ "Open source"³⁶ systems are developed by the Open Source Initiative (OSI) formed in 1998 as an educational, defense and free software administration organization, in a commendable initiative in the history of collaborative development.

According to Pablo Dall'Oglio, the PHP programming language, created in 1994 by Rasmus Lerdorf, was formed by a set of scripts in C language, aimed at creating dynamic pages that he used to monitor the access to his resume on the Internet. Since then, several features were added to PHP, which became Hypertext Preprocessor until reaching the new reality of a language with broader purposes. Nowadays, it is estimated that PHP is used in more than 80% of existing web servers, which places it largely as the most used language for web development.³⁷

In order to understand these languages and platforms in a very didactic way, Michael K. Glass associates them to the functions performed inside a

³²Retrieved from:
http://agu.gov.br/page/content/detail/id_conteudo/287744.
Accessed 2Jul. 2020.

³³Retrieved from: <https://anafenacional.org.br/3o-conafe-bernardo-menicucci-grossi-e-eduardo-alexandre-lang-debatem-inteligencia-artificial-e-advocacia/>. Accessed 3Jul. 2020.

³⁴Retrieved from:
<https://agu.jusbrasil.com.br/noticias/100362832/agu-aposta-em-inteligencia-artificial-e-automacao-de-processos-para-agilizar-trabalhos-juridicos>. Accessed 2Jul. 2020.

³⁵GLASS, Michael K. et al (2004). p. 34.

³⁶ According to OSI, the "open source" label was created at a strategy session held on February 3, 1998 in Palo Alto, California (USA), following the announcement of the release of Netscape's source code.

³⁷DALL'OGGIO, Pablo (2018). E-book.

restaurant. So, while PHP would be the chef of the restaurant, combining dynamic information to meet the request for new web pages, MySQL would be a good amount of ingredients used by PHP. The information records are stored in MySQL databases. To compose this picture, Apache would finally have the function of a waiter, who receives the order from the customer and sends it to the kitchen with the specific instructions on how the meal should be prepared.³⁸

While it may seem strange to use the service of a restaurant as a reference to understand the internal intelligence functioning of a web-based system of Federal Public Administration judicial and administration proceedings, this serves well to demonstrate how Apache, MySQL, and PHP represent a popular combination and how well they operate together.³⁹

In summary, this demystified view of what can be used in good practices in the legal area in the defense of the Federal Public Administration also helps to demonstrate to legal operators that it is possible to understand the functioning of the programming language and apply free technologies, accessible with open codes of global access. And, to a large extent, this was what allowed a revolution in the performance of Brazil's largest legal service.

III. SUPPORT TOOLS IN THE MANAGEMENT AND DISTRIBUTION OF LEGAL TASKS

Aware that the adoption of automation instruments was no longer negotiable in the global reality, the Federal Public Advocacy began to accompany the digital era with its own creation tools⁴⁰ applied inside and outside SAPIENS. In addition to the excessive volume of lawsuits, there was the challenge of developing its own tools within the career, without spending public financial resources, for the mass management of legal tasks, in order to maintain transparency and in search of broader control of the activities developed by its members.

In addition, as a public defender of the State, its activities should include performance and productivity targets, as well as seeking to reduce the number of court sentences for effective savings to the public purse. It was in this spirit that the AGU conveyed the first news of the

official use of AI in 2013,⁴¹ due to the introduction of automated procedures by attorneys in the states of Sao Paulo, Mato Grosso do Sul and the Southern Region. That was considered an important career achievement, with technologies developed by its own members, for better management of judicial proceedings and administrative documents.

The work continued with the creation of the SAPIENS system, which allowed the implementation of intelligence routines, through similarity analysis techniques, which reduced the number of servers involved in bureaucratic activities. The migration from SICAU to SAPIENS ensured the execution of the same information by the system and even implemented intelligence routines, through similarity analysis techniques, in order to optimize the limited human element.

The registration of activities in SAPIENS made it possible to better assess the productivity levels of public lawyers, identify the areas in which there should be better conflict management and/or resettlement of public employees. In addition, it made it possible to observe which procedural actions are in greater or lesser number and in which sector of the Public Administration they are, in order to allow the analysis of public management data, the direction of strategic action plans and the development of solutions for the comparison of other areas.

At this point, it is important to present some automation systems used by the AGU with the following functions: i) screening of legal proceedings collected directly from the various systems of Judicial Power; ii) consulting the systems; iii) drafting and virtual petitioning and; iv) performing calculations in the course of the proceedings. Let us follow the description of each of the AI tools gathered in the Optimized Attorney's Portal.⁴²

For the consultation of the Judiciary System, four tools are used: 1. The so-called "CAMELO", whose function is to facilitate the search in the systems of the

⁴¹ News released on March 4, 2013. Retrieved from: https://www.agu.gov.br/page/content/detail/id_content/230719. Accessed 18Jul. 2020.

⁴² The Optimized Attorney is a project part of the Immediate Response in Social Security Lawsuits Program - PRIAP, Best Practices Subprogram, which seeks to disseminate, catalog and expand successful initiatives that can bring improvements in the organization and production of units. The project is part of the General Coordination of Projects and Strategic Affairs - CGPAE/PGF/AGU. Retrieved from: <https://agudf.sharepoint.com/sites/PGF-CGPAE/SitePages/Procuradoria%20Otimizada.aspx>. Accessed 23Jul. 2020.

³⁸ GLASS, Michael K. et al (2004). p. 35.

³⁹ GLASS, Michael K. et al (2004). p. 36.

⁴⁰ Here, the vision of Administrative Law as a "toolbox" fits. On the subject, see: RIBEIRO, Leonardo Coelho (2017).

National Institute of Social Security (INSS),⁴³ by administrative process and in the preparation of communications for requesting such processes; 2. The "LOKI", which is a robot responsible for automating searches in the INSS systems, allowing the gathering of the searches in the Federal Justice system of the Northeast Region⁴⁴ or in SAPIENS; 3. the "MAST", which searches, by the number of the register of individuals, in the sites of the Judiciary of the State of Sao Paulo, for purposes of identification of lawsuits previously filed with results in Excel spreadsheet; and, 4. The "ROBÔ INSTRUÇÃO", which uses Excel to extract data from the INSS systems, by searching the address of the author of the lawsuit in SAPIENS and in the database of the Federal Revenue. The Robot Instruction saves in PDF files, making the protocol directly in the virtual system of the Judicial Power.

For registration of tasks in SAPIENS based on procedural movements was created the "Optimus", which operates in integrated systems. Through it, it is possible to analyze communications from the Judiciary through "keywords" pre-defined (editable) by the user. Afterwards, "labels" are generated that allow the automatic routing of the tasks by the Registration sector. This set allows, easily and quickly, the separation of activities to be performed by other users.

In the same utility there is the "PRIME", a program for reading the contents of the documents viewed in SAPIENS, in HTML and PDF formats. "PRIME" allows the initial labeling and its completion, which creates a migration of documents to the SAPIENS reading interface.

The "PRIME" system works in the tasks tab of SAPIENS by analyzing "key expressions" that are predefined and editable by the user. Afterwards, programmed "tags" are generated, such as letters of request from the Judiciary of public values, if in the conviction there are fines, court decisions or expert reports. From these, the tasks are directed to the public lawyers according to each attribution of the organization. This system may even suggest a procedural document to the concrete case, but it will be up to the lawyer to decide which procedural measure is appropriate.

A third system called "MERCURIO" consists of a macrosystem for sorting, distributing and labeling in batch and in an automated way. Through this system, it is possible to perform a self-sorting mechanism, through which the user previously registers repetitive judicial decisions with paradigms and associates them to an internal organization label. In addition, "MERCURIO" contains modules that allow the labeling, alteration of the internal sector and automated distribution in one of the tabs of SAPIENS, which makes the separation of processes internally functional and the redistribution to public lawyers.

"THOR" is a robot that integrates Crete with SAPIENS, allowing the automated registration of the judicial process, organizes subpoenas and citations from key words in the purpose of the subpoena or in the content of the attachment that is in the extension HTML or searchable PDF. The robot has additional functions such as the identification of calculations, hearings, control of expertise including the analysis of the profiles of conclusions of professionals for purposes of monitoring public lawyers. As an additional function, it also performs the procedural instruction with the registration of the documents presented in the judicial process and generates a report of these documents.

Another system also adopted in screening is the "MACRO E-SAJ", which consists of a Macro Excel spreadsheet, used for reading and labeling subpoenas that are sent by the Judiciary. As mentioned in the "PRIME" function above, this spreadsheet allows reading the judicial decision and searching for previously registered expressions to then include a classification in the system.

The "SURICATO" was created for the trial guidelines published by the Courts, which identifies relevant actions for the AGU. Thus, the system assists in the filtering of the judgment guidelines, highlighting the processes of greatest interest, such as actions classified as priority, large debtors, which are previously registered in the system by the user.

Following the tools adopted in the screening of judicial proceedings, the "MARA" is also based on a screening spreadsheet extracted from the site of the Judicial Power in the state of Sao Paulo with the content of the subpoena, with terms established by the user.

Finally, there is the "ROBÔ CADASTRO" and the "DR. JORGE". The "ROBÔ CADASTRO" operates by means of Excel macro spreadsheet, extracts the subpoenas from the panel of subpoenas of the Judiciary system and registers the new processes in SAPIENS. Through the same Excel medium, "DR. JORGE" operates

⁴³ The INSS is a federal associate Government agency created on June 27, 1990, responsible for the operationalization of general Brazilian social security rights and provider of social security services. It covered more than 50 million citizens and approximately 33 million beneficiaries in 2017. Article 201 of the Federal Constitution established the nature of a contributory basis and mandatory participation.

⁴⁴ System called Crete, belonging to the Federal Regional Court of the 5th Region, in the northeast of Brazil.

in the State of Alagoas, with the functionality of generating petitions and protocol in CRETA.

It is important to mention that these automation tools (robots) are used only in the management of mass litigation, created and developed equally by attorneys and servers within the AGU. They search for pre-defined terms in documents and analyze the process "backwards", reading HTML and searchable PDF, and work as an automated sorting and labeling system.

After the process screening phase, the next step is to describe the AI tools for preparing drafts of procedural documents and sending them to the Judicial Power (petitioning).

In this phase, the AGU works with three systems, two of which were created⁴⁵ by the AGU. The "PANDA", system that attaches process parts in SAPIENS in an automated way, in the form defined by the user previously, which allows the user to assist in the production of minutes in SAPIENS throughout the country by teams that make the movement of tasks by SAPIENS.

The system called "MANO" downloads from a SAPIENS printout the parts and attachments in the tasks and transports them to a folder with the identification of the court case number and the type of document. "MANO" classifies in the system which is the procedural document (and its administrative annex) to be launched in the system of the Judiciary.

Furthermore, for the activities of judicial calculations it is used spreadsheets of calculations in batch, with the automatic monthly update of the indexes and automated assembly of parts of proposal of agreement, for which it is necessary to fill the fields in blank indicated in the developed spreadsheet. The "SAGUI CALCULO" was also developed in the Central and Southeastern Regions, a program to assist civil servants in the area of calculations in social security lawsuits, with research fields in the INSS systems and in judicial proceedings. The program, by means of a macro system, enters the data captured in the calculation system for purposes of checking and controlling the amounts due in lawsuits in which the government does not win.

Also worthy of note is the creation of the segmented performance control report, generated through Excel with data from SAPIENS, which shows the success rate by model of defense piece or registered resource. It

allows the judge of each state and public attorney to determine the results of their work in the process. This control allows mapping the theses with the highest success rate and which are no longer accepted by the Courts, arguments that should be improved. In the same way, it indicates public lawyers who do not concentrate good performance or who need training in their work.

In the area of management, there is also the use of jurimetrics mapping, a method that connects the law and statistics⁴⁶ institutes for the evaluation of defense theses and success rates, as well as in the identification of themes with reform of decisions⁴⁷ by team resources, which are the foundations to be improved in defense, among other points.

Orchestrating these mechanisms promotes transparency and broad access to data from all judicial and administrative processes in which federal public lawyers operate, in addition to creating an internal network of tasks and quantification of work within the AGU.

In conclusion, it should be emphasized that professionalization allows the systems to be always up to date with new versions, creating in the day-to-day improvement of the instruments, and through suggestions from the public lawyers themselves, which represents an invitation to professional engagement and communication among its members, with considerable gains in efficiency.

IV. CONCLUSION

Humanity has arrived at such a stage of interconnection between people, between their data, that there is no way of thinking in the fields of science in an isolated way and far from the knowledge of its main recipients: people.

⁴⁶ According to Filipe Jaeger Zabala and Fabiano Feijo Silveira, Lee Loevinger (Jurimetrics: the next step forward) coined the term 'jurimetrics', which for the first time united legal theory, computational methods and statistics, in order to analyze the jurisprudence and make the use of law more predictable. On the subject, see: ZABALA, Filipe Jaeger; SILVEIRA, Fabiano Feijo (2014). pp. 87-103.

⁴⁷ It should be noted that the system of jurimetrics, as well as the aspects related to the adoption of AI, still divides opinions on the use of the data resulting from their analysis. Recently, in March 2019, with regard to jurimetry, the French government, under the argument of accepting the General Data Protection Regulation (GDPR), the regulatory instrument responsible for data protection regulation within the European Union, prohibited the publication of statistical information on judges' decisions by means of Law 2019-222. In Brazil, the CNJ created the application "SupremoemAção" that provides detailed information on the production of judgments and the volume of legal proceedings for each of the current members of the The Supreme Federal Court (STF).

⁴⁵ Mouse Recorder" is an external software, not developed by AGU, used to automate repetitive mouse and keyboard routines. After recording a sequence of commands, it is possible to replicate it multiple times in an automated way.

As in most issues related to the legal area, there are points and counterpoints to the use of automation instruments and AI in the judicial defense of the federal Public Administration, which is why the public operator should associate technology to the service of the jurist, as a means and not as an end, substitute. In addition, the adoption of technology exempts the public lawyer's time from bureaucratic and managerial activities for dedication to more sensitive and complex issues.

For this reason, all legal services provided in the defense of the Public Administration, in addition to being linked to constitutional administrative principles, must be developed with a view to lawfulness and be guided by a communicative and open vision that the tools used and their data will be accessible to citizens. Efficiency is shown to be real when its numbers show productivity and results.

Likewise, although the systems are operated by public agents specialized in information technology and are developed within closed environments due to their complexity, the results of the use of these AI tools must be shared with transparency, accessibility and in a language that is suitable for comprehension by professionals from all areas of knowledge.

According to Daniel Kahneman, when approaching his "prospect theory", human beings tend to make decisions focused more on possibilities of loss than on possibilities of gains, besides dealing with what he calls "the causal variability of the noise of judgments".⁴⁸ It is worth saying: the human being is averse to losses.

Therefore, in order for human rationality to consider something useful, it is necessary that the advantage of changing a previous behavior is demonstrated, in the same way it occurs for new methods of work to be accepted. It is in this context of representativeness that transparency should help eventual resistance and criticism with which the legal world receives the automation tools promoted by AI applied to its own services.

If the expectation is that the Public Administration of the 21st century will follow the digital age, its legal services also need to be in this same compass, working on a constant evolutionary process, aligning constitutional and legal perspectives to the connectivity of AI tools.

In summary, the adoption of AI tools by federal public law allows a focus on the preparation of legal

theses, investment in effective judicial measures and attention to the study of concrete cases.

Indeed, as Aires José Rover, one of the pioneers in the study of interactions between AI and Law in Brazil, said about 20 years ago, "one of the most precious characteristics of the use of Artificial Intelligence techniques is the possibility of removing from the operators the cognitive weight of routine decision making, freeing them into the noblest activities."⁴⁹

In addition, by quantifying the operational activities, the internal organization of information, data and documents, it will be possible to achieve levels of performance and responses at a higher speed than the conflicts themselves. All this allows us to conclude that, especially in view of such expressive numbers, the creation of the SAPIENS interface and the respective automation tools make it possible to channel the knowledge into an increasingly efficient and specialized legal service.

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Tuberculosis Teaching in Graduation in Nursing: An Integrative Literature Review

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Abstract—Objective: to analyze scientific publications on teaching tuberculosis in undergraduate nursing. Method: The search was carried out in databases, with the time frame between the years 2011 to 2020. For the treatment of the data, the technique of content analysis was used, with categorization of the findings. Nine complete original articles were selected that answer the central question of the research, whose data were grouped in tables. Results: The analysis of the literature allowed the elaboration of three categories, namely: Category 1- Difficulties in teaching tuberculosis in undergraduate nursing, Category 2- Perception of teachers and students about teaching tuberculosis and 3- Teaching-learning methodologies of tuberculosis nowadays. Conclusion: Although there have been several advances with the improvement in the integration between teaching and health services, investments are still needed in the teaching-learning and evaluation process, since in the studies listed there are still several obstacles.

Keywords—Tuberculosis. Teaching. Nursing.

I. INTRODUCTION

Tuberculosis (TB) is still a serious and challenging global public health problem. Worldwide, in 2018, around ten million people became ill from tuberculosis and 1.5 million people died from it, with TB being the main cause of death from a single infectious agent. The disease disproportionately affects males, young adults and low-income countries, pointing to the association between the occurrence of TB and socioeconomic factors (Brasil, 2020).

Difficulties in the academic training of health professionals, especially nurses, have had an impact on health care for people with tuberculosis, such as delayed diagnosis. Therefore, there is a need to incorporate new methodologies to improve the skills of undergraduate and graduate students in the health field, as shown by Grecco et al. (2014) study who found weaknesses in undergraduate nursing education regarding the Directly Observed Treatment (DOT) of TB, as this is one of the priority strategies of the National Tuberculosis Control Program (PNCT). Among others, the fragility of teaching will have a negative impact on both the management of the program and the assistance to people with the disease.

Investment in education needs to be provided from the academy, through meaningful learning, as for Bittencourt (2011) regarding the teaching-learning of TB, it is emphasized that the use of active methodologies, capable of integrating different teaching strategies, is paramount to develop critical and reflective thinking.

Studies indicate that professional training in health is still partly disconnected from the reality of the labor market and the proposal of the Unified Health System (SUS), since there is still a poor distribution of the workforce, determined and conditioned by inter inequalities. and intra-regional, the training process that does not value the aspects of health promotion and prevention, the disarticulation between training and service institutions, teaching dissociated from work (Villa et al., 2006).

The health care process must be integrated with teaching and research (generation of new knowledge and new processes and methodological development), observing the real health needs of the population, from the perspective of interdisciplinarity, interprofessionality, interinstitutionality, which means work integrated, in a bilateral relationship with its partners and with a social impact (Villa et al., 2006).

Thus, this study aimed to analyze scientific publications on the teaching of tuberculosis in undergraduate nursing.

II. METHOD

The research is an integrative review which has the purpose of gathering and synthesizing research results on a delimited theme, in a systematic and orderly manner, being an instrument for the deepening of knowledge about the investigated theme, allowing the synthesis of multiple published studies and general conclusions about it (Polit; Beck; Hungler, 2011).

Although there are variations in the conduct of methods for the development of integrative reviews, there are standards to be followed. In carrying out this review, six steps were used: selection of hypotheses or guiding questions for the review; selection of studies that will compose the sample; definition of the characteristics of the studies; categorization of studies; analysis and interpretation of results; and, report of the review (Mendes; Silveira; Galvão, 2008).

The guiding question for the elaboration of this integrative review was: What are the scientific productions available on the teaching of tuberculosis with an emphasis on undergraduate nursing?

The survey of bibliographic studies took place during the month of July 2020 and five databases were chosen: Latin American and Caribbean Literature in Health Sciences (LILACS), Database in Nursing (BDENF), in the Scientific Electronic Library Online (SCIELO), Medical Literature Analysis and Retrieval System Online (MEDLINE) and Google Scholar.

Following, the validated DECS descriptors were used: "Tuberculosis"; "Teaching" and "Nursing", using the Boolean operators AND, in Portuguese and English, in the last 10 years, published in the period from 2011 to 2020. A total of 12,776 articles were found, which after reading the titles and abstracts, were selected nine articles that showed similarities with the object of this study.

For data collection, we opted to use the instrument validated by Ursi (Mendes, Silveira and Galvão, 2008).

The analysis of the selected studies took place in a descriptive manner, in order to enable the observance and description of the data, thus, it was possible to gather the synthesized knowledge on the subject in question. From this, three empirical categories were elaborated, which will be presented and discussed below, in which Bardin's content analysis method was used to explore the content. In order to guarantee the success of this study, it was decided to describe and distribute the results in tables, highlighting the main findings of each research. As for the discussion, it was carried out in a descriptive manner, in order to achieve the objectives of building an integrative review.

III. RESULTS AND DISCUSSION

There was a shortage of national scientific publications in the health area on the subject considering that Brazil is a country with a high incidence and prevalence of tuberculosis. Tables 1 and 2 shows the characteristics of these studies, in which articles in Portuguese predominate with 77.7%; as for the approach, 44.4% is qualitative, 44.4% is quantitative and 11.1% is an experience report; with regard to the type of magazine, 55.5% is national and 44.4% is international; as for indexing, 33.3% at SCIELO, 33.3% at LILACS and 33.3% at Google scholar.

In this integrative review, a total of nine original scientific articles were analyzed, which strictly met the selection of the sample previously established.

Table 1: Distribution of studies.

Nº	BASE	AUTHOR. YEAR.TITLE. PERIODIC.	OBJECTIVE	METHODOLOGY
TB01	SCIELO	Barrêto et al., 2013. Tuberculosis care management: from training to the practice of nurses. Revista Brasileira de Enfermagem.	Analyze the relationship between the education of nurses and actions directed to the management of tuberculosis care.	Qualitative study, carried out in one of the municipalities in the metropolitan region of João Pessoa-PB. Ten nurses from the Family Health Strategy participated in the study. Data collection was carried out in February 2010 through a semi-structured interview script. For analysis of the empirical material, the technique of content analysis was used.
TB02	SCIELO	Ponce et al., 2013. Tuberculosis diagnosis: performance of the first health service sought in São José do Rio Preto, São Paulo, Brazil. Cad.	Cross-sectional study with the objective of analyzing the performance of the first health service sought for the	81 patients undergoing treatment were interviewed. A questionnaire based on the Primary Care Assessment Tool, adapted for TB care, and the health service assessment framework (structure and process) were adopted. The data were analyzed using descriptive techniques and multiple

		Saúde Pública.	diagnosis of pulmonary TB in São José do Rio Preto, São Paulo, Brazil, in 2009.	correspondence analysis.
TB03	SCIELO	Pereira et al., 2016. Management and management of the hierarchical levels of the national tuberculosis control program. Interdisciplinary Journal of Health Education.	Know the structure and functioning of the PNCT at all levels of management and management (federal, state and municipal).	Experience report made by Nursing students of the 4th year, 8th semester, Block II, from the State University of Pará, together with two preceptor nurses. Planned visits and rounds of conversations were carried out with professionals who work at the levels responsible for the management and management of the Program in the city of Belém (PA), from 10/14 to 10/23/2015. For the development of conversation circles, a schedule of visits was prepared and the Ministry of Health's Manual of Recommendations for the Control of Tuberculosis in Brazil was used.
TB04	Google Scholar	Martins et al., 2020. Simulation of clinical skills of nursing students during the care of tuberculosis patients. International Journal of Development Research (IJDR)	Evaluate the clinical skills of nursing students regarding the diagnosis and assistance to patients with tuberculosis, using the Structured Objective Clinical Examination (OSCE) modality.	Descriptive study with a quantitative approach, carried out with 30 Nursing students from the last year of their graduation and who were taking the Supervised Internship in Collective Health curricular axis of a public university in northern Brazil.
TB05	Google Scholar	Martins et al., 2020. Objective Structured Clinical Examination (OSCE): perceptions of nursing students in tuberculosis diagnosis. International Journal of Advanced Engineering Research and Science (IJAERS)	To evaluate the perception of nursing students at a public university about the Objective Structured Clinical Examination (OSCE) on the topic of tuberculosis diagnosis.	Quanti-qualitative research, carried out in the Nursing Graduation Course of a public university, in June 2019, with the participation of 30 nursing students, who answered a self-administered questionnaire. Pearson's percentage and chi-square were used for statistical analysis. For the analysis of qualitative data, the free word evocation technique was used.
TB06	Google Scholar	Martins et al., 2020. Profile and experiences of nursing students related to tuberculosis: an evaluation of health education. International Journal of Advanced Engineering Research and Science (IJAERS)	This study aimed to evaluate the sociodemographic profile of nursing students and their experiences with tuberculosis (TB) in undergraduate nursing at a public university.	Quantitative-descriptive research, carried out in the Undergraduate Nursing Course of a public university, in 2019, with the participation of 30 5th year students, who answered a self-administered questionnaire. Percentage and Pearson's chi-square were used for statistical analysis.

TB07	LILACS	Carvalho et al., 2019. Tuberculosis: knowledge among undergraduate nursing students. Revista Brasileira de Enfermagem	To analyze the knowledge about tuberculosis among undergraduate nursing students at a Federal University of Higher Education.	Descriptive study carried out in a transversal way, with a quantitative approach. Data were collected through a questionnaire prepared based on the WHO guide for the development of instruments for assessing knowledge, attitudes and practices related to tuberculosis. The students were categorized into groups of "knowledge" and "little knowledge" based on the average percentage of responses for the analyzed variables. Descriptive statistics techniques were used.
TB08	LILACS	Assis et al., 2019. Importance of the tuberculosis theme in undergraduate nursing: teachers' discourse. Rev baiana enferm	Analyze teachers' discourse on the importance of tuberculosis in undergraduate nursing courses.	Qualitative exploratory study, developed between January and March 2015 at two public nursing universities in the state of Amazonas, Brazil. Fifteen nursing professors participated in the study, the majority of whom were female, had a master's degree, with more than five years in teaching, experience prior to teaching and only one professional bond.
TB09	LILACS	Grecco, 2014. Directly observed treatment of tuberculosis: learning processes in a higher education institution. Rev enferm UERJ.	To analyze the theoretical and practical learning processes related to the Directly Observed Treatment of tuberculosis among nursing students at a public institution of higher education in Ribeirão Preto, São Paulo.	I work with a quantitative and qualitative approach, whose collection was carried out in 2011. A self-administered instrument containing five questions was used, so that the analyzes took place, respectively, through descriptive statistics and the theoretical-analytical basis of the Collective Subject Discourse.

Source: Research protocol, 2019.

Table 2: Evidences from the studies.

Nº	EVIDENCE
TB01	There is a predominance of thematic in the hospital space, which results in the training of professionals with a restricted look at the disease clinic, due to the distance between what governs the policy of training workers for the Unified Health System (SUS) and education. It is possible to perceive the distance between TB care and the relation between theory and practice. It assumes that the inadequacy of traditional teaching-learning processes and organized in disciplines contributes to maintaining gaps between the training institution and service dynamics; the failure to monitor TB sick people in the internship spaces, limiting themselves only to the presentation of the structure and organization of the health service and observation of assistance; mechanistic and task practice more consistent with the biomedical conception, in which, based on the signs and symptoms presented by the patient, they elaborate the "menu" of assistance, as activities related to diagnosis, treatment and monitoring; Limitation in the identification of people with suspected TB, resulting in delayed diagnosis.
TB02	It shows that the Emergency Care Units (PA's), as one of the main entry points for the diagnosis of TB, should be qualified to suspect and detect the cases, as well as to carry out a joint / articulated work with the other

	points of attention in order to link the patient. their unit of origin, making it possible to monitor and manage the case properly. In this study, the PA's showed the worst performance, and was associated with the suspicion of diseases other than TB, which may have led to the failure to request sputum smear and x-ray and, consequently, the failure to perform the diagnosis in the first health service sought. Such results reflect the professionals' unpreparedness to diagnose TB, in which the PA's are not included in the training and evaluations carried out by the PNCT, mainly due to work overload and limited number of human resources, causing the centralization of information. In this sense, the construction of contextualized strategies that promote dialogue between national political guidelines and the uniqueness of health services, with continuous training and supervision of health professionals, would assume a fundamental role for TB control in order to identify failures to be addressed. faced in care / management and improving skills. However, it is extremely important that the proposal for permanent health education is part of an organized and articulated service network. Therefore, the professional's preparation for TB control should start in technical and higher education institutions, by including guidelines with sufficient time for theoretical and practical teaching, in order to enable the future professional to deal with the disease. However, in Brazil, the teaching of TB at undergraduate level is still unsatisfactory, fragmented and disconnected from control programs, reflecting the Flexnerian formative model.
TB03	It reports the importance of nursing students in knowing all levels of the PNCT control program, in order to understand the skills of their management and management levels.
TB04	Academics performed better in procedural skills, specifically in pulmonary auscultation and physical examination of the respiratory system. Furthermore, cognitive spheres such as knowing and remembering, integrative spheres such as analyzing and reasoning and affective represent the lowest domain rates among academics.
TB05	The study shows that 73.3% of the students reported that the scenario developed in the OSCE exam contributed to the exercise of nursing in the face of the diagnosis of tuberculosis, 76.7% considered it necessary for the Nursing Courses to modify the preparation of the students in relation to tuberculosis and 76.7% recommend developing greater skill for nursing consultations and home visits to patients.
TB06	The results show that the majority of academics never participated in courses or scientific events, just as few had experiences with extracurricular activities. It was found that 76.6% underwent nursing consultation for patients with TB; 70% made administration / supervision of treatment directly observed; 53.3% requested sputum tests; 50% scheduled and monitored patient care; 33.3% were vaccinated with BCG; 23.3% instructed sputum collection; 20% applied and read tuberculin tests; 20% researched TB cases in the general clientele and no academic made a home visit to a TB patient, the latter being a worrying fact. Thus, they consider to be partially prepared to serve clients with tuberculosis.
TB07	60 nursing students were interviewed. "Little knowledge" was observed among students with less time spent studying at the university and without previous contact with the topic and "knowledge" among those whose knowledge about tuberculosis was acquired in health services. Knowledge gaps were identified among undergraduate nursing students, suggesting the need to rethink teaching-learning strategies on the topic.
TB08	As a result, two discursive blocks emerged: Importance of the theme of tuberculosis in the curriculum structure; and role of nurses in tuberculosis control. The meanings produced by the professors' discourse allowed us to conclude that tuberculosis, as an important disease from the epidemiological and social point of view, needs to have a wider scope in the curricular matrix of undergraduate nursing courses, considering the role of this profession in control actions disease.
TB09	It was observed that most of the 72 interviewees had no contact with the theme during the course and that the limited knowledge presented was based on the hegemonic model of health action. It is understood that a greater articulation of educational practices related to tuberculosis and the treatment directly observed in the training of generalist nurses is necessary, given that this has specific attributes in the management of care and assistance to patients with tuberculosis, family and other communicants.

Source: Research protocol, 2019.

The analysis of the literature found made it possible to elaborate three categories based on relevant points, namely: Category 1- Difficulties in teaching tuberculosis; Category 2- Perception of teachers and students about the teaching of tuberculosis and Category 3- Teaching-learning methodologies of tuberculosis today, which will be developed below.

Category 1- Difficulties in teaching tuberculosis

Regarding category 1, which addresses the difficulties in teaching tuberculosis, article TB02 shows that the Emergency Care Units (PA's) are one of the main entry points for the diagnosis of TB, so professionals should be better qualified to suspect and detect the cases, as well as to carry out joint / articulated work with the other health care points in order to link the patient to his / her health unit of origin, enabling the follow-up and appropriate management of the case. Such results reflect the professionals' unpreparedness to diagnose TB, in which the PA's are not included in the training and evaluations carried out by the Tuberculosis Control Program, mainly due to work overload and limited number of human resources, causing the centralization of information.

In this sense, the construction of contextualized strategies that promote dialogue between national political guidelines and the uniqueness of health services, with continuous training and supervision of health professionals, would assume a fundamental role for TB control in order to identify failures to be addressed in care or management and improving skills. However, it is extremely important that the proposal for permanent health education is part of an organized and articulated service network.

Therefore, the professional's preparation for TB control should be intensified in technical and higher education institutions, by including guidelines with sufficient time for theoretical and practical teaching, in order to enable the future professional to deal with the disease. However, in Brazil, TB teaching at undergraduate level is still unsatisfactory, fragmented and disconnected from control programs, reflecting the Flexnerian formative model. It is verified, therefore, that the gaps in graduation will have repercussions on the professional life of nurses, in which they will present difficulties in clinical management.

While, in article TB09, it was possible to identify that most of the study participants in question (70.84%) had no contact with the theme of DOT during the undergraduate nursing course. Consequently, many were unaware of the use of this strategy for TB control and, among those who reported having had contact (29.16%), a predominance of the response was identified in the last year of academic training. This fact is considered worrying, especially

because the professional nurse must have developed skills in the prevention and control of the disease, which must be guided by the adequate planning of comprehensive interventions (political, economic and health), starting primarily from the scope local.

Another difficulty revealed was the students' lack of information regarding biosafety standards and lack of knowledge of basic concepts in relation to the disease and its forms of contagion. In view of these data, the gap between the teaching proposed by the universities and the real health needs of the population can also be observed, a fact that can still be modified if, however, the content paradigms still prevalent in educational institutions are overcome.

In view of the fact that the area of nursing focuses its activities mainly on the care of people, the work process of these professionals is based on contact and human relationship. Thus, the idea that it is up to the university to play a fundamental role in what concerns the training of professionals imbued with scientific and technical knowledge, but above all, humanitarian, with a view to improving the quality of life and health of the population, is ratified.

Therefore, a greater articulation of educational practices related to TB and DOT is necessary in the process of training generalist nurses, given that this professional has specific attributes in the management of care and assistance to TB patients, their families and other communicants. Thus, an educational practice based on the incorporation of innovative and problematic learning processes is essential, in order to offer subsidies for the improvement in the qualification of health professionals with higher education, aiming at strengthening disease prevention and promotion practices to health population.

Category 2- Perception of teachers and students about the teaching of tuberculosis

The TB01 article brings reports from nurses regarding the experiences of the undergraduate course in which they reveal that, during the course, the learning spaces were mainly focused on the healing field. It is observed that the subjects with the longest training time had their experience to control the disease, exclusively at the referral hospital. As for nurses with less than ten years of training, in addition to the hospital space, they also experienced TB care at the Family Health Unit (FHU).

What draws attention in the testimonies is related to the predominance of the TB theme in the hospital space, which favors the training of professionals with a restricted look at the disease clinic and brings out an apparent distance

between what governs the policy of training workers for SUS and education.

It is observed in the nurses' statements that the curricular matrices emphasize a strictly biological approach, collaborating to train professionals to act in purely clinical health and, consequently, distanced from the reality in which the population groups experience the illness of TB. It is noticed that nurses addressed both the superficiality and the distance from TB care with regard to the relationship between theory and practice. It assumes that the inadequacy of traditional teaching-learning processes and organized in disciplines contributes to maintaining gaps between the training institution and service dynamics.

In addition, there are no testimonials from the nurses interviewed that emphasize preventive care, nor do they mention that their realization is done prioritizing the family and community, since they are constituents of the patients' lives.

As it is a social and stigmatized disease, it is considered important that this professional does not learn only the clinic, treatment and control, but that he advances in the understanding of the subjectivity and uniqueness involved in the care process based, above all, in the integrality of care. It is recognized that active learning methodologies are viable in this proposal, as the student places himself next to the teacher who has the task of guiding and facilitating the educational process as a being who also seeks knowledge.

However, dialoguing with these students does not mean delegating all the elaboration of the problem to them, but rather leading them to a process that allows a deep analysis of the problem, so that they can discover its dimension and seek answers to the proposed questions.

The TB07 study raises the problem that, more than half of the nursing students (55%), had not had previous contact with the TB theme (provided assistance, knows someone with TB or had a class on the subject), it was not considered well-informed on the subject (56.7%) and wished to obtain more knowledge on the subject (98.3%), although all (100%) reported having heard about TB, especially at the university (76.7%). As for the level of knowledge about TB, the majority (73.3%) reported that the causative agent of the disease was bacteria, while approximately a quarter of the students reported that the causative agent of the disease was a virus (26.7%).

Regarding the symptoms of the disease, everyone agreed that coughing for more than three weeks is one of the symptoms of the disease (100%), although they were not clear about its characteristic - dry (70%) or productive (76.7%) . Most reported that hemoptysis is necessarily

among the classic symptoms of TB (81.7%), as well as chest pain (66.7%), shortness of breath (90%) and fever without a definite cause for more than seven days (73.3%). Approximately a quarter of the students (23.3%) were unaware of the minimum duration of TB treatment, which is 6 months.

There were participants who reported that TB transmission occurs via contact with saliva (75%), by handshaking (25%), by touching / contacting public items (43.3%), via sexual contact (8 , 3%) and per insect bite (1.7%). Regarding disease prevention, the participants stated that to avoid contamination by the bacillus, it is necessary not to share glasses and cutlery (75%), avoid handshakes (26.7%), wash hands after touching public items (78, 3%), use a condom (20%) and use repellent (13.3%). It was observed that the students did not assume the relationship between good nutritional status and vulnerability to TB (63.3%).

One nursing student reported that TB has no cure (1.7%). Although all (100%) reported that the cure for TB occurs through "specific" drugs, it was observed that some (12.3%) students were unaware that such drugs were antibiotics. Some study participants also mentioned that one of the ways to obtain a cure for TB is by taking the vaccine (38.3%) and praying (18.3%).

Sputum smear microscopy and chest x-ray were not cited as the main diagnostic methods for TB (6.7% and 23.3% respectively). Some students did not believe that they could contract the disease (13.3%), considering it not very serious (25%).

When analyzing the knowledge and beliefs of nursing students about TB, in relation to previous contact with the topic, it was possible to observe that, among people who had previous contact with the subject, basic questions were answered incorrectly. Therefore, this study showed vulnerability on the part of the students with regard to knowledge related to TB.

This fact is worrisome, as the nurse inserted in a health institution must systematize care for the individual, family and community. In the context of TB control actions, one of its interventions is to guide them regarding transmission and environmental measures to prevent the disease, in order to collaborate with the interruption of the transmission chain and to demystify misconceptions, avoiding the stigmatization of the disease and abandonment of treatment. Furthermore, as health professionals, the lack of knowledge can lead them to not adopt individual safety measures, making them more vulnerable to contamination by the TB bacillus.

The TB05 article showed that after the clinical skills test on tuberculosis, students received feedback using the debriefing technique, in which the team of evaluating professors highlighted the most relevant points observed during the test, in order to generate reflections in students about conduct towards patients. The results show that, in the opinion of most nursing students (73.3%), the scenario developed in the Objective Structured Clinical Examination (OSCE) contributed to the practice of nursing in the face of TB diagnosis; the majority (76.7%) considered it necessary that Nursing Courses should modify the preparation of academics in relation to TB, in addition, the majority (76.7%) of academics recommended the development of greater skill for nursing consultations and home visits to TB patients.

The academics described their perception of the OSCE method and the moment of debriefing, in which the most evident words were: knowledge; learning; reflection; confidence; empowerment; required. During the performance of the OSCE exam, the evaluating professors made important notes to be observed during the moment of debriefing, such as the need to further investigate the symptoms of TB; difficulties in performing the physical examination; nervousness during the test, evidenced by the student's attempt to interact with the examiner, which is not allowed during the test; some academics did not read the exam results that were on the table; at Station 5, little emphasis was placed on the importance of not abandoning treatment; doubts about where the patient should be referred; some academics identified tuberculosis, but did not identify it in the exam, which was the multidrug-resistant form; some scholars wrongly cited treatment time.

This study shows that it is necessary to reflect on the structuring of the current nursing curriculum, especially with regard to practical training and the acquisition of all the necessary skills throughout the course. Academics must effectively and intensively train these skills (manuals, clinical reasoning and conduct) in real patients, real situations and real scenarios, and which also include hospitals, basic health units, urgencies and emergencies and ambulatories.

There must be a balance in the distribution of the workload and in the focus of practical learning among all sectors of nursing. It is through mandatory internships in all sectors of activity that students will have the opportunity to apply their acquired knowledge and develop the skills and competencies necessary for the exercise of the profession.

However, possibly, these academics are not fully and adequately inserted in their practice scenarios throughout

their undergraduate studies, or else they are not the main "actors" in these scenarios. Thus, they do not gain autonomy, do not acquire security for decision making and, above all, do not develop clinical reasoning skills, as they are unable to apply the knowledge they have learned.

Regarding TB teaching, the need to incorporate new teaching methods, new forms of assessment and new practice scenarios was highlighted, in order to diversify students' experiences and contemplate their expectations regarding the nursing course and according to skills and competencies necessary for the professional nurse in the management of care for TB patients.

Added to this, the fact that the OSCE does not evaluate the student in real conditions, especially checking "show how you do" and not "he does". Arguably, direct and practical observation in real patients provides a more realistic and integrated view of clinical skills, but the lack of standardization in this form of assessment provides low reproducibility and reliability for use in scientific research.

The TB06 article shows that academic experiences in relation to TB need to be intensified and more valued by universities. It is necessary to implement evaluations of curricular axes to detect possible flaws in its structure. Corroborating these findings, the DCNs recommend that the training of nurses be based on competences and skills to be developed during the training process and favor technical-scientific, ethical-political and socio-educational conduct, in order to allow future professionals to recognize health as a right, in order to guarantee the quality of care at all levels, planning, organizing, managing and evaluating the nursing work process, in partnership with other professionals in the workplace.

Therefore, nurses must have training with a generalist, humanistic, critical and reflective profile, able to know and intervene in the most prevalent health-disease situations in the national epidemiological profile, with emphasis on their region of activity, identifying the bio-psychosocial and effects of its determinants. Universities invest little in teaching evaluation and are stuck with archaic models of summative evaluation, in which many teachers are more concerned with assigning grades than with the quality of teaching. This may be related to the precariousness of the training offered to teachers in relation to the new assessment tools. Therefore, investing in new teaching and assessment methods is essential in the current reality of higher education, in addition to offering qualifications to teachers.

The article TB08 analyzes the speech of professors of undergraduate nursing courses and two discursive blocks emerged, which address the importance of the theme of

tuberculosis in the curriculum and the role of nurses in tuberculosis control actions. The speeches emphasize TB as an endemic, reemerging, neglected, socially constituted disease and signal the importance of the knowledge acquired about TB during graduation for future professional practice. With regard to the knowledge of students, they emphasize their importance because they can be professionals who apply the knowledge acquired, organizers, guardians or managers of the health units. In addition, other relevant points such as the need for a multidisciplinary approach to disease control, expanding the theme in the curriculum matrix, as well as "demystifying TB" in relation to teachers, students and the population.

The professors make an analysis as to the different positions that nurses occupy in the exercise of their profession and that may be related to TB control actions. Nursing has shown itself to have a legitimate discourse on issues related to care for people with TB, with great experience in controlling the disease, both in the hospital and in public health, involving the prevention, treatment and training of health workers to act against the disease.

The discursive sequence "students will be future nurses" leads us to consider that being a nurse is a protagonist in the organization and management of the TB program. They emphasize the importance of students already encountering situations that involve the person with TB during the academic course and during their internships. Knowledge about the prevention and diagnosis of diseases are basic elements for the future nurse, since the lack of this can make the care for people with TB and their contacts deficient, which increases the risk of disease transmission among professionals and in population.

The meanings produced by the professionals' discourse allowed us to conclude that TB is an important disease from an epidemiological and social point of view and needs to have a wider scope in the curricular matrix of undergraduate nursing courses, in view of the protagonism of this profession in actions to control disease. Thus, the teaching-learning process about TB needs to be constantly reframed by teachers and by the higher education institution, so that the profile of the graduate is that of a professional capable of acting in the control activities of this disease of great epidemiological relevance.

Category 3- Teaching-learning methodologies for tuberculosis today

In view of the difficulties and challenges previously exposed, several methodologies have been used as a way to diversify the theoretical and practical activities in teaching tuberculosis in undergraduate nursing, which can provide

rich experiences in learning in which students are motivated to be the protagonists in building knowledge and exercising autonomy in decision making.

The TB03 article shows that planned visits and rounds of conversations were carried out with the spheres responsible for the management and management of the PNCT in the city of Belém, Pará, year 2015, during the practices of the discipline Management and Management of Health and Nursing Services, where were visited:

- State Coordination of the Tuberculosis Control Program / Secretariat of Public Health Attorney (SESPA);
- 1st Regional Health Center / SESPA;
- Municipal Coordination of the Tuberculosis Control Program / Municipal Health and Environment Secretariat-Belém (SESMA);
- State Reference Hospital in Tuberculosis - Hospital Barros Barreto;
- Escola do Marco Health Center;
- Curió Municipal Health Unit.

For the operationalization of the conversation circles, the competences at the federal level were discussed among researchers to understand their role. Then a schedule of visits for the state and municipal spheres was elaborated, which was extremely important for the organization of this study. Conversation rounds took place between researchers and local officials.

For the development of the activity, the Ministry of Health's Manual of Recommendations for the Control of Tuberculosis in Brazil was used, specifically the chapter relevant to the competences of the management and program management spheres. From these competencies, all the actions, in accordance with the manual, performed by each sphere were detailed. A bibliographic search was also carried out on the subject for the acquisition of relevant knowledge and information to be discussed in the visits.

The experience allowed the students to understand in loco the whole process for the operationalization of the PNCT actions, from the moment of identification of the suspected case in the Basic Health Unit, until its entry in the records of the Diseases Information and Notification System (SINAN- TB) which is the main source of data for the actions of Epidemiological Surveillance (VE) of tuberculosis in the federal, state and municipal levels. SINAN-TB works in a network and aims to collect, transmit, consolidate data routinely generated by VE, through a computerized network, thus enabling the dissemination of data and the dissemination of information.

The data entry of the notification / investigation form in Sinan-TB must always be performed by the notifying municipality. Proper completion of the fields in these forms (completeness) is essential to monitor the dynamics of the disease and define intervention priorities, as well as the forms of diagnosis and treatment of cases, in addition to the operational and epidemiological indicators of importance for the control of the PNCT. This enabled a more in-depth view of the PNCT and to understand its importance for the city of Belém.

The relevance of experiences like this is emphasized for academic and professional training in the health area, specifically in nursing, since nurses often exercise management activities at all levels. Beyond knowing the pathological characteristics of tuberculosis, it is the duty of every health professional inserted in the services to know the rules of the PNCT, as well as to understand the skills of their levels of management and management, so that they can base their actions, collaborating for the control disease.

The TB04 article deals with the use of the OSCE method during an evaluation process in an undergraduate nursing course, in which a checklist was used to assess the clinical skills of students in the diagnosis of tuberculosis. The instrument consisted of five stations divided as follows: Station 01: Anamnesis (symptomatology, socio-epidemiological conditions and Basic Human needs); Station 02: Physical Examination; Station 03: Nursing Actions (request for exams, guidance on sample collection); Station 04: Diagnostics and monitoring on the network; Station 05: Diagnosis of multidrug-resistant tuberculosis and Nursing Care.

These areas were chosen because they represent the steps of the nursing consultation and the skills necessary for the diagnosis of tuberculosis, according to the skills of the nurse, who needs to be constantly updated, as new knowledge and technologies are constantly created. Therefore, it is up to the nurse to provide comprehensive assistance to users with suspected or confirmed tuberculosis. In view of this need, the OSCE constituted a valid, reliable, viable and reproducible form of assessment, making it possible to assess, in its multiple dimensions, specific competences, in a planned, structured and diversified manner.

This research made it possible to verify the skills and difficulties of nursing students regarding the diagnosis of tuberculosis, as well as to know the factors that contribute to the improvement in performance or that hinder this process. In addition, the results allowed a joint reflection between teachers and academics about teaching and learning practices, as well as the evaluation process. The

findings also point to possible flaws in the current curricular structure of nursing courses, with regard to practical training and the acquisition of skills by students.

IV. CONCLUSION

From this study it was possible to know about the teaching-learning methodologies currently applied in the teaching of tuberculosis in undergraduate nursing, as well as to understand the difficulties and the perception of teachers and students about this process. Although there have been several advances, such as the improvement in the integration between teaching and health services, investments in changes in the teaching and evaluation process are still necessary, since, in the studies listed, several obstacles still persist.

Despite the increase in the number of undergraduate courses in Nursing, the studies analyzed showed that the curricula of undergraduate courses in nursing have inadequacies in content and pedagogical practices for the exercise of activities that involve the plurality of health system needs.

When expanding this discussion, there is a need to understand that the construction of a thought based on the recognition of transdisciplinarity collaborates in the formation of professionals working in a perspective of teamwork and, consequently, with the management of care. In this sense, the pedagogical methods used by the training institutions should assist in the training of health professionals with the ability to see the user as a singular subject, with experiences and stories to be considered in the care process.

There is a need for training institutions to approach health services, in a dialogical relationship, in order to better organize the learning spaces, while the methodologies adopted in this process are able to build critical and reflective subjects about the reality to be faced. It is recognized that there is still a long way to go in the perspective of the training of professional nurses, who work with innovative care practices and who come close to SUS precepts.

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Social Vulnerability and Rainfall: Impacts on Collective Health

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Abstract—Objective: To analyze the relationship between the prevalence of waterborne infectious diseases in the city of Limoeiro do Ajuru and the risk of flooding. Method: To obtain the data, data from the Brazilian Unified Health System (DATASUS), cases of acute diarrhea and respiratory infections in the rainy period 2007 to 2017 were analyzed in the database of the Brazilian Institute of Geography and Statistics (IBGE). To obtain the rainfall data for the Joana Coeli Station from 2007 to 2017, a consultation was carried out on the website of the National Water Agency (ANA). Results: The supply of treated water in the flood risk area is mostly improvised; there is also a lack of septic tanks, problems that contribute to soil and water contamination in the rainiest season, factors that lead to the emergence of waterborne diseases and respiratory problems. Conclusion: The study indicates that, in the research site, the areas of risk of flooding, combined with social and environmental vulnerability associated with high rainfall, cause the appearance of acute diarrheal diseases and acute respiratory infections in individuals in the locality.

Keywords—Floods. Acute diarrhea. Respiratory problem. Rainy season.

I. INTRODUCTION

In Brazil, climate changes such as rainfall variation are the result of natural and social processes that can generate natural disasters, problems to human health due to floods, floods and floods, modifying the ecosystem and biological cycles that can increase the incidence of infectious diseases and non-transmissible⁽¹⁾.

It is very frequent in Brazil situations of vulnerability of the population to risks, on a daily basis, due to the lack of urban planning, poverty and environmental problems, characteristics that were detected in the city of Limoeiro do Ajuru, Pará, region of integration of Tocantins, where the social and health determinants are aggravated, mainly with population growth in areas without urban structure⁽²⁾.

In 2010, the city of Limoeiro do Ajuru had a low human development index of 0.493 and more than 54.62% of the population had an income of less than one minimum wage; the main economic activity was concentrated in public administration, in the fish trade and agriculture⁽³⁾. In the municipality there is a predominance of floodplains close to the Tocantins River, favorable to flooding in periods of rainier weather. The rainy season, associated with social and infrastructure factors, causes flooding, which in turn causes economic, social and environmental damage, causing diseases to people in vulnerable situations^(4, 5).

In addition to unwanted social conditions, the municipality is also deficient in terms of environmental sanitation. There is precariousness or absence of rainwater

drainage, inadequate management of solid urban waste and sewage is responsible for social problems caused by rains that cause flooding⁽⁶⁾.

According to the epidemiological data of the municipality of Limoeiro do Ajuru in 2016, waterborne diseases prevailed, as well as there was a predominance of care in the local health system, particularly when there is a higher incidence of rainfall. In the period between the years 2007 to 2017, the prevalence of acute diarrheal diseases and respiratory infections was notorious, which affected the population of the studied locations.

In this context, the present study aimed to analyze the relationship between the prevalence of waterborne infectious diseases in the city of Limoeiro do Ajuru with the flooding risks and the health impacts of the community.

II. METHOD

This was a study with a descriptive quantitative approach, comprised of four stages, namely: 1 - Identification of the research site; 2 - Fieldwork; 3 - Data collection; 4 - Document analysis.

The research site was based in the municipality of Limoeiro de Ajuru, which has considerable rainfall as well

as diseases that prevail during the rainy season. As a reference we have the vulnerable population in areas at risk of flooding; the demand for care for acute diarrhea and respiratory infections in the urgency and emergency of the municipal hospital, thus outlining the profile and characteristics of the vulnerable population in the municipality.

Epidemiological data were extracted from the system of acute diarrheal diseases (SIVEP-DDA) provided by that of the 13th regional health department of the Secretary of Health of the State of Pará (SESPA) and in the database of the Brazilian Institute of Geography and Statistics (IBGE). Electronic means were also consulted on the website of the National Water Agency (ANA) to obtain the rainfall data for the Joana Coeli station in Limoeiro do Ajuru, from 2007 to 2017.

The mapping of the points with the highest incidence of flooding in rainy periods was carried out by evaluating the addresses of the records of the system of acute diarrheal diseases (SIVEP-DDA) and acute respiratory infections (Figure 1).

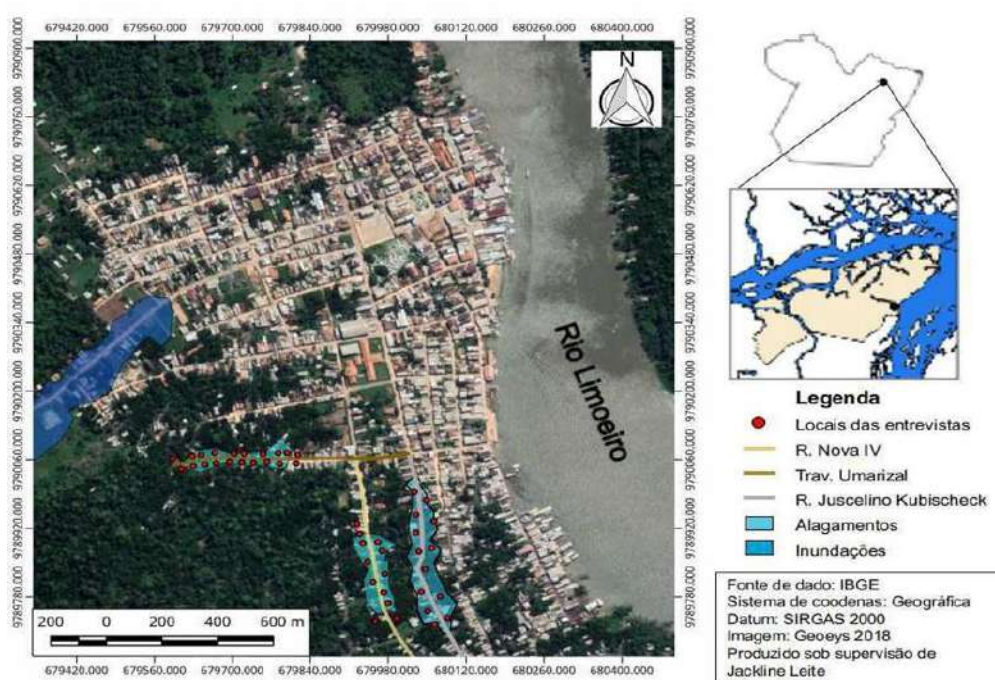


Fig.1: Location map of flood and flood areas.

Source: Oliveira JL, 2018. IBGE cartographic base.

The data obtained were verified and entered in the Libre Office Calc software, which constituted a database. Descriptive statistics of the study were prepared in tables

and graphs, based on the calculation of frequencies (categorical variables) and measures of central tendency

and dispersion (means and standard deviations of quantitative variables).

The rainfall data were analyzed using the Time Series method, to verify the correlation between the cases of acute diarrheal disease and the volume of rainfall over the period from 2007 to 2017.

III. RESULTS AND DISCUSSION

According to the survey on rainfall at the Joana Coeli station in Limoeiro do Ajuru from 2007 to 2017, there was

a slight downward trend from 2014 to 2017. This significant rainfall variability results in notable annual deviations. During the 10 years, the highest rate of precipitation in Limoeiro do Ajuru occurred in 2009, with a total of 3,822 mm, resulting in a positive variation from the normal of 47%. On the other hand, in 2016, it was the year that presented the lowest index: 949.5 mm, with a negative deviation of 44% in relation to the average. Table 1 shows the rainfall distribution, and highlights that in March 2009 there was the highest rainfall and the lowest precipitation in November 2015.

Table 1: Monthly pluviometric series, per year, in the municipality of Limoeiro do Ajuru, measured by rain gauge from Joana Coeli station, from 2007 to 2017.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Jan	210,4	638,7	491,3	187,3	458,5	266,6	323,6	200,6	113,9	163,7	135,4
Feb	469,9	252,3	558,8	282,1	507,9	357,9	402,9	179,8	250,5	75,6	235,7
Mar	653,4	565,9	793,2	384,4	381,4	448,1	446,1	148,4	293,4	146,5	171,5
Apr	371,7	335,9	406,3	252,6	566,7	371,2	557,2	303,9	360,5	250	169,8
May	254,2	237,2	467,7	462,6	393,7	247,1	337,7	69,4	299,6	51,5	92,5
Jun	165,5	301,4	404,3	183	140,7	121,9	160,8	63,7	176,3	53,8	67,4
Jul	158,7	56,9	255,2	133,2	212,2	101,4	216,7	158,8	61,5	70,5	33,9
Aug	105,5	104,5	42,1	42,4	145,8	106,6	146	29,2	12,2	11,5	11,6
Sep	46,8	82,0	48,4	65,7	33,8	43,2	48,3	46,6	7,6	4,8	7,4
Oct	118,1	10,8	86,8	8,6	130,1	95,9	8,7	37,1	10,6	5,1	30,1
Nov	84,4	146,5	9,5	102,1	261,7	16,3	143,5	87,2	1,3	11,5	23,4
Dec	244	162,7	258,4	248,8	127,3	255	108,8	28,3	3,1	105,0	78,8
Total Annual	2882,6	2894,8	3822	2352,8	3359,8	2431,2	2900,3	1353	1590,5	949,5	1057,5

Source: Oliveira JL, 2018; data extracted from the National Water Agency - ANA, 2017.

However, despite climatic conditions influencing the geographic distribution of prevalent diseases, it is relevant to analyze other factors to explain the number of cases of acute diarrhea and respiratory infections in a given region. In addition to assessing hydro climatic conditions, it is also necessary to assess the socio-economic conditions involved in the issue⁽⁷⁾.

The occurrence of constant flooding in areas where there is a lack of infrastructure, sanitation and others responsible for the health and well-being of the population, make people vulnerable to diseases, because with the waters overflowing with garbage and debris that cause the proliferation of insects and other undesirable species⁽⁸⁾.

Fieldwork in the affected areas reveals that the treated water supply in the flood risk area in Limoeiro do Ajuru is improvised with unprotected plumbing in most homes; it also reveals the lack of septic tanks in approximately 40% of this affected population, problems that contribute to soil and water contamination, which with increasing rainfall invades homes.

Thus, the absence or deficiency in the protection of water resources, mainly in relation to human or animal excreta, is capable of developing a series of pathogenic organisms such as viruses, bacteria, protozoa or intestinal helminths. The most frequent causes of contamination in the field of population groups concern open or poorly

closed water tanks and a lack of personal and environmental hygiene habits⁽⁹⁾.

To promote public health, drinking water is provided through collective water supply that aims to capture water from the source, treat it and distribute it through a distribution network to the buildings. However, in Limoeiro do Ajuru, individual systems such as wells in rural areas and on the outskirts are still common and not always safe and adequate from the sanitary point of view⁽⁶⁾.

Although precarious, the public water supply system is relevant in promoting public health, but to meet the characteristics of drinking water quality, it must have characteristics suitable for consumption, such as the absence of: taste and odor, toxic substances, pathogenic microorganisms and still present concentrations of residual chlorine within the quality standards⁽¹⁰⁾.

In this perception of exposure and propensity, the deficiency of basic sanitation in Limoeiro do Ajuru stands out as an environmental and social vulnerability, associated with the low income of the resident population, highlighting the potability of water that is essential for human life as a risk factor⁽¹¹⁾.

These results contribute to the Municipal Human Development Index (MHDI) being the 134th place among the 143 municipalities in the State of Pará, thus, it is among the lowest index (0.493 according to the IDESP-2016 report). The MHDI represents an adaptation of the global HDI methodology for application in the comparison between Brazilian municipalities, it is an indicator of the inhabitants' ability to guarantee a standard of living that ensures their basic needs⁽¹²⁾.

The survey data (table 2) reveal that the annual average of cases of acute diarrhea and acute respiratory diseases recorded at the hospital of Limoeiro do Ajuru were 790 cases of respiratory diseases and 1,025 cases of diarrheal diseases, from 2007 to 2017. Such data are worrisome from the point of view of health, the environment and the social situation of the population, since most of these citizens have incomplete elementary education and live without instructions related to public health, which allows greater health problems. This analysis remains current on the previous one carried out by the Ministry of Health between environmental sanitation and the health impacts of Brazilian citizens assessed in general terms⁽¹³⁾.

Table 2: Measures of position and variability in the number of cases of diarrhea, respiratory diseases and rainfall in the municipality of Limoeiro do Ajuru, from 2007 to 2017.

Variable	Mean	DesvPad	Minimum	Maximum
Diarrhea Cases	1024,5	188,2	669,0	1333,0
Cases of Acute Respiratory Diseases	789,9	232,9	460,0	1133,0
Total PRP (mm)	2.327	963	950	3.822

Source: National Water Agency (ANA), 2017.

On a ten-year time scale (2007-2017) (Table 3), there are records of acute diarrhea and respiratory infections in urgent and emergency care at the Ajuru lemon hospital. Such data show evidence between the correlation of the total rainfall with the higher number of diarrhea cases in relation to the cases of respiratory infections, and that the

rains have great influence in determining the period of occurrence of the diseases. In this case, the prevalence of diarrhea and respiratory infections confirms that its prevalence is associated with social, environmental and urban regulation⁽¹³⁾.

Table 3: Distribution of Acute Diarrheal Disease Cases, total and average rainfall in the municipality of Limoeiro do Ajuru, from 2007 to 2017.

Year	Diarrhea Cases	Respiratory Diseases Cases	Total PRP (mm)	Mean PRP (mm)
2007	813	783	2882.6	240.2

Year	Diarrhea Cases	Respiratory Diseases Cases	Total PRP (mm)	Mean PRP (mm)
2008	1116	826	2894.8	241.2
2009	1333	1117	3822	318.5
2010	1220	595	2352.8	196
2011	968	1133	3359.8	279.9
2012	1143	599	2431.2	202.6
2013	1115	1073	2900.3	241.6
2014	1020	460	1353	112.7
2015	669	678	1590.5	132.5
2016	946	593	949.5	79.1
2017	926	832	1057.5	88.1

*PRP = Precipitação pluviométrica.

Source: Limoeiro do Ajuru Municipal Hospital (2018); ANA (2018).

The number of cases of Acute Diarrheal Disease was higher in the period from 2008 to 2014, decreasing from 2015 to 2017; with respect to respiratory diseases, there was a decrease in 2016 and 2017. It is worth mentioning the year of 2009, which experienced greater rainfall and a greater number of cases of acute diarrhea and acute respiratory infections (table 3). Note that the average rainfall volume in the municipality, coincides with the last two years.

It is also noted that over the years between 2007 and 2017 the total precipitation per year has decreased in the region over the years. In this same period, a downward trend is observed in cases of diarrhea and respiratory diseases that may be related to the decrease in precipitation, in the relation of the lower the precipitation, the lower the probability of problems related to rain diseases.

Since flooding is also the result of inadequate public management and basic sanitation and other elements, they become factors of great risks to the precarious living conditions of the population with a low Municipal Human Development Index (MHDI), it is necessary to improve the capacity to care for the population problem and enable the basic needs of citizens to be ensured such as health, housing, education, among others⁽³⁾.

Economic factors and social inequality are some of the most relevant causes that lead to poor health conditions, as poverty can result in malnutrition, poor living conditions, poor levels of education, construction of houses or work located in areas with environmental risks⁽⁴⁾.

The assessment of environmental risk in Limoeiro do Ajuru is essential, given that the city is undergoing a disorderly expansion phase, with no structure in unplanned areas, which leaves the population vulnerable⁽¹⁴⁾. Thus, social vulnerability considers insecurity and exposure to risk and disturbances caused by events or economic changes, has its direct effects on the living conditions of less favored social groups, at the same time that the availability of resources and strategies of families are important elements for facing impacts on collective health⁽¹⁵⁾.

IV. CONCLUSION

The study revealed that the social vulnerabilities associated with flooding in the rainy periods at the research site showed significant impacts on the population's health, with emphasis on acute diarrheal diseases and acute respiratory infections.

The rainfall analysis between the years 2007 to 2017 in Limoeiro do Ajuru highlighted the month of March 2009 with the highest index associated with the number of sick people, obtained through the health records of the local hospital and official data. But, despite the fact that the volume of rainfall has been decreasing over the years, as well as the number of cases of diseases related to water transmission and respiratory problems, health problems in rainy seasons, maintain the correlation between the high volume of rain and the increase in acute diarrhea and respiratory infections in the municipality.

In our view, minimizing the amount of infectious diseases mentioned can occur if there are mechanisms to prevent social and health determinants, such as: improving environmental conditions, educational, economic actions and minimizing risk factors in order to reduce vulnerability of the population.

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Predictive studies of solid waste production capacity in fast food restaurants using the bootstrap method and time series

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Abstract— Fast food restaurants are responsible for much of the solid waste produced in Brazil. The management of these wastes has a such fundamental importance, because the environmental impact caused by its inadequacy causes incalculable damage to the environment. The performance of the solid waste management system can be determined by evaluating your service level. In restaurants, the level of solid waste service is determined based on the quantity generated. Therefore, the objective of this study was to develop a statistical planning to explore the predictability of the amount of solid waste generated in a fast food restaurant, aiming to develop a monitoring system, based on sustainability indexes, increasing knowledge about the relevant processes and possible internal barriers. Thus, a computational routine was created in the C++ language through the bootstrap statistical method. The results showed that the bootstrap method is a robust statistical tool to predict the amount of solid waste generated in fast food restaurants. The use of time series was important for comparative studies with the data obtained by the bootstrap method, as well as the implementation of a routine predictive analysis of solid waste in a fast food restaurant.

Keywords— Nutrition, Commercial Restaurants, Environmental Analysis, Statistical Modeling, Monte Carlo.

I. INTRODUCTION

The huge increase in solid waste generation worldwide requires the development of waste management strategies for a sustainable environment (1). When examining the impact only on climate, for example, it's seen that the food sector (food industry, wholesale and retail, restaurants and home use) represents about a quarter of the climate impact of consumption, while the impact on the water system is even more pronounced due to excessive fertilization (2).

Comprehensive legislation was built in the European Union, RED 2009/28/EC, with objectives and targets to improve waste management, as well as to reduce toxic gas emissions and adverse health and environmental impacts. Such legislation was developed with the concept of a hierarchy of waste management options, which includes the legally binding prioritization of management activities. In essence, prevention is the most desirable

option, followed by the recovery and recycling of materials (metal, glass, paper recycling or composting of organic waste), recovery of energy from waste (by incineration or digestion of biodegradable waste) and finally disposal (landfill) without recovery of materials and/or energy as the least desirable option (3).

In the case of Brazil, approximately 31.9% of the waste collected is composed of recyclable materials, but just over 1% of the waste is recovered in selective collection programs (4). This fact is the direct object of the National Solid Waste Policy, which brings together the set of principles, objectives, instruments, guidelines, goals and actions adopted by the Federal Government of Brazil, alone or under cooperation with States, The Federal District, Municipalities or individuals, with a view to integrated management and environmentally appropriate management of solid waste (5). This Law allows a model to be made to monitor the amount of solid waste in several instances.

Restaurants are major producers of solid waste (6), which are produced, practically, in all stages of food processing until reaching the final consumer, bringing significant impacts to public health and the environment. Therefore, it's necessary to increase the knowledge of the qualitative and quantitative characteristics that can be generated in these establishments. It's known that the shared responsibility for the life cycle of the product guides for the reuse and recycling of materials, since they have economic and social value, being promoter of work, income and citizenship (7).

Several authors highlight the importance of studying solid waste as a basis for the development of sustainable policies aimed at combating it (8,9). As people become aware of the implications of solid waste, the decrease in environmental impact is almost immediate. Therefore, it's necessary to ensure that awareness of waste becomes a corporate target for restaurant owners, and monitoring is carried out continuously (10). Champions 12.3, a coalition of executives from governments, companies, international organizations, research institutes, groups of farmers and civil society to combat despair, conducted a study in 114 small restaurants in 12 different countries on the analysis and dumping of solid waste. The result indicates that with every dollar invested in reducing food waste, for example, an average restaurant saves \$7 in return (11).

So, the implementation of efficient solid waste management schemes may also be able to reduce environmental impacts such as pollution, global warming and energy deficit, protecting human health and boosting social and economic sustainability (12). Currently, many sustainability researches focus mainly on the application and measurement of ecological efficiency (13). However, in the case of solid waste produced in restaurants, monitoring is of fundamental importance to estimate the quantities produced.

Statistical methods are powerful mathematical tools used to estimate the amount of solid waste produced. Through the results obtained, it's possible to carry out an adequate planning of environmental management. Therefore, based on the assumption of the importance of the large amount of solid waste generated in commercial restaurants, the objective of this study was to use the bootstrap method to estimate the amount of solid waste produced in these establishments, in order to take more effective measures in the prevention and destination of them, thus minimizing the environmental impacts caused in nature.

Bootstrap is a highly efficient computational method for inferential statistical analysis and doesn't

depend on many assumptions. This method was developed by Efron (14), and has been used in different areas of knowledge. The bootstrap method corrects possible deviations from the estimate and achieves more accurate and robust results. It's based on the idea that using only the available data can sometimes give better results than making unjustified assumptions about the populations we are trying to estimate (15).

Conditional efficiency measures are necessary when the production process not only depends on inputs and products, but also can be influenced by external factors. Such measures are estimated by means of a non-parametric calculation of the conditional distribution function of inputs and outputs. For this, procedures and smoothing parameters, bandwidths, basis of bootstrap methodology (16) are involved. Thus, providing a qualitative (compositional) and quantitative (parametric) comprehensive characterization of the total waste generated in fast food restaurants is mandatory for this study.

Time series are important resources used in predictive studies. Time series analysis comprises methods that try to understand such mathematical resources, within the underlying context of the data points or to make predictions. It has many different objectives, depending on the field of application. It includes predicting future values of the series, extracting a hidden signal from noisy data, discovering the mechanism by which data is generated, simulating independent achievements of the series to observe how it can behave in the future (and therefore, for example, to estimate the probability of extreme events) and eliminate the seasonal component of data sets to reveal the underlying trend more clearly (17). Due to its high applicability in mathematical research of predictability, time series can be used to perform predictive studies of solid waste production in fast food restaurants.

II. METHODOLOGY

2.1. Characterization of the site and sampling criterion

The research was conducted in the city of Recife, Brazil. The restaurant chosen for this study belongs to a large fast food chain. In this restaurant, the turnover of food sales is quite intense, being produced large amount of solid waste. Plastic, glass, metal and paper samples were collected. To obtain the data, weighing (gravimetry) of the waste was performed monthly by the cleaning collaborators, and recorded in an Excel spreadsheet, referring to the months of January to December 2019. The data obtained were statistically analyzed using the bootstrap method, aiming to estimate the solid waste

generation capacity of the studied establishment. From then on, it will be possible to suggest sustainability indicators suitable for restaurants, since until then, there is no citation in the literature.

Due to the predictability given by the bootstrap method, it was possible to carry out a planning based on the 3R principle (Reduction, Reuse and Recycling), which allows the economy to stop being linear to be circular (18). The circular model allows solid waste to be significantly reduced, thereby maximizing the use of products.

2.2 Sustainability indicators

Management practices require instruments for continuous improvement, so having a performance evaluation system is essential, considering that it's necessary to carry out measurements and evaluation in order to have a control of the studied system (19).

The evaluation systems can be presented in the form of indicators, indexes and rates, representing mechanisms for monitoring trends in reality (20). Such instruments can be used to analyze the efficiency of expenses, improve technical administrative management, in addition to the continuous improvement of systems. Any improvements possibly made from the use of these instruments can assist in planning new projects, in monitoring their implementation, reformulations and adjustments (21).

With the creation of the Advisory Commission on Environmental Statistics at IBGE, a Brazilian governmental institution, in 2001, with a team of experts from other official Brazilian institutions, the construction of IDS-Brasil was carried out, with the validation of 59 indicators (22). Every two years, from 2002 to 2015, IBGE published "Sustainable Development Indicators – Brazil", providing information on the Brazilian reality.

Sustainability indicators cover the environmental, economic, social and institutional areas, as well as allowing the monitoring of the integration of economic and environmental decisions (23). They help decision-making and results follow-up, as well as allow a comparison of results from different scenarios (24). As for the selection of indicators to be used, in general, it should be relatively in small numbers, and reflect the important trends of interest (25).

For Hammond (26), indicators can communicate or inform about progress towards a certain goal, but they can also be understood as a resource that makes a trend or phenomenon that is not immediately detectable.

The limitation in the collection of information about a performance system requires that the system be analyzed by a set of easy measurements, defined by

Stricker *et al.* (27) as indicators. According to this author, these values are used as representations due to the fact that they are measurable, and act as a way of controlling the progress of the strategies and goals established for the development of the process.

There are still no robust studies on sustainability indicators, specifically in commercial restaurants. Although the PNRS is very clear about shared responsibility, which implies that the producer of the waste has responsibility for it until its final destination, but unfortunately there's no inspection enough about it. So, without proper supervision, restaurant managers end up adopting their own parameters that suit their reality. And what you see in restaurants in the city of Recife is that they haven't yet prepared themselves for the circular economy mentioned in this work.

Based on the work carried out by Ayvaz *et al.* (28), a company is considered sustainable, if and only if, it participates in a reverse logistics network through strict planning of environmental management of its solid waste produced. It's recommended that the system operators establish procedures for managing and monitoring the collection of solid waste until recycling, in order to know how much is actually being directed to reverse logistics. Thus, it will be possible to establish efficiency indicators for waste management related to different territorial conditions (29). Also, the evaluation of the main indicators of zero solid waste management should be inserted in this context (30). Due to the high turnover, and consequently, the large amount of solid waste produced in a fast food restaurant, reverse logistics should be mandatory for the sustainable operation of the system (31).

In reverse logistics, the recycling rate is an important indicator of the sustainability of any company that produces high amounts of solid waste. The recycling rate (TR) is defined as the percentage of resources recovered from a solid waste producing unit. Mathematically, TR is defined as the ratio between the amount of materials regenerated during recycling (M) and the total amount of waste produced and collected (Q), as shown in Equation 1 (32).

$$T_R = \frac{M}{Q} \quad (1)$$

2.3 Statistical analysis of data

2.3.1 The bootstrap algorithm

The basic idea of the bootstrap method is to infer about an estimate (such as sample mean) for a population θ parameter (such as population mean) in the sample data. It's an independent sampling resampling method with

replacement of existing sample data with the same sample size n , and performing inference between this resampled data. Generally, the bootstrap method involves the following steps:

1. A sample of the population of size n is taken.
2. A sample is drawn at random and with repetition from the data of the original sample of size n , and replicated until obtaining the B simulated bootstrap terms. This process is called bootstrap resampling, and each simulated sample is known as a pseudo-sample. In the present study, an algorithm was built in the C++ computational language using the Monte Carlo method, that uses the renu random number generator (33). Figure 1 shows a simplified scheme of the algorithm's operability for the analyses using the bootstrap statistical method.

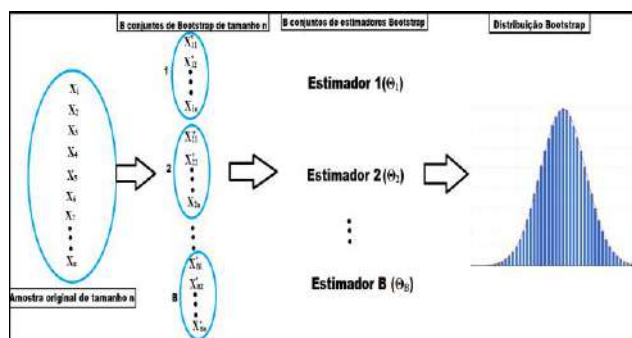


Fig 1. Simplified scheme of bootstrap algorithm.

3. The θ statistic is estimated for each bootstrap sample, thus obtaining the arithmetic mean in each resample procedure, until it reaches the simulation value B .
4. The sampling distribution with the bootstrap means is then constructed, using them to make more statistical inference, such as: estimating the value of the general mean, estimating the standard error of the statistic for θ , and obtaining a confidence interval for θ .

Thus, it's possible to generate new data through the bootstrap resampling of a given existing sample, and to make statistical inference only with them. The central idea of the bootstrap auto-boot technique is to make certain types of statistical inference with the help of the power of modern computers. When Efron (14) introduced the bootstrap method, he was particularly motivated by assessing the accuracy of an estimator in the field of statistical inference.

2.3.2 Bootstrap distribution

To generate the bootstrap distribution by the simulation process presented in item 3.3.1, a random

sample of size n obtained from a given population was considered. In this case, from the original set formed by the n $x = (x_1, x_2, L, x_n)$ elements, the bootstrap samples were randomly $x^* = (x_1^*, x_2^*, L, x_n^*)$ obtained, with replacement, at each stage of the interaction. The value x^* doesn't indicate the creation of a new dataset, but a set of values resampled with x . After the simulation, the set of estimators $\hat{\theta} = (\theta_1, \theta_2, \theta_3, K, \theta_B)$, who formed the bootstrap distribution, was obtained. In each interaction process, the estimator value equal to the bootstrap arithmetic mean of each sample was obtained, data by $\bar{x}_1^* = x_3, \bar{x}_2^* = x_8, \dots, \bar{x}_B^* = x_6$. Since we're dealing with random sweepstakes in the original dataset, not caring about the order to get the bootstrap sample, it's possible to have sequences of $x_1^* = x_7, x_2^* = x_{10}, x_3^* = x_2, L, x_B^* = x_3$ type. Thus, during the random draw, a number may not appear, others may appear one or more times, etc.

Let \hat{F} be the bootstrap distribution formed by the estimators of $\hat{\theta}$, with $1/n$ probabilistic mass, then the value of F was calculated by Equation 2 (14).

$$\hat{F}_{(n)}(x) = \frac{\sum_{i=1}^n I(x_i \leq x)}{n} \quad (2)$$

Where:

$\hat{F}_{(n)}(x)$ - the non-parametric maximum likelihood estimator of F ;

$I(x_i \leq x)$ - indicator function.

In an orderly way, the elements of the bootstrap distribution can be presented in the sequence below (14):

$$\begin{aligned} x_1^* &= [x_{11}^*, x_{12}^*, L, x_{1n}^*] \\ x_2^* &= [x_{21}^*, x_{22}^*, L, x_{2n}^*] \\ &\vdots \\ x_m^* &= [x_{m1}^*, x_{m2}^*, L, x_{mn}^*] \end{aligned}$$

For each \bar{x}_i , we will always have an associated estimator $\hat{\theta}_i$ for each resampling procedure. Similarly, the mean \bar{x}_B can also be replaced by the estimator $\hat{\theta}_B$ which

is the arithmetic mean of the bootstrap n estimators. For both situations, we will have Equations 3 and 4, respectively.

$$\hat{\Theta}_i = \sum_{i=1}^n \frac{x_i^*}{n} \quad (3)$$

$$\hat{\Theta}_B = \sum_{i=1}^B \frac{\hat{\Theta}_i}{B} \quad (4)$$

For the original samples, the population standard deviation estimator was calculated using Equation 5. On the other hand, the standard error estimator $\hat{\theta}$ was calculated using Equation 6. The bootstrap standard error was calculated using Equation 7.

$$\sigma_m = \sqrt{\frac{1}{m-1} \sum_{i=1}^m (\bar{x}_i^* - \bar{x}_m^*)^2} \quad (5)$$

$$\hat{s}_B = \sqrt{\frac{1}{B-1} \sum_{i=1}^B (\hat{\Theta}_i - \hat{\Theta}_B)^2} \quad (6)$$

$$\sigma_B = \frac{\hat{s}_B}{\sqrt{n}} \quad (7)$$

Where: n is the original sample size.

In statistics, the representation through a confidence interval shows the amplitude of the values in relation to the probability of containing a certain unknown population parameter. However, if sampling is repeated multiple times for a given significance level, the probability that the confidence interval contains the unknown population parameter increases significantly. Thus, the bootstrap resampling method is an excellent alternative to build confidence intervals for a given statistical parameter. For the present study, the z -standard bootstrap confidence interval (CI) was used, with a significance level of $100(1-\alpha)\%$, estimated using Equation 8, considering that the estimator $\hat{\theta}$ has normal distribution and standard deviation calculated by Equation 6.

In the present study, the statistical analysis of the data was performed using the empirical bootstrap distribution.

$$CI_{Boot-z}(\bar{x}_m^*, 100(1-\alpha)\%) = \left[\bar{x}_m^* - z_{\alpha/2} \sigma_{m_{boot}}; \bar{x}_m^* + z_{\alpha/2} \sigma_{m_{boot}} \right] \quad (8)$$

2.3.3 Time series analysis

To analyze the predictability of solid waste production in the studied restaurant, time series with moving averages and Holt exponential smoothing were used.

Let the time series Z_1, Z_2, L, Z_n be stationary and constant, so that you have it for a certain time $t = 1, 2, \dots, N$, $Z_t = \mu_t + a_t$, where: μ_t and a_t are respectively, the unknown parameter that varies in time and random noise.

Considering that the group was formed by the Z_i ones has normal distribution, then: the mathematical hope of a_t is given by $E(a_t) = 0$ and its variance by $Var(a_t) = \sigma^2$. Thus, in a mathematical procedure that uses simple moving averages of a time series, one should calculate the arithmetic mean of the most recent " n " observations, as shown in Equation 9 (34).

$$M_t = \frac{Z_t + Z_{t-1} + K Z_{t-n+1}}{n} = M_{t-1} + \frac{Z_t - Z_{t-n}}{n} \quad (9)$$

In the case of Holt's exponential smoothing technique, $Z_t = \mu_t + T_t + a_t$. The new term T_t refers to the local trend of the dataset. Thus, the values of the level and trend estimators were calculated by Equations 10 and 11 (34).

$$\bar{Z}_t = \alpha Z_t + (1-\alpha)(\bar{Z}_{t-1} + \hat{T}_{t-1}), 0 < \alpha < 1 \quad e \quad (10)$$

$$t = 2, 3, K, n$$

$$\hat{T}_t = \beta(\hat{Z}_t - \hat{Z}_{t-1}) + (1-\beta)\hat{T}_{t-1}, 0 < \beta < 1 \quad e \quad (11)$$

$$t = 2, 3, K, n$$

Where: α and β are called smoothing constants, $\alpha \geq \beta$. So, it was possible to estimate the value of Z_{t+h} using Equation 12, originating in " t ".

$$\hat{Z}_t(h) = \bar{Z}_t + h\hat{T}_t, \forall h > 0 \quad (12)$$

III. RESULTS AND DISCUSSION

3.1 Estimation of the amount of solid waste produced

The values of the amounts of plastic, glass, metal and paper from the restaurant studied (Pilot Project) are shown in Table 1. In the calculation of the standard deviation of the statistical analyses used, a 95%

significance level adopted was considered empirical bootstrap distribution, according to Efron (14). Considering the operation of the restaurant, it was observed that there was a selective collection of solid waste that was collected directly by the City of Recife, as no agreement was made with associations of waste pickers. The data presented in Table 1 showed great variability, which really required a robust statistical method for Its analysis.

Table 1. Amount of solid waste produced.

Month	Solid waste (kg)			
	Plastic	Glass	Metal	Paper
Jan	302	65	71	510
Feb	314	73	46	502
Mar	302	47	56	453
Apr	275	28	58	389
Mai	260	44	51	324
Jun	310	49	66	587
Jul	324	60	82	533
Aug	250	53	75	368
Sep	240	58	52	345
Oct	285	43	58	302
Nov	298	42	62	475
Dez	344	62	91	529

Any temporal event can be expressed as a combination on a graph called a periodogram, and you can observe the different periods (how long it takes to complete a full cycle) and amplitudes (maximum/minimum value during the cycle). This fact can be used to examine the periodic (cyclic) behavior of a given event. A periodogram is used to identify the dominant periods (or frequencies) of an event. This can be a useful tool for identifying dominant cyclic behavior in a series, especially when cycles are not related to the monthly or quarterly seasonality commonly found. Figures 2, 3, 4 and 5 showed the periodograms of the amount of plastic, glass, metal and paper produced by the studied restaurant.

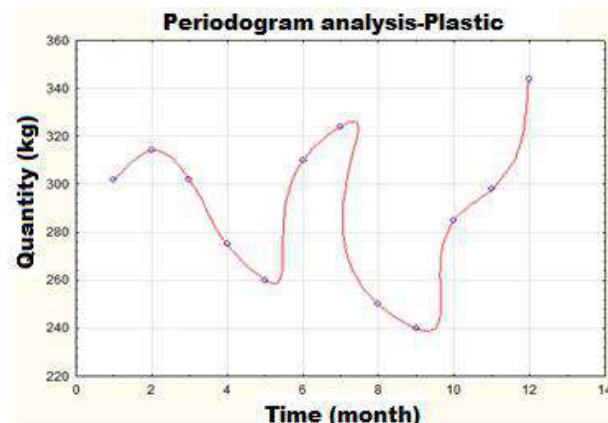


Fig.2: Periodogram of the amount of plastic.

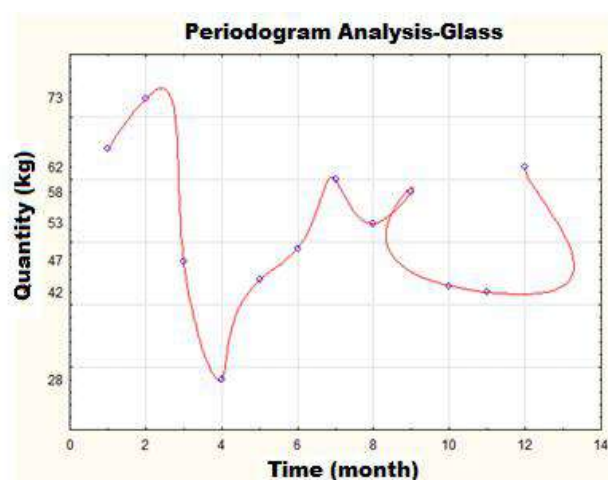


Fig.3: Periodogram of the amount of glass.

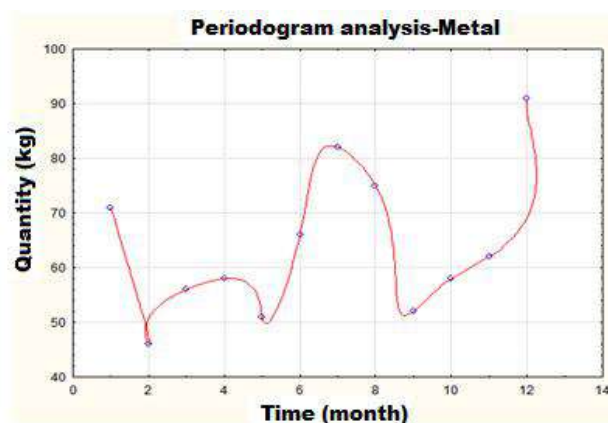


Fig.4: Periodogram of the amount of metal.

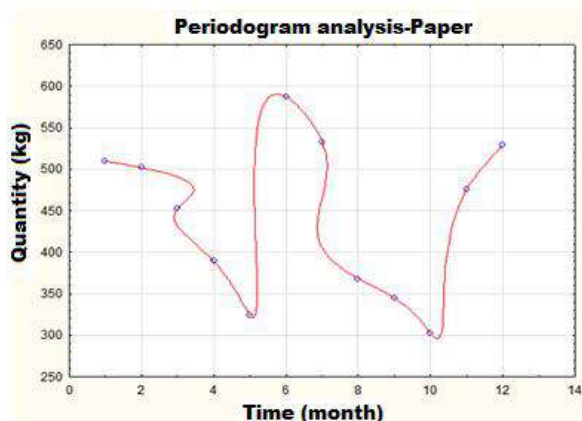


Fig.5: Periodogram of the amount of paper.

Analyzing Figures 2, 3, 4 and 5, great variability is observed in the original quantity of plastic, glass, metal and paper produced by the restaurant. Thus, any statistical study based only on these data would be totally inadequate, as they represent totally unstable systems. In the control graphs shown in Figures 6, 7, 8 and 9, we observed the distribution of the original amounts of solid waste in relation to the arithmetic mean (mean), upper limit (L.S) and lower limit (L.I), with also in relation to the variation within the subgroups, in order to verify the degree of dispersion in the values.

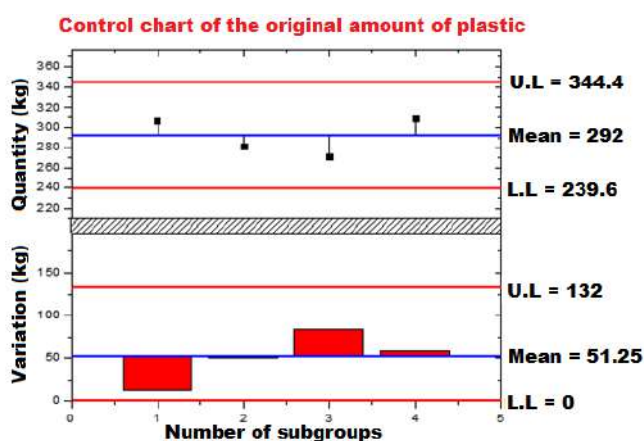


Fig.6: Control chart of the original amount of plastic.

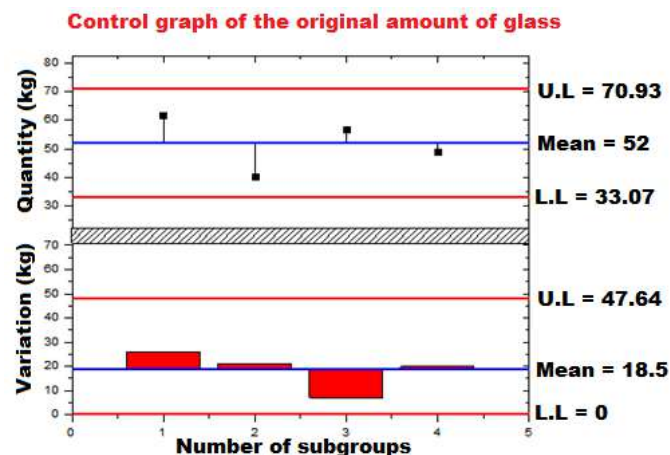


Fig.7: Control graph of the original amount of glass.

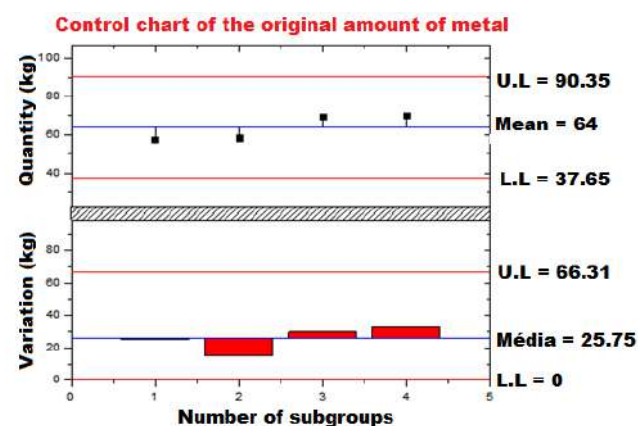


Fig.8: Control chart of the original amount of metal.

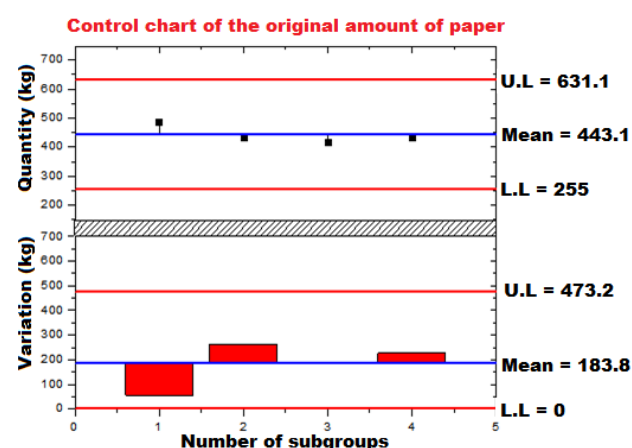


Fig.9: Control chart of the original amount of paper.

Control charts are important statistical quality control tools to improve quality. Quality improvement methods have been applied in the last 10 years to meet the needs of consumers. The product should retain the desired properties with the smallest possible defects, while maximizing profit. There are natural variations in production, but there are also attributable causes that are

not part of chance. Control charts are used to monitor production, and in particular, their application can serve as an “early warning” index in relation to possible “out-of-control” processes (35). To keep production under control, different control charts are established, prepared for different cases, incorporating upper and lower control limits. There are several control charts in use, and they are grouped primarily as control charts for variables and control charts for attributes. The points plotted in the charts can reveal certain patterns, which in turn allows the user to obtain specific information. Patterns that show deviations from normal behavior are raw material, machine configuration or measurement method, human and environmental factors, inadvertently affecting product quality. The information obtained in the control charts helps the user to take corrective actions, opting for specified nominal values, thus improving quality (35).

The use of quality control charts in studies of solid waste production planning in fast food restaurants, such as those shown in Figures 6, 7, 8 and 9, constitutes a very useful statistical tool for instrumental analysis. However, observing these figures, it was verified that the amount of sample was insufficient for an adequate statistical planning. This can lead to gross errors of interpretation, if statistical analyses are performed only with the original data, especially when the purpose of discussing the application of indicators of sustainable local development is intended. Since it's impossible to “create” new samples, the use of the bootstrap method that uses the so-called “pseudo-samples” from the original data set is a very feasible alternative to observe the production behavior of the restaurant, in case there are larger quantities than those presented in Table 1. Figures 10, 11, 12 and 13 show the control charts of bootstrap quantities of plastic, glass, metal and paper, respectively, from the production of the restaurant studied. In obtaining the graphs, 2000 bootstrap interactions were used.

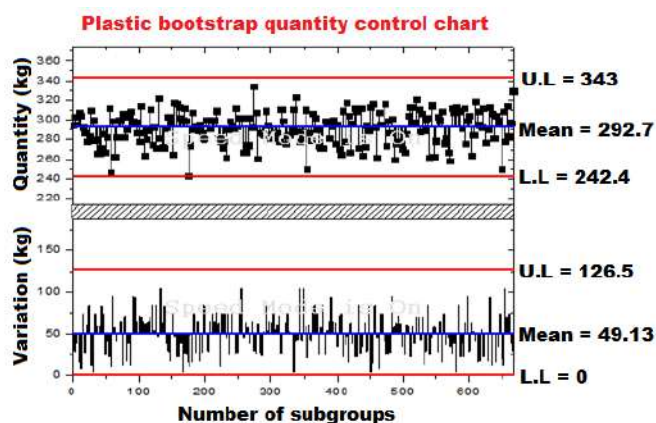


Fig.10: Plastic bootstrap quantity control chart.

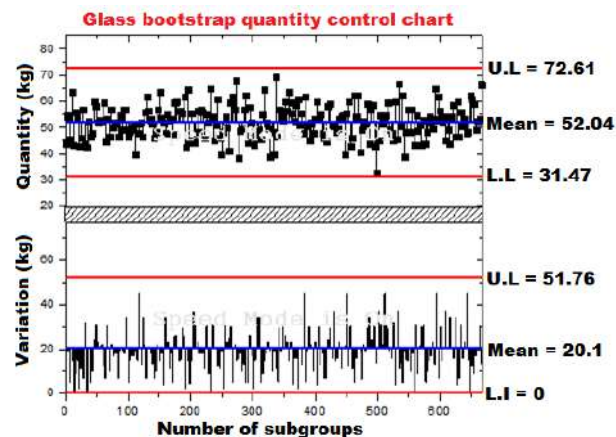


Fig.11: Glass bootstrap quantity control chart.

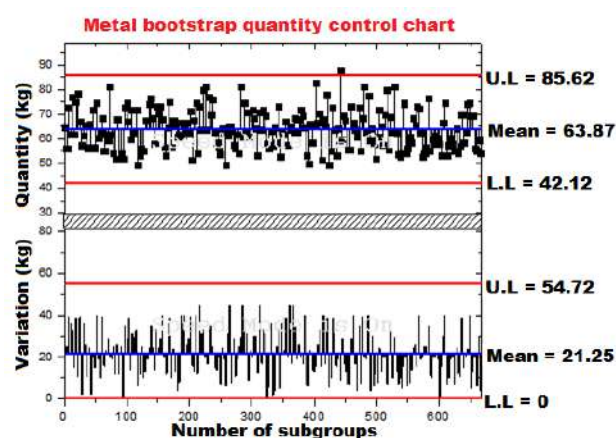


Fig.12: Metal bootstrap quantity control chart.

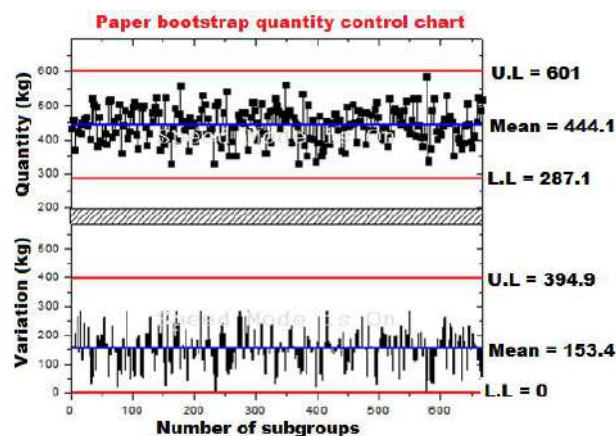


Fig.13: Paper bootstrap quantity control chart.

It's observed in Figures 10, 11, 12 and 13 that the statistical analysis of the original data using the bootstrap method proved to be quite efficient to obtain more stabilized values of the amounts of solid waste produced. Thus, all estimates of central trend measures and dispersion measures should be determined using the bootstrap empirical distribution. However, comparing Figures 6 to

13, it was verified that the arithmetic mean of the original data and bootstrap data didn't differ significantly. According to Efron & Tibshirani (36), the arithmetic mean of the original data and the bootstrap arithmetic mean are robust estimators of the population mean. It's verified in all graphs of Figures 10, 11, 12 and 13, that the dispersion in the original data set (Figures 6, 7, 8 and 9,) was significantly attenuated, resulting in the stabilization of each representative system, which indicated the bootstrap method as an adequate statistical tool to estimate the production capacity of solid waste in commercial restaurants.

3.2 Solid waste regenerated by recycling

Brazil doesn't have laws that establish percentages of recycling rates for fast food restaurants. The rate of recycling is an important indicator of environmental sustainability in companies that produce large amounts of solid waste, such as fast food restaurants. To Wen *et al.* (32), the recycling rate is an important indicator of the performance of the recycling system. IBGE (37) presents recycling rate values in its annuals, being described as one of the indicators of sustainable development in Brazil. Certainly, this indicator integrates guiding principles that existed at the United Nations Conference on Environment and Development that was held in the state of Rio de Janeiro in 1992.

When a company adopts sustainable development indicators, it shows that its stakeholders are really concerned with the environment, and not just about making a profit. Using Equation 1 and the percentage of recycling presented in the IBGE's sustainability indicators yearbook (2013), estimates were made of the amount of material that the restaurant studied should regenerate during recycling to be considered a sustainable company that makes systematic use reverse logistics. For that, the bootstrap quantities of the solid residues shown in Figures 10 to 13 were used, and the results obtained are shown in Table 2.

Table 2. Estimation of the amount of solid waste regenerated by recycling.

Type of solid waste	Recycling rate (%)*	Regenerated quantity (kg)	
		Variation	Average
Plastic	58,9	143 - 202	172
Glass	47,0	15 - 34	24,5
Metal	97,9	41 - 84	62,5
Paper	45,7	131 - 275	203

*Data obtained from IBGE (2013).

The values presented in Table 2 were the estimated indicators of sustainable development of the studied restaurant. It was observed during the research that the collections of solid waste were carried out by the City of Recife, and there was no interest on the part of the stakeholders for the final destination of the collected material, nor the concern for the reverse logistics process. In fact, if there was a reverse logistics network as suggested by Ayvaz *et al.* (28), the restaurant studied should regenerate, at least, the amount of solid waste presented in Table 3. Thus, it's up to the stakeholders of the studied restaurant to establish performance indicators for the management of the solid waste produced, as suggested by AlHumid *et al.* (38).

Recycling reduces the use of natural resources by reusing materials. Much of the natural resources used by Brazilians are not renewable. The non-renewable use of natural resources is a major environmental problem that has been widely discussed in different areas of human knowledge, always considering that the recycling process avoids new waste, thus saving the environment. Fast food restaurants are potential producers of solid waste, so the environmental awareness of their stakeholders must be the *sine qua non* condition for the creation of a systematized reverse logistics network that's able to integrate recycling into the company's production process. According to Vasconcellos *et al.* (39), reverse logistics deals with the recovery and management of goods, and can add value to an image of the company and the environment. Thus, in order to achieve significant amounts of regenerated materials (Table 2), the operators of the restaurant studied should create strategies to establish a systematized reverse logistics network.

In the current national legislation, there is no parameter of ideal amount of solid waste generated. The state of São Paulo, for example, sanctioned on June 25, 2019 the bill of Law 99/2019 that prohibits the use of disposable plastic cups, cutlery and straws in commercial restaurants, with a penalty of a fine of R\$ 503.6 to R\$ 5,306 for those who break the law. This fact probably considerably decreased the amount of plastic produced in restaurants in the state of São Paulo, however, so far there are no comparative studies on this type of solid waste generated.

In the view of the operators of the system, the lack of adequacy of restaurants as sustainable companies is due to several factors, one of which is the insufficiency of physical space to carry out the selective collection (40). It's evidenced in the literature that this lack of concern with the environmental impact is, in fact, related to the lack of environmental education (41,42). This separation and

quantification of the waste produced is not the concern highlighted in the literature, which focuses on the production of recyclable plastics (43). Solid waste can also be solved with better project planning and employee training.

In the study by Picciafuoco (44) recyclable waste corresponded to only 1% of the total generation of waste in food units. However, in the work of Lafuente Junior (45), the waste from the stock and storage of a commercial restaurant corresponded to approximately 37% of the total waste generation. Despite the literature data, it's recommended that the evaluation of increase or decrease of recyclable waste should always be comparative within the unit itself, allowing to monitor the evolution of waste generation over time, since there's no parameter stipulated by Law (46).

Bartolacci *et al.* (47) defines an indicator that allows defining a maximum value of financial cost for the management of recyclable solid waste, but he considers that this indicator is individual, in view of the variables he predicted in the study between different scenarios. However, in the study by Salguero-Puerta *et al.* (48), the index of reuse of plastic waste produced and the amount that can be sold was defined. Such indicators could not be used in this study due to the lack of information regarding the separation of the types of plastics. But, with demand forecasting, it's possible to avoid waste and establish more accurate planning.

3.3 Predictability of the amount of solid waste produced

Studies on the predictability of a given phenomenon is crucial for decision-making, such as it can be used in business practice to predict results of interventions on an interpretable scale and therefore select appropriate procedures (34).

Predictive analytics is the analysis of the data received to identify problems in advance. Unfortunately, many Brazilian companies don't have predictive analyses and don't intend to do it in the near future. Generally, manufacturers are interested in quality control and ensuring that the entire production line is working with the best possible efficiency. With predictive analysis, it's possible to improve the quality of manufacturing and anticipate needs throughout the production line (34).

Manufacturing predictive systems allow users transparency in operations. The basis of a predictive production system is intelligent software, used to control the functionality of predictive modeling. This gives manufacturers the opportunity to proactively implement mitigating solutions to avoid loss of efficiency in manufacturing operations. Forecasting equipment

performance and estimating time to failure will reduce the effects of these uncertainties (34).

According to Ritzman *et al.* (49), the forecast is the evaluation of future events, used for planning purposes. He also states that forecasts are necessary to assist in determining the necessary resources, in programming existing resources and in the acquisition of additional resources, strengthening the idea of sustainability, as this way there will be no waste of products due to excess stock, consequently, the loss of a stopped stock.

Although solid waste is not considered as products of a production line of a fast food restaurant, it's possible to establish predictive studies on the quantities generated in the process. Today's factories and fast food restaurants have many things in common. The backstage of a fast food restaurant are true production lines with high manufacturing efficiency. It's remarkably profitable, and much of this success stems from the innovative methods used in restaurant supply chain management, inventory tracking, and maximizing the speed and quality of delivered food products. Thus, a fast food restaurant is a small factory, with a manager who supervises workers, plans schedules and shifts, tracks inventory and supply chain, oversees an assembly line producing strict quality control on its products. In most cases, the efficiency of the assembly line determines the texture, shape and taste of food, with the main fast food brands making their menu decisions according to what is operationally possible and flavorful. This turns an individual fast food restaurant, in essence, into a miniature factory (50).

Considering that the solid waste generated in a production line of a fast food restaurant behaves as a "product", predictive studies of the quantities produced using time series were performed. For this purpose, the time series with simple moving averages and the exponential smoothing of Holt were used, as suggested by Carlberg (51). Predictive analyses by time series with simple moving averages of plastic, glass, metal and paper quantities for the periods of 3 and 6 months are shown in Figures 14 to 21.

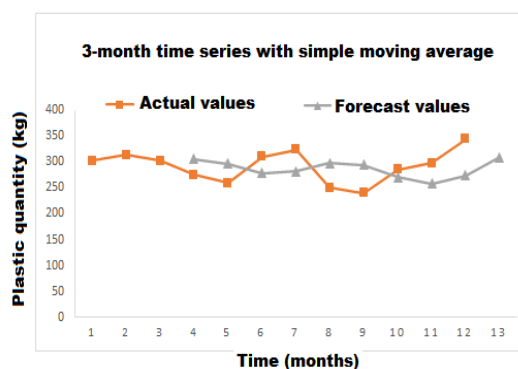


Fig.14: Forecast of the amount of plastic in 3 months with simple moving average.

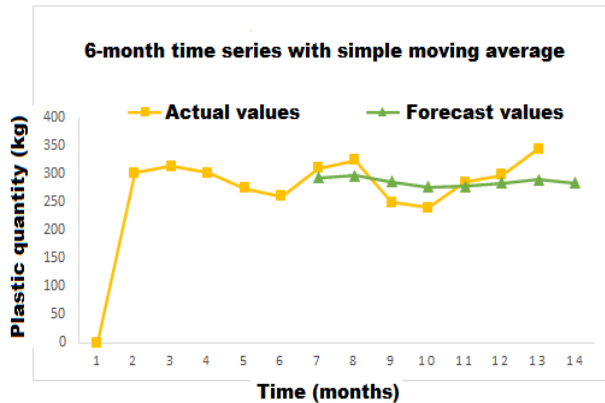


Fig.15: Forecast of the amount of plastic in 6 months with simple moving average.

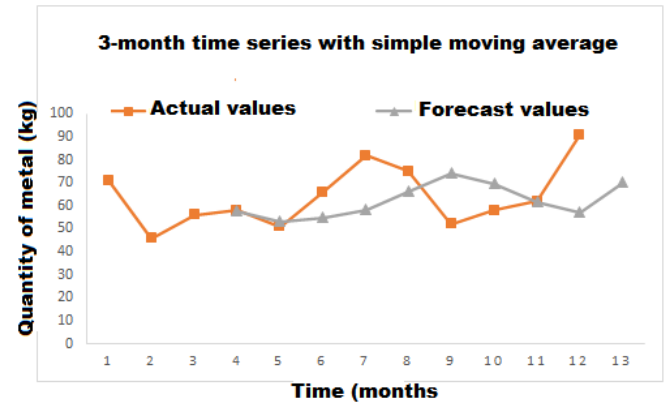


Fig.18: Forecast of the amount of metal in 3 months with simple moving average.

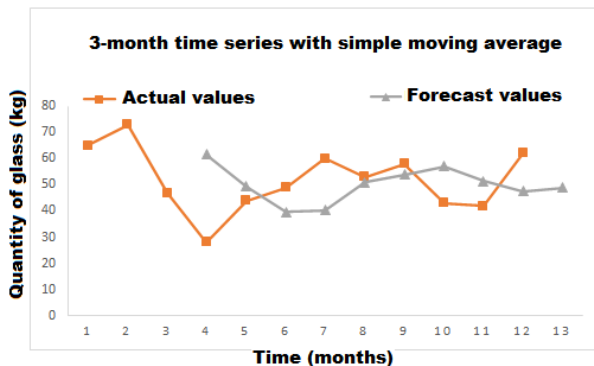


Fig. 16: Forecast of the amount of glass in 3 months with simple moving average.

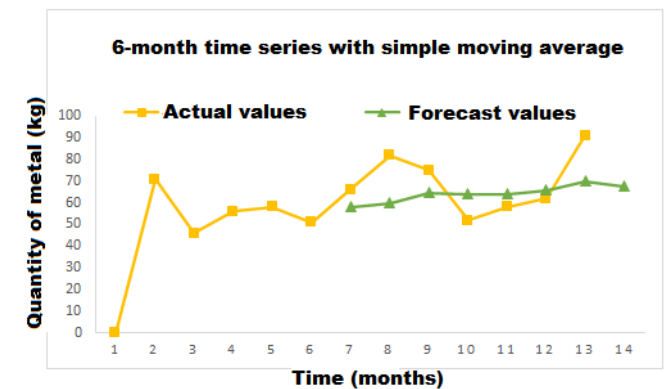


Fig.19: Forecast of the amount of metal in 6 months with simple moving average.

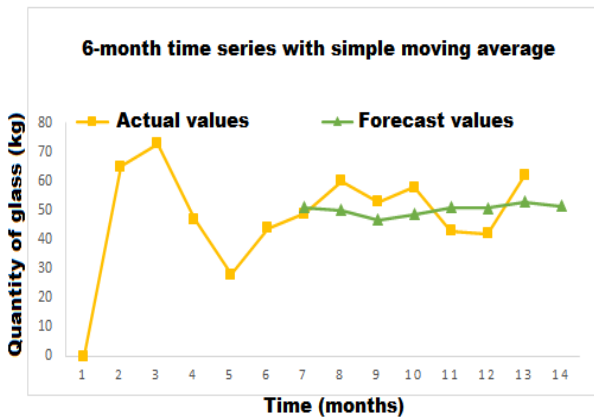


Fig.17: Forecast of the amount of glass in 6 months with simple moving average.

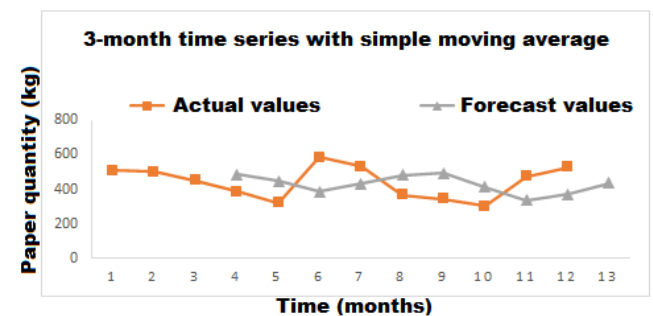


Fig.20: Forecast of the amount of paper in 3 months with simple moving average.

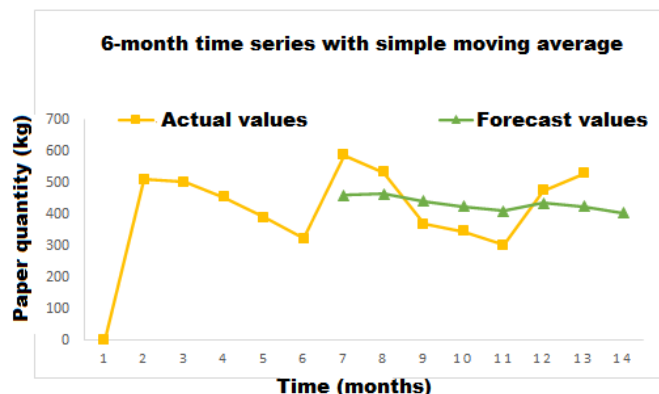


Fig.21: Forecast of the amount of paper in 6 months with simple moving average.

Moving averages may be the best option if there's no other source of information besides the output history of the evaluated product. By averaging your results month by month, quarter by quarter, or year-on-year, you can better visualize the long-term trend that's influencing results. In the analysis of time series with simple moving average, the averages move in time (Figures 14 to 21), and this is due to the entry of new values and output of the old ones (52). In this case, the means are used in the technical analysis identifying trends and assembling the operation strategies.

According to Sanvicente & Mellagi Filho (53) to build a moving average, the duration of the period that the average should be calculated is determined, and then, the average value of the number of observations of the set that was chosen for analysis is calculated. Thus, the average is done regularly with the abandonment of the oldest average and the addition of the newest. On the other hand, the longer the period (time), bigger will be the tendency to linearity. This can be observed for the times of 3 months and 6 months in the time series of the amount of solid waste obtained from the restaurant studied (Figures 14 to 21). In this case, for the 6-month period, the values tended to be more linear than the 3-month period. The forecasts of the quantities of plastic, glass, metal and paper for the period of 6 months tended towards the bootstrap averages presented in Figures 10 to 13. This shows the robustness of the bootstrap method in studies on system's predictability.

To obtain greater stability in predictive analyses of the quantities of plastic, glass, metal and paper, the time series with exponential Holt smoothing was used, the results of which are presented in Figures 22 to 25. According to Samohyl *et al.* (54), this method breaks down the series into its trend and seasonality components and smoothers historical data exponentially, so that old values tend to have zero weight, valuing the most recent observations.

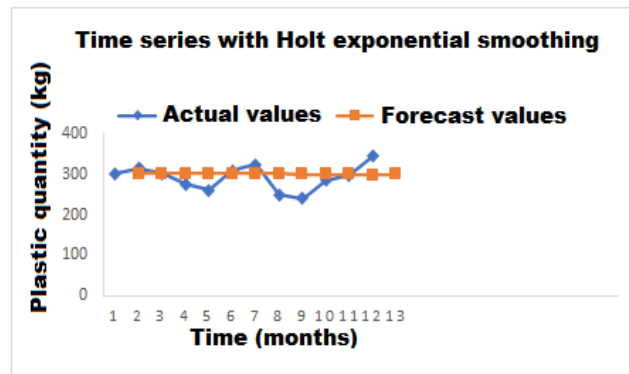


Fig.22: Prediction of the amount of plastic with exponential smoothing of Holt.

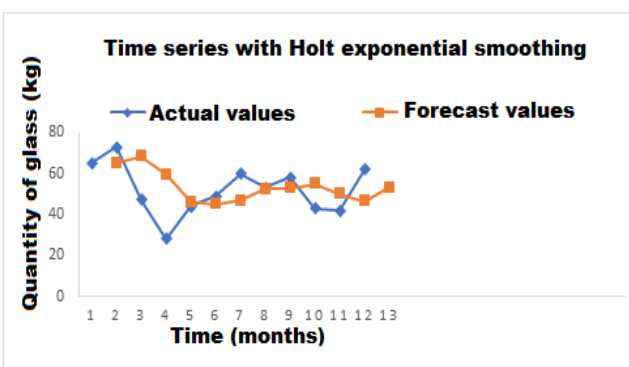


Fig.23: Prediction of the amount of glass with exponential smoothing of Holt.

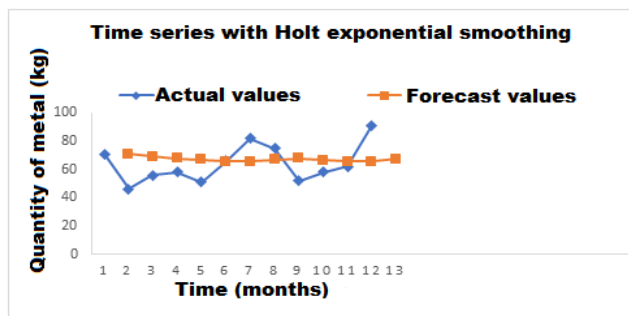


Fig.24: Prediction of the amount of metal with exponential smoothing of Holt.

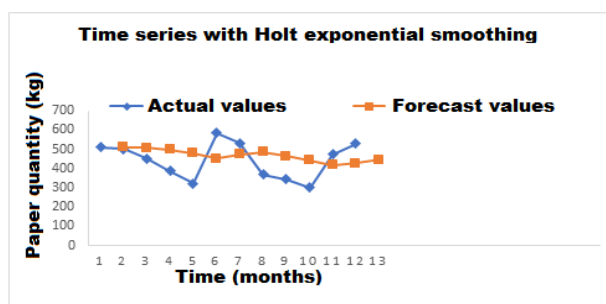


Fig.25: Prediction of the amount of paper with exponential smoothing of Holt.

As can be seen in Figures 22 to 25, the predictability analyses estimated by the time series with exponential Smoothing of Holt tended more rapidly to linearity than the time series with simple moving average (Figures 14 to 21). It's observed in Figure 22 that the forecast values tended linearly to 300 kg, which was not so different from the bootstrap mean value of 292.7 kg presented in Figure 10. Similarly, the trends to linearities presented in Figures 23, 24 and 25 approached the values of the bootstrap means of Figures 11, 12 and 13, respectively. Once again, the bootstrap method proved to be an appropriate statistical tool that can be used in predictive analysis of production system. Silva *et al.* (55) showed that the bootstrap arithmetic mean is a robust central trend measure that is not influenced by anomalous values. This agreed with the works developed by Efron (14).

IV. CONCLUSION

The issue of sustainable development in the restaurant studied lacks the support of its Stakeholders to implement a reverse logistics network of systematization of recycling solid waste produced during its operation.

It's necessary to create laws that establish specific indicators of sustainable development for fast food restaurants, because this type of commercial establishment produces high amounts of solid waste.

The bootstrap method and the time series with simple moving averages and exponential Holt smoothing can be used to make predictability studies of solid waste production in fast food restaurants, avoiding its waste.

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Teacher: Authority in evidence

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Abstract— *The end of authority in modern society has been evidenced by educators and society as a whole. At first, studies point out that this rupture originated from two main factors: the denial of the past by the bias of tradition and the ascension of modern society, which promoted equality in all spheres of human life. It is assumed that teaching is sustained when professors are bearers of knowledge recognized as legitimate in the school hierarchy and this asymmetry is conceived and exercised within an institution bearing the republican principles of equal opportunities and commitment to the common good. In this perspective, we defend a cultural and social scenario that promotes a lasting knowledge, that deals with universal issues, discusses and cultivates tradition, investigates principles and foundations of knowledge in general. It is not a matter of defending a dogmatic posture that denies doubt, but of understanding the contradictions about the ideal and material conditions of the relationship between what is known and what is on the way to learning. The study is theoretical in distinct epistemological fields, aiming at articulating education, philosophy and sociology. An approximation is sought between the concept of authority and knowledge and its relationship in educational processes from authors such as Rousseau (1979), Arendt (2010), Assmann (2000), Bauman (2010), Sennett (2001), Freire (1991), and Morin (2002). Finally, the text also expresses the subjective meaning and the interweaving between the thinking subject and the researched object.*

Keywords— *authority, tradition, educational processes.*

Professor: Autoridade em Evidência

O fim da autoridade na sociedade moderna tem sido evidenciado pelos educadores e sociedade como um todo. A princípio, estudos apontam que essa ruptura se originou a partir de dois fatores principais: a negação do passado pelo viés da tradição e a ascensão da sociedade moderna, que promoveu a igualização em todas as esferas da vida humana. É pressuposto que o ensinar se sustenta quando os professores são portadores de um conhecimento reconhecido como legítimo na hierarquia escolar e essa assimetria seja concebida e exercida dentro de uma instituição portadora dos princípios republicanos de igualdade de oportunidades e de compromisso com o bem comum. Nesta perspectiva, defendemos um cenário cultural e social que promova um saber duradouro, que se ocupe de questões universais, discuta e cultive a tradição, investigue princípios e fundamentos dos saberes em geral. Não se trata da defesa de uma postura dogmática que nega a dúvida e, sim, de perceber as contradições acerca das condições ideais e materiais da relação entre o que sabe e o que está em via de aprendizagem. O estudo é de cunho teórico em campos epistemológicos distintos, com vistas a articular educação, filosofia e sociologia. Procura-se uma aproximação entre o conceito de autoridade e conhecimento e sua relação nos processos educativos a partir de autores como Rousseau (1979), Arendt (2010), Assmann (2000), Bauman (2010), Sennett (2001), Freire (1991) e Morin (2002). Enfim, o texto expressa também a significação subjetiva e o entrelaçamento entre o sujeito pensante e o objeto pesquisado.

Palavras-Chave— *autoridade, tradição, processos educativos.*

Maestro: Autoridad en la Evidencia

El fin de la autoridad en la sociedad moderna ha sido evidenciado por los educadores y la sociedad en su conjunto. Al principio, los estudios indican que esa ruptura se originó en dos factores principales: la negación del pasado por el sesgo de la tradición y el auge de la sociedad moderna, que promovió la ecualización en todas las esferas de la vida humana. Se supone que la enseñanza se sostiene cuando los maestros son portadores de un conocimiento reconocido como legítimo en la jerarquía escolar y esa asimetría sea concebida y ejercida dentro de una institución portadora de los principios republicanos de igualdad de oportunidades y de compromiso con el bien común. Desde esa perspectiva, abogamos por un escenario cultural y social que promueva un saber duradero, que se centre de cuestiones universales, discuta y cultive la tradición, investigue principios y fundamentos de los saberes en general. No es la defensa de una postura dogmática la que niega la duda, sino más bien percibir las contradicciones sobre las condiciones ideales y materiales de la relación entre lo que sabe y lo que está en el camino del aprendizaje. El estudio es teórico en diferentes campos epistemológicos, con el fin de articular la educación, la filosofía y la sociología. Se busca una aproximación entre el concepto de autoridad y conocimiento y su relación en los procesos educativos de autores, como Rousseau (1979), Arendt (2010), Assmann (2000), Bauman (2010), Sennett (2001), Freire (1991) y Morin (2002). Por último, el texto también expresa la significación subjetiva y el entrelazamiento entre el sujeto pensante y el objeto investigado.

Palabras clave— autoridad, tradición, procesos educativos.

I. INTRODUCTION

The bankruptcy of authority in public school is claimed by the society as a whole. Although there are doubts about the category of authority in evidence: legal authority based on the legal framework; the respect for new charismatic characters (within politics and religion); or that one mediated by the love for knowledge. This writing holds on to the authority of school knowledge based on credibility and trust. In the teaching and learning relationship, observations that refer to the difficulty of exercising teaching authority in front of the student often arise. The deauthorization of the teacher stems from a number of factors in the public and private spheres. It is assumed that in the absence of a teacher, there can be no student. Between them, the duties are reciprocal and, if they are poorly fulfilled on one side, they have certainly been neglected on the other one. This is the ethical and rational basis of the intervention in the formative processes of human beings through the teaching task. With regard to the task of teaching, there is no limit or exhaustion of what can be taught: it is impossible to *know everything*. The authority of education is exercised by the relationship of unequal individuals, in which there is a reciprocal recognition of the roles and position occupied by each one. In this concept, what motivated the crisis of the teacher's authority in relation to their students?

A priori, we are treating authority not as a relationship based on violence/force or persuasion, but on

respect and duty. In the field of education, it is on the natural need of children, in the face of unfamiliarity with the common world, to listen, from who knows, to the directions to be followed.

The search for a permanent well-being can be associated with the decline of authority to the extent that the excessive valuation of the new and the random engenders fluid relationships as opposed to the past solidity. Moreover, political indifference reveals a characteristic trait of the new times, in which individuals are overly concerned with their private lives and less with public events. Net values and fragile relationships, driven by private interests, as Zygmunt Bauman describes in his works, have made the crisis of authority significantly acute.

The autonomy of the world of childhood, where children are precociously emancipated from parents insofar as they are raised and educated in non-domiciled spaces, hostages to the information society, averse to habit and tradition, must also be understood within the context of the crisis of authority in education. In the educational processes, there is an accentuated substitution of the references that historically used to move the teacher and student relationship. The protagonism and the individualism, fruits of modern culture, take the deconstruction of these references as a criterion of life. Moreover, it seems that the new beings in formation have grown weary of the authoritarian and repressive relations

of the legally constituted society and have displaced this rejection by rising up against school rules. Other questions, still under study, arise from debates at school level: Is protagonism, demanded by adolescents and young people, a sign of the breach of trust based on unequal knowledge? Is the deauthorization of teachers a consequence of the ephemeral and the negation of tradition? Is the precariousness of the initial training of teachers a source of indiscipline and a breach of trust between student and teacher?

Finally, what matters for the purposes of this reflection, in particular, is the theoretical contribution about the importance of authority in education in the characteristics and singularities defended by the theoretical scope.

II. AUTHORITY ARISING FROM KNOWLEDGE

When it comes to knowledge, there must be an asymmetry between student and teacher, as Plato defended, when the best ones, those qualified by the art of reading and reflection, must lead others, minors and incapable. Education requires distinct roles and responsibilities and is based on the difference of knowledge. Thus, authority is established in a play of forces in which there needs to be certain recognition and cooperation on the part of those who will experience it.

It is not about submission to any authority. The price and weight of being a student is to recognize, as Hannah Arendt (2007, p. 128) wrote, that the teacher is one step ahead. Thus, the educator fulfills, in the school universe, a socially constructed and authorized function.

In Arendt's understanding, the crisis of authority is a political crisis that has spread to the creation of children and to education, spaces where authority has always been required in view of natural conditions: the helplessness of the child, the political need and the continuity of civilization. In this logic, teachers must know more than children themselves, since they are someone who already knows what society is, how it works and is structured. Thus, tradition legitimizes authority, since elders are closer to the past. Children, orphans of a past, are unable to take a leading role in something they do not know and need to recognize that learning becomes a strategic tool in our society, demanding from individuals the ability to be permanently competent trainees/learners.

Arendt considers that

The crisis of authority in education is most closely connected with the crisis of tradition, that is with the crisis in our attitude toward the

realm of the past. This aspect of the modern crisis is especially hard for the educator to bear, because it is his task to mediate between the old and the new, so that his very profession requires of him an extraordinary respect for the past. (1992, pp. 243-244).

Sennett relates authority to certain qualities such as self-control, security (not intransigence), superior capacity for judgment, resourcefulness, example, and affection. Someone who has authority is "someone who has strength and uses it to guide others through disciplining them, changing their way of acting by reference to a higher standard" (2001 p. 30). We are born biological, fragile and totally dependent. In early childhood, we may be among the most vulnerable species of mammals, and when left to our fate, we tend to die. Thus, for Hannah Arendt (2010), education assumes the responsibility of preventing the new being from becoming a harm to society. Collective responsibility for the world is the role of the educational processes, and education has the task of making children co-responsible for the society that has welcomed them. Rousseau expressed this thought when he said: "We are born weak, we need strength; helpless, we need aid; foolish, we need reason. All that we lack at birth, all that we need when we come to man's estate, is the gift of education" (1979, p. 11).

Kant (1999) suggests that who has no culture is a brute and who has no education is a savage. Kant saw, in the conquest of majority by the student, the primary purpose of the educational process. Hence, education would handle the demand of conscious individuals for their autonomy and freedom before the omnipresent State, capable of conducting their destiny. In this understanding, school is not the only legitimate and socially recognized means of building learning and knowledge.

Assmann, in turn, highlights the adoption of culture as something inherent to human beings: "We are born awkward, extremely poor and premature in many respects. As such, we can only survive because our corporeality is already genetically impregnated with extraordinary adaptive capacities that, to a good extent, imply the learning of behavioral rules" (2000, p. 144).

Autonomy and responsibility are values acquired from the educational processes and are consolidated over time; they may even dispense the submission to an educator. Something that resembles what Rousseau describes as an imaginary pupil: "I have therefore decided to take an imaginary pupil, to assume on my own part the age, health, knowledge, and talents required for the work

of his education, to guide him from birth to manhood, when he needs no guide but himself" (1979, p. 17).

Having established these theoretical principles, educating with authority also requires opposing. To this end, it is necessary, in order to not confuse and weaken the authority of parents and educators, to give the correct understanding of the conception that a child bears the same fundamental rights as an adult. Educational processes have the function of interdicting individual or private purposes that may affect the community life. Arendt (2007) argues that authority implies a respect for which a new human being in formation needs to know, from those who know, the directions to be followed. In the same direction, Freire (1993) points out that *teaching* should not mean, in any way, that the teacher should venture to teach without the competence to do so. It does not authorize him to teach what he does not know. The teacher's ethical, political and professional responsibility places on him the duty to prepare himself, to capacitate himself, to train himself even before beginning his teaching activity.

Arendt differentiates authority from other relationships among individuals which imply obedience, such as force and violence. A relationship mediated by violence engenders obedience, but an obedience that comes from fear and not from respect and duty. The legitimacy of authority lies in non-violence and persuasion.

The authoritarian relation between the one who commands and the one who obeys rests neither on common reason nor on the power of the one who commands; what they have in common is the hierarchy itself, whose rightness and legitimacy both recognize and where both have their predetermined stable place (2007, p. 129).

It is possible to identify, in all social, political and economic spheres, authoritarian postures that prevail to the detriment of authority. Sennett (2001) states that in authoritarianism the focus is on repression, without necessarily having a commitment to something productive or aggregating.

Kant calls it *enlightenment* the emancipatory force and the creative capacity of humans:

Enlightenment is man's emergence from his self-imposed nonage. Nonage is the inability to use one's own understanding without another's guidance. This nonage is self-imposed if its cause lies not in lack of understanding but in indecision and lack of courage to use one's own mind without another's guidance (2005, p. 63).

Authority comes from the social role and mastery of knowledge that the teacher possesses. In this understanding, the teacher's authority is reaffirmed by the student when he accepts it and sees him as an authority figure. A priori, the school institution has in its structure principles and values given by the educational system (laws, decrees and regulations) which, within them, also reinforce the teacher's authority. The hierarchical position occupied by the teacher in relation to the student should therefore occur because of his competence and commitment and not as a means of protecting himself from possible threats that the students might represent to his teaching activities. In any case, promoting public education universally and for free is the nation's duty.

2.1 Relativized authority: the ephemeral and the new

The decline of authority can also be understood as a disbelief that accompanies the overvaluation of the new and the disposability. The isolation of people and the relativization of values and references generate what Bauman calls the liquid world:

The solidity of things, as well as the solidity of human bonds, is seen as a threat: any oath of allegiance, any long-term commitment (and even more for an indefinite period of time) foreshadows a future full of obligations that limit the freedom of movement and the ability to perceive new opportunities (as yet unknown) as soon as they (inevitably) present themselves (2010, p. 40).

The fluid and unstable relationships, within the capitalist logic, make stability and solidity impossible. We are constantly witnessing the breakdown of the hierarchy of knowledge manifested predominantly by the symmetry in relationships, that is, everyone has equal places, without distinction between the roles played. The child, the adolescent and the young person who enters the school place themselves in a process of equalization, based on natural and cultural principles and attributes.

Equality is required on the basis of conventions, declarations, and constitutions that, within them, seek to preserve and protect the most vulnerable. The legal apparatus, created to regulate human life, however, disregards the diversity of interests and specific living conditions of individuals within society. By making every human being similar or equal (as determined by the UN

Convention in 1989),¹ prerogatives previously reserved for the adult world, such as freedom and equality, have been extended to the child world.

The consequence of freedom of opinion and expression surreptitiously impacts on the asymmetry of roles played by parents and teachers on children. The Universal Declaration of the Rights of the Child recognizes children as holders of fundamental rights (freedom of opinion, expression, thought, conscience, religion, association, peaceful assembly, and privacy).

When the law enforcement does not recognize the different roles in the evolutionary line of education, it weakens the authority exercised by parents and educators over children.

Inger Enkvist, a former advisor to the Swedish Ministry of Education, in an interview with the newspaper El País (in 2019), argues for the need to restore discipline and authority of teachers in the classroom. "*Children have to develop systematic work habits and for that they need the guidance of an adult. Learning requires effort and when the students are let to choose, it just doesn't happen*" (MENÁRGUEZ, 2019). The educator recognizes the need to draw a line, today diffuse and diluted, that separates adults and children in the public and private spheres of life.

Adults, and especially educators, are presumably the caretakers of knowledge and tradition. The ephemeral denies tradition. Renouncing tradition, however, means to omit the advances and setbacks of the past. Tradition, for Arendt, is what legitimizes elders' knowledge and authority. The negation of the past is the reason for the crisis in education, according to which the educational process consists in replacing, as far as possible, learning by doing. The loss of tradition, in turn, "[...] has meant losing the one that serves as a support, that selects and appoints, that transmits and preserves, that indicates the directions to be followed" (2007, p. 232).

The logic of assigning caretakers of tradition and knowledge is seriously impacted by teachers' initial training and the fluidity of the new. The growth of distance teacher training courses in countries where there is no tradition of reading or writing is a slippery slope into learning. The precariousness of the teacher training, combined with the increase of educational books and manuals that are seen as capable of handling education, impacts on children's behaviour. In the absence of face-to-face relationships, behaviour and rules are established by

virtuality. The prison to which Internet users are subjected constitutes an escape from the outside world as a whole to the inner subjectivity of the individual.

For young people, the main attraction of the virtual world derives from the absence of contradictions and contrasting goals that infest the offline life. The online world, contrary to its offline alternative, makes it possible to think of the infinite multiplication of contacts as something plausible and feasible. This is due to the weakening of the bonds in sharp contrast to the offline world, oriented towards the constant attempt to strengthen the bonds, greatly limiting the number of contacts and the deepening of each one of them (BAUMAN, 2010, p. 67).

The mass and information society has created a concept of equality. It has generated a psychological characteristic according to which everyone knows everything. In this sense, in order to confront individuals influenced by the consumer society it is necessary to empower the educational action. The conquest of this empowerment involves an acquis of specific, interdisciplinary, and pedagogical knowledge of the teacher. Moreover, teaching requires the appropriation of ethical, linguistic, aesthetic and political values derived from the solid scientific and cultural formation of the teacher.

The interhuman bonds, which used to weave a safety net worthy of a broad and continuous investment of time and effort, and were worth the sacrifice of immediate individual interests (or of what could be seen as being in the interest of the individual), become increasingly fragile and admittedly temporary. The exposure of individuals to the whims of the labor and commodity market inspires and promotes division rather than unity. It encourages competitive attitudes, at the same time as downgrades collaboration and teamwork to the condition of temporary stratagems that need to be suspended or completed when their benefits are exhausted. "Society" is increasingly seen and treated as a "network" rather than a "structure", it is seen as a matrix of random connections and disconnections and of an essentially infinite amount of possible disruptions (BAUMAN, 2007, p. 8)

However, observing the contemporary *societal* transformations, as relations become distant and virtual,

¹ Defended with more intensity from the French Revolution, with its trilogy: Freedom, Equality and Fraternity.

individuals are left in an ontological uncertainty, originating from the awareness of the absence of centers of privileged languages or discourses considered elevated. The ephemeral relationship establishes a systemic and dispassionate loneliness of introspection between "life and science". Pragmatism and social and cultural immediacy, averse to all forms of reflection, are certainly at the root of cultural massification and of the impoverishment of critical consciousness that characterizes the current social context.

In this context, we are witnessing the dethronement of the school culture and the teacher's authority. The problem is different from individual postures and becomes systemic and structural when it extends to the whole professional category. More recently, teaching prerogatives and powers, either deliberately or inadvertently, are exercised by new teachers of truth. Roles delegated to the mass media, informers, religionists, moralists, preachers, analysts, ideologists, cultural animators, and circus. Moreover, in a society where institutions are being dismantled (family, public institutions, community and work), the school assumes prerogatives that are presumably not within its competence².

The moment calls for incisive and continuous public policies for the revision of the current licentiate degrees and continued education programs for professionals who already practice the teaching profession. Moreover, there is a need to focus on educational policies, presently pressured by the productive and financial circuits that counteract the flexibilization of educational institutions to offer a lighter education. It is not possible to speak of teaching qualifications and formation of knowledge authorities in the midst of the mercantilization of education which, on the pretext of the "democratization

of education", offers distance learning courses, which are the greater expression of the precariousness of education.

Education as a commodity, moved by owners of educational complexes, is no longer an elementary right. The exacerbation of the individualism and the absence of a hierarchy based on the authority of knowledge have thus caused a crisis of human subjectivity. Moreover, there is no dialogue among universities, nor within them. They constitute an aggregate of nations that live sovereignly: the nation of arts, social sciences, biological sciences, medical sciences, agricultural, exact and technological sciences. Each university compartment respects the authority of its knowledge, but ignores or even denies the authority of the other.

Hannah Arendt (2007) maintains that everything that happens is a response to a summons. According to her, when one love is erased, another one is imposed. This principle is the great question: At a time when education is vacillating with old certainties and does not know how to adopt new loyalties, do younger generations not seek other affiliations?

2.2 The absence of knowledge as a generator of indiscipline and breach of authority

In the school context, authority primarily derives from the relationship of trust established between student and teacher. Trust is established by the asymmetry of knowledge and by the respect for the learner. In this perspective, Sennett (2001) argues that the recognition of authority passes through complex factors, which need to be built up daily in relationships. In this understanding, the teacher no longer has authority simply because he is a teacher, but because he has attitudes and behaviours which make his students perceive a moral asymmetry in him, an ability to be an example and an ethical attitude in line with his moral discourses.

In educational institutions, the supposed authority cannot be required by the evaluation process. The responsibility to evaluate and determine who has or has not learned is the school prerogative, according to the specific legislation. The almost immediate consequence of this exclusivity is the blaming and accountability of the student for success or failure. The speed with which the school evaluates the student cognitively and morally is questionable. Parents, in many situations, even more enlightened in the Kantian sense than the masters themselves, feel unauthorized to interfere in the teaching and learning process by those who arrogate to themselves the power of specialists.

By occupying a position of authority in the evaluation, it is assumed that this is a relationship of trust

² António Nóvoa, PhD in Education from the University of Geneva, acknowledges that the school is currently a fragile and overburdened institution: "Education has taken on many tasks. It is the phenomenon of an overflowing school. Someone needs to do these tasks while no one wants them and the school has to deal with them. But it is one thing to say that they are all school's mission and another to understand that the institution needs to fulfill them while other spheres of society are not strong. When that happens, we will have a sharing that I call the public space of Education. In the public space of Education, the school is not alone. There are other institutions. They also have educational, cultural and scientific responsibilities, among others. We have to trace a path of accountability towards these spheres" (PORTILHO; VICHESSI, 2012, p. 01).

between the educator who knows and the learner who is in the process of learning. How do we respect the authority that uses the evaluation process to neutralise any objection or dissent? Distrust consists in the arbitrariness of those who eventually do not know enough and arrogate to themselves the right to classify and select students as learners or non-learners. Authority becomes inconceivable and absurd, totally devoid of ethical values. The relationship is not based on love and trust, but on an authoritarian position that the evaluator occupies in the relationship with the student.

On the other hand, it is argued that the function of the school is to develop a questioning, critical, citizen behaviour in a democratic society. In the theoretical and practical relationship, inconsistencies in the attitudes of educators are perceived. The paradox created inside the school is that this questioning power is felt as an affront to the teacher's authority.

In fact, authority is, in the first place, an attribute of people. But the authority of people does not have its ultimate foundation in an act of submission and abdication of reason, but in an act of recognition and knowledge: it recognizes that the other is above us in judgment and perspective and that, as a consequence, his judgment precedes, that is, it takes precedence over our own. In addition, authority is not granted, it is acquired, and it must be acquired if it is to be appealed to. It rests on the recognition and, therefore, on an action of the reason itself which, by becoming aware of its own limits, attributes to the other a more correct perspective. This rightly understood sense of authority has nothing to do with blind obedience of command, but with knowledge. There is no doubt that being able to give orders and find obedience is an integral part of authority. But that only comes from the authority one has. Even the anonymous and impersonal authority of the superior, which derives from orders, does not ultimately proceed from those orders, but makes them possible. Its true foundation is, also here, an act of freedom and reason, which grants authority to the superior basically because he has a broader vision or is more consecrated, that is, because he knows better (GADAMER, 2002, p. 419/420).

The loss of authority also derives from the estrangement between old pedagogical practices and the "information society". The imposition of net values, as

described by Bauman, impacts on pedagogical practices and on the teacher/student relationship. How to remain in the classroom for a period of four hours or more, when all technologies are programmed to be exercised for minutes or fraction of seconds?

The profound changes in the organization of society are intensely perceived in economic, social, political, cultural, and philosophical relations. However, possessing information does not mean having knowledge. Transforming information into knowledge is a human process, and not a machine one.

The production of unstructured data does not automatically lead to the creation of information, just as not all information is synonymous with knowledge. All information can be classified, analyzed, studied and processed in any other way in order to generate knowledge. In this sense, both data and information are comparable to raw materials processed into goods by the industry (ASSMANN, 2000, p. 8).

According to Castells, technology is the material basis of this new society:

Technologies assume a prominent role in all social segments, allowing the understanding of the new social structure – network society – and, consequently, of a new economy in which information technology is considered an indispensable tool in the manipulation of information and construction of knowledge by individuals, since the generation, processing and transmission of information become the main source of productivity and power (1999, p. 21).

The great challenge of the school and the teacher – in the new context of the information society – is to develop the reflexive competence that can establish connections with the information in order to transform it into knowledge. The universalization of access to the information has deprived the teacher of the monopoly provider of contents and of the new. Digital natives (students after the Internet) are unaware of the old teaching authority based on the exclusivity of information and knowledge.

The education of the future confronts this universal problem, because there is an increasingly widespread, profound and serious inadequacy between, on the one hand,

disunited, divided, compartmentalised knowledge and, on the other, the increasingly multidisciplinary, transversal, multidimensional, transnational, global, and planetary realities and problems. In this inadequacy the context, the global, the multidimensional and the complex become invisible (MORIN, 2002, p. 36).

At the threshold of the 21st century, the use of the Internet began to have global dimensions, incorporating more attractive elements for reading online and making academic information available on a worldwide network. Theories and conceptions about humanity, science and politics, which demand time, cannot compete with a new computer program, whose functionalities are learned in a short period of time and without the necessity of school. The logic of consumption has entered educational institutions and, like books and equipment, teachers tend to be disposable.

Hypnotized by image and virtuality, a large number of students arrive at school and encounter practices that do not contemplate the technological developments. Although, as Castells argues, the massive use of the Internet also represents exclusion:

Certainly, in the near future, the use of the CMC (community mediated by computers) will expand mainly via educational system and will reach substantial proportions of the population of the industrialized world: it will not only be an exclusive phenomenon of the elites, although it should be less penetrating than the big media. But as it will expand through successive waves, starting with a cultural elite, the use of the practitioners of its first wave will form the communicative habits of the CMC. It will play an increasingly decisive role in shaping the future culture and, progressively, the elites that mold its format will enjoy structural advantages in the emerging society (2000, p. 283).

The academic character of the Internet, in turn, is only partially assimilated by the school. There is a strangeness about its use as a pedagogical tool. The regulation of its use takes space in school debates. Regulations and decrees are produced to inhibit, prohibit or limit the use of electronic media³.

António Nóvoa defends a new way of teaching:

³A typical example is Law No. 14,363 of January 25, 2008, which prohibits the use of mobile phones in state schools in the State of Santa Catarina.

A hundred years ago, societies paid little attention to childhood, to movement, to playing, to communication. They were essentially rural and had an immense rate of illiteracy. This has changed, but we still think Pedagogy as before. We have to start another revolution. It's up to the school to go forward to make the dimensions of knowledge and communication more complex. We need to invent the science of learning – enriched with Neuroscience –, of communication and of learning management (PORTILHO; VICHESSI, 2012, p. 05).

The intensive use of electronic media contributes to maculating the sacralized position historically occupied by the teacher. The relationship deteriorates because of the lack of meaning perceived by younger generations in the didactics used in many schools. Moreover, the teacher's recognition and legitimacy are perceived when he becomes a representative of something that transcends his own relationship with his students. Thus, the crisis in authority also derives from the incoherence between discourse and practice. The transmission of human values such as ethics, respect, love and responsibility is fully effective when taught by example.⁴

In addition to the distance between discourse and practice noted in many professionals, fragmented knowledge and the absence of the universal knowledge generate distrust among students in the process of learning. The multiple and complex human being submitted to a fragmented education diminishes his view of the world, as Morin warns:

Fragmented, compartmentalized, mechanistic, disjunctive and reductionist intelligence breaks up the world complex into disjointed fragments, fractionates problems, separates what is united, makes the multidimensional unidimensional. It is a myopic intelligence that ends up being normally blind. It destroys the embryo of the possibilities of understanding and reflection, reducing the possibilities of corrective judgment or long-term vision (2002, p. 43).

The greater difficulty lies in solving a problem in a global, multidimensional and complex context, acting in a fragmented manner. Divided and scanned knowledge

⁴ The incoherence is extended to the classroom as late arrival, use of cell phones by the teacher in situations where it is forbidden to the student, absence of collegiality or even biological and cultural discrimination exercised on the students.

leads to instrucionism, which means the mere reproduction of information.

This is the first challenge that pedagogy must face, that is, a type of knowledge ready for immediate use and, successively, for immediate elimination, such as that offered by softwares (updated more and more quickly and therefore replaced), which is much more attractive than that proposed by a solid and structured education (BAUMAN, 2007, p. 63).

On the other hand, it has to consider, as Assmann (2000) proposes, the need to reinforce the democratic character of the information society in order to not legitimise the abandonment of those deprived of technologies and, consequently, to allow the creation of a class of info-excluded.

Technologies change behaviours: their trivialization establishes itself on the existing culture and transforms not only the individual behaviour, but that of the whole social group. In this understanding, pedagogy is increasingly instrumentalized in favour of capital. It submits to and assumes the guidelines of the economy, becoming a mere epiphenomenon of it. By dismissing the teacher, who is knowledgeable and authority in his area of knowledge, the education legitimizes the socioeconomic pillars of the contemporary society. The quantification and monetarization of education shifts issues of content and quality of education to a secondary level.

Inger Enkvist, in turn, disagrees with the thought that the student should choose what must be addressed in class.

The new pedagogy promotes anti-schooling. The schools were created with the objective to teach students what society had decided was useful. What is the purpose of the school if the student decides what he wants to do? These currents want to emphasize as much as possible the freedom of the student, when what he needs is a systematic and well-structured teaching, especially if we take into account the distraction problems of children. If one does not learn to be organized and to accept the authority of the teacher in primary education, it is difficult to achieve it later (MENÁRGUEZ, 2019, p. 03).

The educator also challenges the Rousseauian idea that all children want to learn and therefore it is a good option to let them take the initiative and learn on their own. According to her, "the more self-discipline, the more possibilities you have ahead of you and the less desperate you will feel in the face of a limit situation". The

Portuguese writer and educator António Nóvoa defends the return of the legitimacy of the role of the teacher:

My response tends to be brutal. Students don't have to say what they want to learn, what they like and what they don't like. The worst thing to do is to imagine that they decide everything. [...] The Swiss Jean Jacques Rousseau writes that "children should only do what they want". This phrase has served to denigrate the pedagogues because it is misinterpreted. I have read the original version of the book to understand it completely. The passage goes on like this: "But they ought to want only what you teachers want them to want. The child ought not to make a step without you having foreseen it, the child ought not to open his mouth without you knowing what he will say". In other words, it is not a libertarian quote. The teacher must place his authority at the service of the student's freedom. Use it to turn him into an autonomous individual. It is the paradox of Education: to put our authority at the service of the other's freedom (PORTILHO; VICHESSI, 2012, p. 04).

Finally, Hannah Arendt sums up well the dilemma of the crisis of authority that plagues education: "The problem with education in the modern world lies in the fact that, by its very nature, it cannot give up either authority or tradition, and is nevertheless forced to walk in a world that is neither structured by authority nor held together by tradition." (2007, p. 245).

Kant argued that discipline and authority are principles that help to govern human relations: "*When man is allowed to follow his will fully throughout his youth and is not resisted in anything, he retains a certain savagery for life*" (2002, p. 14). The philosopher perceived, in the conquest of majority, the primary purpose of the educational process. Hence, education would meet the demand of conscious individuals for their autonomy and freedom.

However, in the midst of the turmoil of changes coming with post-modernity, a great number of teachers find themselves at a crossroads and in disorder. For this reason, they add individual anxieties born from the uncertainties of their role as educators and fears provoked by the threat of betraying the new.

III. FINAL CONSIDERATIONS

There is no single reason that explains the decline in teacher authority at school. The fact is that there is an urgent need to restore the student's confidence in the teacher. Confidence, as already described in the text, comes deeply from the knowledge of who teaches. From the desired teaching, expected and prepared by the educators. Paulo Freire expresses the prestige necessary to educate in a singular way: "*No one begins to be an educator on a certain Tuesday at 4 in the afternoon. No one is born an educator or selected to be an educator. We become educators, permanently, in practice and in reflection on practice*" (1991, p. 58).

The teaching authority will be guaranteed if there is clarity of the purposes of the interaction – both for teachers and for students – and a clear perception of the roles and responsibilities inherent to each party involved. The path will be the construction of a new relationship in which the teacher will constantly need to look at himself, his weaknesses and potentialities. This look must be from an affective bond and a "link between unequal people", as Sennett asserts (2001, p. 22).

This is a task that involves both institutional and structural planning and the training of professionals who, for the most part, are not prepared enough to be references and authorities in education. It should also be stressed that – often – educators feel the change or absence of traditional values as a crisis. However, there is no absence of values or references, but rather a readjustment and a positivation of some values to the detriment of others. Moreover, teachers affected by the precariousness and crisis of all the institutions of society end up taking on assignments that hide their real task. The teacher's authority assumes a decisive aspect in the social function of the school and in the fight against all forms of indifference and exclusion.

It must be recognized that the initial and continuing training of teachers is only one of the conditions for establishing authority in school education. Teacher authority requires more than the mastery of content. It is exercised within an educational system that must necessarily prioritize public policies to value the school as an institution.

Antônio Nóvoa defends mechanisms for monitoring and improving teaching to assess whether the person is capable of teaching. In his opinion, in order to exist evaluations, teachers must be available for the process. According to the writer and educator, "*it will be very difficult to establish regulatory mechanisms as long as each one assumes that the only boss is the minister of Education or the governor*" (PORTILHO; VICHESSI,

2012, p. 05). The educator fulfills a socially constructed and authorized function in the school universe. It is effectively his role to present the world to the new generations as expressed by Hannah Arendt. New technologies and interaction formats compete with school knowledge. The role of the teacher, in conducting the educational process, requires a mediating character, in addition to the clarity of the principles that govern classroom activities.

Finally, authority must be exercised within a Free State and based on a power of recognition that exists in education, legitimate holders of knowledge not yet universal to everyone.

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Behavior of Outrigger Wall and Wall Belt Supported System under Lateral Loads in a Structure: A Review

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Abstract— Every Structure needs a table to withstand a system of resisting other forces caused by wind or strong earthquakes. One of the best programs is outrigger. Outriggers of structural elements support the formation of lateral loads together. When the complexity of the height of the buildings is increased they become larger as well as the addition of tempting additions to resist systems such as truss consists of belt and outriggers is needed. Utilization of structural regulation adds structural strength by connecting the main building with the remote colony and making the whole body function as a single unit in resistance to the burden. The current review articles deals with the research based on the Outrigger Wall and Wall Belt Supported System by different researchers. The observation includes based on the reviews in that inputs of Outrigger Wall and Wall Belt increase the performance of building in terms of stability, stiffness, strength & cost. It also concluded that this performance are vary with variation is occurs in the location and dimensions parameters such height, depth and plan areas. The research also impact on the system is used as per the guidelines provided.

Keywords— Lateral load, Multistoried building, Outrigger system, Shear wall belt, Stability increment

I. INTRODUCTION

Due to the increasing demand for high-quality and architectural impactful structures and customized roundabouts and roundabouts, different themes, and the increase in height on a daily basis lead to new challenges and the need for new safety systems. In order to withstand earthquakes and strong winds due to the growth of the building, such as the increased instability of the building and the high altitude we need to destroy some protective measures. The slight example consist are bracings, shear-wall, outrigger-system and more. Outrigger Structure Outrigger & Wall belts Since noticing the competition is still taking place in the country. The reason taken under it that when structural load is taken, with vertical and horizontal supports system, obtained a huge amount of combined loads that are generated by the structure and that load must be supported by the structure itself. Since the earthquake produces oscillations from the ground, they are connected to the structure and the most effective way to use it to resist the structure through utilization of these combined system for the use of stabilizers, straps supported by the system, and stabilizing & system consist support strap.

II. OUTRIGGERS

Outriggers are defined as the members who consist of the beams or contact plates from the center to the outside of the posts on both sides that block the structure and operation of the connecting links. The core was provided as a detachable bar holding the entire structure firmly to accommodate loads and moving equal loads out of poles. Greater stiffness is accomplished in this type of structure than conventional frame. An outrigger combines the two elements adding a strong solid that interferes with emergency power. If an outrigger-reinforced building under wind or seismic loads deflection, the outrigger connects the main wall to and away from the posts, a unit to resist lateral loads is act on replaced the full structural system.

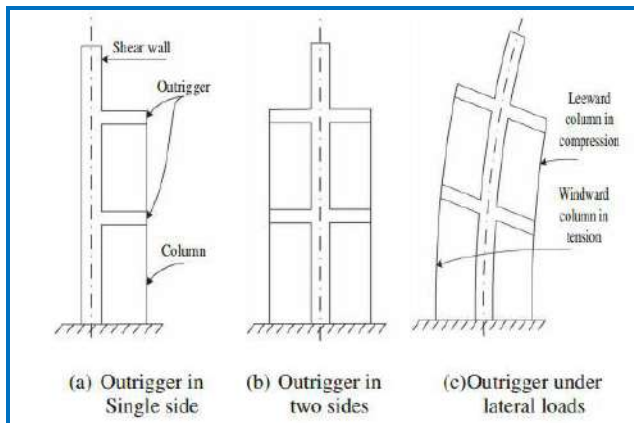


Fig. 1: Concept of Outrigger (a, b) & its effect in Lateral Loads (c)

III. BELT SUPPORTED SYSTEM

The best technique used in huge-story houses is to maintain the body whether it is a bar belt or a truss belt system. It representatives to the structural nodal points & communicate through it. They are termed as belt support systems the reason is the belt is usually made of trusses or bolts, connecting the structure line. The load departs from each member being distributed equally housing. In order to adapt to the force of the wave and to maintain the stability of the structure, the outer straps and straps are used. The Policy is that the outer poles are fitted with the centre of the bar with the braces and straps in one or more positions. The truss straps are attached to the outside pillar of the house while the outside holds them to the main or central vertical wall. The reason behind is this approach due to reduction value is occurs in interference structure with respect to the conventional method.

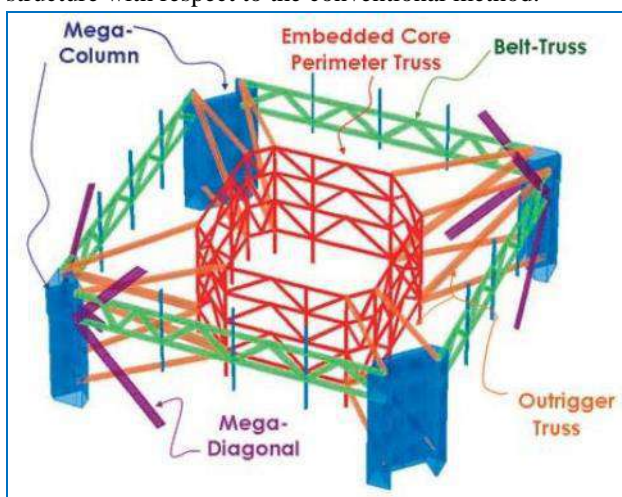


Fig. 2: Typical Concept of Belt Supported System

IV. LITERATURE REVIEW

A review article is an article to gets the current state of a topic and to understand the current demand. A review article examines and shot way to represent past published work based on study, rather than reporting new facts or analyzes. It is termed as survey articles or, in news release, overview articles. For the current project the review of article is based on the Outrigger Wall, Wall Belt and Outrigger structure Subject area so that it is easy grapes the subject knowledge and implementation and future orientated work is carried out with the help of the reviews.

This article discusses the use of the stabilizer system for 30-story high-rise concrete buildings and its comparison with the same building without stabilizer systems. This article emphasizes the exact identification of the status of stabilizers in high-rise buildings. In the second case, the maintenance of the height of the building is the same as that of the normal building, the floor surface is increased by reducing the number of interior posts and without a stabilizer system and stability is checked. The results show the quality of the stabilizers on top and others at 0.5 times the height of the building. With the use of the stabilizer system, the change has been reduced by 26.69% (Nadh V.S., Sumanth B.H. (Feb.-2020))

The research is secondary times impact on the analysis reviews about the outrigger and belt-truss system design for high-rise construction. In this section, by presenting and detailing as much relevant information as possible, a guide is provided for the best fit and size of the outrigger system design. -is a guide that will provide an overview and explanation for applying ideas, concepts, methods, and techniques in reviewing articles for optimal topology and multiple designs. It concluded with a summary of the results of the revised research, understand how useful different limits reinforce the optimal concept of topology and the structural size of a high-rise and circular building. ma fusi-truss system (Alhaddad W., Halabi Y., & et.al. (Feb.-2020))

The articles are based on the study of the design of beam and beam systems for tall buildings. The primary focus is provided on optimal topology and outrigger system size design. The guide will provide an explanation and description of the theories, assumptions, concepts, and methods used in the reviewed articles for optimal topology and size design. The review obtained is useful to understand how different parameters influence the optimal topology and size design of a tall building with truss and truss system. The system meets the initial and final design stages. The codal approach is also adopted by

composing a standard or special code for designing tall buildings (**Alhaddad W., Halabi Y. & et. al.(2020)**)

This article examines the rigid and specific foundation of high-level structures under load. First, a static analysis was performed for four different system structures (such as weather-resistant body, fence, and outrigger body structure (OBF) systems). Under the same static load, the stabilizer reinforcement system was found to provide better control over the high-altitude structure. To obtain these results, a detailed analysis was performed to show how well the immune system was stimulated. Second, detailed analyzes were evaluated to assess the vibration response of a high-rise building. For this reason, the stabilizer system was compared to pendulum-tuned mass dampers (PTMD). The analytical model simulates the supply of the stabilizer decreasing even further by 33% for one and 60% for the solution for the two at the top of the transition. This change in response was confirmed by a detailed solution for the top and middle of the building. The potential reduction rates of the stabilizers received 40% with PTMD and 35% respectively. Based on comparative statistics and solid OBF details, it was found to be a useful addition to the rolling frame (**Salman K., Kim D. & et. al. (2020)**)

The study examines the concept of outdoor storage and considers the layout of the soils. For this reason, a central pull-wall belt of a high-rise steel building is considered. The storage of clay soil under this framework and what is happening to the soil - is subject to soil stimulation. When studying this system, the correct methods are used in Open Sees. In addition, an analysis of an action and decision is made between these decisions and the decisions associated with the system and the policy. Optimised location of outrigger-strap truss system is based on the consideration of the top roof substitute, time base and partition structure and with no interaction of ground-structure. The outputs showed that SSI infection affects the location of the outside of the seat-belts. A detailed analysis of all the data, such as the structural and structural correlation of the soils, showed that the availability of the bond at high altitudes resulted in a lower roof thickness. (**Tavakoli R., Kamgar R. (Feb.-2019)**)

The researcher's patel & jamle worked on outrigger system is made for details because of the fact that the best system is available for high-rise buildings and on the skies. In this system, the outer lines are connected to the main inward or outward path by strong loads on different floors against the shock and moderate action of the main parent should be seismic and windy. In this paper various papers presenting this subject are reviewed to perform a

great deal of work done in this first field. On reviewed the research, it comes about the proven result that drives the development of our research. It also faces the multi-story building to do details for the 13 floors. A total of 13 cases are shown in twin towers with different floor sizes and the best conditions are notoriously resistant to movement. The tower is being considered for zone 4 against dirt roads. Studies have been completed against different segments of seismic, there is an increase in the pit & it is on the roof. Preliminary results of more than one case and the various cases are recommended with the help of statistical data and analysis Staad-pro. The main component of the welding plate is a flexible part of the welding wall, its width and thickness (**Patel N. & Jamle S.(Aug.-2019)**)

Researchers are testing the Ground with ten Storey, 3-dimensional modeled under the influence of earthquakes. Site outrigger based on Taranath method. Response methods have been used for monitoring the performance of seven-stage configurations including conventional, core welds, outrigger and wall belts and outrigger and truss belt support systems. The Base velocity, axial column strengths and members of the axial velocity were studied. Very good chapters for all the topics discussed in this article as well. The results of the Base Shear show that the response is more important than the general structure which seems to be very useful under the normal wave of the normal structure and the main separation. Shear Core outrigger and wall support systems show significant correlation between all time-resistant cases. Underneath the powerhouse shows a great deal when only Shear Core applications will be used. both concepts are useful in separating forces for both Y and Z sides in agents. The regulation of the agents saw good and good sanctity for the construction in the lower partition and the fence. Summary parameter management issues in both Shear Core outrigger and bar support systems. The latter as a Wall strap Wall is more useful than system truss straps (**Dangi A. & Jamle S. (Sept.-2018)**)

The work involves outdoor frames and fence posts that are widely used to reduce drift. Three-dimensional models for the G + 45 concrete structure are being developed and the results are detailed for themselves. For the conflict of zones specific to zone 2 and the method described in IS: 1893 (part1) -2002. Therefore the analysis of wind load can be taken from IS: 875 (section 3) -1987 Finally, a comparison of the periodic studies on the energy generated and used the system "ETABSv.16". Regulation of changes such as back-to-back, treadmill baths, time connection and optimum condition are

associated with outrigger and brake pads (**Mathew M., (June-2017)**)

A list of articles being made for the study of the improvement of spinal cord and their behaviour towards emergency loads. While vertical walls resist large areas of lateral load on the basement of the building and lateral load supported framed on the building consist upper part which is suitable for weak high-rise buildings, buildings are similar in nature built in India, as per India habituation concept floors are utilised as a parking and garages or offices and the upper floors places. This result of the G + 10 structural velocity project reduces the importance of von-misses reinforcement and structural changes in site 1 compared to site 2. Similarly the result is in G + 20 wall-to-wall structures have less significant fracture sites in site 2 compared to site 1. The end of the G + 26 floor structure was concluded to reduce the importance of von-misses sites and less inconvenience to the structure in place 1 compared to place 2 (**Soni P., Tamrakar P.L. & et. al.(Feb.-2016)**)

Examination of texture notes in this paper on various aspects of regulatory structures such as; Status of outrigger configuration in high-rise RC housing, Outrigger model behaviour in High-Rise Steel and integrated housing, outrigger model behaviour in rotating wheel structure and Impact of seismic on structural design (**Gadkari -P. , Gore-G. (2016)**)

The researchers of this paper summarize in detail the Outriggers integration and the current practice of integrating Outriggers into high-rise buildings. Back to this various issues related to the Outriggers have also been discussed. Detailed descriptions of the articles available in the field of Outrigger system are in place and the summaries and opportunities encountered in the study are listed in this document. A new Virtual Outrigger concept is introduced in this paper. It is utilise for the the seat belt in the house for increment in the performance of the house under the load force being studied. Emphasizes the greater benefits of hiring Virtual Outriggers than usual. It is also shown in the affected paper ideas under the Virtual Outrigger (**N.K., Gore N.G (June-2016)**)

An attempt is being made to investigate the inconsistency and behavior of the regulatory environment on by reduction in the depth of the exit & to provide steel structure. The steel and central structures and the steel structure and the layout of the foundations vary in the depth of the exterior. The reduction in the depth of the outrigger is taken as 2/3 and 1/3 of the maximum height with the full maximum height. Equivalent depth is taken for both belt-truss & a normal story and remained the same throughout the day. Key terms include accidental

mixing and slipping. From the analysis of the results obtained, the comparison of the outrigger movements with the upper floor depth and the depth reduction reveals a significant difference under load. (**Shah Kogilgeri S., Shanthapriya B. (July-2015)**)

This work is based on the effects of hurricanes and the evacuations of people outside of the 28, G+42and G+57 are being studied. There are some decisions have been made that will prohibit the opportunity to worked on upcoming area for the researchers. The civil engineer. The results of the demonstrations have significant implications for the higher structures. The increase is high but the same strategy is in place to reduce the complexity. To meet the maximum tensile need bracings are added and also the addition of additional resistance resistors for example truss straps & outriggers is required (**Fawzia S., Nasir A. & et. al. (2011)**)

This study is needed to identify the best location outside of high-rise influence of seismic conditions.. The storey consist 50 floors buildings surveyed and the levels having a highest peak in 3 levels of ground acceleration on the velocity of the points in each segment of the earthquake data were combined to provide a similar level of roadmap. The analysis of the response and behaviour of the building was considered with regard to the legalization of responses such as relocation and safety on the premises. This study showed that the standard deviation of the setting when the external level is 22-24 is higher. Thus it can be concluded that the optimal location are obtained in the range of 0.44-0.48 times its maximum location (**Herath N., Haritos N. & et. al. (2009)**)

The results of the researchers Bayati Z., M. Mahdikhani is on decrement in tension in the ligament with strong stimulants, by the analytical approach adopted for structural model built in Tehran Vanan Park. The results show that proper use of the multi-outriggers system can reduce home volatility. Other than this the outcomes consist of that the structure which having the multi-outriggers system reduced the elements and bases from the structure (**Bayati Z., M. Mahdikhani & et.al.(Oct.-2008)**)

V. CONCLUSIONS

Based on the different researchers study on Outrigger Wall and Wall Belt Supported System the following conclusions are to be made. The points out conclusions are as follows:

1. The belt truss & outrigger system most accepted method for withstanding under lateral loads.

2. The maximum research is based on the optimum height, shear wall location and height, variations in outrigger depth etc.
3. The main aim of the researchers is to increase the stability of the building used, hence increment is observed by different researchers.
4. The structural form used by the Outrigger System for High-Rise, Composite Structure, Multi-Outriggers System, Unsymmetrical Tall Buildings, Steel Structure & braced frame system by different analysis. The bracing & Outriggers System is more priority in it and reduces the effect of lateral loads.
5. The checks made by different researches are seismic performance, impact in the cyclonic region, guideline adopted under for optimum topology concept and design consideration under sizes.
6. Under the behavior of the soil-structure interaction, the systems consist fixed base, location consist of the belt truss at the higher stories imparts the lesser amounts displacement.
7. Difficult connection due to the core is removed & with outrigger system, the structural materials can be applied effectively by utilizing the axial strength and stiffness of exterior columns.
8. The systems minimize hindered space compared to the traditional method. The floor space does not contain any columns and remains among the core and the external columns; consequently, increment in the functional efficiency of the building occurs.

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The correct choice among welding wires ER70S-2, ER70S-3 and ER70S-6, according to the oxidation level of base metal

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Abstract— According to AWS 5.18, the all weld metals produced with filler metals ER70S-2, ER70S-3 and ER70S-6 through GTAW should present the same minimum values in tensile tests, as follows, minimum yield strength 400 MPa, minimum tensile strength 480 MPa and minimum elongation 22%. The impact test requirements to the all weld metals produced with filler metals ER70S-2, ER70S-3 and ER70S-6 should present 27 J as the minimum average impact strength at -29 °C to ER70S-2 and ER70S-6, and at -18 °C to ER70S-3. Although the mechanical properties of the all weld metals produced using these three welding electrodes are quite similar, their chemical compositions are different specially in the contents of deoxidizing elements like Zr, Al, Ti, Si and Mn. The contents of deoxidizing elements are lower in ER70S-3, intermediate in ER70S-6 and higher in ER70S-2. Electrodes and rods of the ER70S-2 classification are primarily used for single-pass welding of killed, semi-killed, and rimmed steels, but may be used for some multipass applications. Due to the added deoxidants Zr, Al and Ti in the chemical composition of ER70S-2, this filler metal can be used for welding steels that have a rusty or dirty surface, with a possible sacrifice of weld quality depending on the condition of the surface. A detailed study to compare the performance of filler metals ER70S-2, ER70S-3 and ER70S-6 was conducted through GTAW bead on plate coupons using the three different electrodes on bright polished and rusty plates. The performance of the electrodes was studied through GTAW groove test weld assembly with and without purging gas. The results showed that, although ER70S-2 presented the best performance among the three welding wires tested in bead on plate in rusty plates, welding groove joints without purging gas using this welding electrode is practically unviable though GTAW. Fluid flow in the weld pool determines GTAW weld pool shape. The force driving the fluid flow is surface tension gradient. This is called Marangoni convection. Due to the higher contents of deoxidants in the chemical composition of ER70S-2, the weld pool produced using this filler wire is strongly deoxidized and the result is that when the area under the arc is heated up, the surface tension drops in the center of the weld pool and the direction of the fluid flow is from the center towards the edges of the pool. The results suggest that the change in the fluid movement due to deoxidation of the weld pool, causes slag to be trapped between base metal and weld pool.

Keywords— ER70S-2; ER70S-3; ER70S-6, Slag formation, Marangoni effect.

I. INTRODUCTION

The Ellingham diagram is used to predict the equilibrium temperature between a metal, its oxide, and oxygen, and by extension, reactions of a metal with sulfur, nitrogen, and other non-metals. The analysis is thermodynamic in

nature and ignores reaction kinetics. Thus, processes that are predicted to be favorable by the Ellingham diagram can still be slow. Figure 1 shows the Ellingham diagram for oxide formation. It is observed that aluminum is oxidized preferentially to titanium, silicon, manganese and iron due to the fact that Gibbs free energy of alumina

formation (Al_2O_3) is more negative than Gibbs free energy of rutile formation (TiO_2), silica formation

(SiO_2), manganese (II) oxide (MnO) and iron oxides (FeO , Fe_3O_4 and Fe_2O_3).[1-7]

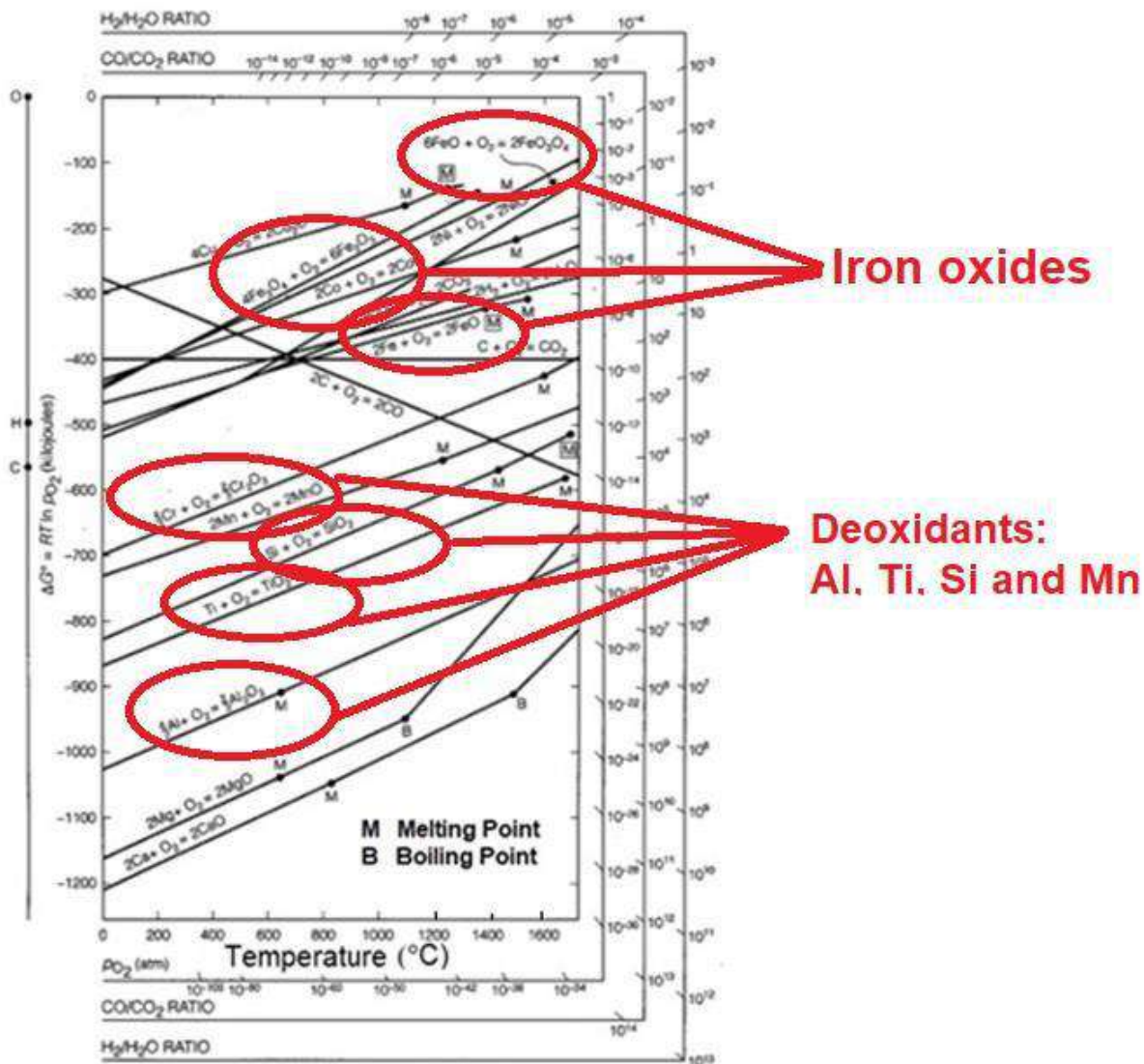


Fig.1: Ellingham diagram of oxides formation. [1,7]

Figure 2 presents the standard free Gibbs Energy (ΔG°) of the reactions for the formation of oxides, sulfides, nitrides and carbides at 1723 K. It is important to observe that

zirconium presents higher affinity with oxygen, sulfur, nitrides and carbides when compared to the other deoxidants aluminum, titanium, silicon and manganese.

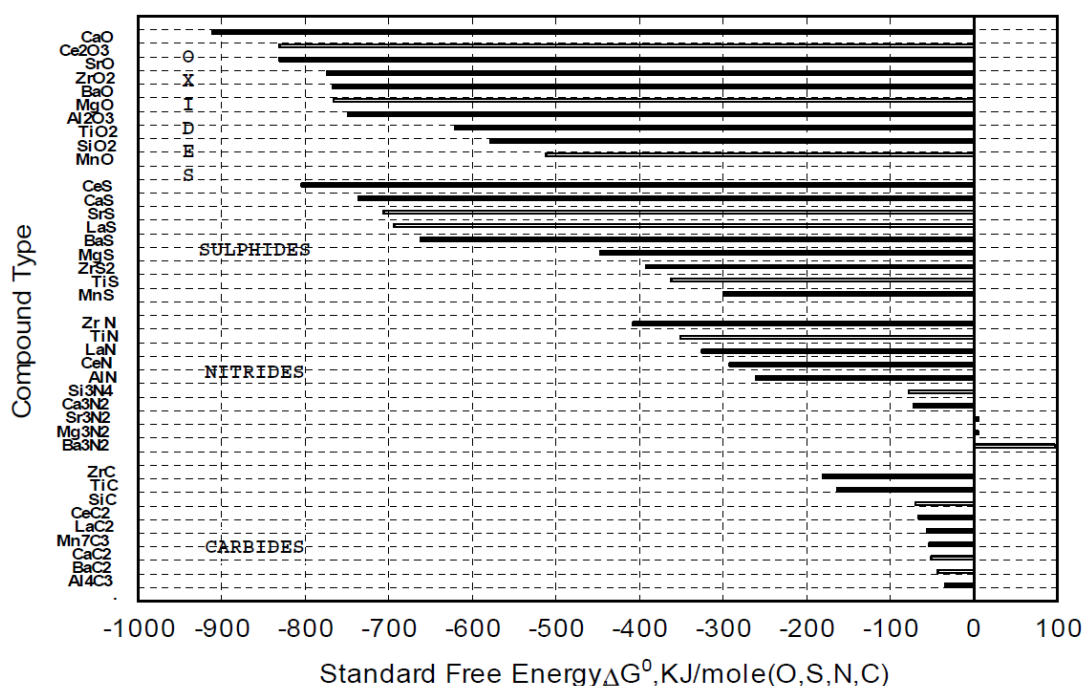


Fig.2: Standard free Gibbs Energy (ΔG°) of the reactions for the formation of oxides, sulfides, nitrides and carbides at 1723 K. [8]

Although the mechanical properties of the all weld metals produced using ER70S-2, ER70S-3 and ER70S-6 welding electrodes are quite similar, their chemical compositions are different specially in the contents of deoxidant elements like Zr, Al, Ti, Si and Mn. The contents of deoxidizing elements are lower in ER70S-3, intermediate in ER70S-6 and higher in ER70S-2.

This information suggests that all weld metals produced using ER70S-2 tends to present lower oxygen contents than those produced using ER70S-6 and ER70S-3, respectively, when welding base metals with similar oxygen concentrations.

In this context, a deeply understanding of the Marangoni effect, looks to be very important to do the correct choice among welding wires ER70S-2, ER70S-3 and ER70S-6, according to the oxidation level of base metal.

The Marangoni effect is the mass transfer along an interface between two fluids due to the surface tension gradient. In the case of temperature dependence this phenomenon may be called thermo-capillary convection.[9-12]

Since a liquid with a high surface tension pulls more strongly on the surrounding liquid than one with a low

surface tension, the presence of a gradient in surface tension will naturally cause the liquid to flow away from regions of low surface tension. The surface tension gradient can be caused by concentration gradient or by a temperature gradient when surface tension is a function of temperature.[9-12]

Fluid flow in the weld pool determines GTAW weld pool shape and the force driving the fluid flow is surface tension gradient. This is called Marangoni convection.

Pure metals (and low sulfur materials) have a negative temperature coefficient of surface tension. When the area under the arc is heated up, the surface tension drops in the center of the weld pool and the direction of the fluid flow is from the center towards the edges of the pool. [9-12]

When sulfur, oxygen, selenium, or other surface-active elements are introduced to the weld pool at very low levels they cause the surface tension to rise with an increase in temperature. In this case, the direction of fluid flow is from the outside of the pool, where the surface tension is lower, towards the center, thus increasing penetration. [9-13]

Figure 3 presents the effect of variation of surface tension with temperature when there is presence of “surface active” elements in the weld pool.

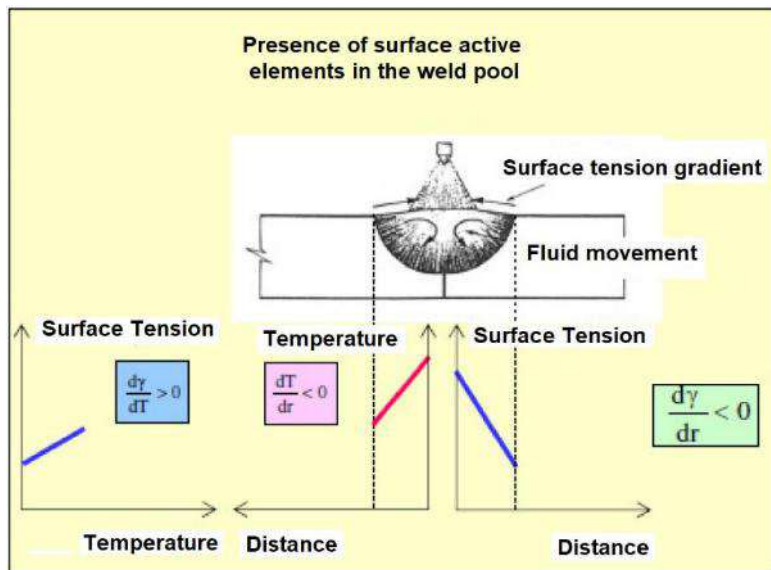


Fig.3: Effect of variation of surface tension with temperature when there is presence of “surface active” elements in the weld pool. [9]

Figure 4 presents the effect of variation of surface tension with temperature when there is absence of “surface active” elements in the weld pool.

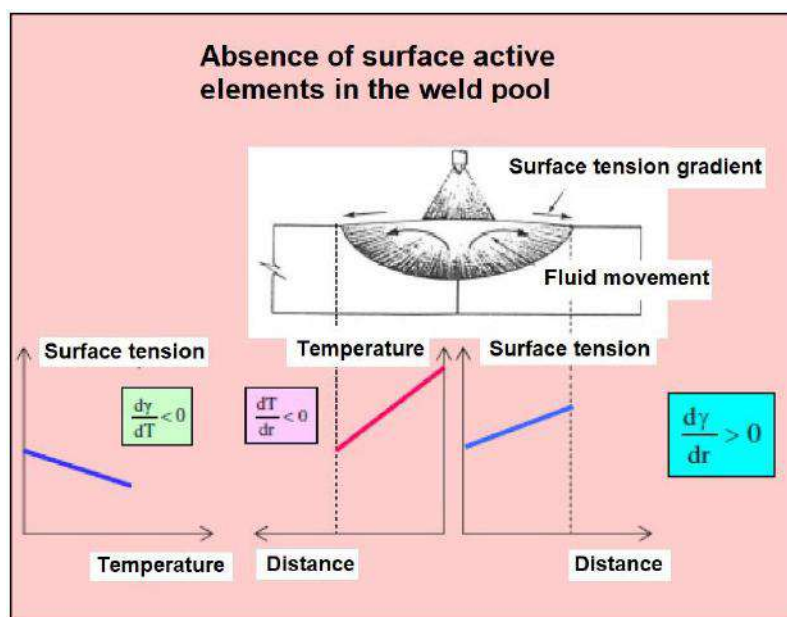


Fig.4: Effect of variation of surface tension with temperature when there is absence of “surface active” elements in the weld pool. [9]

Among the “surface active elements”, oxygen can be added or reduced into the weld metal during welding. Alloying elements like silicon and manganese, which are present in the base metal and the wire, have a high affinity to react

with oxygen and form silicon oxide and manganese oxide. These oxides accumulate on the surface of the weld pool and form slag. As these slags float on the weld pool surface, the weld pool flow pattern can govern the slag

formation location. Besides, the slag formation location can also give an indication of the weld pool flow pattern. The slags have an adverse effect on the weld quality.[12, 13]

II. EXPERIMENTAL

A detailed study to compare the performance of filler metals ER70S-2, ER70S-3 and ER70S-6, all 2.4 mm

diameter, was conducted through GTAW bead on plate coupons using the three different electrodes on bright polished and rusty plates of ASTM A36 150 X 50 X 8 mm.

All the “bead on plate” samples were welded using 99.99% Ar as the shielding gas, 160 A, 14 V and travel speed of 80 mm/minute.

To accelerate rust formation, 3 plates were wet and left at the sun for 8 h in air.



Fig.5: Bright polished and rusty plates of ASTM A36 150 X 50 X 8 mm

The performance of the electrodes was then studied through GTAW groove test weld assembly to allow welding of the root pass with and without purging gas. The plates are of ASTM A36 250 X 50 X 8 mm and the V groove is 60°.



Fig.6: GTAW groove test weld assembly to allow welding with and without purging gas.

The purging gas, when used, was 99.99% Ar. All the “groove test” samples were welded using 99.99% Ar as the shielding gas, 115 A, 11 V and travel speed of 40 mm/minute.

Chemical analyzes were carried out in all samples by means of an optical emission spectrometer, according to ASTM E 1086-08. [14]

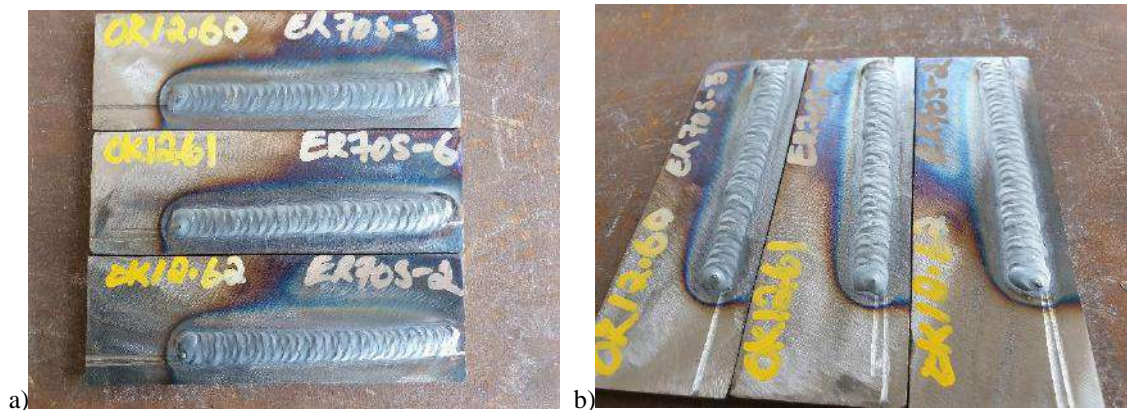
Afterwards, the conventional manual polishing was applied using water slicks (100, 240, 320, 400, 600 and 1000

mesh) in order to standardize the surface finish of the samples. Afterwards, a cloth polishing with 9, 3 and 1 μm diamond abrasive paste was carried out in this sequence. The etching solution used was Nital.

III. RESULTS AND DISCUSSION

Figures 7 presents the bead on plate coupons using the three different electrodes on bright polished and rusty plates of ASTM A36 150 X 50 X 8 mm.

Bead on plate (Bright)



Bead on plate (Rusty)

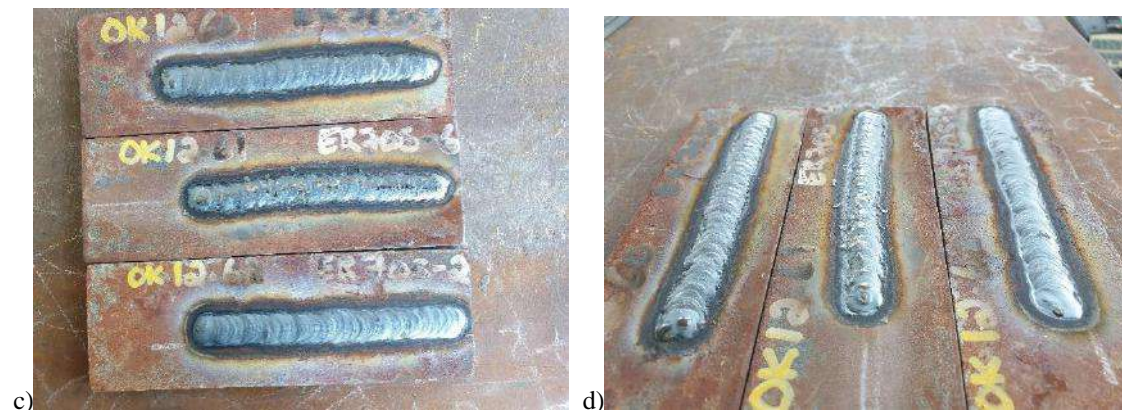


Fig.7: Bead on plate coupons using the three different electrodes on bright polished (a and b) and rusty plates (c and d) of ASTM A36 150 X 50 X 8 mm

The bead on plate tests showed very interesting results. For the bright plates there was almost no slag formation, although, for the rusty plates there was slag formation for the three different electrodes.

In the case of the bright plates, all the three filler metals presented similar good weldability.

Nonetheless, it is important to emphasize that in the case of rusty plates, the three filler metals presented different performances. The ER70S-3 presented bad weldability once a thin layer of slag was formed on the surface of the bead, and some porosity appeared on the surface, as well.

The ER70S-6 presented better weldability than that observed to the ER70S-3, and the slag tended to concentrate on the top of the bead and there was no apparent porosity. The ER70S-2 presented very good weldability and the slag tended to concentrate in the fusion line with the base metal. The bead showed very good wettability and low penetration.

Figure 8 shows the macrographs of the sections of the “bead on plate” coupons produced with filler metals ER70S-2, ER70S-3 and ER70S-6 on the rusty plates.

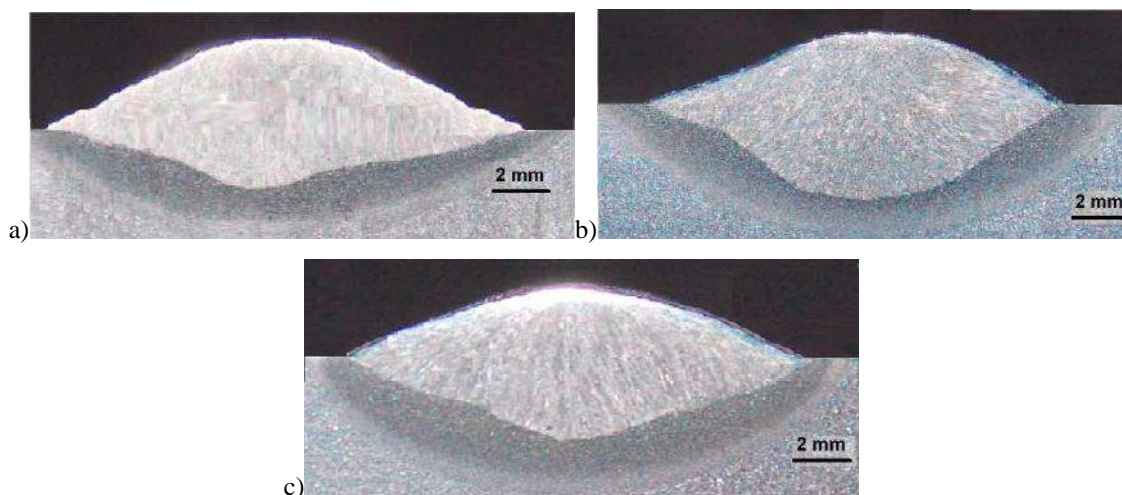


Fig.8: Macrographs of the sections of the “bead on plate” coupons produced with filler metals

a) ER70S-2, b) ER70S-3 and c) ER70S-6.

The higher content of deoxidants on the chemical composition of ER70S-2 leads to a lower content of oxygen in the welding pool, resulting in lower penetration and wider bead. The lower content of deoxidants on the chemical composition of ER70S-3 leads to a higher content of oxygen in the welding pool, and consequently, higher penetration and narrower bead.

Figure 9 presents a model to explain the increasing of penetration and decreasing of the bead width as a function of the oxygen content of the weld pool in “bead on plate” deposits through GTAW, according to the content of oxygen in the welding pools.

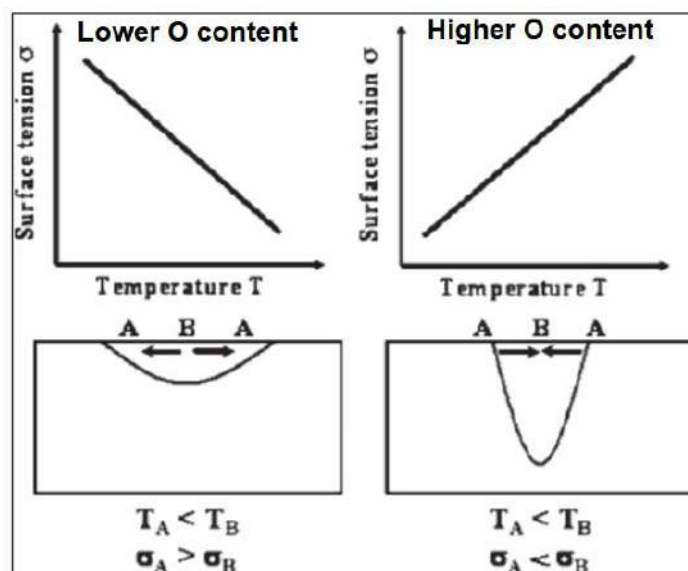


Fig.9: Model suggesting the increasing of penetration and decreasing of the bead width as a function of the oxygen content of the welding pool in “bead on plate” deposit through GTAW.

Figure 10 presents the groove test coupons welded with and without purging gas.

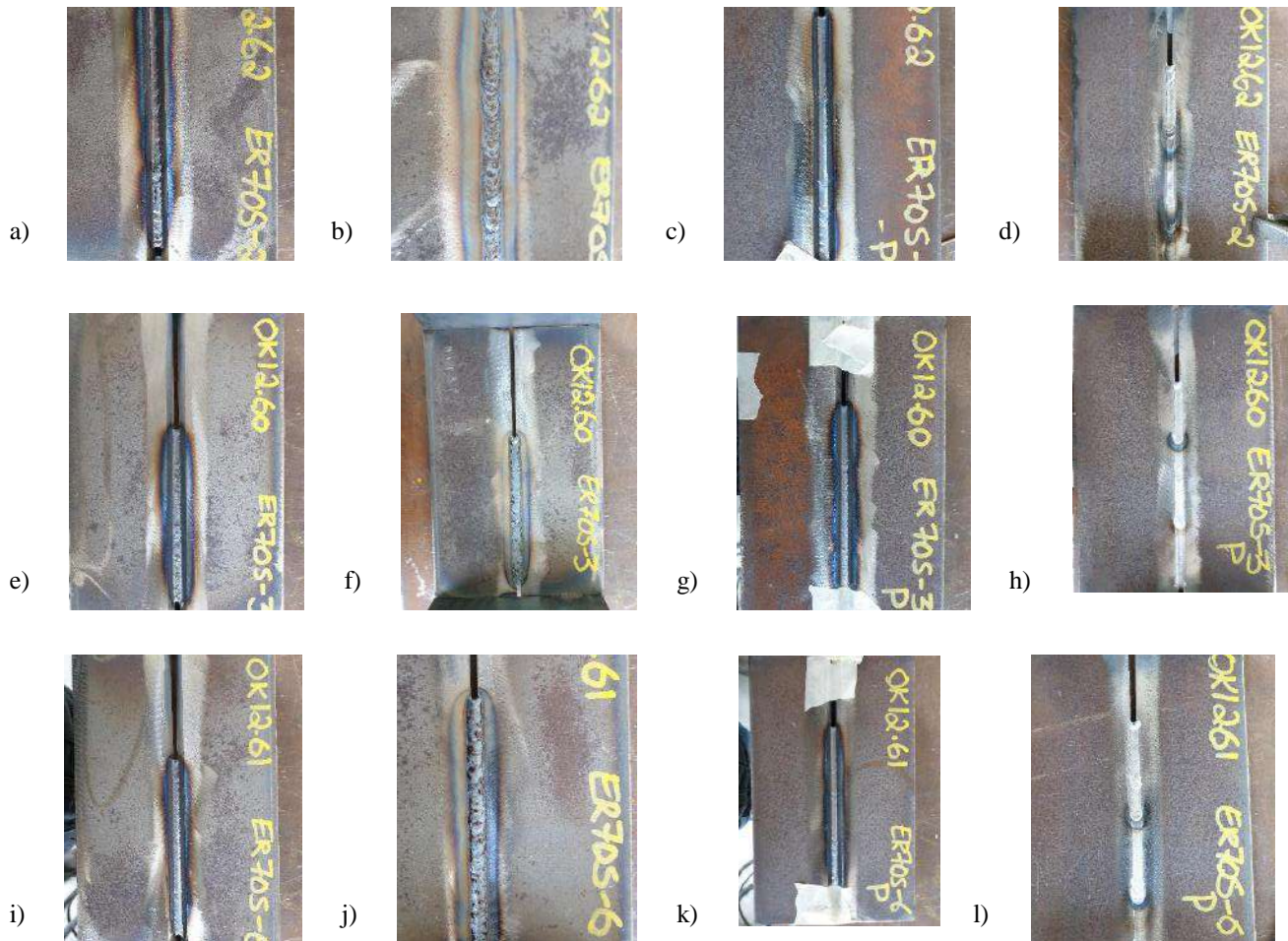


Fig.10: Groove test coupons welded with and without purging gas:

- a) ER70S-2 – Face (no purging), b) ER70S-2 – Root (no purging), c) ER70S-2 – Face (purging),
 d) ER70S-2 – Root (purging), e) ER70S-3 – Face (no purging), f) ER70S-3 – Root (no purging),
 g) ER70S-3 – Face (purging), h) ER70S-3 – Root (purging), i) ER70S-6 – Face (no purging),
 j) ER70S-6 – Root (no purging), k) ER70S-6 – Face (purging) and l) ER70S-6 – Root (purging)

The groove tests showed that both ER70S-2 and ER70S-6 presented weak weldability and ER70S-3 presented somewhat acceptable weldability without purging gas.

Using purging gas, all the filler metals presented very good weldability.

IV. CONCLUSIONS

Although the mechanical properties of the all weld metals produced using ER70S-2, ER70S-3 and ER70S-6 welding electrodes are quite similar, their chemical compositions are different specially in the contents of deoxidant elements like Zr, Al, Ti, Si and Mn.

The contents of deoxidizing elements are lower in ER70S-3, intermediate in ER70S-6 and higher in ER70S-2.

Deoxidized weld pools tend to have a negative temperature coefficient of surface tension. When the area under the arc is heated up, the surface tension drops in the center of the weld pool and the direction of the fluid flow is from the center towards the edges of the pool.

When oxygen, or other surface-active elements, are introduced to the weld pool at very low levels they cause the surface tension to rise with an increase in temperature. In this case, the direction of fluid flow is from the outside of the pool, where the surface tension is lower, towards the center, thus increasing penetration.

The choice of ER70S-2, ER70S-3 or ER70S-6 can lead to change in the direction of fluid flow in the welding pool due to change in the level of oxygen dissolved in the

molten metal, resulting in changing in penetration and bead shape using the same welding parameters.

Welding of groove welds using ER70S-2 and ER70S-6 must be performed with purging gas.

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Execution of Web-Based Crime and Criminals Tracking System to Enable Security and Quick Access

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Abstract— This project work automates web based crime and criminals tracking system. The system is web based application that enable user at the international hotels and at the four police office stations to communicate each other and with district police office. All user of the system are communicating through the internet service provider infrastructure. But if the internet is down, the system will work offline. The system and its database is configured or replicated to the police station's mini server computers at each woredas. Whenever the network is available the mini servers synchronize data with the central server at the district police office. Before we develop this project the international hotels daily fill form about their customers booked in and send by human labor to the nearby police station. The CCTS alleviates this challenge. Now, using our web system the hotel manager or receptionist access the customer booked in hotel registration page from the server, fills and hit submit button. The information is submitted to the police office through the network and saved to their computer at the same time. While the data is being submitted the data is checked against the criminal's list using primary key or unique number, if criminal or suspects found alert or report will be displayed to the system administrator with detail information. The prototype has been tested with data from Adama city district police office. It has been observed that the system successfully registers crime and criminals, lost property, international hotels; customer booked in hotel, generates reports and provides search facilities. In addition to these, customers are not expected to go to the four police stations or woredas if they want to register lost property. As lost property, crime and criminals registered at a station it will be shared across the network. It has also been shown that the system facilitates to view the status of cases, knowledge bases. This system promotes the manual works into digital. It reduces the time, produces accurate results and also implements security for the information.

Keywords— WEB, Crime, CCTV, Network, Server.

I. INTRODUCTION

1.1. BACKGROUND

The Police department and its functioning is an extremely critical and important part of the state Administration in its responsibility to provide general services to the citizens, maintain law and order and security in the country.

Thakur (2003) has defined crime as an act or omission of an act, which is punishable by law. However, an act that is considered as a crime in one place and time may not be true in another place or time.

According to Andargachew (1988), a criminal is an individual person who has violated the legally forbidden act. In fact, there are some factors that have to be taken into account to convict whether a person should be

considered as a criminal or not. Among these, an individual should be of competent age in light with the law of the land; and there must be a well-predefined punishment for the particular act committed.

Crime has increasingly become as complex as human nature. Modern technological advancement and tremendous progress in communication have facilitated criminals of every corner of the world to commit a crime using sophisticated equipment in one place and then escape to another place (Thakur, 2003). These days the globe is facing the proliferation of problems such as illicit drug trafficking, smuggling, hijacking, kidnapping, and terrorism.

Crime has adversely affected the societies of both civilized as well as developing countries by declining the quality of

life, endangering human right and fundamental freedom and posing a serious challenge to the community. Although the level and intensity of the problem might vary from nation to nation no country has remained unaffected.

Availability of relevant and timely information is of utmost necessity in the operations of Police, particularly in investigation of crime, in tracking & detection of criminals. Police organizations everywhere have been handling large amounts of information and huge volume of records pertaining to crime and criminals. Information Technology (IT) can play a very vital role in improving outcomes in the areas of Crime Investigation and Criminals Detection and other functioning of the Police Organizations, such as facilitating data recording, retrieval, analysis and sharing of Information. Quick and timely information availability about different facets of Police functions to the right functionaries can bring in a sea change both in crime and criminals handling and related Operations, as well as administrative processes.

Creation and maintenance of databases on crime and criminals in digital form for sharing by all the stakeholders in the system is therefore very essential in order to effectively meet the challenges of crime control and maintenance of public order. In order to achieve this, the city should meet a common minimum threshold in the use of IT, especially for crime and criminals related functions.

1.2. TREND OF CRIME IN ETHIOPIA

In Ethiopia, crime statistics of the Federal Police Commission has shown that the rate of crime is increasing steadily. A sample survey conducted in the year 1996 by a research team of the Federal Police has shown that in 1986 about 51,869 crimes were reported to the police (Federal Police Commission, 1996). Taking the total population of the country during this period, this figure indicated that one crime was committed among 800 people during this year. Whereas the research report has shown that in the year 1994 about 96,995 different crimes were reported. This reveals that during this period one crime is committed among 568 people. As compared to the year 1986 the total number of crimes committed in the 1994 have shown a significant increment.

The national crime statistics report compiled by the Federal Police Commission in 2003 for the year 2002 has shown that about 219,539 crimes were reported to police throughout the country and out of this 51 percent were committed in urban area while the remaining 49 percent were occurred in rural areas. Moreover, the national crime statistics report has indicated that the Oromia regional state accounts 22.49% of the total crimes reported to the police in the entire country in the year 2002. This figure indicates

that the Oromia region is one of the crime prone regions in the country.

1.3. ETHIOPIAN POLICE STRUCTURE

In Ethiopia, the police organization was established in 1942 under proclamation No. 6 as autonomous institution with the responsibility of preventing and investigating crime incidents. In 1966 the police institution was put under the Ministry of Interior. Since its establishment, the police organization structure has been extended to the lower administration level, which is “woreda” and sometimes a “kebele” (Mesfin, 1999).

Today, Ethiopian police system consists of a Federal Police Service, nine Regional Police forces and the police forces of Addis Ababa and Dire Dawa, which have a special position. The Federal Police Commissioner is accountable to the Minister of Federal Affairs. The Regional States are free to organize their police as they see fit. Nevertheless, all State police forces have a structure similar to that of the Federal Police.

1.4. The Federal Police

The legal basis for the Federal Police is found in the “Federal Police Commission Proclamation, 313/2003”. Article 6 of this Proclamation defines the objective of the Commission as maintaining the peace and security of the public by complying with and enforcing the Constitution and other laws of the country, and preventing crime. The Proclamation also describes the duties and powers of the police organization. According to article 7 the Federal Police are responsible for crime control within designated areas of jurisdiction, all of which relate to state security. International affairs fall under their remit. They also have coordinating duties at the national level.

For instance, the Federal Police provide training, professional and technical advice and support for Regional Police Commissions. The Proclamation *assessment of each justice institution*¹⁰⁵ refers to the positions of the Commissioner and Deputy Commissioner. Broadly speaking, it also covers matters relating to the appointment and duties of police officers. These issues have been fleshed in the staff regulations. This Proclamation provided for the abandonment of military ranks within the police and ended thus the military past (Article 25(1)).

The Proclamation covers the relationship between the Federal and Regional Police. It provides for regular contact and meetings between the various police organizations (Article 23 (3)). When it deems necessary, the Federal Police Commission can delegate the powers given to it by the Proclamation to Regional Police Commissions (Article 7 (15)).

The Government appoints the Commissioner and Deputy Commissioner. The Commissioner of the Federal Police is accountable to the Minister of Federal Affairs (Article 4). This only applies, however, to aspects relating to management issues. The organization operates independently when it comes to operational police work. There is a sound management setup, with a plan and control cycle. The Federal Police is both a centralized and decentralized organization. It operates from various locations in the country, although the focal point is naturally in the capital. The organization chart reveals a line and staff organization. All task areas have been classified under directorates and departments. The largest directorates are crime investigation and crime prevention. These sections of the organization are responsible for carrying out executive police work.

1.5. The Regional Police

The Regional States are free to organize their police as they see fit. Nevertheless, all regional forces, broadly speaking, have a structure that is similar to that of the Federal Police. The respective state authorities appoint the Regional Commissioners. Regional forces are accountable to the Minister of State Affairs for their respective States. This accountability only relates to matters like policy making and financial matters. The regional services are also independent when it comes to administrating and implementing the actual police work. The Regional States are subdivided into a system of smaller administrative units. The police organization mirrors these administrative divisions and operates in a decentralized way. The regional forces have less capacity than their federal colleagues. Therefore, they frequently request the assistance of the Federal Police when carrying out their regional duties. The cooperation between the regions and the Federal Police is good.

1.5.1. Oromia Police

Oromia police is organized under Oromia regional state as Oromia Police Commission and provide the function of the police to society.

1.5.1.1. Adama City Police

Adama city police is organized under oromia regional state police commission and has four stations called woreda1, 2, 3, 4 and one police office which commands the others. The woredas police offices are located at different parts of the city to facilitate service delivery to customers and to prevent crime and track criminals. Currently, the work activities performed among them is manual and there is no network connection. In return, this leads to slow response to the crime, not satisfy the public need in city and report and instructions are delayed. To overcome such obstacles it

is not an option to modernize the city police. The hotels in the city have daily interactions with nearby police office with report of the customers booked in their hotels. This is done through human labor which is time consuming and monotonous. Therefore, the CCTS alleviates this and enables the police officers to provide service to customers within time frame.

This web-based CCTS project aims at creating a comprehensive system for enhancing the efficiency and effectiveness of policing through adoption of principles of e-Governance and creation of a citywide networking infrastructure for evolution of IT-enabled tracking system around 'investigation of crime and detection of criminals. It aims to develop web-based system and mechanism to provide the basis for evolution of an IT enabled state-of-the art workflow (Processes) automation system in a planned manner between international Hotels and police stations, and among police office. It will not only track crime and criminals but will also create facilities and mechanism to provide services like registration of lost properties, verification of suspected or criminal person or found properties, easily accessing the required data from database, list daily cases, solutions and any challenges during work and provide notification to concerned woredas police stations. These facilities are allowed to be visible or accessible to users who have only the right privileges.

1.6. STATEMENT OF THE PROBLEM

Crime is a complex social phenomenon and its cost is increasing due to a number of societal changes and technological advancements, and hence, law enforcement organizations like that of police need to learn the factors that constitute higher crime trends (Wilson, 1963). To control this social evil there is always a need for prudent crime prevention strategies and policies. Understanding and processing of criminal records is one method to learn about both crime and individuals who involve in misdeeds so that police can take crime prevention measures accordingly (Brown, 2003).

Adama city police office use manual systems to share and communicate information which is time consuming and may not be real time communication. Hotels in the city also use repetitive, monotonous tasks such as daily report of their customer booked in hotel information to the nearby police stations. Moreover, citizens need to go to every police station to register their lost property and also not suitable for police stations to cross-check customer booked in hotel information reported by hotels in case criminals want booked hotel. Therefore this project is developed to alleviate the above listed manual systems problems.

This project tries to answer the following leading questions:

- (1) What should have to be done to facilitate data or information sharing among police stations?
- (2) What should have to be done to enable hotels to submit customers booked information in their hotel to the nearby police station?
- (3) How lost properties registered at a station should be distributed to all police stations?
- (4) How can we develop a web based application to track crime and criminals booked in hotel?

1.7. OBJECTIVES OF THE PROJECT

The general and specific objectives of the project are described as follows:

1.7.1. GENERAL OBJECTIVES

The general objective of CCTS is to develop a web based crime and criminal Tracking system that will help in the effort of crime and criminals tracking with the aim of supporting the crime detection and prevention activities at the Adama city Police to facilitate interactions between police district and woreda police stations, among woreda police stations and International hotels.

1.7.2. SPECIFIC OBJECTIVES OF THE PROJECT

To attain the general objective the following specific objectives are set

- To develop crime and criminal, lost property registration modules,
- To construct report generation system,
- To automating back-office functions, and thereby release police staff for greater focus on core police functions,
- To create platforms at city police station and central levels for sharing crime and criminal information databases across police office and stations,
- To develop system or module that enable police officers better track crime and criminals and keep track of progress of cases,
- To facilitate sharing of lost properties across police station

1.8. METHODOLOGY OF THE PROJECT

For the successful completion of this project, a number of data gathering, analysis, and programming tools and techniques are put into use. The data collected focuses on issues like, what is expected from the system? What are the inputs of the system? What are the outputs of the system? What are the rules of processing the input data? How are they processed? Who requires which data in what form?

1.8.1. Data Collection Methods

The data gathering method that have been used are observation, interview and document analysis. Observation supplements the interview while interviewing key commanders, information desk/center officers and inspectors used to clearly understood the system. In addition to observation and interview, there were written documents from the police office and international hotels that were important for the development of the system. These documents are seen or reviewed by group members and listed on the appendix A part of this project.

The sampling technique from non-probability sampling, purposive sampling technique is employed. The group members believed that accurate and relevant information is collected or gained from the key persons or experts. There are four woreda police stations and one police district in Adama city. The data will be collected from the police stations and international hotels.

1.8.2. System Development Tools

This section describes the system development tools used to develop the system. The system is developed on Windows operating. The system development tools used are visual Basic Studio.net 2010 used as frontend to design interface and ASP.Net as server side scripting while the back end is Microsoft SQL 2008. Rational Rose Enterprise edition version 2002.05.00 and Microsoft office Visio 2003 are used to construct use cases, sequence diagrams, activity diagrams, system architecture, object relationships, class diagrams, hardware software mapping and deployment.

1.8.3. Other Tools

Other tools used to develop the CCTS system are Adobe Photoshop used for designing different icon and background image for the interface, Microsoft office word to compile the project document.

1.8.4. System Development Method

The system development methods used in this project is object oriented software engineering.

The core functions of the police are crime detection, crime prevention, call response and court/prosecution. The scope of the project mainly emphasized on the crime and criminal detection core functions of Adama City Police stations and office.

1.9. SCOPE OF THE PROJECT

The core functions of the police are crime detection, crime prevention, call response and court/prosecution. The scope of the project will mainly emphasized on the crime and criminal detection core functions of Adama City Police stations and office.

This section will provide detailed information on the scope of each of the component required for the implementation of this project.

1.9.1. Geographical Scope

The table below highlights total locations which are to be considered for CCTS roll out.

Table 1: Geographical Scope

S.No.	Stakeholders of Adama city police CCTS	Total
1	Police stations	4
2	Central police office	1
3	International Hotels	10
Total number of units		15

1.9.2. FUNCTIONAL SCOPE

The functional scope of this project primarily covers the functions and activities at the Adama city police stations. This can primarily be categorized into the following modules.

1) Registration of

- a. Lost Property
- b. Crimes and Criminals
- c. International hotels
- d. Customer booked in hotel information

2) Verification (cross-check and generate report in case customer booked in hotel information matches information recorded in criminals table).

3) Manage user accounts

4) Search, update and delete data

5) Generate report and print

1.10. LIMITATION OF THE PROJECT

This project mainly focused on crime and criminal tracking that will be done in coordination with international Hotels, police office and police stations but does not involve the citizens as a primary source of the information through the system. In other words, the users are not interacting or give feedback with the system directly. Moreover, sharing of information and crime tracking is performed as long as there is internet availability and power with central server. Because of the time, human resource capacity and skill

available the project confined to Adama police stations and international Hotels.

1.11. SIGNIFICANCE OF THE PROJECT

The web-based crime and criminals tracking system will use information technology to facilitate prevention and detection of crime and criminals and lost properties. Information is shared across all stations if it is registered at a station. This will facilitate communication among the stations and it reduces the time taken to make decision on a case. Therefore, the system improves operational efficiency and effectiveness of the police. CCTS Provide the following capabilities:-

- Enhance ability to analyze suspected criminals and cases
- Reduce workload of the police station back-office activities such as preparation of regular and organized reports and station records management
- A collaborative knowledge-oriented environment where knowledge is shared across the different stations and office.
- Better coordination and communication among stakeholders
- Provide centralized repository

II. LITERATURE REVIEW

2.1. Crime and Criminals

Thakur (2003) has defined crime as an act or omission of an act, which is punishable by law. However, an act that is considered as a crime in one place and time may not be true in another place or time.

According to Andargachew (1988), a criminal is an individual person who has violated the legally forbidden act. In fact, there are some factors that have to be taken into account to convict whether a person should be considered as a criminal or not. Among these, an individual should be of competent age in light with the law of the land and there must be a well predefined punishment for the particular act committed.

Sutherland and Cressey, cited in (Andargachew, 1988), stated that an act would be considered as a crime when it is prohibited by the criminal law. Criminal law, on the other hand, refers to a body of specific rules regarding human conduct, which have been explicitly stated by political authority.

Crime has increasingly become as complex as human nature. Modern technological advancement and

tremendous progress in communication have facilitated criminals of every corner of the world to commit a crime using sophisticated equipment in one place and then escape to another place (Thakur, 2003).

These days the globe is facing the proliferation of problems such as illicit drug trafficking, smuggling, hijacking, kidnapping and terrorism. Crime has adversely affected the societies of both civilized as well as developing countries by declining the quality of life, endangering human right and fundamental freedom and posing a serious challenge to the community. Although the level and intensity of the problem might vary from nation to nation no country has remained unaffected.

2.2. Crime Prevention

The causes for the growing rate of crime include unemployment, economic backwardness, over population, illiteracy and inadequate equipment of the police force (Thakur, 2003).

The form, seriousness and size of the crime, may rely on the form of a society and thus its nature changes with the growth and development of the social system. In every generation it has its own most critical, new and special problems of crime, although the crime problem is as old as man himself. In addition to this, the techniques employed to commit crime are new in the sense that they make use of modern knowledge and technique.

The rise in crime both national and transnational is generally thought as the result of interplay between socio-economic changes. The circumstances surrounding the individual offender such as his personality, physical characteristics intelligence, family background, environmental surrounding such as peer groups, neighbors etc have been subject of the study of crime (Andargachew, 1988). Hence, understanding the attributes of criminals will be helpful to design and implement prudent crime prevention strategies.

Crime, so to say, is one of the most critical social evils a society can face. Hence maintaining law and order is one of the principal functions of any government (Wilson, 1963). For this reason, governments usually establish organizations such as courts, prosecutions and police, which are responsible for the maintenance of law and order in their respective country. These agencies and other related organizations are responsible to curb the rate and occurrence of crimes. To do so, crime prevention agencies need to issue and implement crime prevention strategies. Theoretically, it is argued that crime prevention is better than cure for the following reasons (Thakur, 2003):

- Prevention safeguards the life and property of the society whom the police are in duty to protect.
- It avoids a good deal of trouble to the victim both physical and mental.
- Crime prevention rules out litigation, which follows in the process of detecting a crime.
- Prevention also saves the police from the trouble of recording crime at all odd hours of the day and night and of taking immediate action for the investigation.

Thakur (2003) suggested that intent and opportunity are two major factors that lead to the occurrence of a crime. An individual cannot commit a crime unless and otherwise s/he gets an opportunity even though s/he is intended to commit a crime. Therefore, the best strategy for crime prevention is to provide a system that denies any opportunity for a criminal to commit a crime.

However, these days Law enforcement and investigating agencies have recognized the tremendous value in extracting hidden knowledge embedded in their data warehouses which could be valuable in the process of combating crimes (Megaputer Intelligence, 2002).

The police departments want to reveal frequent crime patterns from historical reports to help them investigate new cases. According to Megaputer Intelligence (2002), the analysis of crime patterns and trends is very important for police officers and analysts can learn from historical crime patterns and enhance crime resolution rate. It also helps to prevent future incidents by putting in place preventive mechanisms based on observed patterns. Another possible advantage is, it can reduce the training time for officers assigned to a new location and having no prior knowledge of site specific patterns to assist them in investigations. In light with the crime patterns extracted from previous records, police can deploy scarce resources to the right place at the right time.

2.3. Crime and Criminals Information System (CCIS)

CCIS is an NCRB-driven program and has been launched in 1990. Since then, it has been implemented in 35 states and union territories and spans over 700 locations. Most of the UKCOPS police headquarters and district headquarters are covered by CCIS and so are some of the 14,000+ police stations in the country. CCIS is primarily an initiative to create crime- and criminals-related database that can be used for crime monitoring by monitoring agencies such as National Crime Records Bureau (NCRB), State Crime Records Bureaus (SCRB) and District Crime Records Bureaus (DCRB) and to facilitate statistical analysis of

crime and criminals related information with the States and monitoring agencies.

CCIS data is used for publishing online reports such as Missing Persons report and is also used as the basis for online query facilities that are available through the NCRB website. In addition, it is also used by NCRB to publish an annual nation-wide Crime Report. CCIS focuses exclusively in Crime and Criminals information and does not address the other aspects of Police functioning.

The CCTNS would provide a comprehensive database of crimes and criminals in Odisha, which will be integrated with central database leading to better tracking of criminals. (TIMES OF INDIAN, Bhubaneswar P17).

In order to realize the benefits of e-Governance fully, it is essential that a holistic approach is adopted that includes re-engineering and standardizing key functions of the police and creating a sustainable and secure mechanism for sharing critical crime information across all police formations. The CCTNS has been conceptualized in response to the need for establishing a comprehensive e-Governance system in police stations across the country.

Over the decade, a lot of research work had been carried out and many computer programs had been written in order to assist the police with information on criminals and crimes. One of such development is the Ohio Department of Rehabilitation and Correction where the system (database) enables you to search for people who have been convicted in Ohio, and the information is usually about when a person is convicted, when the person was sentenced or fined, and when the person was released. Ohio Department of Rehabilitation and Correction protects and supports Ohioans by ensuring that adult felony offenders are effectively supervised in environments that are safe, humane, and appropriately secure. In partnership with communities, it aims to promote citizen safety and victim reparation. (Daniel E.S. Kawai, Dogo H. Samson 2011)

National Crime Information Center (NCIC) of Criminal Justice Information Services (CJIS), Division, located at Clarksburg, West Virginia USA, as cited in (Daniel E.S. Kawai, Dogo H. Samson 2011) is a computerized index of criminal justice information (i.e. criminal record history information, fugitives, stolen properties and missing persons). It is available to Federal, state, and local law enforcement and other criminal justice agencies and is operational 24 hours a day, 365 days a year.

The purpose for maintaining the NCIC system is to provide a computerized database for ready access by a criminal justice agency making an inquiry and for prompt disclosure of information in the system from other criminal justice

agencies about crimes and criminals. This information assists authorized agencies in criminal justice and related law enforcement objectives, such as apprehending fugitives, locating missing persons, locating and returning stolen property, as well as in the protection of the law enforcement officers encountering the individuals described in the system.

2.4. CANADIAN Police Information Centre (CPIC)

The Canadian Police Information Centre (CPIC) was created in 1966 to provide tools to assist the police community in combating crime. Since 1967, CPIC is also a computerized information system available to provide all Canadian law enforcement agencies with information on crimes and criminals.

CPIC transmits requests by authorized agencies to several data banks primarily for law enforcement purposes. One of those data banks is the Criminal Records Information Management Services (CRIMS). CRIMS updates and maintains more than 600,000 criminal records annually and populates criminal record information to the Canadian Police Information Centre (CPIC) Identification Data Bank.

A clear result from a CPIC check does not necessarily mean you have a clear criminal record. There are numerous criminal record systems nation-wide and then there are the provincial courts. Consequently, your criminal record can be stored, and accessed, in any number of ways. If you know you had trouble with the law in the past, and you are contemplating a career change, or some foreign travel, you may not want to rely on just a local police check to give you piece of mind. Consult a specialist in criminal record systems, who can conduct a comprehensive, multi-level criminal record search to ensure all records held on you are uncovered, and if so, dealt with accordingly.

Canadian policing entered the electronic age in 1972 when the Canadian Police Information Centre (CPIC) went online. CPIC (pronounced see'pick) is an automated system operated by the Royal Canadian Mounted Police (RCMP) on behalf of the nation's policing community. While serving a broad range of police information needs, the RCMP summarizes CPIC's purpose as providing "tactical information on crimes and criminals" (RCMP 1995, no. 17).

In investigating crimes and criminals, the police risk making two types of errors. First, they may believe an innocent person to be guilty of wrong-doing. In the parlance of statistical hypothesis test-ing, this would be analogous to making a Type I error (see Ott, Mendenhall and Larson 1978, pp. 218-20). Conversely, police may

falsely believe a guilty person to be innocent of wrongdoing, which would be to commit a Type II error.

In addition to CPIC, the RCMP operates special-ized systems. One is the Automated Criminal Intelligence Information System (ACIIS) maintained by the Criminal Intelligence Service Canada (CISC) network of agencies from across the country. CISC gathers data on organized criminal activities such as “trafficking of illegal drugs, gambling, extortion ... and contract murder” (RCMP 1995, no. 26; Treasury Board 1995, pp. 764, 773). Another system, the Violent Crime Linkage Analysis System (ViCLAS) offers trained specialists a sophisticated analytical tool to identify similarities in crimes committed across the country (Backgrounder to Campbell 1996). Access to ACIIS and ViCLAS is highly restricted and in some areas the systems are not heavily utilized. Ontario forces, for instance, gained access to ViCLAS a few years ago but, until recently, only a fraction of murders and serious sexual as-saults were reported to the system. CPIC on the other hand, is relatively visible and widely used.

When CPIC was introduced, the police community greeted it with enthusiasm. Within two hours of going online, the Ontario Provincial Police (OPP) submitted the plate number of a burned out (stolen) vehicle and recorded the system’s first “hit” (Higley 1984, p. 492).

Maguire argues (2004) information is power and the latest communication facilities give an immediate possibility to retrieve information accurately. Thus, police departments employ information systems to increase police officers’ intellectual capacity to solve social problems and to react efficiently to crime (Maguire, 2004). The quality of work comes from the quality of workers. What can officials do in carrying out their mandate? In this respect, Herbert Simon (1997) recommends that organizations provide an environment that shapes and develops personal qualities and habits. Organizational branches would be more productive when managerial levels support rational and practical instructions. For this reason, managers need accurate information about their jurisdiction and personnel to analyze specific conditions as well as to evaluate organizational performance (Bratton & Knobler, 1998; Maple & Mitchell, 1999).

2.5. Police Information Retrieval System (PIRS)

PIRS is the RCMP's automated information management system used to store, update and retrieve information on case records/occurrences being, or having been, investigated. This electronic indexing system is used by the RCMP, some Municipal Police agencies, by Firearms Officers, and by other federal partners.

PIRS captures data on individuals who have been involved in investigations under the Criminal Code, federal and provincial statutes, municipal by-laws and territorial ordinances. According to the RCMP, in addition to details of an event in a brief synopsis (maximum of 240 characters), PIRS contains limited information relating to investigations and criminal histories.

Unlike CPIC, which essentially contains factual information (e.g., charges and convictions), PIRS may also contain information provided by witnesses, victims and other associated subjects that can be highly subjective, as well as the names of the witnesses, victims, and acquaintances of the accused individual.

PIRS also differs from CPIC in that it contains information on occurrences and incidents that never resulted in charges. That means you can have a PIRS record and not even know it. Entries in the Police Information Retrieval System (PIRS) are assigned codes which bear significance on whether the details on an individual are disclosed in the RCMP's standard four level criminal record check (form 3923e, Consent for Disclosure of Criminal Record Information).

The two major classifications are "Subject Chargeable" (SCH) and "Subject of Complaint" (SOC). Subject Chargeable implies a higher degree of assumed guilt of the individual in question. Subject of Complaint simply denotes that the individual has been brought to the RCMP/Police's attention in an investigation and their name and personal details had to be entered into PIRS for the purpose of maintaining a record of the incident.

Subject Chargeable entries are often revealed in the fourth category of the RCMP's four-section criminal record check; whereas SOC entries are typically not, as they generally denote information which is highly subjective.

2.6. Provincial and Municipal Police Information Retrieval Systems

Similar to the RCMP's PIRS database, Ontario has a police information retrieval system known as OMPACC, while Calgary has PIMS, Edmonton has PROBE, Regina has IRIS, etc. Formal and informal information sharing arrangements are in place between police services or agencies for the exchange of information in these databases.

If you have specific knowledge of your own personal experience/incident that might be included on a local or regional police information system, and you don't want to do a multi-level record search, you may want to obtain information contained on you in provincial and municipal criminal record databases through freedom of information

requests. Contact your provincial privacy commissioner for more information on how to make such a request.

2.7. Goa Police CCTNS

The Vision of the project (CCTNS) is “to transform the police force into a knowledge-based force and improve the delivery of citizen centric services through enhancing the efficiency and effectiveness of the police stations by creating a platform for sharing crime and criminal information across the police stations in the country”(Goa Police Government of Goa RFP Volume 1).

2.8. Information Technology Staffing and Responsibility

As in many police departments, Information Technology (IT) responsibility was housed, until recently, in the Information Management Bureau (IMB) organized internally under Support Services. Technology came to be located in Support Services because it was seen as an essential tool to support community policing by the command staff. Politically, the police department maintained considerable independence and autonomy from city government. This was the case for some time, as the city viewed the department as fully capable of managing its own affairs. The department did respond effectively to political, financial, and intellectual forces in growing its technology capabilities. IT decision makers began formal planning early on by coordinating the gradual phase in of new IT infrastructures related to communications, records management, and CAD systems. As the cost and complexity of technology increased, however, the city took steps to centralize all IT, police included.

In May of 1998, the city reorganized IT and centralized all departmental IT units into one city Information Technology Division (ITD). This was seen as a positive move by some in the command structure, but many patrol commanders and communications staff were not so willing to hand over control of IT. Financially, it made sense for the city to coordinate IT; the city could better integrate systems and, through economies of scale, buy in bulk more efficiently. Further, the police department appeared to be stagnant on many pressing issues, including systems coordination, management, liability, and upgrading computers. As a consequence, the city-centralized IT came at an advantageous time for the Tempe Police Department.

The police department suspects that future IT improvement projects and recommendations will receive more support, since these recommendations will come from the city and will not be seen as self-serving. The reorganization meant that the Criminal Justice Automation Committee and the Criminal Justice Operations Committee were merged. In addition, the police department is optimistic about the

changes because many needs that were left unmet will be addressed. Historically, the police department thought that certain needs were to be met by the city, and the city assumed that the police department was to meet those needs. In reality, neither group met the needs of the other. Overall, the Tempe Police Department command staff views relocating the IT function into the city as a compromise between fiscal needs and control.

Another obvious advantage of centralizing IT responsibility is that city IT employees are more capable of handling IT decisions than police employees. They are more knowledgeable on various IT systems and platforms and hardware and software upgrades. The department also saves the costs of training sworn staff on IT systems and software. Information Systems Related to Professional-Era Policing Operations/Command and Control Systems

The department's computer-aided dispatch (CAD) system was originally acquired in 1982. The CAD architecture consists of one centralized minicomputer talking to mobile data terminals (MDTs). The system uses Public Safety Systems Incorporated (PSSI) designed and supported software. The records management system (RMS) is 32 Police Department Information Systems Technology Enhancement Project (ISTEP) about 12 years old. Both the RMS and the CAD have been updated regularly. The department uses ALERT as its primary RMS and a response CAD system; both are produced by PSSI and, therefore, communicate well with each other. ALERT has a calls for service module that is synchronized daily. ALERT users can access CAD data as little as 24 hours old. A major short-term goal is to have a stand alone RMS that will be year 2000 (Y2K) compliant.

2.9. Reviewed Systems Drawbacks and their Solutions

The reviews described have the following problems:

1. The system does not provide information sharing linkage between hotels and police stations. But, if there is an interconnection between them, criminals can be easily tracked or detected while they booked in hotel without the intentions of hotels or criminals.
2. Daily report of the hotel is brought to nearby police station with human labor which is time consuming and costly. The CCTS system enables hotels submit their report to the nearby police station immediately while they are recording on their computer. This reduces the cost hotels incurred to send report to police station and even save time.

3. Most system would not enable police to register lost properties. The Adama police office CCTS enables police to register the lost properties at a station and then it will be distributed immediately to other stations. No need to walk through other station of the police. This will improve service deliver to the customers, save time, cost and increase the satisfaction of the citizen.
4. The systems are online or web based but no study deals about offline functionality of the crime and criminal system. The CCTS of Adama city police should provide offline functionality. Even though there is no network available the individual computers can work alone and synchronization would be done when the network is online.

III. SYSTEM REQUIREMENT SPECIFICATION

3.1 Introduction

A requirement is a feature that the system must have or a constraint that it must satisfy to be accepted by the client. Requirements elicitation and analysis focus only on the user's view of the CCTS system. For example, the functionality provided by the system, the interaction between the user and the system, the errors that the system can detect and handle, and the environmental settings in which the system operates or utilized.

3.2 Existing system of Adama city police office

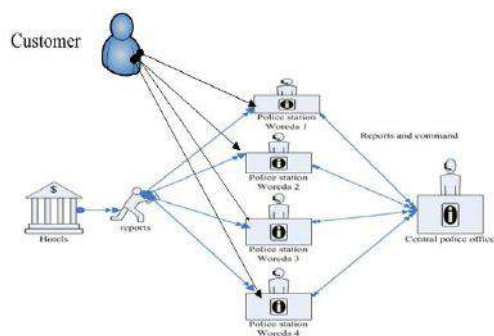


Fig.3.1 Existing system of Adama city police office

As shown on the above fig. the existing system of the Adama city police office uses manual system to exchange information or to send instructions and reports to the head office or district, they use human intermediaries or telephone. When citizens want to apply for their lost properties at police station, they need to go every station. Additionally International hotels in the city report the daily information of their customers booked to the nearby police station using human labor.

3.3 ADAMA CITY POLICE OFFICE CCTS SYSTEM

The new system creates a platform user friendly interface in which police stations and central police office or district exchange information through a centralized database system and enables international hotels to report or submit customer information booked in their hotel to the nearby police station. Moreover, the system supports stakeholders to access and able to work on offline and online environment.

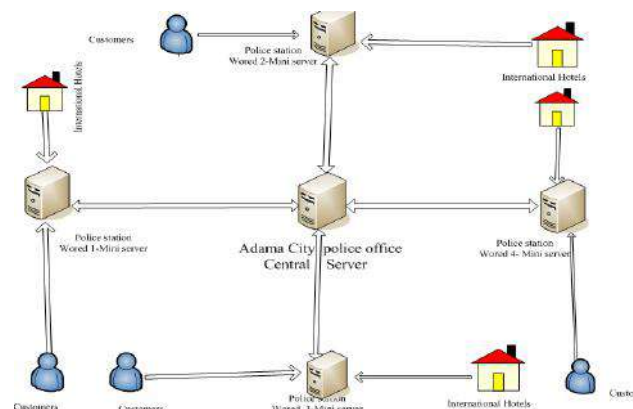


Fig. 3.2 CCTS System

3.4 System Requirement Elicitation

There are different steps, approaches and the main processes involved in the crime and criminal tracking system process of the Adama city police office. In this section the functional and non-functional requirements of the new system will be described and modeled using UML models.

3.5 FUNCTIONAL REQUIREMENTS ELICITATIONS

Functional requirements describe the interactions between the system and its environment independent of its implementation.

3.5.1 Description of the modules and functional requirements

The functionality of the CCTNS application is focused on providing value to the police personnel, specially the officers operating at the cutting edge and simplifying the day to day operations of the police function.

The web-based CCTS system functional requirements are listed as follows:

1. Login

The system has the functionality that enables users to login to the system and perform any activities according to their access privilege assigned to them. That is each actor or system user has his/her own credential stored in the

database. The system will check the keyed values against the values stored in the database.

2. Storing crime and criminal's detail information

The crime and criminals registration module is proposed to register and store cognizable crime and criminals. Registration module would enable assignment of a unique number to facilitate proper monitoring. The details captured may include but not limited to missed persons, crime and criminals and suspected person.

3. Storing property detail information

The property registration module is used to capture detail information about stolen, lost and found properties.

4. Registering International Hotels information

The hotels Interface module of the CCTS acts as a conduit for information exchange between hotels and police stations. This module enables to register and stores detail information about international hotels found Adama city.

5. Recording and submitting Hotel's customer information to police station

The system should support submission of daily customer's booked in hotel information to nearby woreda police office and retain copy of it.

6. Generate Report

This module is used to generate the daily, quarterly, semi-annual and annual report by woreda police office to Adama central police office.

7. Enable user to access knowledge base

This module is used to provide common information that helps the staff members to share information and any knowledge base which leads them to increase efficiency and effectiveness in their work according to their access right. Such as rules, proclamation and selected cases which are assumed to be best practice.

8. Provide search facilities

The search module enables users of the system to surf or look up any data from the database depending on the privilege they have.

9. Manage user account

Create, Update and delete user account module helps the system administrator to manage user accounts.

10. Print

The print module is used to printout the required data or reports by commander and system administrator.

3.6. NON-FUNCTIONAL REQUIREMENTS

Nonfunctional requirements describe user-visible aspects of the system that are not directly related with the functional behavior of the system.

Nonfunctional requirements include:

User Interface and Human Factors

The system will have consistent interface formats and button sets for all forms in the application, will have a form based interface for all data entry and viewing formats, and will generate reports that are formatted in a table and that should look like the existing manual report formats for user friendliness. The system will be easily maintained by the developer or other authorized trained person and it shall respond as fast as possible in registering properties, crime and criminals, generating reports and working over a networked environment. There should be a short training class to explain the functionality of the interface and how to use it. The system is easy to learn, and can handle many jobs at once.

Hardware Considerations

The web based Crime and Criminal Tracking System can be run on any Windows platform. The system did not require special hardware, although the suggested minimum is processor speed is 1.3GHz Pentium compatible PC with 512 MB RAM, 160GB Hard disk capacity and a Network Interface Card

Performance Characteristics

The System should be able to take information from a user and enter it into the database. The speed at which this will be completed depends on the number of records currently in the database. None of the processes are time sensitive, however the response time should be relatively short (somewhere around 20 seconds). A typical load on the system would be multiple users entering information. It was tested for five computers and it works fine and we assumed that the system supports up to 20 clients without any delayness.

Error Handling and Extreme Conditions

The system will be able to handle erroneous input by displaying an appropriate error message and should give only valid result, if no data is found with the specified criteria the System should not have to crash or give invalid response. All error messages produced by the System must be meaningful, so that they can be appropriately acted upon by the users who are likely to see them. If a user requests access to, or searches for, a case which he does not have the right to access, the System must provide an appropriate message

The system should be able to support offline services in case there is no network connectivity and also taken into consideration are possible extreme conditions that may occur while using this software or system, such as hardware failure (i.e. system or hard disk crash). To handle this, the database is backed up onto backup devices.

Quality Issues

During the development of the project the participation of stake holder is required to achieve the objectives of the project. The system developers should design a prototype and provide to the system users that supports them to fully understand the users' needs and their expectations from the system. This enables the developers to gather suggestions and to conform to their expectations to successfully develop the system. Besides this, the system should be available and reliable to provide uninterrupted service for users. That is the system should support an offline service .

System Modifications

The CCTS system is a web based system that is scalable as per the size of the stakeholders. In other words, the system will be configured by police office IT experts or developers as new branches and international hotels are launched through time.

Physical Environment

The system will be deployed on multiple computers located in the central office of the facility, as well as in the woredas police station offices and International Hotels. Because of this, there are no external environmental factors to take into consideration. The computers will be plugged into surge protectors to prevent possible damage from power surges. Also, the temperature and humidity in the room are controlled, and always remain in an acceptable range for this system. And also it refers to the location where the system will be deployed and external constraints that may affect the system functionality. Therefore CCTS system will be deployed at Adama City police office and the stakeholders should be able to perform their normal activity in case there is no network connectivity even though there is no real interaction between the central server and other mini-servers.

Resource Issues

If database file is too big, so it require large media like a tape drive, commonly used in large organizations..

Security issues

Security requirements are important factors in this system as classified data will be stored in the database. User validation will be done during login to ensure that the user is valid and that the user only has access to his or her permission data. The system should be protected against

external intrusions or malicious users through user authentication and antivirus. It is the responsibility of system administrator to create all users account and to grant required privileges to each user.

Documentation

CCTS system user documentation is prepared and attached at the end of the annex.

SYSTEM MODELS

System models describe the scenarios, use cases, object model, and dynamic models describing the system. This section contains the complete functional specification of the system, including mock-ups and navigational charts illustrating the user interface of the system.

Use Case Model

In its simplest form, a use case can be described as a specific way of using the system from a user's or actor's perspective. Use case provide a means to capture system requirements, communicate with the end users and domain experts, and test the system. Use cases are best discovered by examining the actors and defining what the actor will be able to do with the system.

Actors

An actor is a set of roles that users of use cases play when interacting with the system. They are external entities which the system will provide a service for them.

The identified actors that will be participating in the system are:

- Police Stations(information desk officer)
- International Hotels(receptionist)
- System Administrator
- Commander
- Staff Users

Use Case Diagram

A use case illustrates a unit of functionality provided by the system. The main purpose of the use-case diagram is to help development teams visualize the functional requirements of a system, including the relationship of actors to essential processes, as well as the relationships among different use cases. Use cases have descriptive names that describe what a system does but not how it does it and must be unique within a given package.

In CCTS project going to be developed, the following use cases have been identified during the requirements elicitation.

- Register crime and criminal
- Register lost Property
- Search information

- Access knowledge base
- Update record
- Delete Data
- Manage user account
- Register hotel information
- Register customer booked in hotel
- Generate Report
- Login
- Print

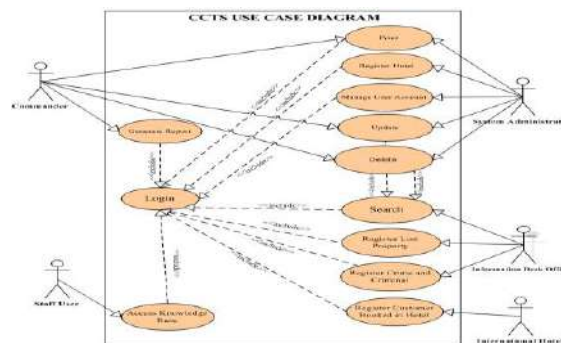


Fig. 3. 3 CCTS Use Case Diagram

The following tables show the description of CCTS use cases.

Table1 Login Use Case Description

Use case Name	Login
Description	The system functionality that enables users to login
Participating Actor	System Administrator, Hotel , commander, Information Desk Officer and staff user
Entry condition	1. User must have user account
Flow of events	2. Type the CCTS URL address on browser and press go button 3. Login Page will be displayed 4. User fills user name and password 5. click the login button
Exit condition	User profile page is opened
Alternative (flow of events)	a) if invalid user name and password entered, an appropriate control validation message displayed at the side of text box controls b) user refill his or her user name and password and press login button

Table 2.Manage User Account Use Case Description

Use case Name	Manage User Account
Description	The system functionality used to create, delete, change user account and set privilege for system users
Participating Actor	System Administrator
Entry condition	System Administrator must have user account
Flow of events	1. Type the CCTS URL address on browser and press go button 2. System Administrator Clicks on Manage User Account hover button 3. Manage User Account form displayed a. Then enter user information to create new user and press on create button b. Search user to delete or update user information and press on delete or update button

	4. Confirmation message is displayed.
Exit condition	User Account created, deleted or updated
Alternative flow of events 1	a). If Create Account page controls are empty and account name is duplicated then b). The Create Account control should display appropriate error message beside the controls c). The system Administrator enter correct information d). Clicks on Create button
Alternative flow of events 2	a). If delete account page password confirmation is invalid then, the system Administrator enter valid information and Click delete button b). If update account control confirmation is invalid then, the update account control should display error message. Then the system administrator enters correct information and press update button

Table 3 Register Customer Booked In Hotel Use Case Description

Use case Name	Register customer booked in Hotel
Description	The system functionality used to register customer booked in Hotel
Participating Actor	Hotel
Entry condition	1. Hotel must have a user account
Flow of events	2. Type the CCTS URL address on browser and press go button 3. Login form displayed 4. Fills user name and password and press login button 5. Customer Registration page is displayed 6. Hotel fills the customer's information 7. Clicks on submit button 8. Confirmation Message is displayed
Exit condition	customer information is submitted
Alternative flow of events 1	a) If data entry error is occurred then, the submit button control displays an appropriate message. b) Hotel enter correct data and press on the submit

Table 4 Register Property Use Case Description

Use case Name	Register property
Description	The system functionality used to register lost property information
Participating Actor	Information Desk Officer
Entry condition	1. IDO must have a user account
Flow of events	2. Type the CCTS URL address on browser and press go button 3. Login form displayed 4. Fill user name and password and press login button 5. Home page displayed

	6. Click on Lost property menu 7. Lost property registration page is displayed 8. Fill lost property information 9. Click on the register button 10. Confirmation message displayed
Exit condition	Property registered
Alternative flow of events	a) If data entry is invalid then the register button control displays field validation message b) adjusts the entries and press register button

Table.5: Register Crime and Criminal Use Case Description

Use case Name	Register crime and criminals
Description	The system functionality used to register crime and criminals information
Participating Actor	Information Desk Officer
Entry condition	1. Information Desk Officer must have user account
Flow of events	2. Type the CCTS URL address on browser and press go button 3. Login form displayed 4. Fill user name and password and press login button 5. Home page displayed 6. Click on Register Crime and Criminal hover button 7. Crime and Criminal page registration page is displayed 8. Fill Crime and Criminal information 9. Click on the register button 10. Confirm message is displayed
Exit condition	Crime and Criminal information is saved
Alternative flow of events	a) If data entry is invalid then the register button control displays field validation message b) adjusts the entries and press register button

Table 6 Register Hotel Information Use Case Description

Use case Name	Register Hotel
Description	The system functionality used to register International Hotel information
Participating Actor	System Administrator
Entry condition	System Administrator must have user account
Flow of events	1. Type the CCTS URL address on browser and press go button 2. Login form displayed 3. Fill user name and password and press login button 4. Home page displayed 5. Click on Hotel Registration button 6. Hotel registration page displayed

	7. Fill Hotel's information 8. Click register button 9. Confirmation message displayed
Exit condition	Hotel is registered
Alternative flow of events	a) If hotel registration data entry is invalid then register button control display error message b) System Administrator adjusts the error with correct value and press register button

Table 7 Generate Report Use Case Description

Use case Name	Generate Report
Description	The system functionality used to generate report
Participating Actor	Commander
Entry condition	Commander must have a user account
Flow of events	1. Type the CCTS URL address on browser and press go button 2. Login form displayed 3. Fill user name and password and press login button 4. Home page displayed 5. Click on Report button 6. Report page displayed 7. If printout is needed click print icon
Exit condition	Report is generated
Alternative flow of events	a. If report is not generated then b. Display appropriate message

Use case Scenario

A scenario is a narrative description of what people do and experience as they try to make use of computer systems and applications [Carroll, 1995].

The following scenarios describe the CCTS feature system functionality from the view point of different actors (system users):

The following tables show the description of CCTS use cases scenarios.

Table 8 Login Use Case Scenario

Use case Name	Login
Description	The system functionality that enables users to login
Participating Actor	System Administrator: Inspector Mesfin
Entry condition	1. Mesfin must have user account

Flow of events	<ol style="list-style-type: none"> 2. Mesfin Type the CCTS URL address on browser and press Return key 3. Login page will be displayed 4. He fills user name and password and click the login button 5. If his name and password is valid then User profile page is displayed.
Exit condition	User profile is opened
Alternative (flow of events)	<ol style="list-style-type: none"> a. If user name and password is Invalid b. Appropriate error message is displayed c. Click Ok button d. Login Page controls reset to empty string and e. user re-enter user name and password as long as counter is equal to 3 f. Click on the login button

3.7 Sequence Diagram

Sequence diagrams show a detailed flow for a specific use case or even just part of a specific use case. They are almost self-explanatory; they show the calls between the different objects in their sequence and can show, at a detailed level, different calls to different objects. The sequence diagrams used in the CCTS project are depicted with their descriptions as follows:

As it is illustrated in Fig. 2 Login sequence diagram below, users such as System administrator, hotel ,

commander, information desk officer and staff user can login to the CCTS with their respective login information. When the user types CCTS URL on the browse and click Go button, the login Page will be displayed, user fills user and password information and then click login button, login controller will be initiated, if the user provides the appropriate input the system display user profile page otherwise the login page is displayed till the maximum threshold is equal to 3.

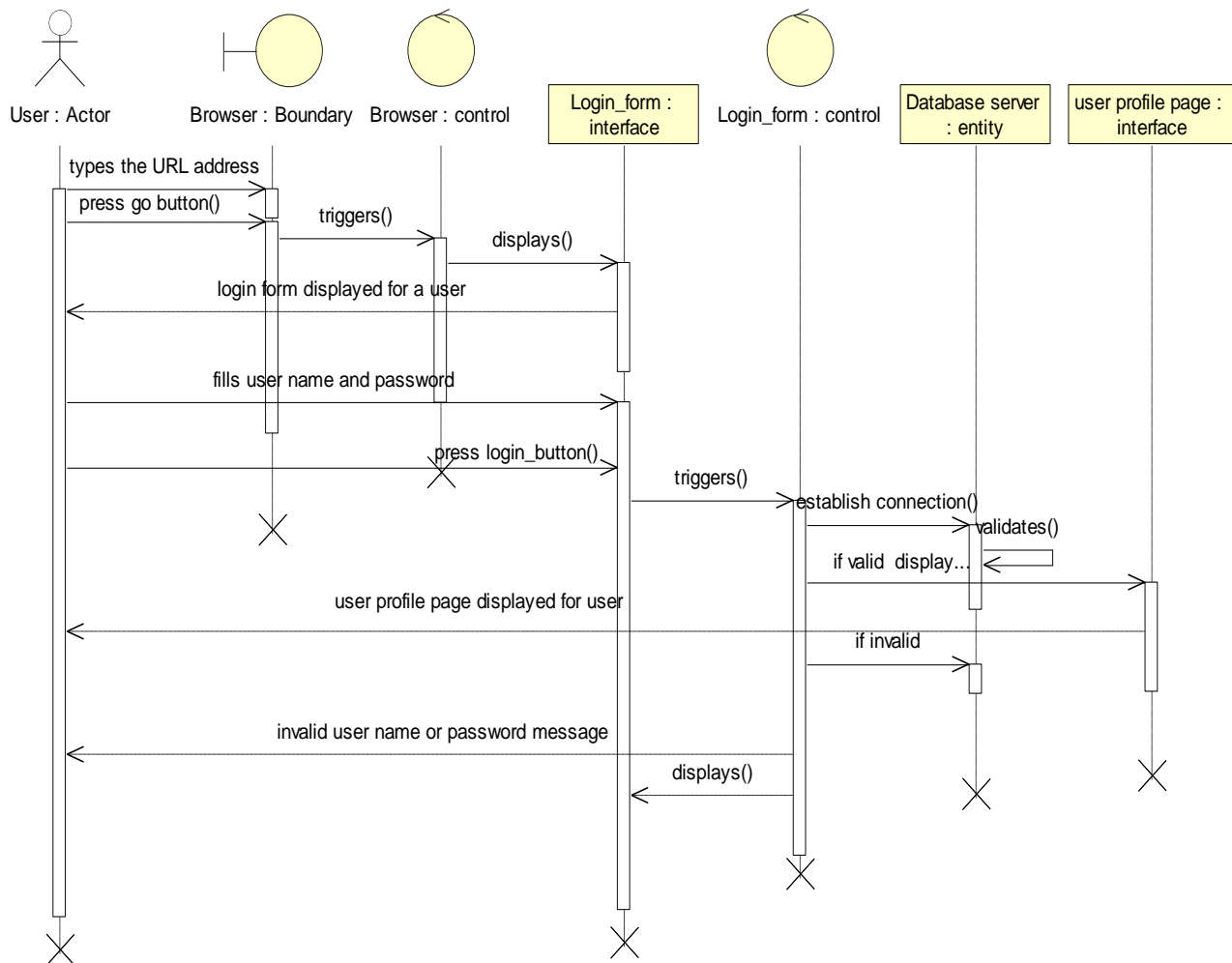


Fig.3.4 Login Sequence Diagram

As illustrated on the figure 3 below, the information desk officer starts system through typing the URL of CCTS and click Go button, login form is displayed, filling proper username and password and press login button, then login button controller validate parameters of the user, and if it is valid and correct the home page is displayed, information desk officer click lost property menu, lost property registration page will be loaded and the user fill

the correct information and click register button then the system will display registration confirmation, If data entry error occurs the system display error messages beside the lost property registration controls with red color. If invalid login information is entered, system will return to login page by resetting controls until the maximum threshold is equal to 3.

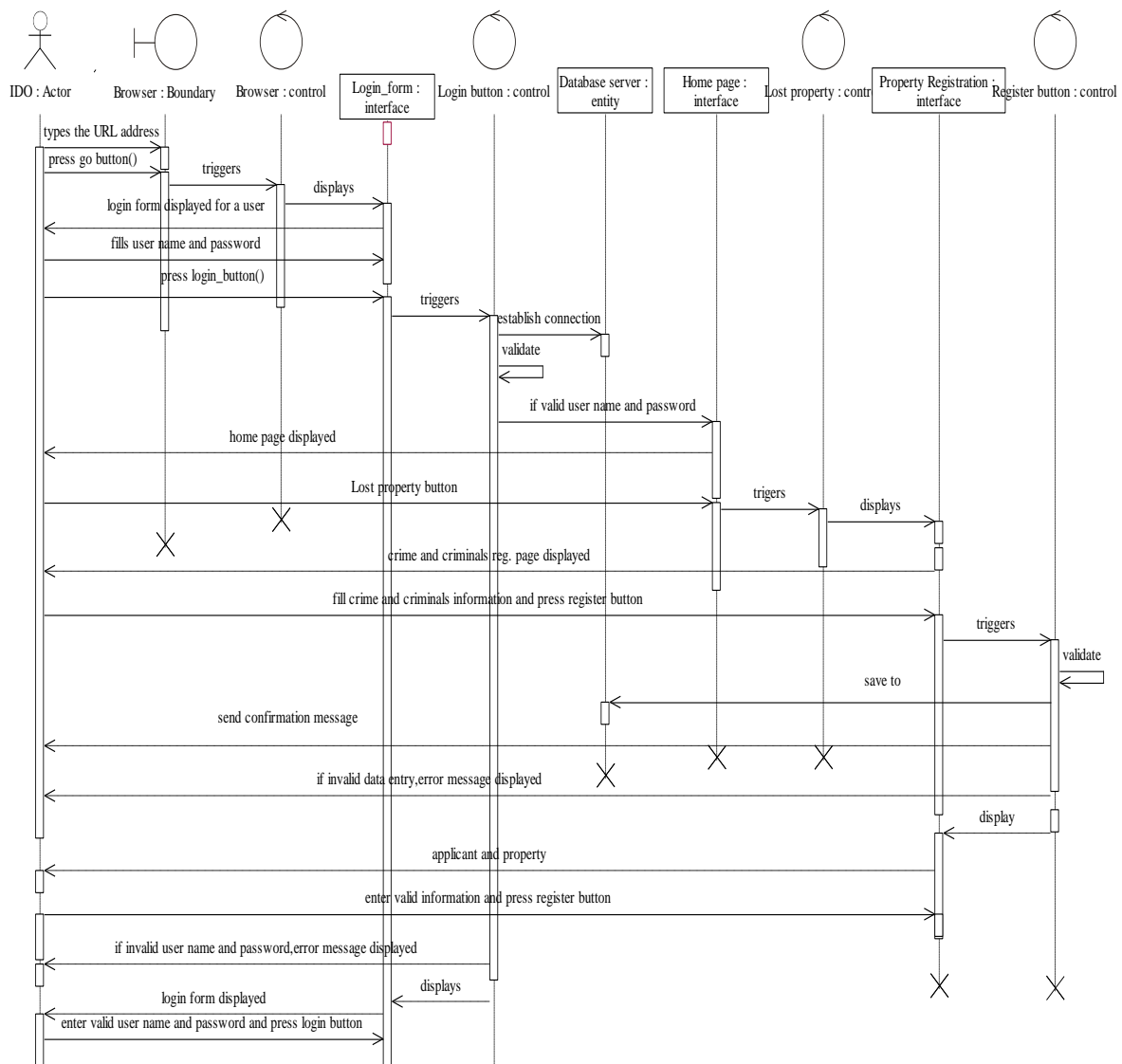


Fig.3.5 Property Registration Use Case Sequence Diagram

As it is illustrated in Fig. 4 customer booked in hotel use case sequence diagram, it shows how hotel can type CCTS URL address on web browser and click Go button then login page will be displayed, fill the correct the username and password, click on login button and establish connection, then customer registration controller will

authenticate and validate the parameters of the user, and if it is valid, the customer registration page will be displayed and hotel fill the customer information then the system will display registration confirmation. If not the system go to login page to reenter the correct user name and password.

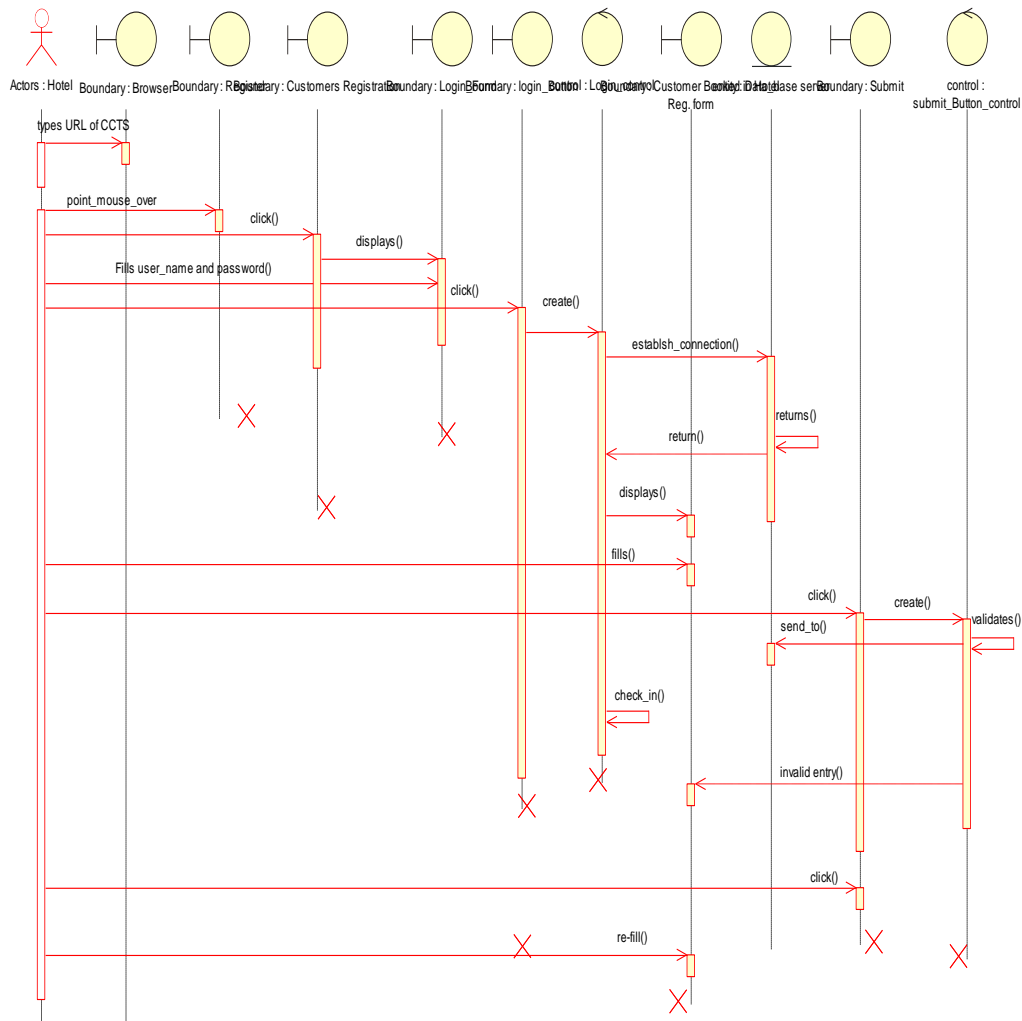


Fig.3.6 Customer BookeFig.4 customer booked in Hotel Use Case Sequence Diagram

As it is illustrated in Fig. 5 Create User Account Sequence Diagram shows how System Administrator manages user account. The user types the URL of the CTS on web browser and press enter key, the login Page is displayed, user fills user and password information then click on the login button, controller will be initiated, and will authenticate and validate the information of the user,

and if it is valid click manage user account button from home page, Manage user account profile is loaded, then user enter valid information and click on the create account button. Finally, system replies the user account creation confirmation message, if data entry is incorrect, refill correct information. If login information is invalid the system return the user to login page.

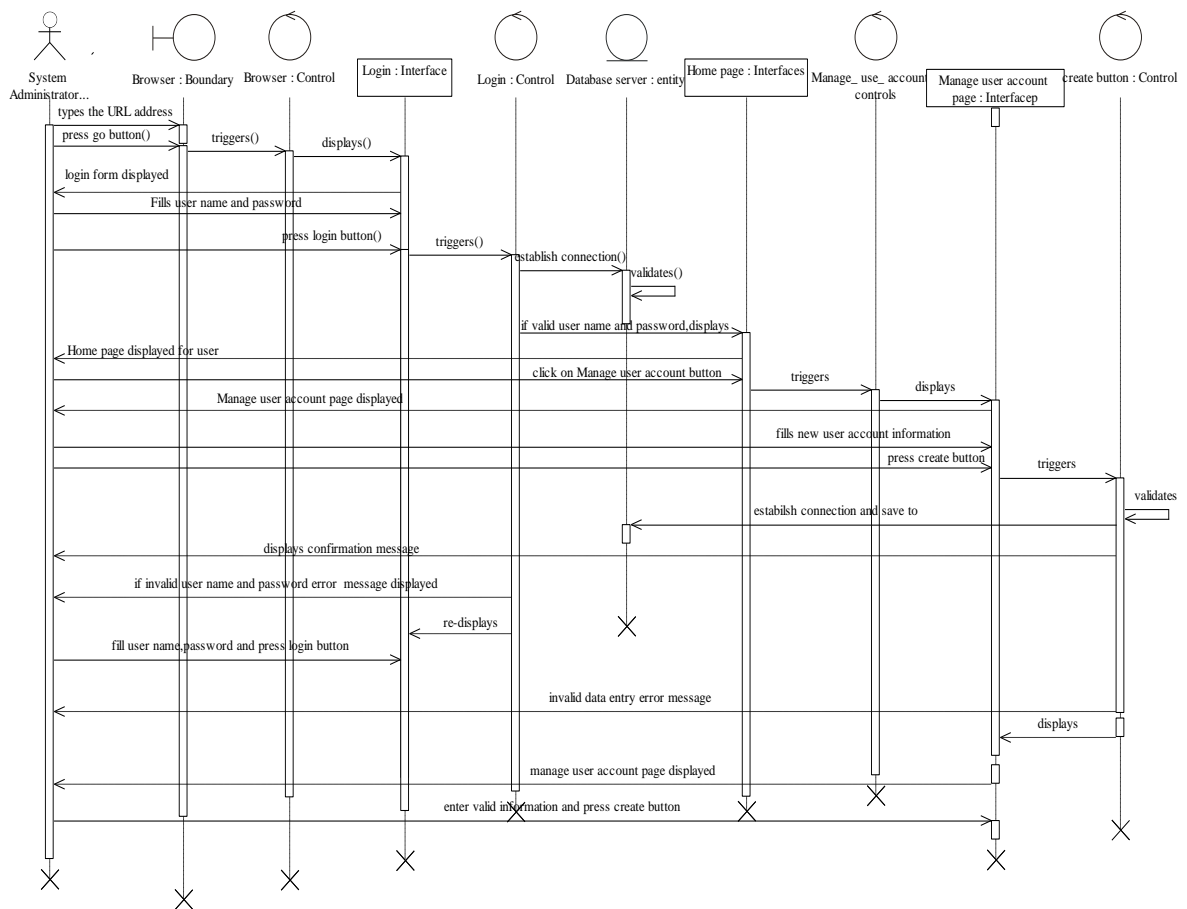


Fig.3.7 Create User Account Sequence Diagram

Crime and Criminal Registration Sequence Diagram Description

The IDO types the CCTS URL on web browser and press Go button, the login page is displayed, the IDO fills login information and hit login button then the login button control instantiate and validation are done. If the validation is correct, the home page will be displayed. The IDO clicks crime and criminals registration button, crime and criminals registration page is displayed, fill the information required and hit register button. If all controls are properly filled the data will be saved to the database and confirmation message is returned.

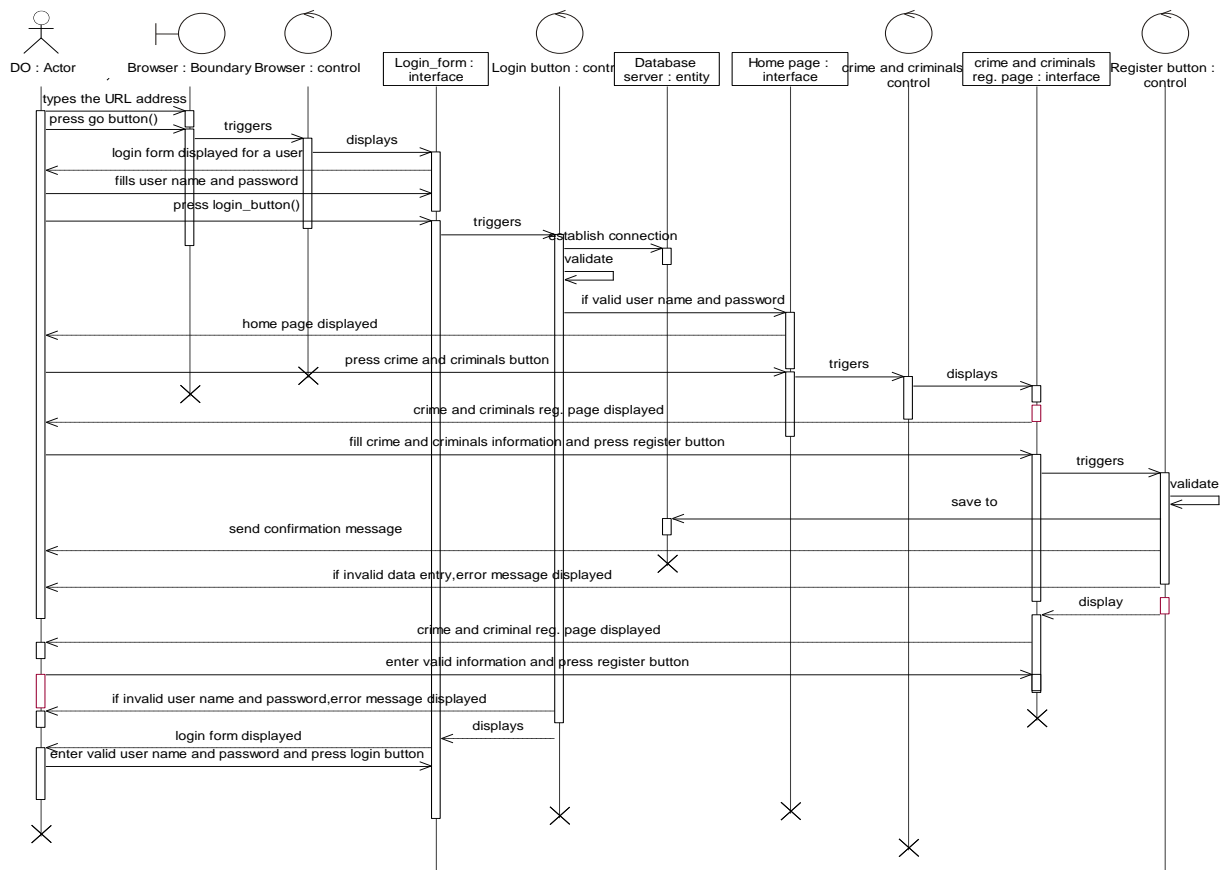


Fig.3.8 Crime and Criminal Registration Sequence Diagram

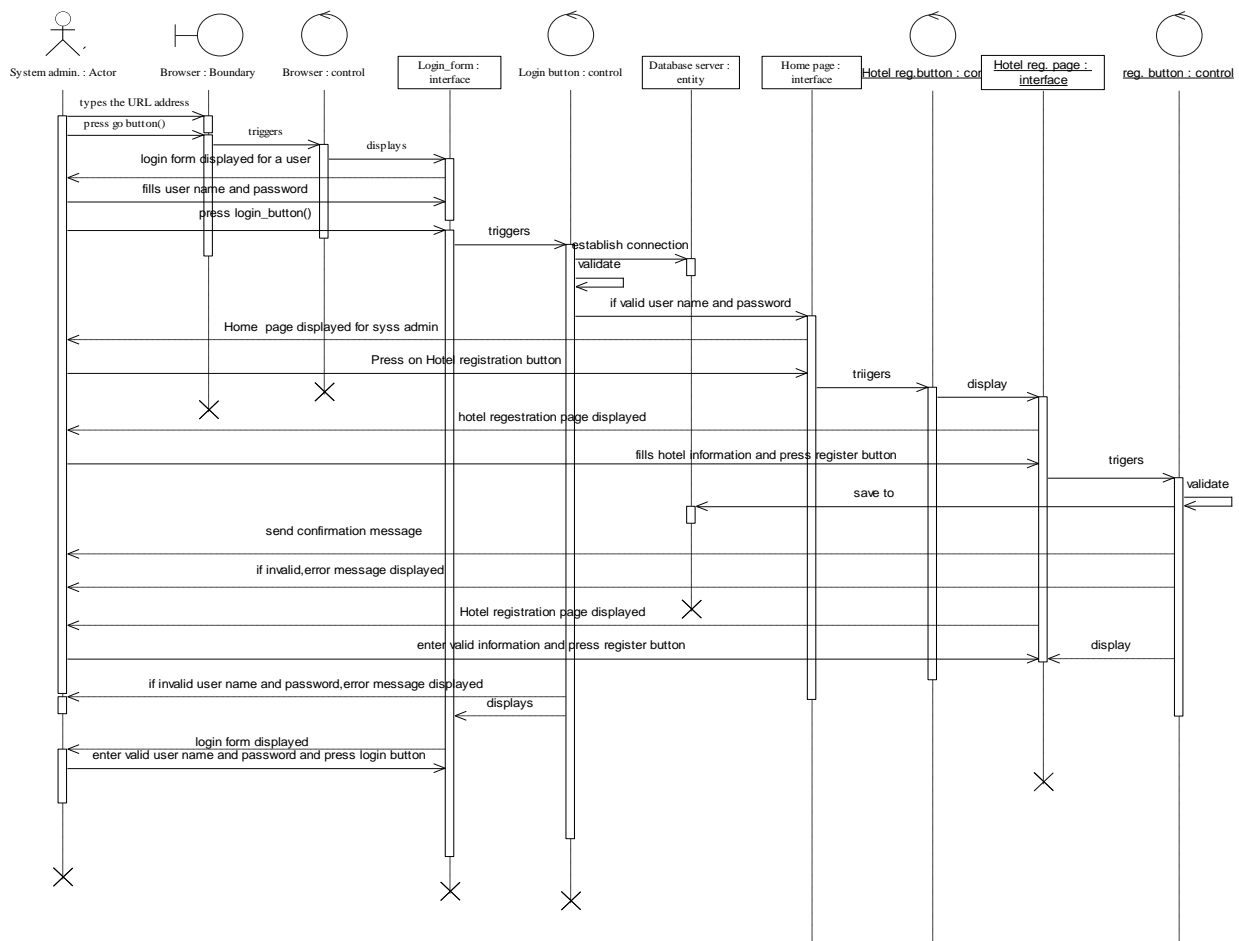


Fig. 3.8 Hotel Registration Sequence Diagram

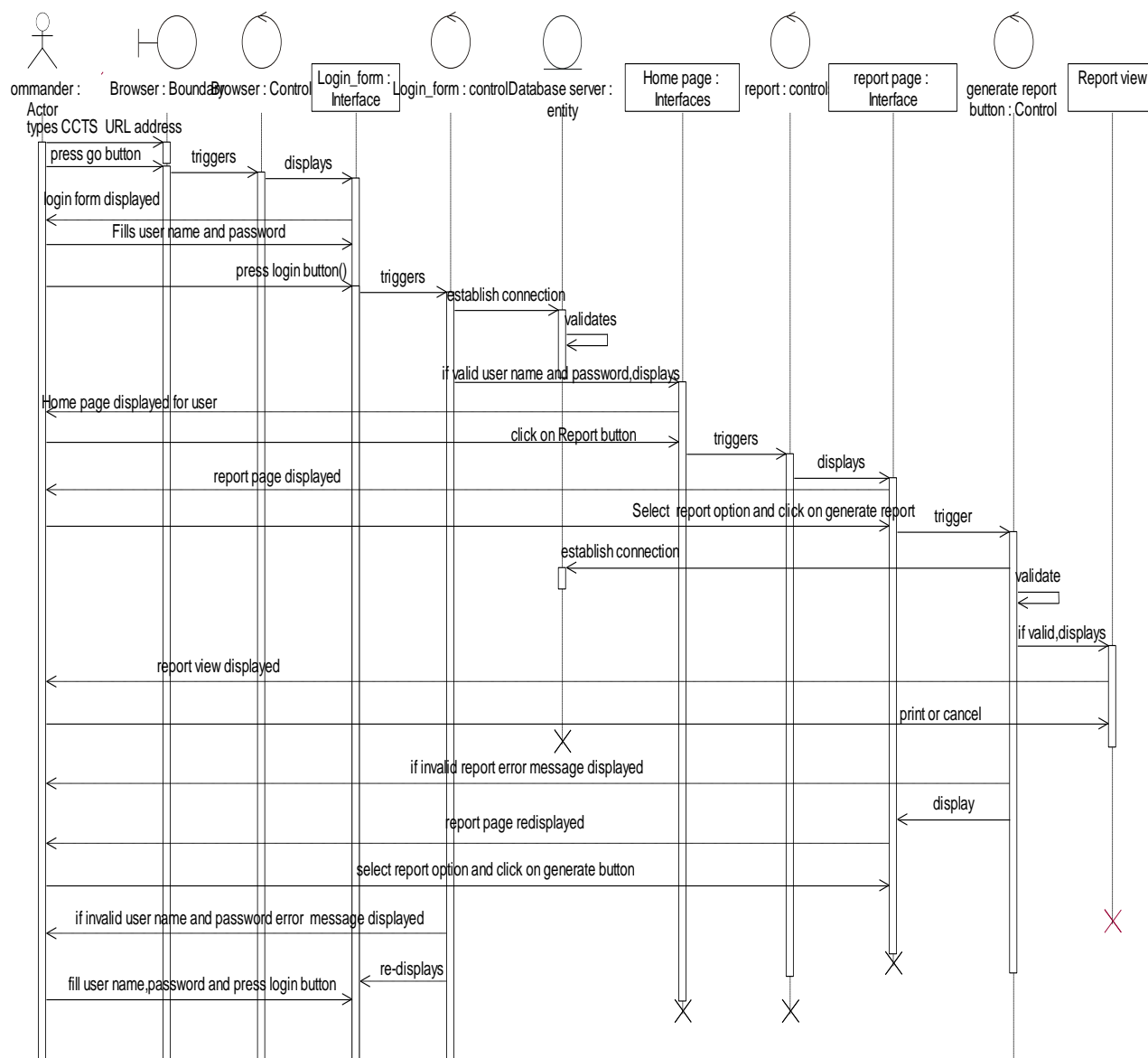


Fig.3.9 Report Sequence Diagram

3.8 SYSTEM REQUIREMENT ANALYSIS

Once requirements have been gathered, the work products noted earlier form the basis for requirements analysis. Analysis categorizes requirements and organizes them into related subsets, explores each requirement in relationship to others, examines requirements for consistency, omissions, and ambiguity, and ranks requirements based on the needs of customers or users.

REQUIREMENTS SPECIFICATION

The System Specification is the final work product or output going to be developed by the system and requirements engineer. It serves as the foundation for identifying what types of tools are required for the development of the new system. In case of CCTS system

project, a written document, the combination of natural language descriptions and graphical model and usage of scenarios are selected approaches that are used in the identifications of the requirements specifications.

ENTITY OBJECTS

Participating objects form the basis of the analysis model. In requirements elicitation, participating objects are found by examining each use case and identifying candidate objects.

The following are entities involved in CCTS projects:

Table 9 Entity List

Entity Name	Description
-------------	-------------

Crime Table	Store crime information
Criminal Table	Store Criminal information
Property Table	Hoard lost property information
Hotel Table	Holds Hotel's detail information
Applicant Table	Used to store applicant or owner information
Hotel Customer Table	Used to store Hotel's customer booked information
User account Table	Used to store user account information
Employee Table	Used to store Adama City Police

	office employee information
Police Station Table	Hoards police stations woreda 1,2,3,4

Boundary Objects

Boundary objects represent the system interface with the actors. In each use case, each actor interacts with at least one boundary object. The boundary object collects the information from the actor and translates it into an interface neutral form that can be used by the entity objects and also by the control objects. Boundary objects model the user interface at a coarse level. They do not describe in detail the visual aspects of the user interface.

Table10 Boundary Objects List

Entity Name	Description
Submit Button	Used to submit form values in to data base
Register Button	A form where system create user name and password for user
Create Button	A button that would be pressed to create user accounts.
Search Button	An interface on which data or information filled or entered
Login Button	Used to trigger login events after login form has been filled
Reset Button	A button to be pressed to clear text box contents
Update Button	A button to be pressed to modify data base contents
Delete Button	A button to be pressed to delete data base contents
Exit/cancel Button	A button to be pressed to logout active user
Browser	Boundary that links actors with interfaces or controls

CONTROL OBJECTS

Control objects are responsible for coordinating boundary and entity objects. Control objects usually do not have a concrete counterpart in the real world. There is often a close relationship between a use case and a control object. A control object is usually created at the beginning of a use case and ceases to exist at its end. It is responsible for collecting information from the boundary objects and dispatching it to entity objects.

Table 11 Control Objects List

Entity Name	Description
Create_account_control	Used to validate account creation process
Lost_Property_Register_control	Used to validate register process
Update_control	Used to validate or control the update process
Delete_control	Used to validate or control the delete process
Login_control	Used to authenticate login process
Generate_report_control	Used to validate generate report process

CrimeandCriminal_control	Used to check crime and criminal process
Submit_control	Used to verify the information of customer booked hotel room with recorded criminal tables.
Home_Page_Control	Used to access the source of knowledge for the employers
Browser_control	Display login form for users
Report_control	Displays report type page
Hotel_registration_button	Used to display hotel registration form
Manage_User_Account_Control	Displays user account page
Reset_control	Used to reset controls to empty string

Table 12 Data Dictionary

Actor Name	Description
Information Desk Officer	Information Desk Officer is a person who register Lost property and crime & criminals at police stations
Commander	Login ,Generate report, search information and View knowledge bases
System Administrator	A person who manage user account, register Hotel, search information, updates records and knowledge bases.
Hotel	A person who logs into the system and register customers' information who booked in the hotel on the behalf of hotel
Staff User	A person who are member of the police office, woreda and able to login into the system and access knowledge base

3.9 Class Diagram And Their Relationships

Class diagram

The class diagram shows how the different entities like crime, criminal, applicant, lost property, hotel, police station, employee, and user account relate to each other. The CCTS class diagram is depicted below.

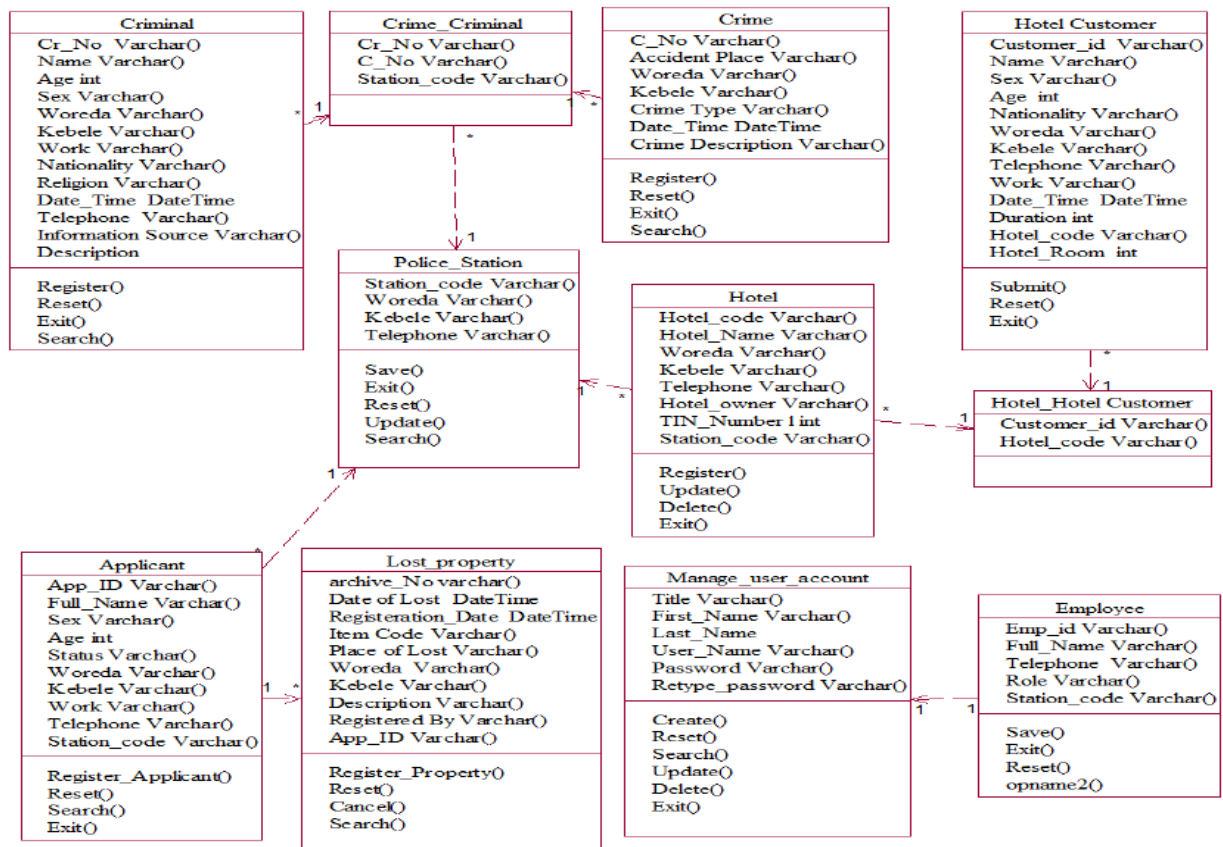


Fig.3.10 Class diagrams with relationships

Since the above entities need further refinement, two conjunction or intermediate tables are used to normalize namely called Crime_criminal and hotel_customer to normalize the relationship between crime and criminal entities and Hotel and hotel_customer entities respectively.

CCTS Entities Relationship

A dependency of any kind between tables in a data model is called a relationship and shown as:

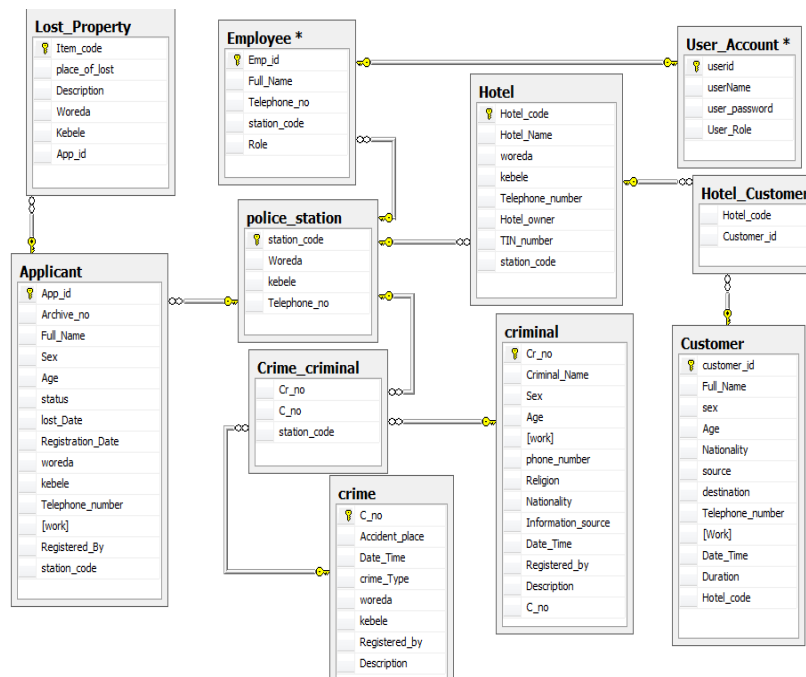


Fig. 3.11 CCTS class diagram with their relationships

The entity relationship figure illustrated above uses some naming convention, description, primary and foreign key as shown below.

Table 13 Naming convention

Entity	Primary Key	Description	Naming Convention	Foreign Key
Crime	C_no	Crime Number	C-no starts with C001.....	-
Criminal	Cr_no	Criminal Number	Cr-no starts with Cr001.....	Station_Code
User Account	User_ID	User identification Number	Auto number	-
Hotel	Hotel_Code	Hotel Unique Code	Starts with three letter followed by three numbers	-
Customer	Customer_ID	Customer booked in Hotel Identification Number	It depends on customers ID numbering format	Hotel Code
Applicant	App_ID	Applicant Identification Number	It depends on applicants ID numbering format	-
Lost_Property	Item_Code	Lost Property serial number or unique identifier	It depends on property's serial number	App_ID, station_Code

3.10 Object Diagrams

Object Diagrams, sometimes referred as Instance diagrams are very similar to class diagrams. As class diagrams they also show the relationship between objects but they use real world examples. Because there is data available in the objects they are often used to explain complex relationships between objects. The object diagram is depicted as:

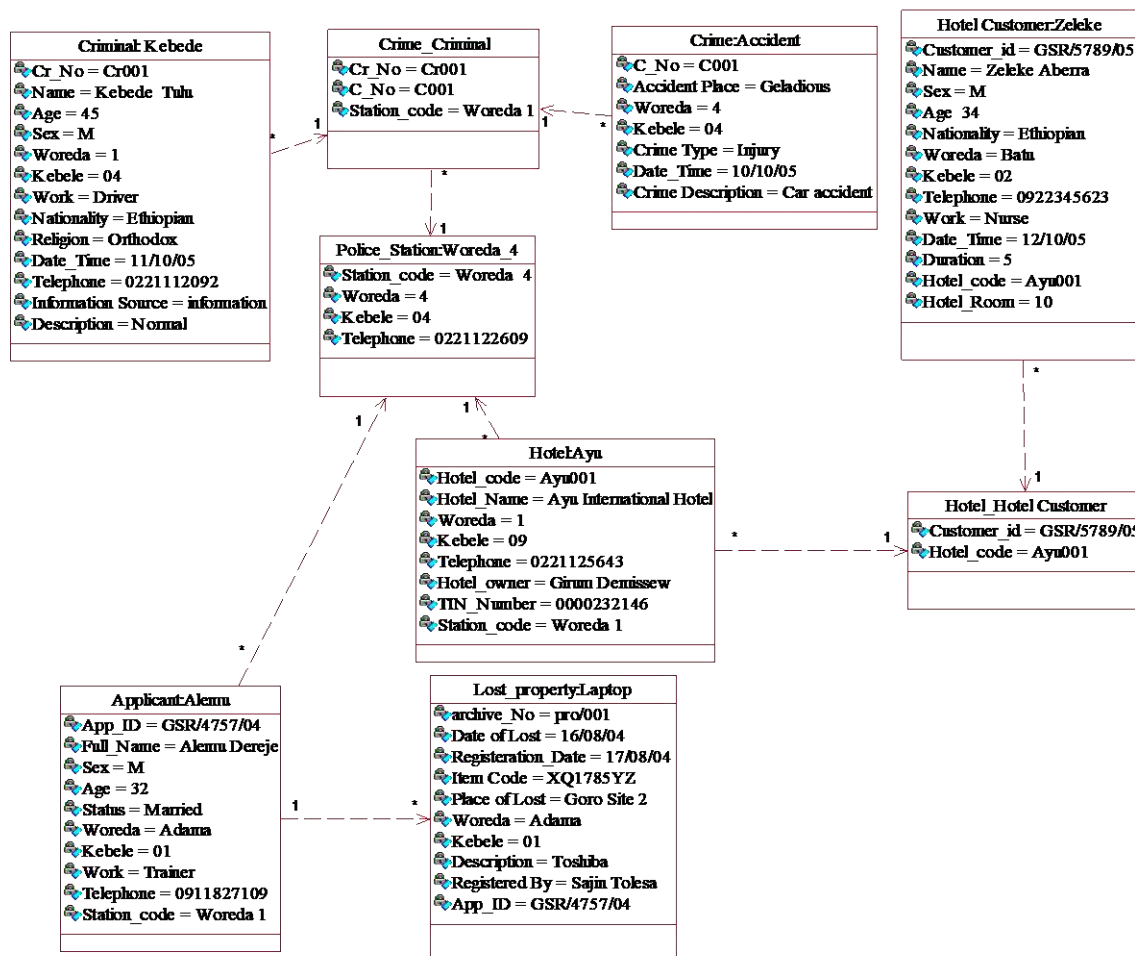


Fig. 3.12 Hotel Customers and Hotels registration object diagram

3.11 ACTIVITY DIAGRAM

Activity diagram is another important diagram in UML to describe dynamic aspects of the system. It is basically a flow chart to represent the flow from one activity to another activity.

Description of the basic notation

- **Initial node:** the filled circle is the starting point of the diagram. An initial node is not required although it does make it significantly easier to read the diagram.
- **Activity final node:** the filled circle with a border is the ending point. An activity diagram can have zero or more activity final nodes.
- **Activity:** the rounded rectangles represent activities that occur. An activity may be physical.
- **Flow/edge:** the arrow on the diagram representing the flow of activities.

The following figures are activity diagrams of the CCTS system project:

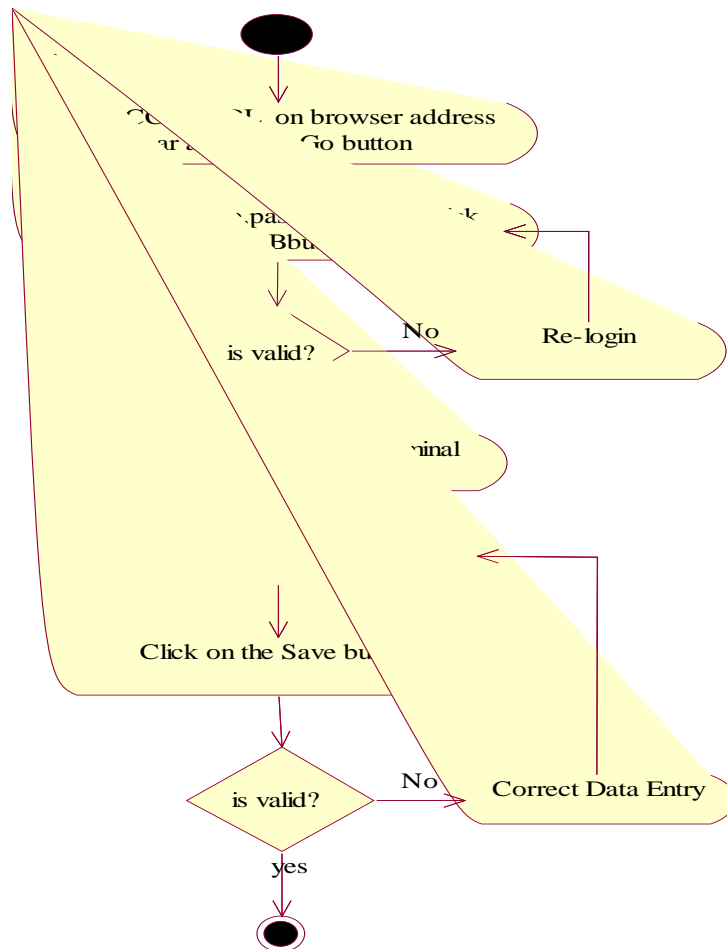


Fig.3.13 Crime and Criminal's Registration Activity Diagram

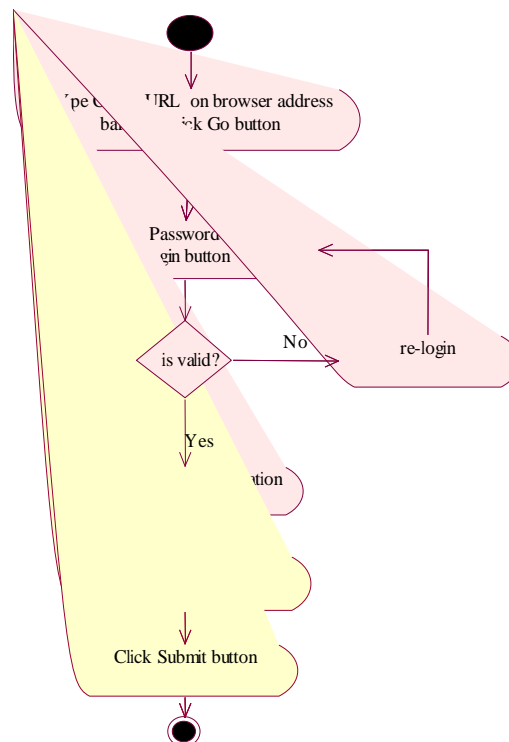


Fig.3.14 Hotel Registration Activity Diagram

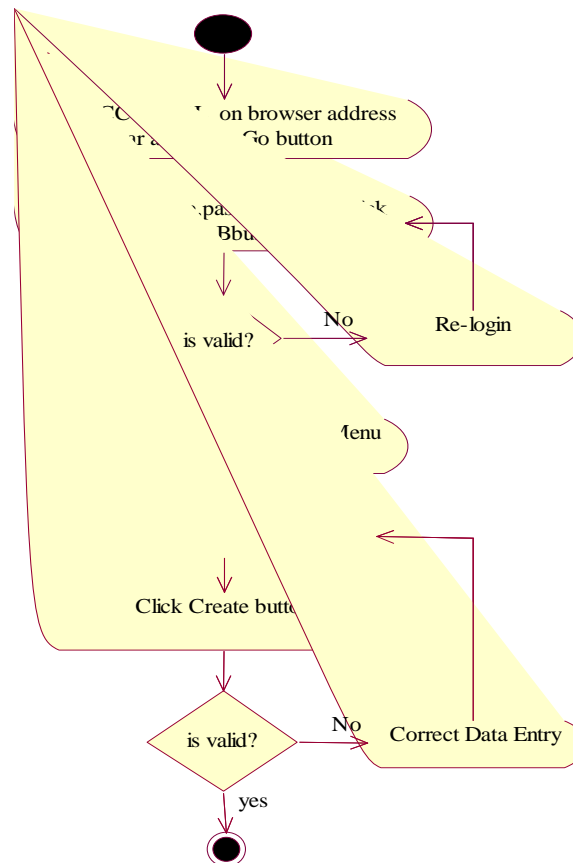


Fig.3.15 Create User Account

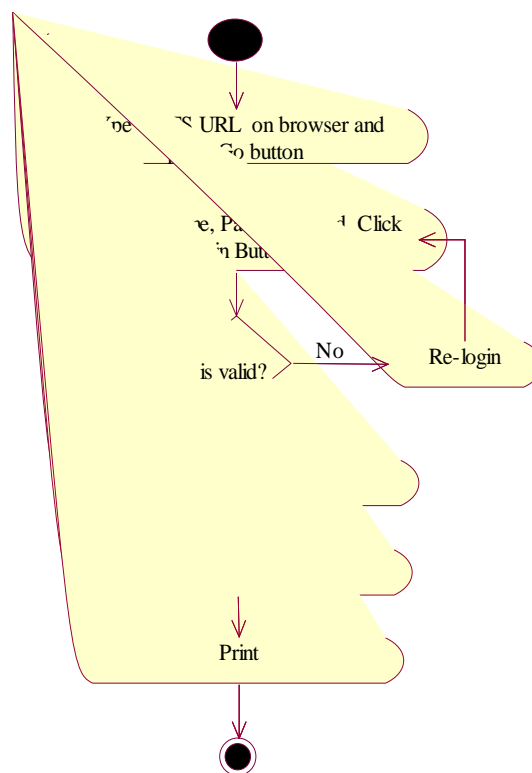


Fig.3.16 Generate Report Activity Diagram

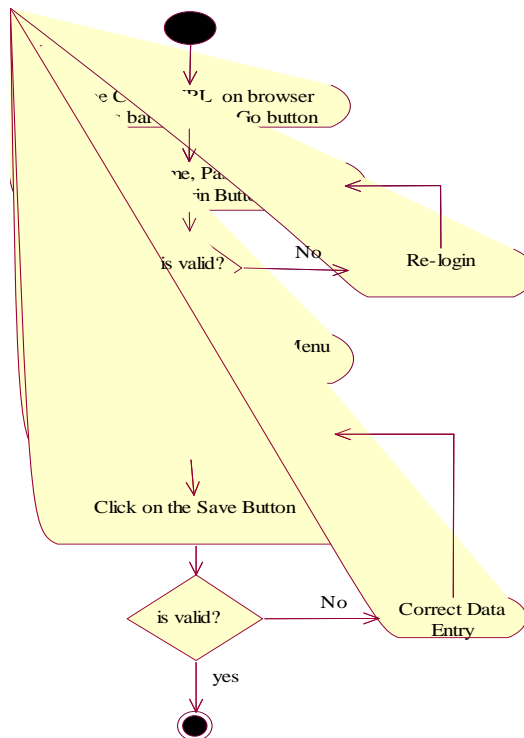


Fig.3.17 Property Registration Activity Diagram

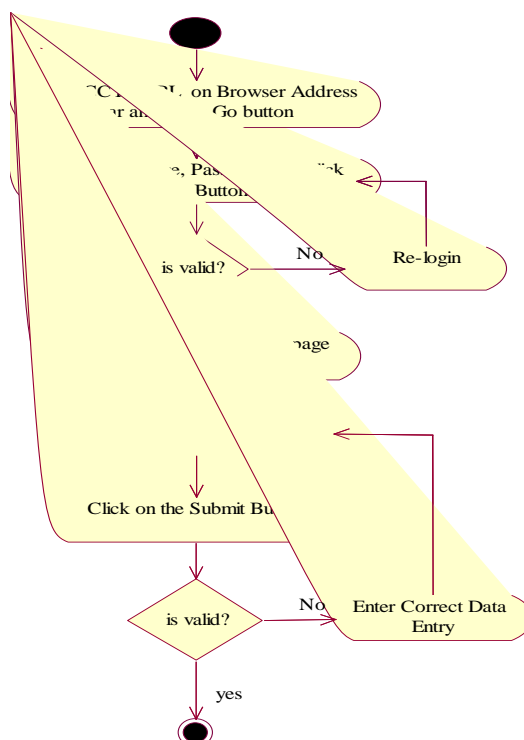


Fig.3.18 Customer's Registration Booked in Hotel Activity Diagram

IV. SYSTEM DESIGN

System design is the transformation of the analysis model into a system design model. Up to now we were in the

problem domain. System design is the first part to get into the solution domain in a software development. This chapter focuses on transforming the analysis

model into the design model that takes into account the nonfunctional requirements and constraints described in the problem statement and requirement analysis sections discussed earlier.

4.1. System Goal

Design goals describe the qualities of the system that the developers should consider.

These goals can be inferred from the nonfunctional requirements already discussed in Chapter 3.

The design goals can be generally grouped into five categories. These are: Performance Criteria, Dependability Criteria, Cost Criteria, Maintenance Criteria, and End User Criteria.

Performance: - The system should respond fast with high throughput, i.e. it should provide search capability and add new records to database within minimum time.

Dependability: - The police office needs the system to be highly dependable. The system should be robust i.e. it should be able to survive invalid user inputs, fault tolerant, reliable and available. Since the system stores sensitive data, high emphasis is given to security to withstand malicious attacks. The system shouldn't allow non- authorized users to access to access the system.

Cost: - The system should be developed with minimum cost possible. Even though the CCTS requires huge budget, the different cost minimization mechanisms are employed such as maintaining malfunctioned materials or equipment's and using existing machines.

Maintenance: - The system should be easily extensible to modify the government rules and regulations criteria, add new functionality, portable to different platforms. The code for the system should be easily readable, understandable and should be easily mapped to specific requirements.

End User Criteria: - The system should have simple and understandable graphical user

interface such as forms and buttons which have descriptive names. It should give reliable response for each user request at least before the session expires.

4.2. System Architecture

The architecture chosen for the system is three tiers. The first layer runs on the client side, the second layer at the middle layer and the third layer will be the database system. The system will run using web technology. This architecture provides greater application scalability, high flexibility, high efficiency, lower maintenance, and reusability of components. Since each tier runs on a separate machine, it improves systems performance.

The system uses dynamic web technology, i.e., adding and retrieving data to and from the data store whenever requested is possible. It requires a client side program which is accessed by the information desk officer, by hotels, by the commanders, staff user and by the system administrator. It needs server side functions that implement the functional requirements and the database system that stores data.

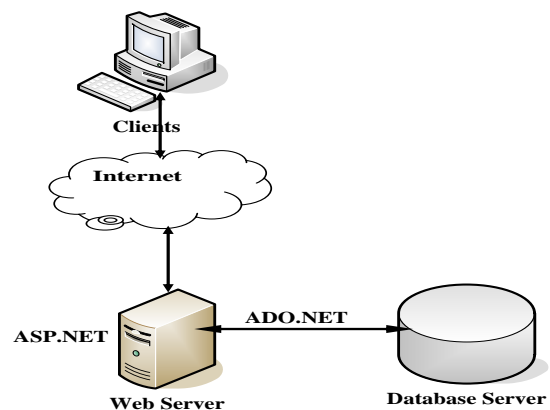


Fig.4.1 Overall CCTS system architecture

4.3. Subsystem Decomposition

From the functional requirements that identified in the system analysis section, the envisaged system consists of the two systems. These are Police System and Hotel System.

Police subsystem package includes the following subsystems:

- Lost Property Registration Subsystem
- Crime & Criminals Registration Subsystem
- Hotel Registration Subsystem
- Generate Report Subsystem
- Search Subsystem
- Access knowledge base Subsystem
- Login Subsystem
- Manage User Account subsystem
- Print Subsystem

Hotel subsystem package includes the following subsystems:

- Login Subsystem
- Customers booked in hotel Registration Subsystem
- Submit subsystem

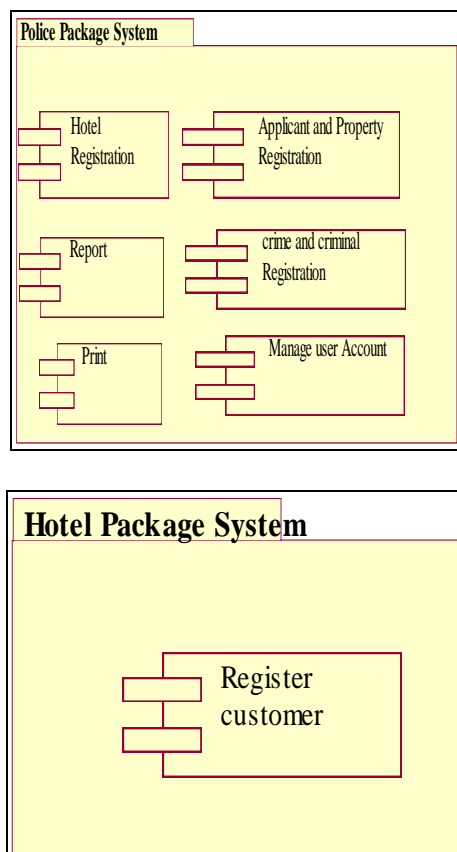


Fig. 4.2 CCTS Package diagram

The description of these subsystems is as follows

4.3.1. Property Registration Subsystem

The property registration subsystem is used to capture and store detail information about stolen, lost and found properties.

4.3.2. Crime & Criminals Registration Subsystem

The crime and criminals registration subsystem is proposed to register and store cognizable crime and criminals. Registration module would enable assignment of a unique number to facilitate proper monitoring. The details captured may include but not limited to missed persons, crime and criminals, suspected person and unidentified dead body.

4.3.3. Hotel Registration Subsystem

This subsystem is used to register new international Hotels in the system database in their nearby police station.

4.3.4. Customers booked in hotel Registration Subsystem

This subsystem should support submission of daily customer's information that booked in hotels to nearby police office woreda and retain copy of it.

4.3.5. Generate Report Subsystem

This subsystem is used to generate the daily, quarterly, semi-annual and annually report by police office woredas to central Adama city police office.

4.3.6. Search Subsystem

The search subsystem enables users of the system to surf or look up any data from the database depending on the privilege they have.

4.3.7. Access knowledge base Subsystem

This subsystem is used to provide common information that helps the staff members to share information and any knowledge base which leads them to increase efficiency and effectiveness in their work according to their access right. Such as rules, proclamation and selected cases which are assumed to be best practice.

4.4. Hardware/Software Mapping

One of the major tasks in system design deals with hardware/software mapping which deals with which components would be part in which hardware and so on. The CCTS is system that performs many functions as described in previous chapter. It consists of web based system used by police stations to record/register criminal and property. The web based system also assists the polices and officials to get or view status and report on cases' achievement and progress and also the web based part is expected to run on a networked environment on different Operating System platforms. The client/server architecture of the system enables different clients to connect to the server remotely through Internet connection. The system has two nodes such as the Web server and Clients. These nodes are shown as UML Deployment diagrams in Figure below.

The nodes can represent specific instances or workstations or a class of computers or web server, which is a virtual machine. The applications of the system will run on the web server connected to the database server by ado.net. Users merely need to start their browsers and enter the URL of the application Web site. The server hosting the Web site is responsible for allocating all the resources the Web application requires.

4.4.1. Deployment Diagrams

Deployment diagrams are used to visualize the topology of the physical components where the system software components are deployed. So they are used to describe the static deployment view of a system. The CCTS web based application is assumed to be deployed in clustered stations (environment) using mini-servers. The users are connected

to the application using internet. The control is flowing from the main server to the clustered or mini-servers.

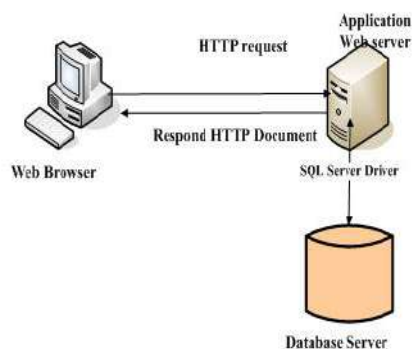


Fig. 4.3 Hardware/Software Mapping

The following diagram shows the CCTS deployment diagram.

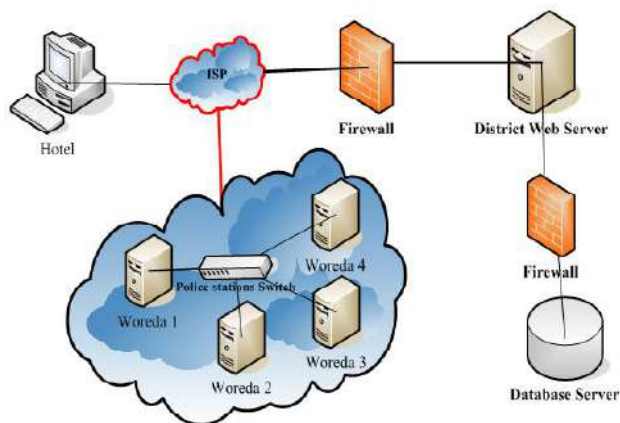


Fig. 4.4 CCTS Hardware deployment diagram

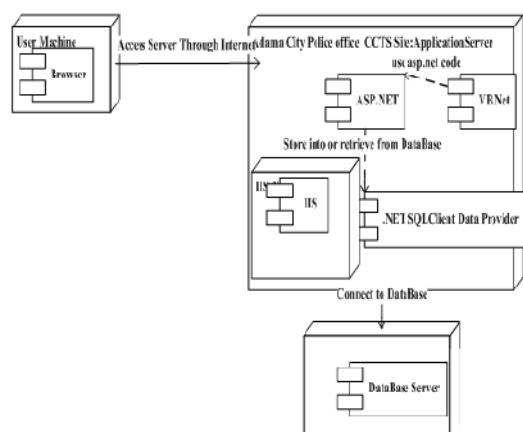


Fig.4.5 CCTS software deployment diagram

4.5. Component Diagrams

A component diagram displays the structural relationship of components of a software system. Components communicate with each other using interfaces. The interfaces are linked using connectors. The following figure shows the component diagram of the CCTS system project.

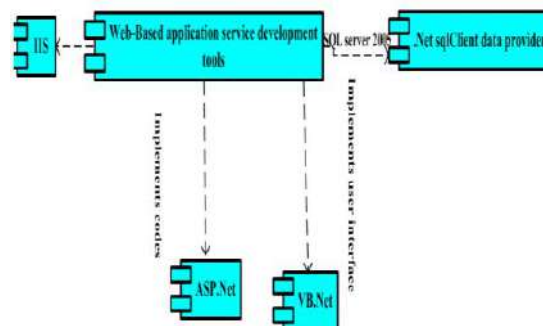


FIG.4.6 COMPONENT DIAGRAM

4.5.1. Persistent Data Management

As it is discussed in the previous sections, the Adama City police office CCTS system consists of a number of sub systems. Property Registration Subsystem, Crime and Criminals Registration Subsystem, Hotel Registration Subsystem, Customers booked in hotel Registration Subsystem, Generate Report Subsystem, Search Subsystem, Access knowledge base Subsystem, Update record Subsystem, and Login Subsystem are web based subsystems that run over a LAN or WAN, and the persistent data of these subsystems will be stored in an SQL Server database.

4.6. Object Relation Mapping

In order to store information persistently we map objects into relations and the attributes into fields to the specific table based on the objects found on the system. Therefore, we identified the major tables that will be implemented on the selected DBMS. For this reason, the mapping of objects to relations is shown as follows:



Fig.4.7 Object Relation Mapping Diagram

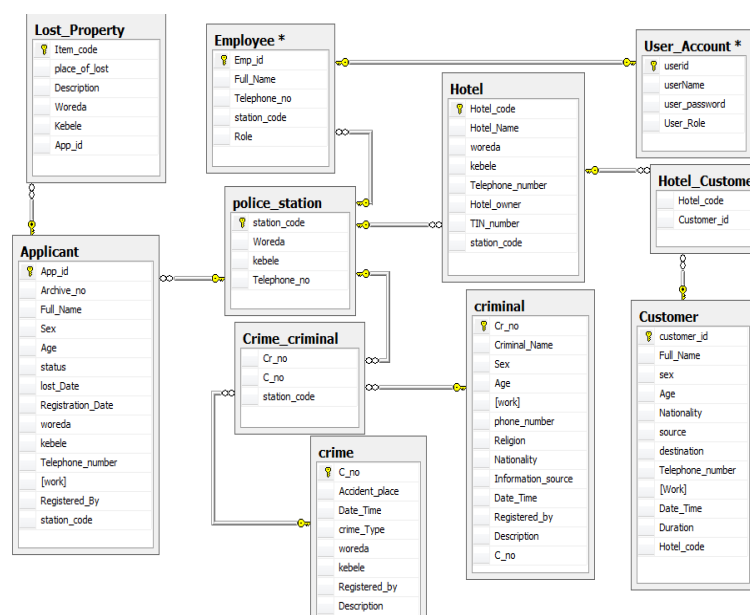


Fig. 4.8 Tables Relationship Diagram

V. SYSTEM IMPLEMENTATION

In this chapter, the tools used in developing the prototype and the developed system are described.

5.1. Programming Tool

The Web application is developed using Active Server Pages (ASP .NET 4.0).

5.2. The CCTS Prototype

Here, the implemented system is described. How the user interacts with the system and some of the results of interaction with the system along with the screen shots are described. When a user types CCTS URL address on web browser, login form is displayed as shown in Figure 5.1 to authenticate the user. If the user has typed the correct user name and password to the login form, the system displays user profile page as shown in Figure 5.1 and then a window containing the main menus of the system is displayed to all users except the hotel as shown in Figure 5.2.

5.2.1. Login Page

The users start Adama city police office web based CCTS system through a login screen displayed as shown below.

Fig.5.1 Login Form

5.2.2. CCTS Home page

Fig. 5.2 Home page

5.2.3. Manage User Account

The manage user account is used to create, delete, update user accounts for users of the system. The system

administrator has all privilege to manage the user account and make system wide changes.

Fig.5.3 Manage User Account Form

5.2.4. Property Registration Form

It is used to register detail information about property lost or stolen or found. The form consists of mainly two sections. These are the applicant detail information section which has the attributes archive number, property owner identification numbers, applicant name, sex, age, status, address (woreda, kebele), date of registration, work and telephone number and property detail information section which consists of the attributes Item Code, Property Type (Stolen, Lost or Found), Place of lost, Date of lost, address (woreda, kebele), and Registered by. The form has Register applicant, register property, Reset and Quit buttons. The Information desk Officer (IDO) at each police station accesses this form by providing appropriate user name and password. Once the form is accessed the IDO fills the detail and hits the save button then the data will be inserted to the database. If error occurs in data entry the system prompts appropriate messages to the IDO and rejects the process. The Clear button is used to reset the value entered to the fields if some misplaced or error occurred and the Exit button is used to exit the form. The graphical user interface is depicted as follow:

Fig. 5.4 Lost Property Registration Form

5.2.5. Crime and Criminals Registration Form

This form is used to register criminals or suspected persons when they are committed crime. The criminal registration form consists of the following attributes. These are Diary number or archive number, Criminal name, mental status, last known address, date and time of registration, sex, Criminal description and photo of the criminal. Crime registration is a form on the same page which is used to register crime details with attributes Crime identification number (CID), Crime Type, address (kebele, woreda), date and time, crime description. The form also includes three buttons namely Register, Reset, cancel and Search button.

Fig. 5.5 Crime and Criminal Registration Form

5.2.6. Hotel Registration Form

This form is used to register hotels detail information. It is filled by the system administrator. The form or page consists of Hotel code, Hotel Name, Address (Woreda, Kebele), TIIN number, hotel owner and Telephone number attributes and four buttons. The buttons are Register, Update, Delete and Exit. The Register button is used to insert new hotel information into the hotel database. The Update button is used to alter attributes of the table when required, for example, when the TIN number is modified or its name is changed. Exit button is used to exit the registration form.

Fig. 5.6 Hotel Registration Form

5.2.7. Customers booked in hotel Registration Form

This form is used to register customers booked in international hotels. While hotels register their customers the data will be submitted to the nearby police station.

Fig. 5.7 Customers Booked in Hotel Registration form

3.2.8. Report Subsystem

This subsystem is used to generate daily, monthly, semiannual and annual reports. When generate report button is clicked the following page is displayed. Select the report type and data source you want to generate from and then click generate button.

For example, the data source selected is user account table.

Fig. 5.8 Generate report page

The following report will be displayed when user clicks on generate report button.

Report View page					
Title	First Name	Last Name	userName	user_password	Con_password
Insp. Tola	Bekele	betesfa	Tola	Tola	Tola
Insp. Tesfaye	Bekele	betesfay	x45@er	x45@er	x45@er
Insp. Mesfin	Bekele	mesfin	mesfin	Mesfin	Mesfin
comm. Tufa	Bekele	tfa200	password	password	password

Fig. 5.9 Daily report generated

3.2.9. Access knowledgebase Subsystem

It is the subsystem in which only accessed by internal user of the system (Adama city police staff) to easily exchange information such as news, best practices, proclamation and etc. The interface varies according to the type of information to be posted to the site.

VI. CONCLUSION AND RECOMMENDATION

6.1. CONCLUSION

Crime is a complex social phenomenon, particularly; technology advancements now a day make more complicated and its cost and impact on the society is increasing. Hence, law enforcement organizations like that of police need to learn the factors that constitute higher crime trends. To control or track this social evil there is always a need for prudent crime prevention strategies and policies. Understanding and processing of criminal records is one method to learn about both crime and individuals who involve in misdeeds so that police can take crime prevention measures accordingly.

In this project so as to combat such challenges the CCTS helps to keep data of customer's booked in international hotels, applicants and their lost or stolen properties details at district and police office stations or woredas. These data is used to facilitate crime and criminals tracking for future or at the time of recording. The system provides comparison facilities about suspects or criminals when the hotel submits daily report to the nearby police station and provides notification to the system administrator.

The other issue that is being addressed in this project is sharing of information among the four police stations and the district so that best practice, stolen properties, news, and progress of the cases are commonly available to stations. Reports are generated by clicking button.

In addition to this, the system enables hotels to send or submit report through network which reduces the cost they incur for human labor, paper, and to save time.

6.2. RECOMMENDATION FOR FUTURE WORK

Since the system on crime and criminal tracking system in Ethiopia is in its infant age it is more recommendable for future work to be further be researched in the area. The CCTS is mainly emphasized on crime and criminal, lost property registration and linking international hotels to police station at Adama city police office and crime prevention and detection core police function. The recommendation for

A) Future researchers

- May develop for a region or a nation.
- The crime and criminal tracking IT tools used by police should need further investigation.
- May develop system on other core police functions
- May develop system that enables citizens to give and receive services directly through the system

B) Adama Science and Technology University

We would like to suggest Adama Science and Technology University to provide assistance for projects that are very important for the region or nation through timely financial services, material provision, journals shortage and preparing curriculum relevant to the specified qualification levels and occupation. The timetable for projects was not posted prior to date. These reduce the quality of the project. We would like to suggest the university to closely see such obstacles for successful completion of projects.

C) Adama City Police Office

The CCTS is developed based on the data gathered from the city police office and the prototype is tested with the actual data used in the office and it has seen that successfully facilitate crime and criminal tracking or detecting. It is suggested that the police office to deploy and use it.

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Two-year follow-up of a direct pulp capping and dental fragment bonding with self-adhesive cement – Case report

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Abstract— Fractures in permanent teeth due to trauma have become an increasingly frequent problem, and these fractures often affect the dentin-pulp complex. Direct pulp capping with MTA and tooth fragment reattachment with a self-adhesive resin cement proved to be a minimally invasive and high success rate procedure over one year follow-up. The objective of this article is to discuss relevant aspects about tooth fragment reattachment and direct pulp capping, reporting a clinical case of anterior tooth fracture. MTA was selected as the direct pulp capping material and tooth fragment reattachment was bonded with a self-adhesive resin cement. Clinical examination after one year recall showed excellent function and esthetics, pulp vitality and periodontal health.

Keywords— Dental Bonding, Dental Esthetics, Dental Pulp Capping, Tooth Crown.

I. INTRODUCTION

The largest number of coronary fractures occur in anterior teeth, mainly in children and adolescents (ANDREASEN; ANDREASEN, 2007; DIETSCHI et al., 2000). The most affected tooth by this type of injury is the maxillary central incisor, due to its most prior position (ZUHAL et al., 2005; BRUSCHI-ALONSO et al., 2010). One conservative and aesthetic way to rehabilitate traumatized teeth is bonding the original tooth fragment to the fracture substrate, the so-called tooth fracture reattachment (FARIK et al., 2002; CORRÊA-FARIA et al., 2010). With this approach, clinical time is decreased, there is less wear and more predictable long term results, compared with composite restorations (FARIK et al., 2002). Authors have reported a 10-year follow-up case report of a tooth fragment reattachment in a lower canine, showing the longevity that this technique may achieve (RESTON et al., 2014). In another study, Moura et al (2013), reported 18 years of success of bonding a homogeneous tooth fragment.

When dental trauma generates pulpal exposure, it is necessary to protect the exposed remnant tissue. Direct pulp capping is indicated when the pulp is accidentally exposed during cavity preparation or by trauma – at least 24 h after the accident (ANDREASEN; ANDREASEN,

1991). Several materials are available to be used in this technique, such as mineral trioxide aggregate (MTA) and calcium hydroxide (CH). The current biocompatibility technology allows the application of these materials in direct contact with the pulp, in cases of small exposures and absence of bleeding, in order to stimulate the dentin bridge formation (ANDREASEN et al., 1995; SAWICKI et al., 2008). The treatment longevity with direct pulp capping using MTA has proved to be more effective than calcium hydroxide (WITHERSPOON, 2008; MENTE et al., 2014).

According to Reis et al. (2009), several materials may be used for bonding dental fragments, such as resin modified glass ionomers, flowable composite and resin cements. In another study, the authors used conventional microhybrid composite resin to reattach the tooth fragment (Macedo et al., 2008). The use of just an adhesive system to adhere the tooth fragment was also reported in the literature (VADINI et al., 2011). In the last years, a new generation of materials were developed, which had the main purpose to decrease the clinical steps, consequently reducing the overall clinical time dispensed. This is the case of self-adhesive resin cements (RADOVIC et al., 2008). However, there are few studies in the literature with the use of these resin cements to reattach tooth fragment.

In this way, the objective of this case report is to describe the treatment and two-year follow-up of a crown fracture with pulp exposure, treated with MTA as the direct pulp-capping agent and restoration by fragment reattachment combined with a self-adhesive resin cement.

II. METHOD

A 22-year-old male patient had an accident fall and fractured the crown of the upper right central incisor tooth (tooth 11 in the ISO system or tooth 8 in the universal numbering system) (Fig. 1). The tooth fragment was recovered by the patient and maintained in water until his appointment at the Clinic of State University of Ponta Grossa, PR, Brazil (Fig. 2).



Fig. 1: Fractured tooth 11



Fig. 2: Tooth fragment

During clinical examination, the patient only reported a slight sensitivity in the dental element. Intraoral examination revealed an oblique fracture line and pulp exposure (Fig. 3), but no alveolar bone fracture. The initial radiograph indicated complete root formation and a closed apex with no periapical radiolucency (Fig. 4).



Fig. 3: Tooth tooth with oblique fracture and pulp exposure

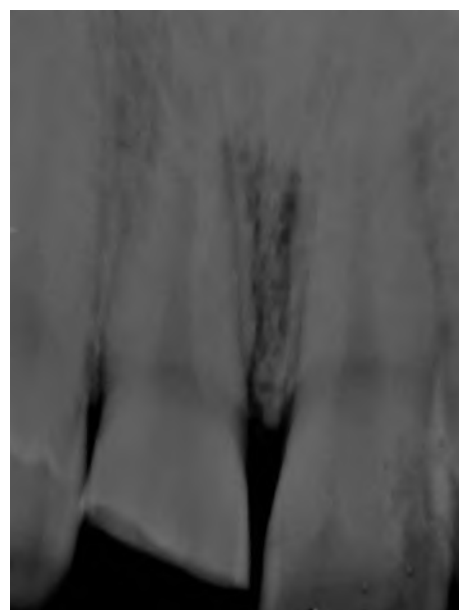


Fig. 4: Radiography showing normal periapical region

Vitality test was conducted (Endo Ice, Maquira, Maringá, PR, Brazil) and the tooth responded positively to the test. There was no pain with percussion test. The other teeth were not affect by the trauma. The treatment plan consisted of direct pulp capping, as the exposure was recent, and tooth fragment reattachment. The patient agreed with the treatment plan and signed the written consent term.

Prophylaxis and infiltrative anesthesia (3% Citanest, prilocaine hydrochloride and felypressin) were

performed. The operating field was isolated with a rubber dam and the dental fragment was placed in position to analyze the adaptation. After obtaining hemostasis, the exposed area was cleaned with copious irrigation of saline solution, and air-dried. The protection of the dentin-pulp complex (Fig. 5) was done with MTA-Angelus (Angelus, Londrina, PR, Brazil), which was manipulated according to the manufacturer's instructions: one sachet with one drop of distilled water were mixed for 30 s in a glass slab with a metallic spatula. A 2-mm thick of the material was slightly condensed over the pulpal exposure with an amalgam condenser (#1, Duflex, SS White, Rio de Janeiro, RJ, Brazil). After the setting time established for MTA (15 min), a small portion of self-adhesive resin cement (RelyX U200 3M ESPE, St. Paul, MN, USA) was manipulated, placed on dental substrate and on the fragment, and light-cured for 20 s (Fig. 6) with an LED light-curing device (Radii-Cal SDI, Bayswater, VIC, Australia) using a power intensity of 1200 mw/cm².



Fig. 5: Protection of the dentin-pulp complex with MTA



Fig. 6: Polymerized of self-adhesive resin cement joining fragments

In order to mask the fracture line, the enamel/fragment interface was beveled with a spherical diamond bur (# 1014 KG Sorensen, São Paulo, SP, Brazil), acid-etched for 30 s (Fig. 7) (37% Phosphoric acid, Condac, FGM, Joinville, SC, Brazil) and cleaned with air/water spray. One single coat of adhesive system (Adper Single Bond 2, 3M ESPE, St. Paul, MN, USA) was applied and light-cured for 10 s. A composite resin (Shade A2, IPS Empress Direct, Ivoclar Vivadent, Schaan, Liechtenstein) was placed over the fracture line (Fig. 8), and light cured for 40 s (Radii-Cal). After that, the resin was finished with abrasive discs (Sof-Lex 3M ESPE, St. Paul, MN, USA), polished with abrasive silicon tips (Optimize-TDV, Pomerode, SC, Brazil) and diamond polishing paste (Diamond Gloss, TDV) (Fig. 9). The occlusion was carefully checked and adjusted in all excursive movements.

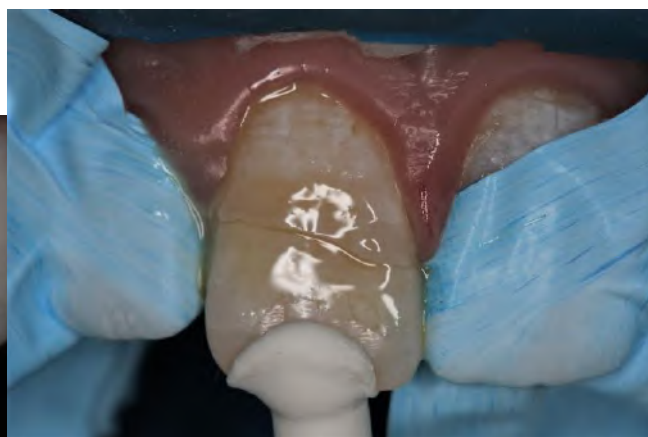


Fig. 7: Groove in the fracture line



Fig. 8: Fracture line masking



Fig. 9: Polishing with diamond paste

III. RESULTS

The patient was recalled in 1 week, 1 month, and 6 months. At the recall appointments, new radiographs were taken, and the pulp-capped tooth was tested with a cold stimulus, responding positively in every section. The two-year recall view also showed the adequate results in terms of aesthetics and functionality (Fig. 10), and another radiograph was taken (Fig. 11).



Fig. 10: Bonding after 2 years



Fig. 11: Periapical radiography showing periapical health

IV. DISCUSSION

Dental trauma is considered a public health problem, causing psychological, aesthetic and physical damages (DIAZ et al., 2010). Reattachment of a fragment to the fractured tooth may result in a positive psychological response by the patient (MAIA et al., 2003).

Dental fragment reattachment is one of the suitable techniques to reestablish aesthetics and function to a fractured dental element (REIS et al., 2004). In contrast to the conventional composite resin restoration, which may result in a not-so-similar coloring and natural contours, the fragment bonding preserve the color, texture, incisal translucency, original tooth anatomy and the clinical time dispensed to a fragment reattachment is less than a composite resin reconstruction, also this is a low-cost technique to the patient (GOENKA et al., 2010).

However, in more severe coronary fractures, where there is pulp exposure, it is necessary to establish the pulp involvement degree. In this way, collection of subjective and objective data is required to perform a well-conducted diagnosis (DIANGELIS et al., 2012). In the present case report, to achieve the correct diagnosis and consequently a correct treatment plan, periapical radiographs and pulp sensitivity test were conducted. It is important to perform control radiographs in the recall appointments to observe the success of the treatment, as was as done in this present study. Radiographs are very important when dental trauma occurs in order to analyze if there is the presence of periapical lesions, root fractures, invasion of the biological space or involvement of other teeth.

The sensitivity test was done to evaluate the pulp involvement degree. It may be selected a thermal test (cold or hot) or electric test (DIANGELIS et al., 2012). In this study, the cold test was chosen as it present higher sensitivity and specificity compared to other tests (DIANGELIS et al., 2012). Once the teeth responded positively, the most recognized procedure to protect the dentin-pulp complex is the direct pulp capping. The main purpose of this conservative approach is place a biocompatible material, directly on the exposed pulp, to provide the formation of a dentin bridge (ASGARY; AHMADYAR, 2013; ROTSTEIN; INGLE, 2019). This procedure aims to maintain and preserve dental pulp vitality, function and health, besides being a minimally invasive therapy as compared with conventional endodontic treatment, as pulpotomy and biopulpectomy (BERMAN, HARGREAVES; 2015). The most employed materials used in this technique are MTA and calcium hydroxide. Although calcium hydroxide is the most frequently used material for direct pulp capping, being considered gold standard for this type of technique for many years, MTA may also be used for this procedure and satisfactory results were found in the last years (WITHERSPOON, 2008; TORABINEJAD, PARIROKH, 2010; MENTE et al., 2014; LI et al., 2015; ROTSTEIN; INGLE, 2019). MTA is a calcium silicate based cement composed of tricalcium silicate, tricalcium aluminate, tricalcium oxide, silicate oxide and other mineral oxides. As well as calcium hydroxide, MTA induces the formation of dentinal bridges (TORABINEJAD, PARIROKH, 2010; ROTSTEIN; INGLE, 2019).

Several studies compared the efficacy of MTA and calcium hydroxide in direct pulp capping (WITHERSPOON, 2008; GOENKA et al., 2010; MENTE et al., 2014; LI et al., 2015). Mente et al. (2014), in a cohort study, observed that MTA is the best option for direct pulp capping compared to calcium hydroxide, when a definitive restoration is made immediately after the conservative pulp therapy. Witherspoon (2008), concluded that MTA is an excellent material indicated for vital pulp therapy and better than calcium hidroxide, in terms of clinical outcome results, as high success rate and long-term sealing capacity.

The materials based on calcium hydroxide tend to dissolve over time and leave a gap between tooth and restoration (HILTON, 2009). Other studies show that both materials induce the formation of hard tissue; however, the hard tissue formed in teeth treated with MTA is more homogeneous and thicker than that produced in teeth treated with calcium hydroxide, so the MTA was the

material of choice for this case report (SAWICKI et al., 2008; LI et al., 2015).

The pH of both materials is similar (10 and 12, respectively for calcium hydroxide and MTA) (PARIROKH; TORABINEJAD, 2010). The antimicrobial potential of MTA is greater than calcium hydroxide, because the pH of calcium hydroxide falls rapidly, while the pH of MTA remains alkaline for longer periods.

Yadav et al. (2013), using the self-adhesive resin cement to bond the tooth fragment, concluded that it is a conservative treatment and less time consumer option. The application mode of the self-adhesive resin cements is significantly simplified, eliminating the etching and adhesive application procedures. These materials combine the characteristics of composite resins, self-etching adhesives and in some cases, luting agents. Positive results of this category of resin cements, found in the literature, are the less susceptibility to humidity, when compared with zinc phosphate cement and conventional resin cements (RADOVIC et al., 2008; GUARDA et al., 2010). Regarding microleakage between dental substrate and resin cements, the results are controversial. Ibarra et al., 2007 showed decreased microleakage between dentin and conventional total-etching cements, compared to self-adhesive cements. On the other hand, Behr et al., 2004 obtained similar marginal adaptation results to dentin and enamel with both conventional and self-adhesive resin cements. In terms of clinical outcomes, the post-operative sensitivity reduction and color stability over time were also found for the self-etch resin cements (BEHR et al., 2004; COSTA et al., 2006).

The dental fragment bond is an extremely conservative procedure, fast and with low cost for the patient, with a very satisfactory aesthetic, being almost imperceptible and an excellent choice of treatment.

V. CONCLUSION

It is possible to conclude that with a correct diagnosis, appropriate materials and monitoring over time, high success rate may be achieved in cases of dental trauma with pulp exposure. Direct pulp capping with MTA and tooth fragment reattachment with self-adhesive resin cement is a simple and fast procedure, which preserved the tooth integrity and promoted excellent aesthetics after two year follow-up.

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Environment Policy and Participation in the Tocantins River Basin, Brazil

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Abstract—A water generated energy is - in the context of care of the environment - an overwhelming international challenge. As far as spring water and water reservoirs are concerned - as in the savannah biome (Cerrado) area of the Tocantins river - care of the environment requires as well technological management as sustained management including participation of local population. The River Basin Management of Tocantins – RBM-TO, has developed institutional procedures in handling the technological management, there is a need to improve the participation of local population in a sustained management process concerning decision making in questions of care of the environment. Water utilization in that savannah area has often been a controversial issue; the fact is that conflicts are caused by a permanent change of climate in that area comprising aridity and inundations. Issues such as generation of energy, water supply and its utilization, and care of the environment have great influence over the quality of life of the local population. The balance and reduction of the environmental impacts, the participation of the local persons concerned must be ensured; surveys and analysis's referring to integrated socio-ecological aspects in support of managing and planning of areas in the region.

Keywords—Environment, Planning, Sustainability.

I. INTRODUCTION

Public participation in the process of environmental protection through technological projects is based on a new approach to environmental management. The central point of the discussion deals with improvements to the efficiency of existing management tools. In the case of water sources and reservoirs with multiple uses in areas of Brazil's savannah biome (Cerrado), according to Myers and Camargo "the most biodiverse Savannah in the world" (Myers; Camargo, 2019, p. 99), sustainable social-environmental policies and broader participation of the general public in matters related to environmental protection are instruments that can guarantee the better functioning of technological systems and of power relations in the governance process. Neves's contributions are relevant to the governance process, "The participation of civil society in water resources management policies occurred until the present administration through the Hydrographic Basin Committees, which foresees the participation of public powers, users and civil society, limiting to 50% of the total representation of public power. Nevertheless, the participation rights are threatened by measures recently taken by the federal government, such as a provisional measure that

extinguishes participative committees and councils." (Neves, 2019, p. 60).

Sustainable social-environmental policies make it possible to properly manage environmental risks, including analyses that support the process of participation, implementation, accompaniment, and evaluation of actions. The environmental impacts and risks are analyzed starting with the initial steps of identification, quantification, minimization and mitigation. These analytical steps generate results that can be used to formulate public policies and ensure the environmental sustainability of water sources and reservoirs for various uses by future generations. The objective of this article is not to make an analysis of environmental impacts and risks of water sources and reservoirs in areas of the savannah, which would require researching some examples of case studies, something that does not correspond to the purpose of this work. The analysis presented here focuses on studies and research, based on information and proposal specifically to manage the water resources of the watershed of the Tocantins river in Brazil.

A number of environmental problems have been identified in the Tocantins river watershed, which is notable for its diversity of water sources and for the rapid development of rural and urban areas (PINTO, 2017). The Tocantins

river basin is located in the savannah biome, being part of what is actually a complex biome that supplies the sub-watersheds of the Araguaia and Tocantins rivers. The water resources of the Tocantins river are undergoing transformations that are causing problems due to the unplanned growth of the urban population, the lack of compliance with existing environmental legislation, inadequate investment in studies and research, lack of information regarding water uses and users, informal mining activities and uncontrolled burning of savannah vegetation, among other things. Of particular note is the unregulated use of lands near the banks of the river for agricultural activities, insufficient protective vegetation along the banks of the river due to the fluctuation in water level, growing use of the adjoining land for agricultural projects, besides the release of untreated domestic sewage and the erosion process of soil and margins. Sustainable management and local participation are instruments that can enable better management of environmental impacts and the reduction of the problems identified.

The objective of the present article is to highlight the importance of social-environmental policies in the public participation process. Indeed, public participation is considered fundamental to the success of environmental protection initiatives, through technology projects and mechanism that contemplate approaches to environmental management. The research discussed herein covers environmental problems identified in the Tocantins river basin caused by the construction of hydroelectric dams, their reservoirs and multiple uses. It also corroborates distortions in water levels and various activities that can have possible environmental impacts. These impacts can occur during construction and with the initiation of operations, producing changes to the atmosphere, water supplies, animal and plant species, in the region of construction and the area affected by the artificial lake. The environmental impacts are additional to the economic, cultural and social impacts. They modify the natural system of the region, with the alteration of the quality and availability of water, provoking conflicts related to the forms of water use (TUNDISI & STRASKRABA, 1999; REBOUÇAS, 2001; TUNDISI, 2013). The minimization of conflict through integrated actions by means of sustainable policies and the participation of the society can make it possible to reduce problems related to the degradation of water quality and supply to end users, guaranteeing in this way a greater environmental sustainable for the region.

The planning of actions for the management of watershed resources should follow criteria for use of reservoirs for the better management of environmental impact,

through integrated actions of environmental management with local participation, besides guaranteeing sustainable use for reservoirs. Some authors (TUNDISI & STRASKRABA, 1999; CAMPOS, 2006; AGOSTINHO; GOMES & PELICICE, 2007; MYERS & CAMARGO, 2019) affirm that management of environmental impacts is a strategic planning tool that can lead to decision-making for greater economic, social and environmental sustainability at the community level.

The clear identification of social-environmental problems favors the formulation and implementation of public policies that can guarantee minimization of environmental impacts. To Neves, "The social control of public sanitation services is one of the basic principles in the national guidelines: a set of mechanisms and procedures that assure civil society access to information, technical representation, and participation in the processes of policy design, planning and evaluation." (Neves, 2019, p. 60). Environmental policy has presented analyses with significant contributions in research of solutions for environmental and technological problems. The control of environmental matters should be based on social-political negotiation and evaluation, as well as the transparency of actions for the objective of overcoming the technical conceptions of environmental problems. Of particular note in this process are the interests and relationships of power of dominating groups who feel they can take isolated decisions without any public participation. Indeed, environmental and technological problems should be observed in a context that integrates the political and social diversities involving technological alternatives that consolidate environmental control.

Some factors are decisive in the process of estimating environmental problems - as much uncertainties as rational decision-making. They can be influenced by some type of forecast, according to Jänicke et al. (2003, p. 128). Insufficient information is a preponderant factor in this process. Percentages are conceived as probabilities relative to the measures of uncertainty, and the technical information presented make up part of the uncertainties involved.

The environmental problem can be defined using the concepts of Campos (2006, p. 32) as a potential threat to the environment and to man, can be transmitted by natural means or constructed and can be defined as all changes to the environment that can come to be a loss to human life. It is understood as an environmental problem, for example, a form of use of water and of soil around reservoirs in the savannah region of the Tocantins river and others. In this way, the agricultural and aquaculture activities carried out along the shores of the river and the watershed or in areas

of moist or salinized soils due to the incorrect use of techniques such as pesticides, conventional irrigation, etc. are activities considered bad for the environment.

Studies and research papers on social-environmental policy and management of water resources participatory processes are important tools of political and technical control and in the identification of environmental impacts and risks on what is referred to as quantification, minimization, and mitigation of the effects of these problems (ANA, 2009; BRUNO & FANTIN-CRUZ, 2020).

II. METHODS

The search for information sustains the data used in the research, being divided between primary and secondary data. (Fig.1).

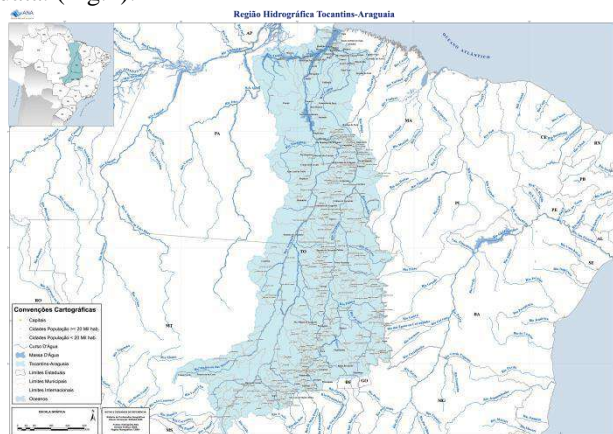


Fig.1: Location of the Tocantins-Araguaia Hydrographic Region. Source: Hidrografia ANA, 2000.

The systematic observations of direct and indirect form is in addition to interviews of stakeholders involved with relocation projects, community leaders, technicians, those being relocated, and employees of the hydroelectric dams. The secondary data were obtained through surveys of bibliographic, documentary and map sources, as well as through field visits, for the purpose of identifying the environmental problems in the areas of the watershed and reservoirs characterizing the critical and fragile areas in terms of erosion, water pollution or risk zones for eutrophication.

For Myers and Camargo, “The geographical position of Tocantins makes it a frontier state between the Cerrado and the Amazonian regions. It is also the site of one of Brazil’s most important river basins, the Baixo Tocantins. However, due to its relatively small size, not very much attention has been given to Tocantins in comparison to other states in the Amazon region. As a consequence, Tocantins has fewer regulations governing land use and lower capacity to monitor deforestation and land

exploitation [...]. In 2017, for example, only eight percent of the Cerrado was protected and off - limits to agriculture or development, as compared to 46 percent of Brazil’s Amazon region [...]. Furthermore, 90 percent of Brazil’s field agents that monitor and control deforestation are deployed in the Amazon region, making enforcement of deforestation policies difficult.” (Myers; Camargo, 2019, p. 99-100). (Fig.2).

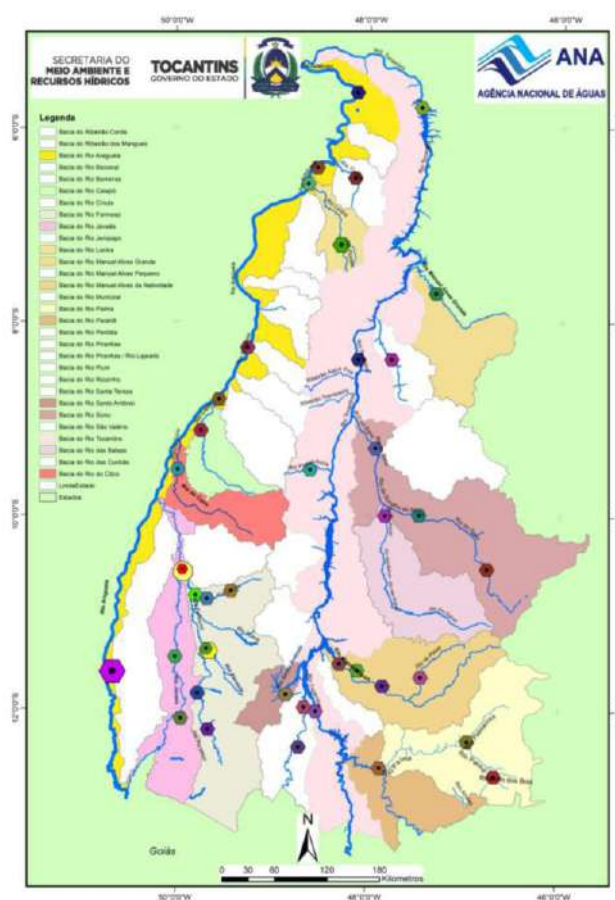


Fig.2: Location of rivers, affluent rivers, hydrographic basins and hydrographic reservoirs of the Tocantins-Araguaia Hydrographic Region. Source: SEMARH; ANA, 2020.

Das Mortes and Itacaiúnas are the four principal rivers that form the Tocantins river basin occupying a total area of 757,000 km². The region of the Tocantins watershed was colonized by Europeans between the end of the 16th century and the beginning of the 17th century and these colonizers had as their objective to settle territory, guarantee mineral wealth and enslave indigenous people. The decline of mining lead to the expansion of agriculture in

the 19th and 20th centuries and to the founding of towns and cities that could process, transport, and consume the agricultural outputs.

During the 1950s and 1960s, the Tocantins watershed suffered great impacts with the economic development of the country and the construction of Brasília. The annual population growth during the 1990s was 1.66%. The urban population grew 3.74% per year, while the rural population fell at a rate of 2.34% (MÜLLER, 1995). Urban development in cities and states in the Tocantins river basin region results in increased use of water resources, conflicts between users and deterioration in the quality of surface and underground bodies of water (HENRY, 1999).

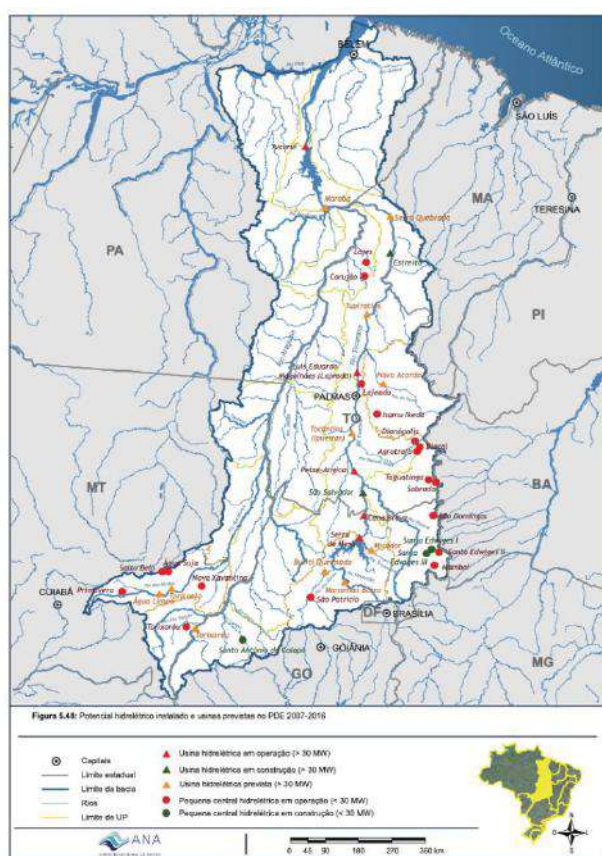


Fig.3: The hydroelectric potential of the Tocantins-Araguaia Hydrographic Region. Source: ANA, 2009.

The Tocantins river reservoirs supply the populations of the region, as well as industries, farm irrigation, aquaculture, navigation, tourism, leisure activities, dilution of sewerage, and ecological protection, in addition to electricity generation. In the document BRASIL (2004, p. 42) the predominant use of water is for farm irrigation which represents 50.5% of all uses. A rural vocation is confirmed, with predominance of the use of water for irrigated agriculture (ANA, 2009, p. 117-118).

The generation of energy is the objective of the construction of reservoirs of hydroelectric plants, it is observed that there is no planning of the reservoirs as environmental issues through environmental protection programs and participation of society are not considered. The carrying out of environmental impact studies (EIA) for reservoir projects, according to the 1986 legislation, is mandatory, thus, there is a greater concern with the environmental issue (CONAMA, 1986). (Fig.3).

III. RESULTDS AND DISCUSSION

The results presented here cover some aspects that are considered important for the consolidation of social-environmental policies. The legal and regulatory issues correspond to the National Policy for Water Resources (NPWR) through the practice of multiple uses of water and the execution of control, conservation and prevention measures. For Trindade and Scheibe, "More than 15 years after enactment of Brazil's National Water Resources Policy and Waters Law (Lei no 9.433 of 8 January 1997), which determined that the administration of water resources be conducted through decentralization, participation and integration, this goal has still not been attained and there have been many problems that delay the realization of this law, particularly those linked to decentralization." (Trindade; Scheibe, 2019, p. 1).

Thus it is considered a policy that promotes planning strategies and principle for integrated management of water resources with sustainability and analysis of impacts and risks (BRASIL, 2004, p. 31). This policy for water resources is indicative of public participation in making decisions related to water uses and a "politicization" of water resource management.

The institutionalization of public participation corresponds to institutional aspects of water resource management, as described by Guivant and Jacobi (2003, p. 26). The Advisory Board and the National System for Water Resources (NSWR) decide on issues and conflicts along with the Hydrographic Basin Committees (HBC) that guarantee the participation of uses, municipal governments and civil society (MENEZES & BIESEK, 2014). Society's participation in the water governance process started with the Federal Constitution of 1988, which introduced the water resources management system, "such as user-pays principles and participatory management." (Victor; Almeida; Wong, 2015, p. 9). Also, Victor, Almeida and Wong found that "The Constitution of 1988 was important in establishing a foundation for jurisdictional authority over water bodies but it was considered only the first step in reforming the water system. Industrialization and rural-

to-urban demographic shifts throughout the 1970s and especially the 1980s brought significantly greater demand for water and also for power generation. This led to a boom in hydroelectric plant construction to meet the power demand.” (Victor; Almeida; Wong, 2015, p. 10-11).

Other issues are the socio-environmental aspects that portray the problems of the dry season, the geology of the area with sandy formations and vegetation in the savannah with the influence of the Tocantins river reservoirs. The impacts and risks relate agriculture and agriculture through irrigation projects in full expansion, on the one hand, they promote benefits to the population, on the other hand they contribute to put the health of their inhabitants at risk, in addition to the quality of water and soil through use of fertilizers. The environmental problems of aquaculture result from the lack of control in the use of reservoirs and tanks near the margins of the basin. The practice of feeding species that are grown through feed causes a certain degree of pollution in the reservoirs with the introduction of varieties of nutrients. This practice has provoked serious criticism, in South America Chile and in Europe Poland are examples of countries that use the method of cultivating species with feed and nutrients, some countries such as Germany, Denmark and Norway this method is prohibited.

Trindade and Scheibe considers that “The watershed plan is the main guide for the decisions of a Watershed Management Committee, because it provides a diagnosis of the real situation of the watershed, which allows projecting goals, objectives and actions to preserve and maintain the quality and quantity of water for the entire population, minimizing future conflicts over water use.” (Trindade; Scheibe, 2019, p. 3).

IV. CONCLUSION

The level of information regarding environmental problems, together with the lack of mastery of techniques necessary to minimize social-environmental conflicts generated by the construction of large reservoirs, in addition to the difficulties in organizing and coordinating with the local population, represents barriers in the process of negotiating between the River Basin Management of Tocantins – RBM-TO (coordination) and the affected communities.

The representatives of the institutions involved in the execution of the projects and programs together with partner entities of the State of Tocantins such as SANEATINS, CELTINS, UFT and others visualize the challenges as a big social-political construction project in which it is necessary to minimize environmental impacts and risks resulting from the productive activities, especially agriculture,

cattle-raising, and fish farming in areas close to the banks of the river and the watersheds or areas of moist or salinized soils, as well as incorrect use of pesticides, conventional irrigation, etc. (Fig.4).

The activities considered bad for the environment result on a large scale in impacts and risks of “Eutrophication” that are considered grave for the Tocantins watershed. One can observe in recent years a growing process of “Eutrophication” with environmental disturbances felt all along the Tocantins river.

The shallow areas of the Tocantins river reservoirs find themselves constantly in a process of change influenced by agricultural projects and raw sewage from urban areas. (Fig.4).

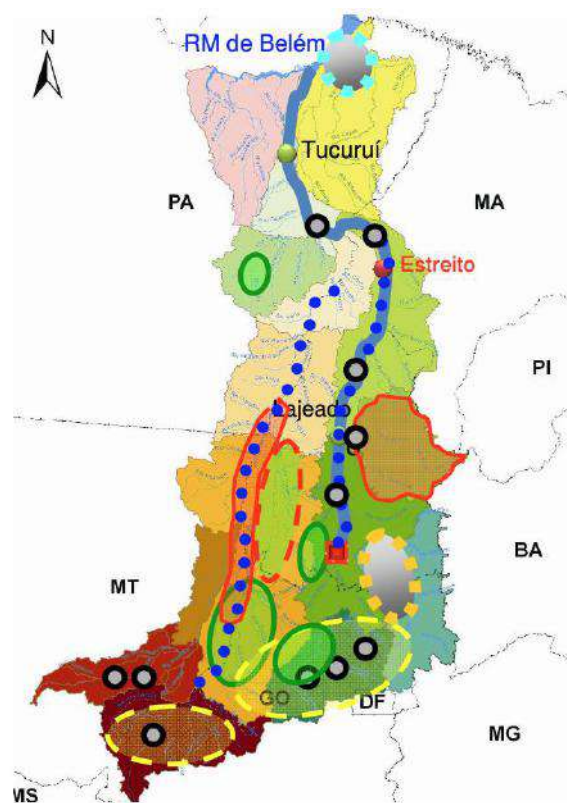


Fig.4: Eutrophication of rivers of the Tocantins-Araguaia Hydrographic Region. Source: ANA, 2009. Author's adaptation.

Nonetheless, it is important to note the existence of civic entities that are developing various programs and social-environmental projects with the participation of the local population around the reservoirs of the Tocantins river basin. The implementation of these social-environmental programs and projects has mitigated the environmental impact and risks beginning with the construction of data

banks and the participation of the local population, for the purpose of instruction and priority of meetings and seminars that promote a conscience for environmental protection (LAROCA, 1995; DEL RIO & OLIVEIRA, 1999; GUIVANT, 2002).

Some problems are identified and recognized as being social-environmental in nature. Among these are sewers to channel untreated domestic and industrial waste to reservoirs; pesticides that pollute the waters, and the soil salinization around reservoirs. These problems determine and influence the environmental survival of the Tocantins river.

Also one notes in recent years, a growing number of irrigation projects and programs along the Tocantins river. The expansion of these projects and programs produce, on the one hand, real benefits to the population of the Tocantins river basin in terms of new business opportunities and consequent increases in family income. On the other hand, these projects generate certain risks to the survival of local people and communities in terms of a healthy quality of life. Indeed, one can say that the quality of water and soil in the areas of the Tocantins river are threatened, as result of the constant use of commercial pesticides, agricultural “protector” products and chemical fertilizers.

A quite serious problem is the various uses for different purpose of water that provoke social-environmental conflicts among users (BICUDO; TUNDISI & SCHEUENSTUHL, 2010). Activities related to agriculture, cattle-raising, and fishfarming are considered important for the development of the Tocantins river region. However, the economic benefits can be more than offset by the harm done to local communities in terms of degraded water quality, which affects both local people and other life in the watershed (MORETTI & MARINHO, 2013; SPINOLA; VITORIA & CERQUEIRA, 2016).

This work shows conclusively that, despite studies on environmental impact and risks done in accordance with Resolution n. 001/1986 of the National Environmental Council (CONAMA) and the National Environmental Policy, which mandate the preparation of environmental impact studies in the case of various human “interventions” relative to natural resources, such as construction of dams and reservoir, the problems identified in terms of environmental impact and risk continue to occur in the regions of the Tocantins river basin (CONAMA, 1986).

According to CONAMA Resolution n. 001/1986 of the guidelines of the National Environment Council for the assessment of environmental impact, determines the law that, “Considering the need to establish the definitions, responsibilities, basic criteria and general

guidelines for the use and implementation of the Environmental Impact Assessment as one of the instruments of the National Environment Policy, resolves:

Art 1. For the purposes of this Resolution, any change in the physical, chemical and biological properties of the environment, caused by any form of matter or energy resulting from human activities, which directly or indirectly, affects:

I - the health, safety and well-being of the population;

II - social and economic activities;

III - the biota;

IV - the aesthetic and sanitary conditions of the environment;

V - the quality of environmental resources.”

(CONAMA, 1986, p. 636).

The results of studies and research show that Tocantins river basin is a great water source, but that also its use depends on efficient form of exploitation through integrated development for the region as a whole. Clearly, the water resources of the Tocantins river should not be used exclusively for the generation of electricity. Other functions should be explored for the purpose of economic development, including irrigation, navigation, supply of water, tourism, fishing, etc.. Nonetheless, all of these activities should be properly managed to ensure the overall environmental protection of the region.

One of the mechanisms that can favor new concepts for the efficient use and an integrated development of the region is the management and planning with participation of the local population in the decision-making process of socio-environmental policies (VICTORINO, 2003; LEAL, 2004; GUIVANT, 2015). The participation of the local population can be exercised through the process of forming committees that are still unsustainable in the Tocantins river basin.

A watershed committee should be composed of various regional stakeholders that have involvement in regional development projects and programs and have the main objective of promoting the process of managing social-environmental policies and environmental impacts and risks, based on best practices of environmental management.

Thus, Trindade and Scheibe say that “It is up to Watershed Management Committees to perform a strategic role in the National Water Resources Policy, because they are the entities that materialize the decentralization of management, include the participation of governments, users and civil society and have

watersheds as the units of management. They are also proponents of public policies. Thus, the success of their operation to a certain degree signifies the success of the water policy itself.” (Trindade; Scheibe, 2019, p. 1).

The watershed committee is an instrument to develop and implement integrated management strategies as part of a larger local community-based governance process (PORTO & PORTO, 2008; EMPINOTTI; JACOBI & FRACALANZA, 2016), which would stimulate and demand the participation of federal, state and city governments in partnership with representatives of civil society and users in the formulation and implementation of social-environmental policies. In this sense, Victor, Almeida and Wong considers that “This new approach provided an integrated way to view and manage water and also introduced three important changes: the river basin was designated as the territorial unit for water resources planning; water was defined as a finite resource with an economic value; and national water management was defined to be a decentralized and participatory system.” (Victor; Almeida; Wong, 2015, p. 11).

The conclusions of this work show that the Tocantins river basin as quite favorable to the development of agriculture, cattle-raising and other forms of animal husbandry, and fish farming, as well as related agribusiness and population growth. These, however, will tend to degrade the environment and result in reduced water resources affecting the region's biodiversity. Accordingly, the development of social-environmental programs with policies that stimulate public participation, an open planning process and best practices for water resource management can facilitate the integration of studies and research in the Tocantins river basin.

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Central Chemoreflex Sensitivity and Parasympathetic Nervous Activity in patients with Heart Failure

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Abstract— Although some studies point towards exacerbated central chemoreflex sensitivity (CCS) and reduced parasympathetic nervous activity (PNA) in patients with heart failure (HF), others dispute this finding by indicating their unchanging condition. The aim of this study is to compare CCS and PNA between patients with HF and healthy individuals. Eighteen patients with HF and 14 healthy individuals participated in the study. CCS was assessed through 7% CO₂ rebreathing test for 4 minutes. PNA was determined based on Fast Fourier Transformation using the high-frequency component of heart rate variability. CCS was not different between HF patients [MD: 0.83 (0.49 to 1.54) l.min.mmHg] and healthy individuals [MD: 0.88 (0.16 to 2.56) l.min.mmHg]. PNA in HF patients [MD: 288 (266 to 1188) ms] also did not differ from healthy individuals [MD: 299 (81 to 1099) ms]. In conclusion, HF patients subjected to adequate clinical management may present preservation of CCS and PNA.

Keywords— Central chemoreflex sensitivity, vagal modulation of heart rate, heart failure, autonomic control.

I. INTRODUCTION

Heart Failure (HF) is a complex clinical syndrome in which the heart becomes unable to effectively pump blood due to functional and anatomical cardiac impairment [1,2]. Over time, it can lead to several electrophysiological changes, as well as to changes in respiratory and cardiac control reflexes [3] such as chemoreflex sensitivity and parasympathetic nervous activity [4,5].

Exacerbated central chemoreflex sensitivity (CCS) is a pathophysiological change often attributed to HF [4]. It leads to chronic sympathetic nervous system overactivation and to reduced parasympathetic nervous activity (PNA) [5], which favors disease progression and worsened prognosis [6]. Thus, it results in increased cardiac arrhythmia and heart failure-associated mortality rates [7].

Although some studies point towards exacerbated CCS in HF patients [1,7,8,9] others contradict this finding by suggesting that CCS and the parasympathetic nervous activity remain unchanged [10] Based on these divergent

findings and on the clinical importance given to these data, the aim of the present study was to compare CCS and parasympathetic nervous activity between HF patients and healthy individuals.

II. METHODS

2.1 Sample

HF patients were screened based on echocardiographic examinations performed at local reference centers in cities located in Rio Grande do Sul State, Brazil, from 2014 to 2018. Eighteen (18) HF patients and 14 healthy individuals, who were matched by sex and age group, participated in the study. Inclusion criteria comprised clinically stable HF patients, who are classified as NYHA functional classes I, II and III, and whose medication had not been changed in the previous 3 months. Patients presenting unstable angina, atrial fibrillation, acute myocardial infarction or recent cardiac surgery (< 6 months), severe obesity, smoking habit, and spirometry-

assessed chronic obstructive pulmonary disease were excluded from the study [25]. Healthy and physically active individuals reporting smoking habit were also excluded from the study. All participants signed the Informed Consent Form. The study was approved by the local Research Ethics Committee.

2.2 Study Protocol

The CCS and parasympathetic nervous activity assessment protocol was performed in the morning, in a room with controlled temperature (22°C). All individuals were instructed to fast, to avoid caffeinated and alcoholic beverages for at least 10 hours before the test and to not exercise for at least 48 hours.

CCS was evaluated based on the CO₂ rebreathing technique [26]. After participants were left to rest in sitting position for 15 minutes, they were connected to a system, which consisted of a spirometer coupled to bacteriological and oral filter. The inspiratory pathway was connected to a trachea with three-way valve in order to allow participants to breathe ambient air or gas coming from a 30-liter balloon. Volunteers subjected to the protocol used nasal clip. Initially, 5 basal minutes were recorded and, then, participants inhaled a mixture of CO₂ (7%) and O₂ (93%), for 4 minutes. CCS was based on the ratio between minute ventilation (MV) and partial end-tidal CO₂ pressure (PetCO₂), which was calculated through linear regression analysis and expressed in liters per minute per mmHg (l.min.mmHg).

PNA was evaluated after participants had rested in supine position for 15 minutes. Individuals were connected to a system composed of a spirometer coupled to bacteriological and oral filter. They used nasal clip and were instructed to perform 15 controlled breathings per minute, which were guided by the sound of a metronome for 10 minutes. PNA was obtained through spectral analysis by applying the *Fast Fourier Transform* algorithm over 5-minute segments. The low frequency component (0.04 - 0.15 Hz), representative of sympathetic and parasympathetic nervous activity and the high frequency component (0.15 - 0.45 Hz), representative of parasympathetic nervous activity, were expressed in ms [27].

2.3 Variables

Respiratory flow was assessed in a spirometer (FE141 spirometer, ADInstruments, Sydney Australia, 1000-liter flow head) calibrated with a 3-liter syringe. Respiratory rate (RR) and tidal volume (TV) were determined through the respiratory flow channel. Minute ventilation was calculated in additional channel by multiplying the RR (breathing/min) by the tidal volume [28]. HR was

noninvasively measured beat by beat (ADInstruments, bioamp ML132, Australia). PetCO₂ was measured in a capnograph (CO₂ gas Analyzer-17630, Vacumed, Silver Edition, USA). Systolic (SBP) and diastolic (DBP) blood pressures were measured in mercury sphygmomanometer (Unitec®, Brazil), which was placed on participants' dominant arm along with a stethoscope (Rappaport Premium). Arterial oxygen saturation (SatO₂) was measured with a pulse oximeter (CONTEC CMS50C) positioned on participants' middle finger. The PowerLab system [Powerlab / 16SP ML880, AD Instruments (ADI) A, USA] was used to collect data, which were analyzed in the LabChart Pro V.8 software, ADInstruments.

2.4 Statistical analysis

Data presenting normal distribution were expressed as mean and standard deviation. Student's t-test for independent samples was used to compare normal distribution variables between groups. CCS and PNA data did not present normal distribution, so they were expressed as median and confidence interval. Mann-Whitney test was used to compare these two variables between groups. Two-way analysis of variance (ANOVA) was used to evaluate respiratory and hemodynamic responses during CCS assessment, since they recorded normal distribution. $P \leq 0.05$ was considered significant.

III. RESULTS

Table 1 shows the characteristics of healthy individuals and HF patients. One HF patient was classified as NYHA functional class III (moderate symptoms), eight HF patients were classified as functional class II (mild symptoms) and nine of them were at functional class I (no symptoms) [11]. The low and the high frequency component of HR variability in HF patients did not differ from healthy individuals.

HF patients presented CCS: 0.83 (0.49 to 1.54) l.min.mmHg, whereas healthy individuals presented CCS: 0.88 (0.16 to 2.56) l.min.mmHg; there was not significant difference between groups ($P = 1.00$).

Table 1. Participants' characteristics

	HF (n=18)	HS (n=14)	P
Sex	12 men / 6 women	9 men / 5 women	-
Age (years)	57 ± 7	57 ± 6	0.95
Weight (kg)	80 ± 15	72 ± 10	0.41

Height (m)	1.99 ± 0.06	1.80 ± 0.17	0.76
BMI (kg/cm ²)	27.6 ± 3.9	25.03 ± 2.55	0.15
Beta-blockers (%)	88.8	-	-
ACE-I (%)	50	-	-
Diuretics (%)	72.2	-	-
Anticoagulants (%)	72.2	-	-
LVEF (%)	35.8 ± 8.9	-	-
Ischemic HF (%)	77	-	-
NYHA (I/II/III)	9/8/1	-	-
CCS (l.min.mmHg)	0.83 (0.49 - 1.54)	0.88 (0.16 - 2.56)	1.00
LF (ms)	288 (266 - 1188)	299 (81 - 1099)	0.96
HF (ms)	1063 (416 - 5257)	357 (195 - 1685)	0.32

Normally distributed data were expressed as mean and standard deviation. Non-normally distributed data were expressed as median and confidence interval. HF: heart failure; HS: healthy subjects; CCS: central chemoreflex sensitivity; LVEF: left ventricular ejection fraction; LF: low frequency component of heart rate variability; HF: high frequency component of heart rate variability; BMI: body mass index; ACE-I: angiotensin-converting-enzyme inhibitors; NYHA: New York Heart Association.

Table 2 shows that the central chemoreflex progressive increases MV in HF patients and healthy subjects. PetCO₂ presented similar increase between HF patients and healthy subjects at all times in comparison to baseline values. HR increase at the 3rd and 4th minutes was similar in both groups in comparison to baseline values. HR increase was similar in both groups from the 2nd minute on. SBP and SatO₂ increase in all CO₂ administration minutes, and DBP increase from the 2nd minute on, were similar in both groups in comparison to baseline values (Table 2).

Table 2- Responses during CCS assessment.

		1	2	3	4
Group	Baseline	min	Min	min	min
MV	HF	24	29	35	37
		±12	± 11*	± 13*	± 16*
	HS	22	26	30	34
		±10	± 12*	± 14*	± 16*
PetCO ₂	HF	48	52	55	55

		± 6	± 7*	± 7*	± 8*	± 9*
RR	HS	52	58	60	62	63
		± 7	± 7*	± 9*	± 9*	± 10*
	HF	17	17	17	18	18
		± 4	± 4	± 4	± 5*	± 5*
HR	HS	17	16	18	17	18
		± 3	± 4	± 4	± 4*	± 5*
	HF	72	73	75	77	77
		± 7	± 8	± 8*	± 9*	± 11*
SBP	HS	67	67	67	68	70
		±10	± 10	± 11*	± 12*	± 13*
	HF	127	129	132	136	134
		±18	± 17*	± 18*	± 21*	± 17*
DBP	HS	127	135	138	141	147
		±12	± 16*	± 13*	± 15*	± 15*
	HF	84	88	90	93	93
		± 9	± 12	± 15*	±17*	±18*
SatO ₂	HS	87	91	92	97	94
		± 8	± 10	± 13*	± 16*	±17*
	HF	98	99	99	99	99
		± 2	± 1*	± 1*	± 0*	± 0*
SatO ₂	HS	97	98	99	99	99
		± 2	± 2*	± 0*	± 0*	± 0*

Data expressed as mean and standard deviation.

CCS: central chemoreflex sensitivity; HF: heart failure; HS: healthy subjects. ANOVA: MV (minute ventilation): time = 0.001; group = 0.549; time*group = 0.855; PetCO₂ (partial end-tidal CO₂ pressure): time = 0.001; group = 0.038; time*group = 0.573; RR (respiratory rate): time = 0.003; group = 0.187; time*group = 0.574; HR (Heart Rate): time = 0.001; group = 0.071; time*group = 0.224; SBP (systolic blood pressure): time = 0.001; group = 0.326; time*group = 0.056; DBP (diastolic blood pressure): time = 0.001; group = 0.540; time*group = 0.969; SatO₂ (peripheral oxygen saturation): time = 0.001; group = 0.303; time*group = 0.149.

* p < 0.05 in comparison to baseline value.

IV. DISCUSSION

The current study has shown that the CCS of HF patients does not differ from that of healthy individuals.

CCS preservation in HF patients could explain the preserved PNA recorded in our study, a fact that could contribute to improve the survival prognosis of these individuals.

Our findings about CCS preservation in HF patients in comparison to such preservation in healthy individuals are in compliance with previous studies conducted by Paleczny *et al.* (2017) [10] and Contini *et al.* (2013) [12]. According to these studies, patients presented low-severity symptoms and most of them were classified as NYHA I and II. The low CCS severity recorded for HF patients assessed in the aforementioned studies, and in the present research, could explain the CCS preservation [10,12].

In addition, the use of beta-blocker drugs could influence the chemoreflex sensitivity response. Paleczny *et al.* (2017) [10] found unchanged CCS in HF patients treated with beta-blockers and ACE-I. These findings may explain, at least in part, the findings in the present study, since 88% of the assessed individuals used beta-blockers. According to Contini *et al.* (2013) [12], beta-blockers with different pharmacological characteristics (drug-blocked receptor type) have different effects on CCS - Carvedilol is the most effective drug in reducing CCS and peripheral chemoreflex sensitivity, since it improves ventilation efficiency during exercise sessions. According to Toledo *et al.* (2017) [13], the use of propranolol (beta-blocker) in animal models also eliminated the deleterious effects of CCS overactivation, such as autonomic dysfunction and cardiac arrhythmia.

The use of beta-blockers could also explain the preserved PNA found in HF patients than in healthy individuals. These drugs presented antagonistic action to sympathetic activation, restored cardiac and circulatory reflex control, attenuated vasoconstrictor neurohumoral systems and improved myocardial performance by reducing individuals' heart rate and oxygen demand [14,15]

Although some studies have recorded exacerbated CCS, the prevalence of this finding was not high in all studies. Mirizzi *et al.* (2016) [8] have found CCS exacerbation in 56% of patients. However, these patients were older, presented lower LVEF, larger right ventricular diameter and worse ventilatory efficiency than the ones assessed in the present study. Giannoni *et al.* (2008) [9] found increased CCS in only 20% of patients who presented the worst clinical severity. On the other hand, Giannoni *et al.* (2009) [7] found CCS exacerbation in 23% of HF patients who have presented low functional capacity, low parasympathetic nervous activity, as well as high

prevalence of paroxysmal atrial fibrillation and ventricular tachycardia.

Accordingly, findings in the present study may have been influenced by the exclusion of patients with atrial fibrillation, since previous studies have shown that patients with chemoreflex exacerbation have higher prevalence of atrial fibrillation [16,17], as well as that atrial fibrillation in HF patients may be associated with reduced vagal modulation of HR [16,18], which leads to increased cardiac arrhythmic events [19] and heart failure-associated mortality rates [20].

According to the meta-analysis conducted by Pearson & Smart (2018) [21], PNA was predominant or improved in HF patients who underwent, or started, physical exercises of several modalities such as weight training, aerobics, inspiratory muscle training and yoga, among others. Prospective long-term cohort study with 256 HF patients reinforces that the severity of inspiratory muscle weakness, and shorter walking distance, by 6-minutes walk distance test, proportionally increases mortality risk, but this outcome is more accurately discriminated by the maximal inspiratory pressure [22].

However, patients assessed in the present study were physically inactive, and it corroborates the idea that adequate clinical management based on the use of beta-blockers, and the clinical stability provided by these drugs, represent a protective effect according to the vagal modulation perspective.

The CCS and PNA preservation in HF patients assessed in the present study suggests better prognosis for them, since increased chemoreflex sensitivity can cause peripheral vasoconstriction and lead to clinical HF worsening [16] exacerbate dyspnea symptoms and exercise-related fatigue [23] as well as increase the risk of cardiac events with reduced survival rates [9].

Thus, the adequate clinical management based on beta-blockers, the exclusion of individuals with atrial fibrillation, the low disease severity and the clinical stability of HF patients assessed in the present study may have contributed to preserve both CCS and the PNA.

According to a recent study [24], the preservation, or not, of the PNA in optimally treated HF patients did not show differences in survival rates in a 5-year follow-up. Although CCS preservation did not show prognostic survival implications in a previous study with a 15-month follow-up [10] it is necessary conducting a long-term research on the prognostic and clinical implications on the chemoreflex sensitivity of patients subjected to optimal clinical management.

V. CONCLUSION

Heart failure patients may present central chemoreflex sensitivity preservation, and even increased parasympathetic nervous activity, due to appropriate clinical management. The impact of these findings on patients' survival should be investigated in long-term cohort studies.

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Assessment of the level of consciousness in adult patients admitted to an Intensive Care Unit (ICU)

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Abstract— *Objective: This study made it possible to analyze the level of consciousness through the Glasgow scale, of adult patients hospitalized in Intensive Care Units. Method: This is a descriptive study, with a quantitative and qualitative approach. The research was carried out in the three Intensive Care Units in a hospital in the interior of Bahia (Brazil). The study population consisted of 20 patients admitted to these units, aged 18 years or over, of both sexes, who were hospitalized in the sector for at least 24 hours and who had already performed at least three physiotherapy sessions during the period. January to October 2019. The Glasgow Coma Scale and sociodemographic questionnaire were used. Results: The results resulted from the division of two categories: I) Assessment of the level of consciousness; II) Sociodemographic data. Only three patients did not have the maximum score on the Glasgow Coma Scale (15 points). The sample consisted of 55% (n = 11) women and 45% (n = 9) men. Most patients, exactly 70%, were aged 60 years or over. As for the reasons for the individuals' admission to the ICU, respiratory (25%), heart disease (25%) and neurological (15%) were the most frequent, followed by other causes such as trauma, neoplasms and post-surgery (40%) . Conclusion: The results obtained are relevant to the planning and execution of actions in intensive care units aimed at assistance to the elderly and qualified care.*

Keywords— *Intensive Care Unit; Inpatients; Glasgow scale; Qualified Care.*

I. INTRODUCTION

Intensive Care Units (ICUs) are hospital sectors that receive patients who need intensive care and specific resources that provide necessary support for life (GOMES & CARVALHO, 2018).

Since its creation, people have acquired a view that the ICU is related to the finitude of life, thereby generating tension, fear and anxiety, when it comes to

hospitalization in this unit (NEPOMUCENO JUNIOR & SILVA, 2018; MOREIRA & COSTA, 2018).

According to studies by Bonfada et al., (2017) and Bini et al., (2018), the age group that has high rates of hospitalization in these units are the elderly, which can reach 52% of hospitalizations in Brazil, and the longer I live, the greater the commitment to health, generating longer hospitalization.

Patients hospitalized in these sectors are constantly evaluated by the multidisciplinary team, who use resources and scales to examine the health status of these individuals (ALBUQUERQUE, 2015; BASILE-FILHO et al., 2018). And the Glasgow Coma Scale Score (GCS) is one of the most used scales.

The GCS score was developed to combine the results of the three factors of the scale into a single index, assigning a score according to the level of awareness presented spontaneously or through stimuli. They are: eye opening, verbal response and motor response. Their possible values ranged from 3 to 15 (TEASDALE et al., 1979).

In 2018, it became the Glasgow Coma Scale-Pupil score (GCS-P), in which the assessment of pupil reactivity as a reflection of brainstem function was added to the scale. Passing values from 1 to 15, by combining the score of the previous factors subtracting the pupil score (BRENNAN et al., 2018).

The assessment of the level of consciousness must be a simple, objective, accurate and reliable examination that facilitates communication between the team (TEMIZ et al., 2018). And the GCS-P provides this standardized and universal approach.

Thus, the aim of this research was to assess whether patients admitted to the ICU are lucid and oriented, through the application of the Glasgow Scale. Such analysis generates subsidies for the performance of more qualified care, since the profile of the hospitalized patient enables health actions that are more adequate to the reality of the population that is there (ROCHA et al., 2007).

2007).

Therefore, knowing the sociodemographic characteristics and the level of awareness of a population served in the ICU enables the planning and insertion of assessment tools and methodology for the assistance of qualified professionals (ROCHA et al., 2007).

II. METHODOLOGY

This study is part of a larger project entitled: "Physiotherapeutic Care and Humanization in Intensive Care Units in a Public Hospital", and met the requirements of Resolution 466/12, which discusses research involving human beings (BRASIL, 2012), accepted by the Ethics and Research Committee of the State University of Southwest Bahia (UESB), under number 3,050,221 on November 30, 2018.

It is a descriptive study, with a quantitative and qualitative approach. This type of research describes phenomena and exact facts, the qualitative one perceiving and describing it through numbers, while the qualitative one, by subjective aspects (FERREIRA, 2015).

All researchers received on-the-spot training on the data collection instrument. For this, a structured form was used containing questions directed to the study variables related to the Glasgow scale and sociodemographic profile.

The research was developed in three adult Intensive Care Units (ICU) of a hospital in the interior of the state of Bahia in Brazil. The study population consisted of 20 patients admitted to these units, aged 18 years or over, of both sexes, who were hospitalized in the sector for at least 24 hours and who had already performed at least three physiotherapy sessions in the period. January to October 2019.

As an inclusion criterion, the patient should have preserved oral and / or written verbalization skills, be lucid and guided, proven by the Glasgow Scale, to respond to the research instruments and agree to participate in it, being assured to stop participating in research. any stage of the research, without any penalty or loss, as well as the confidentiality and anonymity of the data collected, signing the Free and Informed Consent Term (ICF).

Patients who had a reduced level of awareness and a deficit in understanding were excluded, being considered vulnerable by the research ethics guidelines.

A questionnaire consisting of closed questions related to sociodemographic data was used for collection. Addressing topics such as: name, sex, education, age, primary diagnosis, marital status, length of stay in the ICU, sessions held in Physiotherapy. It is an open question for the patient to describe what it is like to experience hospitalization and its permanence in this sector.

The Glasgow Coma Scale (ECG), which has 3 behavioral indices, was used to assess the level of consciousness, considering eye opening, verbal response and motor response, totaling 15 scores plus pupillary reaction evaluation.

The variation in the scores regarding the eye opening response is 1 to 4, verbal response 1 to 5, motor response 1 to 6 and pupillary reaction 0 to 2. To reach the result, it is necessary to subtract the ECG value from the pupillary evaluation. The minimum score is 01 and the maximum is 15 points. It is the scoring system most used internationally to assess comatose patients in intensive care.

This scale was developed by Teasdale and Jennett in 1974, at the University of Glasgow, and was created to standardize the clinical observations of adults with severe TBI, with alterations in consciousness. The scale was intended to minimize the variation between observers, to allow comparative studies on different behaviors and to have a guide to estimate prognosis. In 1979 it was revised with the addition of a sixth value in the motor response (TEASDALE et al., 1979). In 2018 an update was made, where the pupil assessment was integrated (BRENNAN et al., 2018).

The analysis of the two categories was performed using descriptive statistics and presented as a form of absolute numbers and percentages of the software Statistical Package for Social Sciences (SPSS), version 22.0 for Windows.

III. RESULTS AND DISCUSSION

The results are presented in two categories: I) sociodemographic data; II) assessment of the level of consciousness.

3.1. Sociodemographic data

The research was carried out with 20 patients aged 18 years or older, with an average age of 60.45 (\pm 15.1 years), who were at least 24 hours hospitalized in the ICU and who were already being treated by physiotherapy, for at least three calls. The sample consisted of 55% (n = 11) women and 45% (n = 9) men. Table 1 shows the sociodemographic data regarding marital status, education and diagnosis of hospitalization at the unit.

Table 1 – Characteristics of patients admitted to the intensive care unit. Jequié/BA, 2019.

Variables	% answer	N	%
Gender	100%		
Female		11	55%
Male		9	45%
Age	100%		
18 a 39 years		2	10%
40 a 49 years		1	5%
50 a 59 years		3	15%
60 a 69 years		8	40%
70 a 79 years		5	25%
80 a 89 years		1	5%
Marital status	100%		
Single		8	40%
Married		9	45%
Widowed		3	15%
School	100%		
Incomplete primary		15	75%
Complete high school		3	15%
Illiterate		2	10%
Diagnosis of Intensive Care Unit admission	100%		
Systemic lúpus		1	5%
Arm Fracture		1	5%
Aneurysm		3	15%
Chronic obstructive pulmonar disease		4	20%
Pneumonia / Pleural effusion		1	5%
Exploratory Laparotomy		1	5%

Neoplasm	2	10%
Hepigastric hernioplasty	1	5%
Polytrauma	1	5%
Cardiopathy	5	25%

There is a significant portion, exactly 70% of the elderly, when the age groups equal to or above 60 years are added. Such data are expected, given that population aging is a worldwide phenomenon and that around one million people turn 60 every month worldwide. There is a worldwide trend towards an increase in the age group of the population, which is reflected in the profile of hospitalized patients. It should be noted that the technological advances of recent times allow to prolong life and contribute to this fact (QUEIJO, 2002; SIEBENS et al., 2000; SALES-JÚNIOR et al., 2006).

Specifically in the national context, it is estimated that in 2020, the elderly will be 30.9 million, around 13% of the Brazilian population, placing Brazil among the seven countries with the largest elderly populations in the world. As a result of this process, the number of diseases that are characteristic of the elderly increases, resulting in organic destabilization that leads to the need for ICU beds to meet the demands of these patients (BENTO, 2007; MARIK, 2006).

Regarding the predominance of sex (55%) was female, this data can be explained by means of (table 1), in which the highest percentage of the number of hospitalizations is between cardiopathy (25%) and Pulmonary Disease Chronic Obstructive (COPD) (20%), mischaracterizing data from the literature in which the prevalence is male, as well as in the study by Freitas et al., (2017), that 50.7% of the patients were male and had diagnosis of Ischemic Heart Disease. These data can be explained due to the high number in the records of car accidents and violence, which often undergo surgery and / or need intensive support in the first hours (MATIAS et al., 2018; PERÃO et al., 2017).

As for the reasons for the individuals' admission to the ICU, respiratory (25%), heart disease (25%) and neurological (15%) were the most frequent, followed by other causes such as trauma, neoplasms and post-surgery (40%) (Table 1). What corroborates with other studies, Matias et al., (2018) and Castro et al., (2016), in which they describe that the main pathologies that lead to hospitalizations in intensive care units are related to cardiovascular and respiratory problems, being justified due to physiological aging and susceptibility to the development of chronic problems.

Regarding the hospitalization period, 50% of the patients remained for 3 to 6 days, a figure equivalent to that found in the literature. With regard to marital status, the majority (45%) are married, data that differ from those found in the literature in which the elderly profile is widowed (CAMPOS et al., 2016).

Regarding the level of education of the participants, 75% have incomplete elementary education. When analyzed in the light of larger research, but also from the perspective of age by time of schooling, it is noted that the individuals in this research have a lower level of education than is common for their ages. The northeastern region, in which the state of Bahia is located, has the lowest educational level by age in Brazil. However, the participants in this research have an even lower level of education than those found in most of the citizens surveyed in this region (IBGE, 2019).

Table 2 describes the amount of time that patients were hospitalized in the ICU and the number of visits made by physiotherapy within the sector. For this, we divided into groups of those who performed from 3 to 5; 6 to 10 and above 10 sessions.

Table 2: Number of days of hospitalization, Physiotherapy sessions performed and Age of Patients.

Age	ICU Length of stay	Number of Physiotherapy sessions performed
68 years	3 days	3 a 5 sessions
43 years	3 days	3 a 5 sessions
20 years	3 days	Over 10 sessions
71 years	4 days	3 a 5 sessions

71 years	4 days	3 a 5 sessions
71 years	4 days	6 a 9 sessions
72 years	4 days	6 a 9 sessions
63 years	5 days	3 a 5 sessions
56 years	6 days	6 a 9 sessions
64 years	6 days	6 a 9 sessions
50 years	7 days	3 a 5 sessions
60 years	7 days	3 a 5 sessions
83 years	7 days	Above 10
61 years	10 days	3 a 5 sessions
76 years	10 days	6 a 9 sessions
57 years	10 days	Over 10 sessions
62 years	12 days	Over 10 sessions
30 years	12 days	Over 10 sessions
62 years	13 days	Over 10 sessions
69 years	approx. 1 month (about 30 days)	Over 10 sessions

The average length of stay of patients in the ICU was approximately 7.61 days, with 95% of these patients remaining hospitalized after completing the survey collection (Table 2).

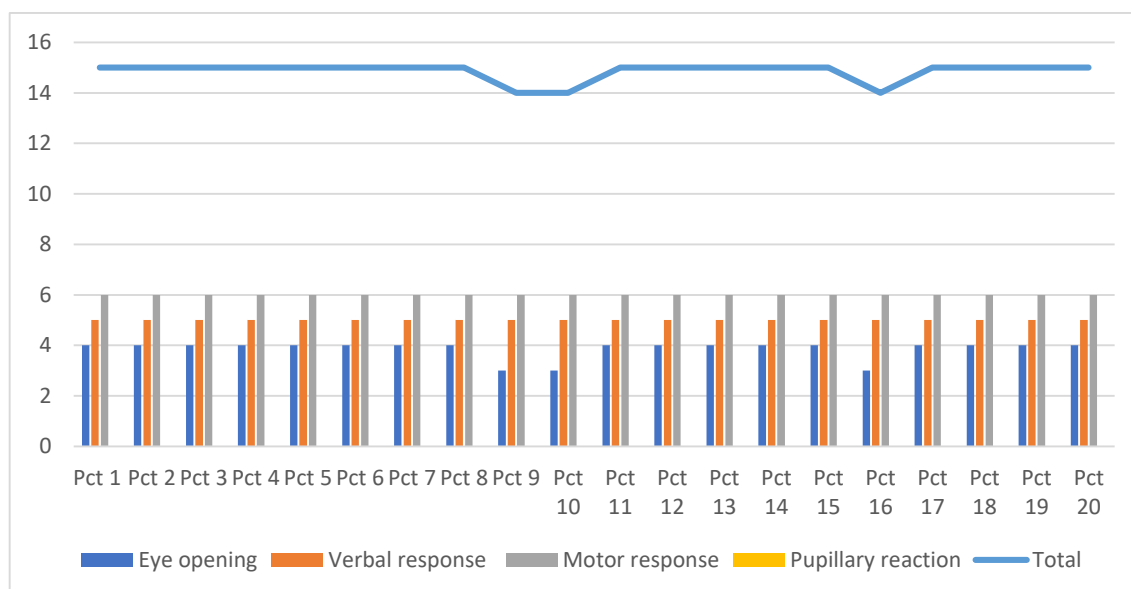
When crossing the data of ICU stay with the patient's age, it is observed that the older the age, the longer the hospital stay. A study carried out by Rodriguez et al., (2016), found that most ICU admissions (19%) occur in the 50 to 59 age group, followed by the 60 to 69 age

group (17.1%) and , in third place, aged 40 to 49 years (15.1%).

3.2 Assessment of the level of consciousness

All patients were assessed using the Glasgow Coma Scale to check their level of consciousness. Only three did not have the maximum score (15 points), with a reduction of 1 point in the item "eye opening" (Graph 1).

Graph 1. Patients who scored on the Glasgow Coma Scale (ECG)



The highest score for responses on the Glasgow Coma Scale (ECG) occurred between verbal and motor responses, obtaining 100% of the values. The three patients who scored below 15 points on the Glasgow scale, were on average 68.6 years old.

It is noted that, possibly, older patients tend to have lower ECG scores. Despite this study evidencing this, other specific factors must be observed in each patient, such as, for example, the patient's difficulty with the verbal response due to difficulties in understanding due to age or associated mental comorbidities, as well as the degree of unconsciousness that the patient has. finds.

Other studies highlight the importance of ECG for the classification of patient profiles with factors associated with both pathological conditions and public health issues. A survey of 1.354 trauma victims found that 95.5% of the traumas were classified as mild by the ECG (score from 13 to 15). However, the traumas evaluated as severe by the scale (score from 3 to 8) corresponded to 2.6% of the visits, being more frequent at night (47.1% of the serious traumas occurred between 18 and 24 h), on Sundays (26 , 47%) and Fridays (23.52%) (GUIZZO et al., 2020).

In another study, composed of 1,289 patients, it was found that individuals with a higher ECG had higher survival. Still, it was noticed that of the patients evaluated by ECG, male patients had lower survival when compared to female. In addition, greater survival was noted in patients using vasoactive drugs (ARRUDA et al., 2019). Thus, it is understood that ECG is important both as an assessment tool and in the design of patient profiles.

IV. CONCLUSION

Finally, some limitations of the present study must be considered, among them the fact that a considerable population was not used in relation to the Brazilian population, which may restrict the validity of the results. The data found in this study are representative when compared to the same sector in other hospitals or sectors in the same hospital.

However, this is one of the few recent studies that characterize patients admitted to intensive care units in a developing country and certainly represents an advance for a better understanding of the national profile of patients admitted to this specific service. The study made it possible to identify that the patients admitted to the ICU are lucid and oriented about the Glasgow scale and that 70% of these patients are elderly.

In view of these considerations, new perspectives for studies to be developed emerge, in order to expand the

knowledge about hospitalized patients, classify them and, consequently, dimension the entire team so that the workload is in accordance with the care demand. required by patients in their specificities, seeking quality care and professional improvement.

Thus, it is concluded that the method used proved to be capable of being used due to the ease in verifying the accuracy of the evaluated responses and the reduced time for application, which averaged 5 minutes.

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Monitoring of Wildlife Mortality on a State Road in Rondônia, Western Amazon

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Abstract— Objective: describe the monitoring of the mortality of wild animals on a state road located in the municipality of Cacaulândia, state of Rondônia, Western Amazon, caused by the hit of vehicles. **Method:** the methodological procedure follows that recommended in the manual of the Brazilian Center for Road Ecology Studies (CBEE). **Result:** in the 19-month study period, the identification of animals run over and killed by vehicles reaches 2.57 animals per day, corresponding to an average of 77.1 animals per month and totaling 1,464.9 animals. This value corresponds to 0.073 animals killed per km traveled. The most victimized animal class was that of reptiles with a relative frequency of 51%, followed by mammals with 26.5%, birds with 14.3% and amphibians with 8.2%. **Conclusions:** peak deaths of wild animals occur on rainy days in the Amazon region. However, in the warm season and in the period of forest fires in the region, wildlife mortality rates remain quite high. What is expected is that this study will serve as an elementary basis so that managers of public policies of the infrastructure service in which the road component of the state of Rondônia is a part can adopt mitigating measures consecrated with the effectiveness in reducing / mitigating impacts in different biological groups, in the specific case of wildlife mortality.

Keywords— Wild animals. Run over and deaths. Road 140. Rondônia. Western Amazon.

I. INTRODUCTION

The Brazilian road system has expanded considerably in recent decades. According to several authors, among them, Bandeira; Floriano [1], Silva [2], Weiss; Viana [3] these road networks provide great benefits to society by enabling land transport, improving the efficiency of transporting people and the circulation of commercial products, generating more jobs and giving more access to information, education, health and leisure. However, according to Weiss; Viana [3] these same highways and roads cause damage to nature, influencing people's quality of life and changing the natural patterns of biodiversity, becoming one of the main elements when it comes to impacts on the natural environment. In addition to these impacts caused by the construction of highways, it is possible to list the running over of wild animals, as the main cause of death on the roads [4].

According to Freitas [5], highways and roads are becoming a threat to fauna diversity because they directly influence the mortality of wild animals due to being run over, a fact that implies greater attention on the part of public bodies so that this rate decreases. Silva [2] clarifies that the direct and indirect negative impact of highways on the environment ranges from planning to its effective construction and maintenance. The evolution of animals does not follow the development of the road system that changes territories without changing natural boundaries, that is, it fragments the habitat. They also impose a very significant barrier to the survival of wild animals in terms of being run over [2].

According to Bergallo, Vera and Conde [6], roads are among the environmental changes that have caused the most extensive impacts on natural landscapes of the 20th century. For Forman and Alexander [7], their ecological effects are not restricted to the road, but extend across the landscape, generating physical impacts, such as erosion and alteration of local hydrology; chemical products, such as dispersion of pollutants; biological, such as destruction of natural environments, barrier effect that subdivides populations and runs over wild animals. Roads and highways can cause isolation and fragmentation of environments and force populations of animals to cross them. This fact increases the likelihood of running over wild animals [8]. The highways interfere with the animals' natural route, which when trying to cross it in search of food or refuge, can become a victim of being run over. These victimized animals are attractive to others, such as carnivores, and can cause new accidents [2]; [3]. Santana [9] warns that the alarming number of running

over of wild animals in road networks often occurs due to the flow of nearby vehicles, and even within Conservation Units. Another reason is the availability of food, such as grains, which attracts animals to the track. Both can cause the loss of local biological diversity [9].

For Brandt et al [10], highways can function as ecological barriers, subdividing populations of wild animals, causing water and soil pollution and leading to mortality by being run over. Schonewald-Cox and Buechner [11] show concern when stating that the mortality of wild animals due to being run over can be a serious threat to the persistence of species that exist in low densities, such as those threatened with extinction. The presence of the highway in the life area of certain species and the availability of food on the highways are the main causes of accidents with wild animals [12]. Lima and Obara [12] argue that the high incidence of animals killed on the highways is due to two reasons: first, the highways cut through habitats and directly interfere with the natural displacement of species; second, food is available along the highway. In the latter, the garbage generated by the negligence of the drivers, the fruits and seeds of the shrub and tree species close to the road, and the carcass of run over animals, which attracts the carnivorous mastofauna, are presented. Bissonette [13] eases the situation by arguing that highways should be permeable to the movement of animals, and ways to avoid being run over and facilitate crossing should be part of planning the construction or expansion of roads.

According to the Brazilian Center for Studies in Road Ecology (CBEE) 1.3 million animals die daily and at the end of a year, up to 475 million wild animals are run over in Brazil, that is, studies show that every second, approximately 15 animals die from being run over on Brazilian roads. Small vertebrates, such as frogs, small birds, snakes, among others, are part of the vast majority of animals killed by being run over. Of these dead animals, 45 million are divided into 40 million medium-sized animals (eg hares, opossums, monkeys) and 5 million are large (eg pumas, maned wolves, jaguars) guinea fowl, tapirs, capybaras [14]. The Guimarães study [15] "The main cause of death of wild animals in Brazil" makes reference to the data presented by CBEE, where it corroborates that 90% of the deaths of wild animals, are of small vertebrates. Forman and Alexander [7] running over animals is the primary source of road death. Vieira [16] in "Mortality on mammal roads in central Brazil" corroborates this thought. Silveira's studies [17] "Ecology and conservation of carnivorous mammals in the Parque

Nacional das Emas, Goiás”; Rodrigues et al [18] “Impact of highways on the fauna of the Ecological Station of Água Emendadas-DF; Rosa and Mauhs [19] “Running over wild animals on the RS-040 highway” are unanimous in stating that running over wild animals is a serious problem, but little evidenced. Although for Carvalho and Pereira [20], a run over animal causes a very noticeable ecological impact. The trampling of wild animals shows that there are patterns determined by the surroundings of the trampling area, having as reference the vegetation, the climate and the habits of the different species [21]. There are numerous studies on the mortality of wild animals on highways, mainly from research carried out in other countries and with different methodologies and approaches such as those of researchers Seibert and Conover [22]; Rosen and Lowe [23]; Bissonette [24]; Massemin [25]; Pinowski [26]; Orłowski and Nowak [27]; Clevenger et al [28]; Saeki and McDonald [29]; Kanda et al [30].

According to Sassi et al [31], the search for information on the dimensions of the impact generated by the highways has received the attention of researchers in several countries, among which stand out the studies by Van der Zande, Ter Keues, Metikoshl [32] “The impact of roads on the densities of four bird species in an open field habitat - evidence of a long distance effect”; Kuiken [33] “Consideration of environment and landscape factors in highway planning in valued landscapes: in Australian survey”; Vieira [16] in Highway mortality of mammals in central Brazil; Philcox, Grogan, MacDonald [34] “Patterns of otter *Lutra lutra* road mortality in Britain”. Some important studies carried out in Brazil have contributed to the discussion on the subject in the academic and technical environment. These studies include the research by Jácomo, Silveira, Crawshaw [35]; Prada [36], Rodrigues et al [18]; Rosa and Mauhs [19]; Mathias [37]; Pereira et al [38]; Prado et al [39]; Tumeleiro et al [40]; Melo and Santos-Filho [41]; Cherem et al [4]; Oliveira et al [42]; Rodrigues et al [43] and Fischer [44].

Regardless of the methodology adopted in studies on the mortality of wild animals on roads, there is a consensus that there is an underestimation of the frequency of dead animals. On the roads of the Brazilian Amazon, studies on the behavior of wild animals are still scarce, including being run over and killed. According to Sousa and Miranda [45], the mortality caused by being run over can be highly impactful for natural populations, especially for species threatened with extinction and for those with relatively large areas of life and low reproduction rates. The theoretical basis

of the research is based on what Forman and Alexander [7] proposed as Road Ecology. It refers to ecological research whose theme grows over the years, based on evidence that dramatic effects on the ecosystem and ecological processes are related to road construction, a theme that is built from engineering and planning, ecology, geography, space. The Ecology of Roads comprises the study of the effects that a road can cause on fauna and flora and from these negative effects find solutions that prevent or minimize these effects [7]; [46]. Brazilian Road Ecology is emerging from the embryonic phase to become an important line of applied research. There is an increase in the number of researchers and research on the subject and publications [47].

Studies suggest that in regions with a high level of habitat loss and fragmentation, some ecological processes are negatively affected [48]. This seems to be the case in the Amazon Region, where different environmental conditions and engineering aspects are part of each road. However, there is no way to generalize a solution, as there are different situations for each road. Thus, studies of wild fauna must be carried out on the roads under construction, so that it is possible to identify species and areas that most need protection. Educational initiatives, implantation of road surveillance devices and even users when correctly implanted are part of a set of measures to protect fauna in the vicinity of roads. The use of fences to prevent animals from crossing roads, causing them to cross lower passages are important devices used to avoid being run over. The association of these passages with wide bridges and culverts, also, can be inferior passages, constructed for this purpose. Preventive and warning signs and speed control devices are important protection mechanisms [49]. The aim of this study is to describe the monitoring of the mortality of wild animals on a state road located in the municipality of Cacaulândia, state of Rondônia, Western Amazon, caused by vehicle being run over. It is expected to contribute with subsidies to establish strategies to mitigate the mortality of wild animals on Rondônia's roads.

II. METHOD

2.1. Methodological procedure

The work was carried out in the municipality of Cacaulândia, State of Rondônia, Western Amazon, Brazil, from March of the first year of study to September of the second year, totaling nineteen months of data collection. Systematic monitoring of the running over of wild fauna on

state road 140 and its surroundings was carried out, according to the methodology standardized by Maia and Bager [50]. This methodology is derived from the methodology of Projeto Malha, developed by the Brazilian Center for Studies in Road Ecology (CBEE), from the Federal University of Lavras / MG, which aims to create an integrated process of collecting, storing, analyzing and proposing mitigation measures of impacts of linear undertakings (roads) on the trampling of wild fauna. The most detailed visualization procedure possible should be adopted [51].

The route, previously defined, consists of the RO 140 highway in a 25.0 km route; surroundings I c25 with 5 km and surroundings II c15 with 5 km long. The daily route was traveled at a speed of approximately 30 km / hour, on a 125-cylinder motorcycle. If the animal was on the track, it was safely removed and taken off the road. In hit and run locations, the carcass was photographed. Monitoring start

and end times were also recorded. The animals found dead, after being identified and photographed, were sent to the Biology Laboratory of a private college in the region. For a better understanding of the identification of the areas where the occurrence of these events is greater, a schematic drawing is made that represents the points where they found carcasses and their spatial distribution on a road. (Figure 1). In the example, the monitored road was divided into five sections (A, B, C, D, E). This scheme identifies where there are more wild animals run over and killed, visualizing the distribution of occurrence points [52].

Identifying stretches of road where there is a greater number of animals run over is a fundamental step in planning the implementation of measures to mitigate the impacts that victimize wild animals. The marking of the geographical positions of the accidents also makes it possible to correct errors in the geographic coordinates.

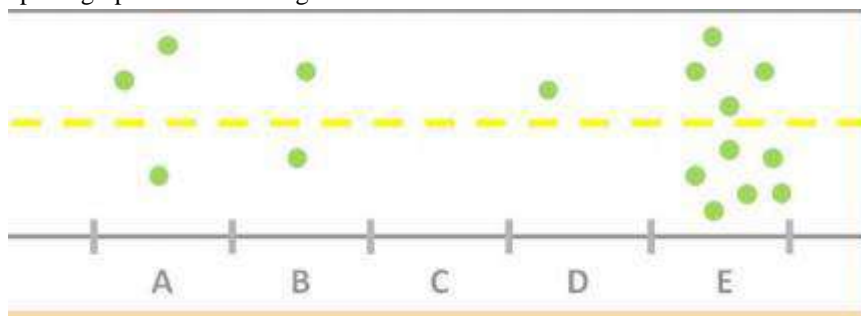


Fig.1: schematic drawing on the distribution of animals run over along the highway. Green circles represent run over individuals. Sections A, B, C, and E represent sections of the monitored road [14].

2.2. Data Collection Location

Cacaulândia is a new municipality, separated from the Municipality of Ariquemes, on February 13, 1992. It is located 61 km from Ariquemes and 207 km from Porto Velho. Formed by the Managed Settlement projects - PAD Burareiro and Marechal Dutra, divided into plots of 250 ha, respectively. It originated from a project created by Polonoroeste to provide support to farmers in the region, called the Núcleo Urbano de Apoio Rural - NUAR, receiving the name Cacaulândia, because it is a large cocoa producer. It is located at latitude 10° 20' 21" south and at longitude 62° 53' 43" west, being at an altitude of 205 meters. It has an area of 1,962 km². The 490 road has precarious infrastructural conditions, requiring maintenance of constantly plugging holes, and the neighboring or surrounding roads do not have asphalt covering.

2.3. Statistical analysis

The collected data were organized in tables with the aid of the spreadsheet editor program "Microsoft Office Excel 2010" and the chi-square test was performed.

III. RESULTS AND DISCUSSION

In the study period corresponding to 19 months, the identification of animals run over and killed by vehicles on a state road and two secondary roads in the municipality of Cacaulândia in Rondônia, Brazilian Amazon, reaches a figure of 2.57 animals per day, corresponding to the average 77.1 animals per month and totaling 1,464.9 animals. Considering that it is only a stretch (25 km) of a state road and two secondary roads of 5 km each, in only one municipality in the state of Rondônia, it can be inferred that

the number of animals run over and killed on the roads of the Brazilian Amazon are extremely worrying.

In this study, only a sample equivalent to 1 (one) day / from each of the 19 months of monitoring was considered, where the absolute frequency of 51 animals affected and killed was found. Of these, only 49 were run over and killed were considered to be able to perform the taxonomic classification. The comparisons between state highway 140 and its two surroundings and the period considered in relation to the total number of dead animals are shown in Table 1. Bearing in mind that the chi-square value found was lower than that in the table, the data obtained in the survey are thus considered valid, since it demonstrates independence from each other and the deviations are not considered significant. The value found in relation to the methodology adopted corresponds to 0.073 animals killed per day per km traveled.

Table 2 shows the comparison between taxonomic groups, at the class level, by monitored stretch. Data analysis shows that the most victimized class was that of reptiles with a relative frequency of 51%, followed by mammals with 26.5%. Birds with a relative frequency of 14.3% and amphibians with 8.2% complete the sample group of run over and killed wild animals identified and classified in the research sample. The data showed a predominance for reptiles in relation to others, a fact that can be linked to the fact of the mobility of these animals, since when they crawl or move around the land they are not seen by drivers. It is very relevant to demonstrate that the animals run over have a higher peak on rainy days in the region, very close to those that occur on hot days and in the period of forest fires. Considering that the chi-square value found was lower than the tabulated one, as well as the deviations were practically insignificant, therefore making the data found valid.

According to Guimarães [15] the animals most affected, corresponding to 90% of deaths, are small vertebrates, such as frogs, snakes and smaller birds. Bager, Fontoura [47] suggest that for birds and reptiles, the increase in trampling is positively related to rainy seasons, being more expressive in the summer. On climatic seasonality, studies by Fischer [44], Rosa and Mauhs [19], Prada [36], Mathias [37], Melo and Santos-Filho [41] have already pointed out that in some regions the mortality of wild animals varies seasonally. While the study by Ferreira da Cunha et al [52], revealed the same frequency of running over of wild animals during the different months of the year and the dry and rainy seasons. The study by Rodrigues et al

[18] also found no changes in the number of animals run over in different climatic seasons. Pereira et al [38] also found no significant difference.

Authors like Bencke and Bencke [54]; Seibert and Conover [22]; Seiler [55] suggest that accidents with wild animals occur mainly in the rainy season, which is generally associated with the reproductive period and the greater availability of food sources, such as fruits, seeds, flowers and other animals that stimulate the movement of fauna, increasing thus the probability of crossing the highways and, consequently, the chances of collision with cars. Forman and Alexander [7]; Pinowski [26] corroborates this evidence.

Ferreira da Cunha et al [53] recorded 308 animals run over, 86% of which were mammals, 11% birds and 3% reptiles. For this author and collaborators, it is difficult to compare the hit and run mortality rate between the works carried out on Brazilian highways due to the different methodologies applied and the characteristics of the road, such as surrounding vegetation, proximity to conservation units, vehicle flow, number of lanes rolling, weather data, etc. The mortality rate found in the study by Ferreira da Cunha et al [53] using the methodology of running over animals per km traveled (0.014 animals / km traveled) was lower than those found by other studies such as Prada's [36] of 0.048, Silveira [17] of 0.054, Jácomo, Silveira, Crawshaw [35] of 0.06 and by Rodrigues et al [18] of 0.168. Sássi et al [31] found 228 animals run over. In the study by Sássi et al [31] mammals represent the majority of run over animals, followed by birds, amphibians and reptiles, in the following order: mammals (128), birds (72), amphibians (26) and reptiles (2). Sássi et al [31] used the kilometer traveled methodology and found an average of running over 0.010 animals / km traveled. Fischer [44], Rosa and Mauhs [19] and Melo and Santos-Filho [41] in their studies also found the highest frequencies of mammals run over on the roads. Other studies such as Mathias [37], Prado et al [39], Prada [36] and Rodrigues et al [18] registered the majority of birds, while Rodrigues et al [43] registered the majority of amphibians.

Monitoring of wild fauna run over around the Carijós Ecological Station, Gleba Ratones, carried out by Martin [56], showed that there was no difference between the three stretches covered in the run over rate. Of the 78 identified run over animals, 49 were mammals (62.83%). The frequency of species and animals run over was approximately constant over the months. This fact suggests that these animals use the fragments around the highway as a

dispersion route for their daily activities. Some species run over on highways can be attracted to the road to feed on carcasses [19]; [57] or from grains falling during transport by trucks [36]; [58]. In a work by Pinowski [26], there was a higher incidence of *Didelphis marsupialis* (Didelphidae) and snakes (Ophidia). Possum deaths may be related to the eating habits of these animals. Snakes and lizards are often attracted to hot asphalt, especially after rain, and are crushed by cars [59].

In the study by Ramos-Abrantes et al [60], 188 specimens of run over vertebrates were recorded. Mammalia was the most representative group with 108 specimens (57.4%) registered, followed by Reptilia with 37 specimens (19.7%), Birds (14.3%) and Amphibia (8.6%). *Cerdocyon thous* (Linnaeus, 1766) was the species with the highest number of individuals run over, alone accounted for almost half of the records (N = 87; 46.5%). In the study by Pereira Corrêa, Barbosa Sales [61] 130 animals run over were

recorded and identified. There were four groups of animals with different frequency of deaths. Opossums (*Didelphis marsupialis*), black-headed vulture (*Coragyps atratus*), rodents (Rodentia) and Quatis (*Procyonidae Nasua nasua*), were the most frequent rate of animals run over during the month / day. The other groups, Lizards (Iacertia), Tamandua-mirins (*Tamandua tetradactyla*), Tatu Galinha (*Dasypus novemcinctus*), Sloth (*Bradypus variegatus*), Ocelot (*Leopardus pardalis*), Jararacas (*Bothrops jararaca*), Porco do masto-queixada *Tayassu pecari*, were the least frequent, month / day ratio. Some taxa could not be identified due to the crushing of the carcasses. Therefore, as can be seen, there is differentiation of individuals and species, depending on the biographical units of the fauna, climatic variations, breeding season, seasonal movements, habits and behavior of animals and a series of variables in environmental, social and economic contexts, among others.

Table 1. Absolute number of 1 (one) day / month of wild animals run over and killed on state highway 140, mean and standard deviation.

1 (one) day / month	Road/Nº Total Animals				Standard deviation
	RO140*	C25**	C15***	Average	
I	1	1	0	0.3333	0.5774
II	2	2	0	1.3333	1.1547
III	4	2	0	2.0000	2.0000
IV	2	0	0	0.6666	1.1547
V	0	0	1	0.3333	0.5774
VI	1	0	0	0.3333	0.5774
VII	1	0	0	0.3333	0.5774
VIII	0	1	1	0.6666	0.5774
IX	3	2	0	1.6666	0.5275
X	0	1	1	0.6666	0.5774
XI	1	0	0	0.3333	0.5774
XII	1	1	0	0.6666	0.5774
XIII	1	1	2	1.3333	0.5774
XIV	2	1	1	1.3333	0.5774
XV	0	3	0	1.0000	1.7321
XVI	1	1	0	0.6666	0.5774
XVII	3	0	1	1.3333	1.5275

XVIII	1	0	0	0.6666	0.5774
XIX	3	0	0	1.0000	1.7321
Average	1.3684	0.8421	0.3684	0.8772	0.9346

RO140* State road in Cacaúlândia / Rondônia. Surrounding Road I** Surrounding Road II***.

Source of data: [52].

Degree of freedom = 38 / level of significance $p = 0.05$ or 5% / chi-square value tabulated for this degree of significance is 26.509.

Table 2. Absolute frequency of the collection sample of 1 (one) day / month of animals run over and killed according to the taxonomic class on highway 140 and two surroundings in Cacaúlândia-Rondônia.

1 (one) day / month	Fa	Mammal	bird	Reptile	Amphibian
I	1	0	0	1	0
II	4	1	0	3	0
III	6	0	1	4	1
IV	2	2	0	0	0
V	1	0	1	0	0
VI	1	0	1	0	0
VII	1	0	0	1	0
VIII	2	1	0	1	0
IX	5	1	2	0	2
X	2	0	0	2	0
XI	1	0	1	0	0
XII	2	0	0	2	0
XIII	4	0	0	4	0
XIV	4	1	0	2	1
XV	3	0	0	3	0
XVI	2	1	1	0	0
XVII	4	3	0	1	0
XVIII	1	0	0	1	0
XIX	3	3	0	0	0
Total	49	13 (26.5%)	7 (14.3%)	25 (51%)	4 (8.2%)
Average	2.5789	0.6842	0.3684	1.3158	0.2105
Standard deviation	1.5390	1.0029	0.5973	1.3765	0.5353

Fa Absolute frequency. Collection (C) In this study, the collection refers only to a sample equivalent to 1 (one) day / month.

Source of data: [52].

Degree of freedom = 54 / level of significance $p = 0.05$ or 5% / chi-square value tabulated for this degree of significance is 34.764.

Figure 2 shows a reptile run over on road 140, with vegetation in a stream on both sides of the road with a small forest, while figure 3 shows a dead mammal.



Fig.2: Dead reptile on the road. Photograph: [52].

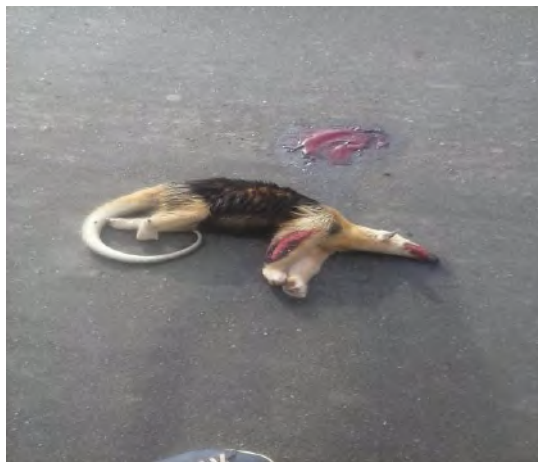


Fig.3: Dead mammal on the road. Photograph: [52].

Figure 4 below shows a bird run over and killed on road 140, with vegetation grazing on both sides of the road and Figure 5 shows an amphibian run over and killed.



Fig.4: Bird run over and killed. Photograph: [52].



Fig.5: Amphibian run over and killed. Photograph: [52].

Trombulak and Frissell [8] have already announced that road construction is an important cause of ecological imbalance and can cause several impacts, such as: changes in animal behavior; change in physiological state; introduction of exotic species due to changes in habitat; stress and / or removal of native species; food chain modification; fragmentation and alteration of habitats by edge effect; interception of corridors of natural dispersion of terrestrial fauna; population isolation and loss of individuals by collision with vehicles. Cherem et al [4] adds that in addition to these impacts caused by the construction of highways, it is

possible to list the running over of wild animals, the primary cause of death on roads. For Hengemuhle and Cademartoti [62], roads cause several impacts to the environment and the running over of wild animals can reduce the population of certain species to worrying levels. According to Ferreira da Cunha et al [53], these accidents can be reduced by decreasing the speed of vehicles, with obstacles that compel the driver to respect them, such as the installation of speed reducers (electronic barriers and / or circuit breakers) at the points mentioned above and in the places considered critical points. Rodrigues et al [18] suggested including the content about the running over of wild fauna in the training program for the acquisition of the national transit card.

According to Hengemuhle and Cademartoti [62], the so-called road fauna can have several functions, such as indicating local biodiversity, teaching about displacement behavior, seasonal dynamics of species present in the surroundings. For Oliveira [21], animals cross roads to supply diverse needs, such as migration, search for food and occupation of territory, and are daily exposed to the imminent risk of being run over. Bager [63] asks another question when stating that the main impacts to local biodiversity caused by roads and highways can be acute (immediate destruction of habitat) or chronic (long-term consequences). Glista, Devault and Dewood [64] explain that roads are necessary, but it is undeniable that they directly affect the habitat of wildlife. According to these three authors, road ecology is a new field and has developed many important works, but there are still few studies comparing the before and after the implementation of measures aimed at reducing accidents with wild animals. Without these studies, it is impossible to assess their effectiveness, but there are measures with a low degree of complexity that certainly have an effectiveness in reducing animal deaths from being run over, such as: manhole tubes (also called amphibian tunnel), passage of lower fauna, passage of upper fauna and use of barriers along with fauna passages. For IBAM [65], different mitigating measures can be used together to minimize the problem of high rates of animals run over on roads: speed reducers, signaling, environmental education, landscape management around the road and wildlife crossing. Of these, some aim to educate drivers and thereby contribute to a change of habit (for example: license plates, speed reducers) and others serve to change the habits of animals, such as

fauna passages, airline tickets, fauna viaducts, elevated, fences or driving fences.

Ideally, there should be prior planning so that at the time of construction of the highway, these measures were already included in the project. This would make the structural mitigation measure more economical. But the reality is that, in general, these measures are only thought after the construction of the highway, which demands the diagnosis of the critical points of running over of fauna [65]. According to DNIT [66] there is no way to generalize a solution, as there are different situations for each road. Thus, studies of wild fauna must be carried out on the highways under construction, so that it is possible to identify species and areas that most need protection so that wild animals are not run over. Educational initiatives, implantation of highway inspection devices and even users when correctly implanted are part of a set of measures to protect fauna in the vicinity of roads. The use of fences to prevent animals from crossing the roads, causing them to cross lower passages are important devices used to avoid being run over. The association of these passages with bridges and wide culverts can also be lower crossings, called droughts, which are built for this purpose. Preventive and warning road signs and speed control devices are structures that depend on the need [66].

Iuell et al [67] in "Wildlife and traffic: A European handbook for identifying conflicts and designing solutions" highlight that several measures have been proposed and implemented over time to minimize the impact of highways on fauna. Objective to avoid accidents with wild animals in susceptible points and to restore some degree of connectivity [67]. For Sássi et al [31] the running over of wild animals, known as "road fauna", can serve as indicators of local biodiversity, in addition to providing ecological data on the natural history of some species. Monitoring road fauna can reveal interesting aspects, such as the pattern of displacement and the seasonal dynamics of some populations of species present in the community. Fischer [44] adds that with this information, it is possible to assess the degree of local conservation and establish priority areas for conservation.

Table 3 shows the known mitigating measures, the effectiveness in reducing / mitigating impacts on different biological groups.

Table 3: known measures to mitigate the direct impacts of highways on wildlife.

Type		Mitigating measures	Biological groups			
			I	H	A	M
Structural interventions		1. underpasses				
		2. large underpasses				
		3. multipurpose underpasses				
		4. tunnels for amphibians and reptiles				
		5. ecoducts or ecosystem bridges				
		6. overpasses				
		7. multipurpose overpasses				
		8. tree extract passages				
		9. road tunnels				
		10. elevated overpasses				
		11. bridges and pontoons				
		12. modified manholes				
		13. noise barriers				
		14. expansion of the central construction site				
Management	For those who use	1. educational campaigns				
		2. road signs				
		3. speed limitation				
		4. reduced traffic volume				
		5. temporary ban				
		6. fauna detention systems				
	Biological	7. alert and chase away				
		8. beacons				
		9. food				
		10. carcass removal				
		11. habitat modification				
		12. fences and barriers				
		13. population reduction				

Subtitle:

	Recommended
	Inadequate

	Possibly adequate
	Undetermined effectiveness
xxxxxxxxxx	No known use in Brazil

I= ichthyofauna, H= herpetofauna, A= birdlife, M= mastofauna.

Figure 6 shows the existing alternatives in the context of environmental licensing.

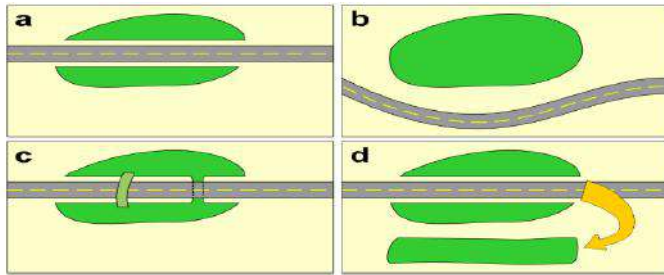


Fig.6: Schematic representation: a) impact caused by the road (habitat fragmentation), b) neutralization of the potential impact by altering the route, c) mitigation of the impact caused by the implantation of fauna crossing structures and d) compensation through the allocation of equivalent habitat for conservation purposes. Adapted from Iuell et al [67].

IV. CONCLUSIONS

The present study allowed us to describe the monitoring of the mortality of wild fauna victims of being hit by vehicles on a state road located in the municipality of Cacaúlândia, state of Rondônia, Western Amazonia, aiming in the future to generate subsidies to establish strategies to mitigate mortality caused by run over. We used a methodology derived from the methodology of Projeto Malha, developed by the Brazilian Center for Studies in Road Ecology (CBEE), from the Federal University of Lavras / MG. This methodology aims to create an integrated process of collection, storage, analysis and propose measures to mitigate the impacts of linear developments (roads) on the trampling of wild fauna.

In the study period corresponding to 19 months, the identification of animals run over and killed by vehicles on a state road and two secondary roads in the municipality of Cacaúlândia in Rondônia, Brazilian Amazon, reaches a figure of 2.57 animals per day, corresponding to the average 77.1 animals per month and totaling 1,464.9 animals. This value corresponds to 0.073 animals killed per km traveled.

Considering that it is only a stretch (25 km) of a state highway and two secondary roads of 5 km each, in only one municipality in the state of Rondônia, it can be inferred that the number of animals slaughtered by vehicles on Brazilian Amazon roads is extremely loud and worrying.

In this study, only a sample equivalent to 1 (one) day / month of monitoring was considered, where the absolute frequency of 51 animals hit and killed was found. Of these, only 49 animals hit and killed were considered. The most victimized animal class was that of reptiles with a relative frequency of 51%, followed by mammals with 26.5%, birds with 14.3% and amphibians with 8.2%. The results showed a predominance for reptiles over others, a fact that can be linked to the fact of the mobility of these animals, since when they crawl or move around the land they are not seen by drivers. It is very relevant to demonstrate that wild animal deaths have a higher peak on rainy days in the Amazon region. However, in the warm season and in the period of forest fires in the region, the rates of trampling and killing of wild animals remain quite high.

What is expected is that this study will serve as an elementary basis so that managers of public policies of the infrastructure service in which the road component of the state of Rondônia is a part can adopt mitigating measures consecrated with the effectiveness in reducing / mitigating impacts in different biological groups, in the specific case of wildlife mortality.

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Development and Optimization of Classic Multiplex RT-PCR for the SARS-CoV-2 Detection

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Abstract— Develop alternative methods for the identification of SARS-CoV-2 is essential for epidemiologic studies and interspecies correlations, allowing the allocation of scant resources to the Real-Time PCR (qRT-PCR) for patient diagnosis. The aim of this study, therefore, was to develop and optimize a multiplex reverse transcription-PCR (RT-PCR) assay to detect SARS-CoV-2 in nasopharynx clinical samples as an alternative to qRT-PCR. Bioinformatics tools to specific primers design analyzed genome sequences of the new coronavirus available on GenBank. The assay was proposed to amplify partial segments of *N* genes and *RdRp* region of the *orflab* gene of SARS-CoV-2, recommended targets by the World Health Organization (WHO). Reaction control used positive commercial control and samples from patients known to be positive and negative. The results of this study demonstrated that it was possible to optimize the RT-PCR for the detection of SARS-CoV-2 through a multiplex assay in agreement with the gold standard, precursors results for validation studies of this alternative method for epidemiological and animal health surveys are until now unclear.

Keywords— Coronavirus Disease 2019, Molecular Biology, Diagnosis, Multiplex Polymerase Chain Reaction.

I. INTRODUCTION

One of the main responsible for the present severe acute respiratory syndrome cases is the new Coronavirus (SARS-CoV-2). The first cases appeared in 2019 in Wuhan, China. The World Health Organization (WHO) classified the virus disease COVID19 as a pandemic in March 2020.

The coronavirus that belongs to the *Coronaviridae* family that is characterized by a positive simple RNA genome and enveloped viruses. Composed of four structural proteins, spike (S), membrane (M), envelope (E), and nucleocapsid (N), being the innermost protein linked to the viral genome ^{1,2}. RNA-dependent RNA-polymerase (RdRp) region and *N* gene are known

as the most conserved genomic regions, and therefore the best target for the detection of SARS-CoV-2 strains according to the United States and Chinese Centers for Disease Control and Prevention (CDC) and the WHO ^{3,4}.

Biomolecular methods prioritize the detection of viral particles in the acute phase of disease progression. The WHO recommends the use of *real-time* PCR (qRT-PCR) for COVID19 diagnosis as it is a highly sensitive and specific method, using as a standard protocol the research of the gene that encodes the *N* protein ⁴.

Even though qRT-PCR is highly sensitive and specific for the acute phase of the infection diagnostic, it is a method whose implementation is arduous, requires high-cost equipment and specifics imported reactants, and

a highly-skilled technical team. It is verified the scarcity of these inputs in the market at the time of vast international demand from the pandemic state. In Brazil, few laboratories have this standard methodology for the SARS-CoV-2 diagnosis, leading to laboratory overload and, consequently, underreporting cases⁵.

For isolation measures and medical intervention to be taken, the agent detection must be carried out as soon as possible for viral spread control. Thus, it is essential to develop methods of rapid execution, with lower cost and with high sensitivity and specificity for SARS-CoV-2, to ensure the diagnosis, monitoring, control, and prevention of the disease dispersion in the population. Conventional PCR preceded by viral RNA reverse transcription (RT-PCR), for example, can be performed with national reactants and may have the same detection capability of the agent at the beginning of clinical signs, being a possible methodological alternative for detecting viral particles.

In this context, the present work objective was to develop, standardize, and optimize the classic multiplex RT-PCR for simultaneous detection of SARS-CoV-2 *N* genes and RdRp region of *orflab* gene using positive commercial control and positive and negative clinical, for further validation as a diagnosis method, triage, epidemiological studies, fluctuation, and interspecies correlations.

II. METHODS

The *primers* design was used with eight SARS-CoV-2 genomic sequences held in a public database (*GenBank*), targeting the viral genome *N* genes and RdRp region, listed by WHO for SARS-CoV-2 detection (https://www.who.int/docs/default-source/coronaviruse/whoinhouseassays.pdf?sfvrsn=de3a76aa_2). The reference genomic sequences are those of access in *GenBank* MT081066 (*N* gene) and MT072668 (RdRp of *orflab* gene). For primers designs, *Primer 3* (<http://primer3.ut.ee/>) and *Primer Blast* (<https://www.ncbi.nlm.nih.gov/tools/primer-blast/>) programs were used.

Using positive commercial control patterns for *N* gene (2019-NCOV_N Positive Control Kit, IDT, EUA – 200.000 cópias/μL), assays were optimized in uniplex PCR with N1-F (5'-GGTTCACCGCTCTCACTCAA-3') and N2-R (5'-CAAGCAGCAGCAAAGCAAGA-3') primers, beginning on 155 and 673 nucleotides of MT081066 sequence, respectively, with expected products of 519 pb.

Two primers forward (RdRp1F 5'-AATAGAGCTCGCACCCTAGC-3' and RdRp3F 5'-GCCTCACTTGTTCTTGCTCG-3' – start on 76 and 322 nucleotides of MT072668 sequence, respectively) and two *reverse* (RdRp2R: 5'-CCGCCACACATGACCATTTC-3' and RdRp4R: 5'-GCCGTGACAGCTTGACAAAT-3' – start on 434 and 527 nucleotides, respectively) were evaluated for *orflab* gene RdRp region. Each set of primers was appraised individually. The *primers* synthesis was performed in Brazil (Custom DNA Oligos Synthesis, ThermoFisher) on the scale of 50N.

The standardization and optimization of technique used samples of four patients newly diagnosed with SARS-CoV-2 per *qRT-PCR* (gold standard). The epidemiological surveillance team from the municipality of Araguaína, Tocantins state, Brazil, responsible for monitoring positive patients in the referred locality, collected two positives (samples 1 and 4) and two negatives (samples 2 and 3). The participation of the patients was voluntary. The team of this project made all the material available for these patients collection: a set of three swabs (rayon tip and plastic rod) combined (bicavitary nasopharyngeal and oropharyngeal) stored in the same tube (sterile Falcon type with a capacity of 15 mL) containing 3 mL of sterile saline solution (0,9%). The samples were immediately sent under refrigeration to the Microbiology Laboratory of Federal University of Tocantins, Araguaína campus.

The DNA extraction was promptly performed in a commercial kit (BioGene Extração de DNA/RNA viral, Bioclin, BR) in a biosafety environment. The reverse transcriptase enzyme (SuperScript™ III, Invitrogen, USA) was used in the reverse transcription according to the manufacturer recommendations with random oligos available in the enzyme kit.

The commercial mix (Platinum™ Hot Start PCR Master Mix, Invitrogen, USA) performed the multiplex PCR reactions to provide higher reproducibility. Each one of the primers was added in 1 μL (20 pmol) per sample to each assay. The uni and multiplex reactions final volume was 30 μL/each, with the application of 1 to 4 μL of reverse transcription product.

Amplification conditions were optimized in gradient (T100 Thermal Cycler, Bio-Rad, USA) to *N* gene with temperature/time conditions determined in a cycle of 94°C/5 min; 40 cycles of 94°C/45 sec, 52°C/45 sec and 72°C/1 min; followed by a final extension cycle at 72°C/10 min.

Amplification products were submitted to electrophoresis in agarose gel at 2%, stained in ethidium bromide (0,2 mg/mL), and documented under ultraviolet light. The Brazilian National Research Ethics Commission (CONEP) previously approved the research project (Presentation Certificate for Ethical Appreciation n° 33350720.9.0000.5519).

III. RESULTS AND DISCUSSION

The serial dilution of positive commercial control in TE buffer (Tris-HCl [10mM]: EDTA [1 mM]) sensitized 100 genomic fragments of the primers determined for *N* gene amplification.

Uniplex assays tested samples 1 and 4 from patients for each one of the searched genes. The test results for the *N* gene coincided with the diagnosis by the gold standard (*qRT-PCR*), being noticed 519

bp amplicons in samples 1 and 4 and negative results in samples 2 and 3, presenting the same result if applied 1 µL until 4 µL of the reverse transcription product.

Once it was expected to develop a multiplex protocol for SARS-CoV-2 detection, the same optimized amplification conditions for the *N* gene performed uniplex assays of clinical samples for the RdRp region. In the individual assays of each set of primers for the *orflab* gene was observed that the forward primer RdRp1F with both RdRp2R and RdRp4R did not present samples 1 and 4 amplification. It can be related to differences in melting temperature that influences in the annealing temperature. Therefore the primer RdRp1F was discarded from the multiplex test.

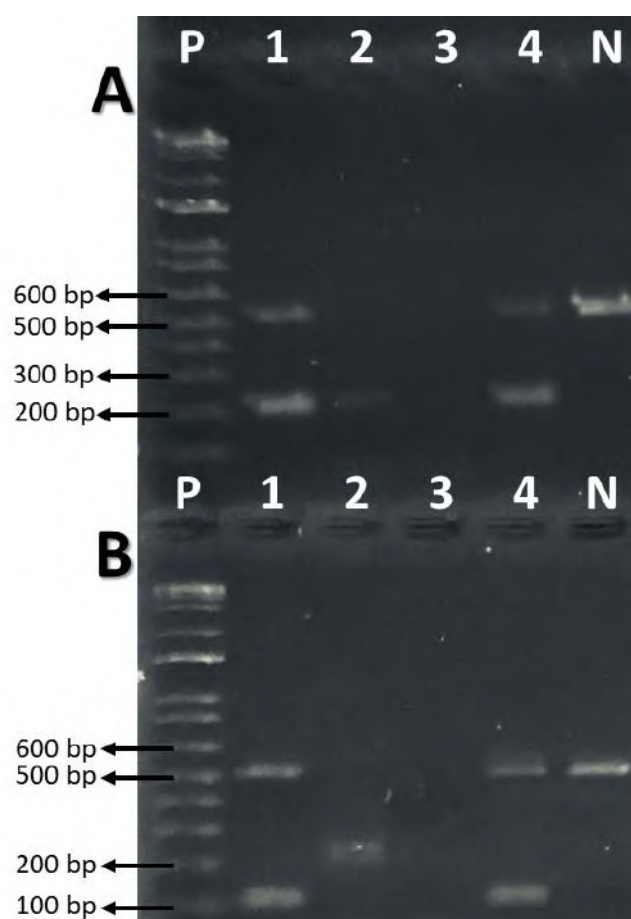


Fig.1: Multiplex PCR reaction result for SARS-CoV-2, *N* genes, and *orflab* RdRp. In the A subsection, it is possible to verify the PCR results for the *N* gene of 519 pb and RdRp of 204 bp search in the samples 1 and 4 positive in the gold standard (*qRT-PCR*) and negative results in the negative samples 2 and 3. In the B subsection, it is possible to verify the same result for the *N* gene and 111 pb product of the RdRp gene by changing the primers. P = molecular weight marker and N = positive commercial control for the *N* gene applied 1.000 multiplex PCR copies.

However, when uniplex PCR subjected the clinical samples 1 and 4 to the RdRp region utilizing the forward primer RdRp3F was observed the products amplification of 111 and 204 bp with the RdRp2R and RdRp4R reverse primers, respectively, in the samples known to be positive (1 and 4) and negative results in the negative samples (2 and 3), enabling them to the amplification protocol established for the *N* gene.

For the optimization of the multiplex assay for the RdRp and *N* gene, the N1-F and N2-R primers were tested with RdRp3F and RdRp2R primers and in another assay with RdRp3F and RdRp4R primers. Figure 1 represents the results. It can be observed that in both assays, the samples known to be positive 1 and 4 simultaneously presented the expected results for the RdRp and *N* gene amplification. Moreover, samples 2 and 3 known to be negative, did not show size amplification of the expected genetic fragment.

The researchers involved in this study elaborated on a research protocol to validate the referred method based on local epidemiological data and have a favorable ethical decision of CONEP for testing other 342 patients suspects of COVID19 cared by the Brazilian public health system. The prospection of this study is to validate this alternative methodology for triage in the case of high sensitivity and low specificity, create a molecular tool for epidemiological studies of incidence/prevalence of SARS-CoV-2 in populations, in addition to epidemiological correlations evaluation with domestic or production animals species.

IV. CONCLUSION

Considering positive commercial control for the *N* gene and this pilot study clinical samples, it was possible to determine primers and amplification conditions for the detection of SARS-CoV-2 in positive patient samples for COVID19 in classic multiplex RT-PCR assay for *N* genes and RdRp region. However, it is still necessary to carry out a validation study with a bigger number of samples to obtain more robust and significant results to establish this method as an alternative to *q*RT-PCR. This will provide methodological resources for the execution of infection rates fluctuation and interspecies epidemiological correlations studies that are until now unclear.

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Pharmacological Activity of *Calendula officinalis*: A systematic review

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Abstract— *Phytotherapy has established a therapeutic medicinal model that has exponentially been increasing over the years. Plants secondary metabolites stand out in the field of pharmacology, as a result of its biological effects in man. This study discusses about the pharmacological effects of Calendula officinalis at different researches, given that this contribution is important among researchers and the entire market, aiming at the therapeutic advancement. Calendula officinalis showed high therapeutic efficacy when applied in healing, anti-inflammatory and antiseptic processes due to its bioactive compounds.*

Keywords— *Pharmacological activity, bioactives, Calendula officinalis, phytotherapeutic.*

I. INTRODUCTION

The tropical forests, located in countries like Brazil for example, are the most diversified biologically source, and this country has a third of the global flora. The development of phytomedicines (PTM) demands a high cost, however, with the sustainable use of the national biodiversity, together with the association between universities and companies, some of the difficulties faced can be supported aiming at generating new PTM to our country^[1;2].

Searching for phytotherapy has been verified as a part of health care, since the populations have started asking about the risks of synthetic drugs misuse, associated with its cost, making people replace them with the use of medicinal plants. The PTMs might have their efficacy compared to the drugs produced through a synthetical way, for this, the transformation of a plant have to preserve its chemical characteristics, making that its pharmacological action – observed from the production of secondary metabolites – remain integral^[2].

The secondary metabolites, generally, have a complex structure of low molecular weight, they have important biological activities and they are presented at some groups of plants and with reduced concentrations. Before, they were already classified as plant excretion products, however, according to the performed studies, it is possible to realize their participation on biological activities exerted by plants for answering to the environment, as well as, for its notable pharmacological activity, being important not only for the field of pharmacology, but it is

also used in food, perfumery, agronomy, among other things. They can be resumed – in relation to their origin – from the metabolism of glucose mainly through the chiquimic acid and the acetate^[3].

The plants secondary metabolites stand out in the field of pharmacology for their biological effects in human. An example of PTM at which the metabolites are extracted is the *calendula officinalis*, where some of their therapeutical recommendation are going to be described during this literary review.

Calendula officinalis species belongs to the Asterecae family, common known as marigold, golden flower, daisy or only as calendula. Its name comes from latin calendes, for its great flowering time, being connected to the astrological summer symbol. They have orange petals which are visible during the European and Mediterranean summer. The flowers are the part used for the pharmacological extractions or for another kind of extraction, due to its capacity of producing secondary metabolites which are able to be indicated for therapeutical treatments, such as anti-inflammatory, healings and antiseptics^[4;5]. Its mainly compounds are the saponins, triterpenoid esters and flavonoid, being also used for burning treatment, skin inflammation, ulcers, wounds and eczema^[4].

The study about pharmacological activities of *Calendula officinalis* aims to gather scientific evidences connected to its therapeutical effect of this specie, reaffirming that the continuity of these studies and projects are necessary to authenticate and improve the evaluated

applications. This study still aims at reinforcing phytomedicines using in daily disorders due to the increasing at searching for natural actives, where their use might be assimilated to the synthetical actives, being able to be less hurtful to the organism as used in a safety way and scientifically reasoned.

II. METHODS

It was performed a systematic review aiming at searching for articles, books, monographs, essays and thesis related to the proposed topic in the following data base online/researching portals as Google Scholar, Scielo (Scientific Electronic Library Online), Scopus, CAPES (Improvement Personal Coordination of Higher Education) and OJS (Open Journal System), through the following descriptors, in English and Portuguese: medicinal plants, phytotherapies, *Calendula officinalis*, bioactives and pharmacological activity. It has been selected researchers published from 2015 to 2020.

III. RESULTS AND DISCUSSION

Based on Lavagna and others' project which proved that the *Hypericum perforatum* extract provides the surgical healings in childbeds, mainly caesarean operation, Jahdi et al performed a controlled clinical study, randomized for testing the healing effect of calendula in caesarians, since in Iran, the frequency of setbacks after this kind of childbed are high^[6]. Seventy women aged from 20 to 35, pregnant (from 37 to 42 weeks) were randomly divided in two groups. The group of control did not receive post operative treatment and in the second group have been applied in the seams, twice a day, during ten days, an ointment made by calendula hydroalcoholic extract with two percent of flavonoid.

For pondering the healing degree through the days, it has been adopted REEDA's Scale, which consists of a healing evaluation method in the postpart perineal region and accounts five points of the inflammatory process: redness, edema, bruise, drainage and approach^[7]. The full numeration for analysis varies between 0 and 15 in which 0 is a skin with healthy features (healthily). For comparing the groups at REEDA's Scale it has been used the T independent test. At the last day of study, 63,9% of the calendula group was at the scale 0-0 and, at this same scale, 0% of the control group. Between 1-5 of REEDA's scale 36,1% from calendula group and 11,1% from control group. Between 6-10, 0% calendula group and 77,8% control group. At the scale between 11-14 there were not

participants treated with calendula, but there were still 11,1% from the group without postpart treatment.

This way, the authors concluded that from the third to ninth post surgical day, the wounds treated with calendula ointment have been completely healed, acknowledging an efficacy in the epithelial reconstructing process, not allowing the releasing of histaminic enzymes which causes inflammation, due to flavonoid, saponins and triterpenoids^[8], since the most of calendula elements are stated like eliminators of free radicals and healings through the artificial cross-links producing^[9].

A study has performed by Buzzi et al. during thirty weeks has evaluated the effectiveness of the hydrogocolic Plenusdermax® *Calendula officinalis* extract in the healing of stressing ulcers (SU). All patients have been followed by nurses up to the conclusion of the whole procedure. The wounds have been photographed and evaluated according to PUNCH's Scale (Pressure Ulcer Scale for Healing) used for pondering the healing procedure of stressing ulcers and results of treatments, by considering three topics: the area of the wound, the appearance of the wound surface and the amount of present exudate^[10].

As higher ulcers demands on more time for healing than ulcers in lower areas, the patients have been divided in two groups, by aiming at getting better results. The whole injured area have been well moistened by spray of calendula, twice a day. The result have reached by Buzzi et al with the topic application of calendula bioactive extract (Plenusdermax®) has been that there was no considerable importance at the healing time of the SU on high and low area. On average, this period has been from $12,5 \pm 7,8$ weeks. At half the studying time, 63% of SUs have been completely healed. Reaching thirty weeks of treatment, 88% have permanently been recovered, even though, those people who have already had SU for three months.

Plenusdermax® spray showed anti-inflammatory, anti-edematous, anti-erythematous and healing actions, what was actualized through the triterpenoid monoester bioactives, alcohol of triterpene, triterpenic oligoclase and flavonoid^[11]. The present study, this way, authenticates Jahdi's et al work, for that, both researches attribute the healing activity to the same bioactives. Still on Buzzi's et al study, it was realized bacterioscopy of swabs in the injuries and it was verified the presence of *Staphylococcus aureus*, *Escherichia coli* and others microorganisms, but after the application of calendula spray, it was observed a substantial decreasing of the colonies of these bacterium, verifying an antibacterial and antifungal activity. This result was very important once offensive substances are applied with oxidant effect to cure SU and for

controlling bacterium colonies^[11]. As a result of this the natural extracts are excellent options to topic alternative treatments.

Carvalho et al also followed a way of ulcering treatment, but on diabetic patient's feet and associating calendula to the laser therapy of low intensity (LTLI). At the first day, the ulcers have been evaluated through clinical attendance, ultrasound and Doppler, at the end (30 days) these analysis have done over^[12]. The researchers concluded that, the calendula oil, as in the isolated form as combined with the LTLI, showed a distinguishing improvement in the healing and in the chart of pain. Being one more work that contributes with the authors already mentioned, certifying the favour of neovascularization and formation of the collagen fibers to the cellular proliferation, along with the antiseptic and anti-inflammatory effects.

A regulated randomized research, double-blind, performed by Phazohide et al enrolled eighty women with reproductive age and no pregnant for comparing the effect of metronidazole and *Calendula officinalis* in bacterial vaginosis (BV). The ointment of calendula was made of the flower. The entire process of extraction and preparation was realized in the Department of Bacteriology of the University of Medic Sciences Shahid Beheshi, Iran. The bottles and the solidity of the two preparation were similar^[13]. For diagnosing BV, they used three standards: pH>4.5, whitish discharge or whitish gray or thin; dissipation of fish odor through additioning of 10% of KOH and the presence of pista cell in the microscopy.

When diagnosed, by a randomly way, the women received extracts of calendula or metronidazole^[13]. Pazhohide et al supported their research on Roosphashire's et al. Evidence that acknowledged an anti-bacterial effect of the *Calendula officinalis* aqueous extract on Gram-positives strains, this way, they confirmed their results when they realized that both groups were free of odor, pruritus^[13]. Previously, the two participant groups of the study presented symptoms equated to the odor, vaginal discharge, dyspareunia and dysprudia, however, the pruritus was analysed by considerable way in the group that received the *Calendula officinalis*, that is the calendula is as efficient as the metronidazole for actioning against bacterium action. These foundations ensure the observation by Buzzi et al by noting that the bacterium colonies have been reduced after the therapy with Plenusdermax®.

Supporting the following of antibacteriana activity, Ribeiro et al evaluated *in vitro* this pharmacological activity at nine phytotherapeutics mouthwashes available in the market. The calendula showed the higher halo of inhibition of *S. mutans* and activity similar to the

chlorhexidine, as showed in others studies^[14]. For this, Ribeiro et al proposed *C. officinalis* for controlling the dental biofilm.

As topic treatment, the calendula also was used in injuries caused for the noxiousness of radiation during the operation for combating the cancer. Every care oncological method use aggressive substances to the organism, thus, when it is found a phytotherapeutic that helps in the progress and also can have low noxiousness, this discovery becomes important as for science as for the patient. According to Shneider et al, the goal of comparing the action of *Calendula officinalis* to the essential fatty acids (EFA) in the treatment of radiodermatitis in patients with neck and head cancer. The participants of the survey received randomly bottles with EFA or calendula, both through topic way and with the same bottles. All the skin area was moistened by 12 to 12 hours, with the products would be tested, from first to the last day of radiotherapy. The application was made in the hospital and a familiar was advised how to keep going along at home.

After the fifth and thirtieth day of sessions, the skin was evaluated^[15]. Both the patients from the group of calendula as the patients from the EFA were receiving radiotherapy relationed to the chemotherapy and there was also a marked amount in the two groups from people who received treatment with Cobalt-60, an gamma radiation emitter, with high tissue permeation and half long life^[16]. These combination potentialize the radiodermatitis^[15]. As conclusions, Shneider et al understood that in the EFA group occurred radiodermatitis from the fifth to twentieth session, while calendula's group only occurred it from the twentieth session on. Therefore, calendula had higher protective activity at the appearance of radiodermatitis, secured for its healing acitivity.

Babae et al tested the effect of calendula extract flower in patients with oropharyngeal mucositis (OM), a kind of injury that like the radiodermatitis is caused for the radiotherapy. The individuals were divided in two groups and by eventual way were distributed placebos and mouthwashes with calendula extract, for being used during seven weeks. In the group of calendula, none of the patients needed drugs for the most severe OM, without any cessation of the radiotherapy. Beyond that, at the end of the treatment, in this same group there were not any case of OM during all the treatment. At the second, third and sixth week, the proportion of the injuries were smaller with calendula than with the placebo^[17]. Such result was relationed to the following secondary metabolites: carotenoids, triterpenes and essential oils and can be applied to Scheider's et al study.

Fontes (2015) has studied on his master degree's thesis the activity of phytotherapeutic formulation with *Calendula officinalis* in the metabolism of rats induced to the dyslipidemia by coffee diet, which consists of a diet with many hyperlipidic food for causing the increasing on the weight of the animals^[18].

After the administration of the formulation during forty experiencing days, the author has concluded that the phytotherapeutic made by *Calendula officinalis* 0,42% flavonoids promoted a modulator effect of the lipidic profile, substantially reducing the LDL cholesterol levels and increasing the HDL^[19]. The dosage 100 mg/kg had the best result in the lipidic rates of rats, this way, Fontes has suggested that this dosage should be used like parameter to the other researches, even though in man. The conclusion was justified with the presence of flavonoids and their antioxidant action and atheroprotective^[19], however, the author highlights that it is not possible to verify these properties only to the flavonoids, because others studies have to be performed to verify if these effects are not results of an interaction between a lot of bioactives present in calendula.

More similar to Fonte's study was Kaur's et al research, at which they verified the efficacy of the ethanol extract 95% of calendula flowers after the using of arginine in rats, for the reason that the arginine increases the standards of the mediatory inflammatory and induces the metabolic acidosis, causing the necrotic pancreatitis^[20]. Based on antioxidant, anti-inflammatory and healing of *Calendula officinalis*, which can be supported through the study by Okzol et al where it was showed that the calendula reduced aminotransferase aspartate, dehydrogenase lactate and phosphokinase creatine, oxidative stress in rats exposed to the cigarette fume and increased the HDL cholesterol rates^[21]. The present research supported its results at which calendula extract reduced the levels of serum lipase at the third and fourteenth day, beyond that, it assuaged TBARS (levels of reative substances to the thiobarbituric acid) like index of lipids^[22] and increased the levels of reduced GHS^[20].

The upshot of the monography work performed by Martins reinforces Fontes' and Kaur's et al. conclusions. Martins quantified the oxidant activity of each bioactive found in the ethanoic solution of calendula desidratated flowers at different concentration, relationing to the efficiency of the extract. The authors used a method to find the presence of antioxidant compounds, based on elimination of the permanent free radical 1,1 definil- 2 picrilhidrazil (DPPH method)^[23], by concluding that calendula antioxidant action is derivated from flavonoids, cartenoids and essencial oils^[24].

A list of the works used in this bibliografic review is found in the Table 1, aiming at better exposing the results. In the Fig. 1, as a quantitative way, are showed such pharmacological activities remarked at each study.

Table.1: Abstracts of the works used in the present research

STUDY	YEAR/AUTHOR	CONCLUSION
The impact of calendula ointment on cesarean wound healing: A randomized controlled clinical trial	Jahdi et al (2018)	Calendula oitment efficacy in the caeserians healing process.
Usage of <i>Calendula officinalis</i> in the prevention and treatment of radiodermatitis: a randomized double-blind controlled clinical trial	Schneider et al (2012)	The reduction at the development of radiodermatitis in people who used calendula was greater than those ones who used EFA
Pressure ulcer healing with Plenusdermax® <i>Calendula officinalis</i> L. extract	Buzzi et al (2016)	Promising antibacterial, antifungic and analgesic activities in the <i>Calendula officinalis</i> extract
The effect of <i>Calendula officinalis</i> versus metronidazole on bacterial vaginosis in women: A double-blind randomized controlled trial	Pazhohideh et al (2018)	<i>Calendula officinalis</i> antibacterial activity is as eficiente as metronidazole.
Herbal formulation containing <i>Calendula officinalis</i> effect	Fontes (2015)	Significant improvement at the lipidic profile of the rats, due to the

on lipid metabolism in Wistar rats fed with cafeteria diet		antioxidant properties present in calendula.
Antimicrobial activity of different herbal mouthwashes	Ribeiro et al (2015)	<i>Calendula officinalis</i> showed antiseptic, antibacterial and biostimulant actions.
Efficiency studies and antioxidant activity of calendula extracts by processing extract through solvent	Martins et al (2017)	Comprovação of antioxidant activity actualized through flavonoids and caretonoids.
<i>Calendula officinalis</i> ameliorates l-arginine-induced acute necrotizing pancreatitis in rats	Kaur et al (2016)	<i>Calendula officinalis</i> effect in the increasing of GHS levels and reducing of TBARS levels.
Low-level laser therapy and <i>Calendula officinalis</i> in repairing diabetic foot ulcers	Carvalho et al (2016)	The use of <i>Calendula officinalis</i> oil by isolated way or combined with LTLI provided aceleration in the tissue repair, decrease of the wounded area, anti-inflammatory and analgesic action.
Antioxidant capacity of <i>Calendula officinalis</i> flowers extract and prevention of radiation induced oropharyngeal mucositis in patients with head and neck cancers: a randomized	Babae (2013)	Reduction of the intensity of oropharyngeal mucositis.

controlled clinical study		
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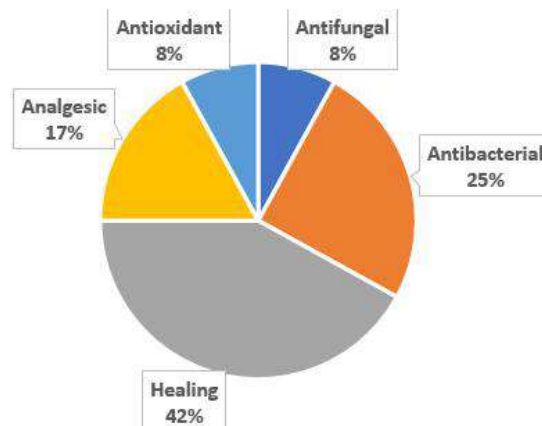


Fig. 1: Pharmacological activities of *C. officinalis* founded in the literature.

IV. CONCLUSION

Nowadays, it is verified a greater preoccupation in relation to the alopatics drugs using, as due to their effects as to their cost. The increasing of studies and researches in relation to the phytomedicines is important due to its efficacy, that in some cases, it can be compared to with the synthetic actives. The results observed at this literary review can significantly contibute for the population health improvement, for the evidences showed until this moment, concluding that *Calendula officinalis* using, when applied on healing, anti-inflammatory and analgesic processes, showed higher therapeutic efficacy.

Furthermore, it is important to emphasis the importance and necessity of going on the clinical essays and studies, which gather data that show efficacy and security for phytomedicines using.

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Ecological boards molded from low-cost local wood particles for wall panel

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Abstract—This research proposes a wall panel component molded from a wood of *bracatinga* (*Mimosa Scabrella*) and a lignin-phenol-formaldehyde adhesive. The development of a product with a simple and ecological construction technology was adopted as the approach, using low-cost wood particles. A composite made of *bracatinga* wood particles and alternative residual lignin (lignin-phenol-formaldehyde) adhesive was developed and characterized. The designed wall panel component was prototyped in full scale to evaluate the molding process and the final quality of the product. Preliminary results obtained with the pilot experiment demonstrated that the composite had properties and values that met the requirements of the standards EN 312:2010 and NBR 14810-2:2013, for structural boards for use in humid conditions (type P5). To prove the ecological aspect of the product, CO₂ emissions resulting from its manufacture and the amounts of carbon of non-fossil origin and fixed by it (expressed as CO₂ uptake) were calculated. The final balance proved to be favorable.

Keywords— Wood closure panels, Molded products and reconstituted wood, Sustainable construction.

I. INTRODUCTION

In Brazil, wood wall panels are not properly used and do not meet the requirements for tightness and hygrothermal comfort, distancing the population from construction systems that employ wood (BITTENCOURT & HELLMMEISTER, 1995).

Therefore, the purpose of this study is to develop a product or a board molded from wood particles for house wall paneling. This development can allow the formation of walls with space between the panels for better thermal and acoustic insulation, as well as water and electric installations. Due to their good ratio between mechanical strength and low density, well-designed wood products are easy to assemble into construction elements and provide considerable design freedom.

Molded products are formed from composites, which are structural molding materials consisted of a continuous polymeric phase (matrix) and reinforced by a discontinuous phase (fibers/particles). The composites are consolidated by a polymer crosslinking process (curing), in which the two phases are physically and chemically aggregated (MOSLEMI, 1974).

In this research, the process applied for molding products was based on compression. According to Razera (2006), this process allows the use of wood as a matrix, raising its concentration to 90%. This fact represents a significant increase in the use of raw material from renewable sources in the product composition.

The basic components used to manufacture wood products, molded by the compression process, are wood particles and adhesives. In this procedure, wood is reduced to small particles, which must be dried to approximately 3% humidity and mixed with the adhesive, whose type and content are defined according to the characteristics desired for the final product. During the gluing process or incorporation of the adhesive into the particles, components can be added to enhance the qualities of the product – such as catalysts, types of paraffin (acting as a waterproofing agent for particles), fungicides, insecticides, and flame retardant products – and to modify its visual appearance, e.g. dyes and pigments (MOSLEMI, 1974).

After the particle mat is formed, it is deposited in the mold for the molding consolidation phase. The

compression molding process is divided into two stages, according to Moslemi (1974):

- a. Pre-compression of the material to generate parts with shallow surfaces; and
- b. Compression, which is capable of generating deep printing with prominent shapes and consolidates the product.

A basic molding scheme is illustrated in Figure 1. It can be observed that the metal mold defines the shape of the product consolidated by pressure and temperature.

The molds, usually made of steel or aluminum, are composed of two parts that are joined together through a male and a female part. The "female" part (hollow part of the mold) provides shape and finish to the external surface of the product, whereas the "male" part generates the internal surface of the product.

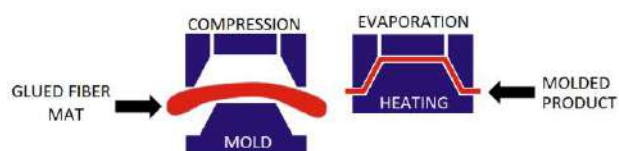


Fig.1: Scheme of the hot molding process.

Source: RAZERA (2006).

According to Razera (2006), the most relevant factors for the development of compression-molded products are those related to mold geometry and the production process. Regarding the mold geometry, the following main aspects must be considered: wall thickness, pressure direction in the mold, and uni or multidirectional pressing.

Wall thickness of the pieces must be constant, as far as possible. When the product design requires different thicknesses in the various sections of the pieces, the transition from one thickness to another should be gradual. The corners of the pieces – except for those formed in the mold closing plane – must be rounded and have a wide radius, with values between 0.2 and 0.5 times higher than the thickness of the product walls. Demolding angles, draft angles, and extraction angles are inclinations attributed to the cavities and contours of the male molds to facilitate the demolding process (VERONESE, 2013).

During the design of molds for wood particle composites, the arrangement of openings must be strategically planned in order to avoid the concentration of steam and moisture (arising from the moisture of the particles and the resin composition), which can lead to the delamination of the inner layers of the product (MOSLEMI, 1974).

The factors inherent to the production process are mold heating (regarding the material), press closing speed, specific pressure, heating time, curing time, and demolding time (RAZERA, 2006).

The main raw materials used to manufacture molded wood boards are wood particles and adhesive. In the production process, the adhesive and other additives are incorporated into the particles. Then, they are molded and pressed at high temperature and pressure.

It is worth noting that molded wood products – such as the one developed in this research – can be easily coated with films of excellent aesthetic aspect by means of application technique at high or low pressure. However, this operation was not the object of this research.

1.1. SUSTAINABILITY OF WOOD PRODUCTS FOR THE CONSTRUCTION INDUSTRY

One of the main objectives of the construction industry nowadays is to construct sustainable buildings and increase environmental awareness. Wood products have technical and aesthetic properties that make them desired in various applications, but their main advantage is their low environmental impact, due to its renewability and ease of reuse by recycling (AZAMBUJA, 2018). Producing wood products consumes much less energy than other materials (FAO, 1990). As aforementioned, wood products allow several reuse options, which makes them excellent material to be used within the context of a circular economy or reverse logistics. Wood products also have, as advantage, a significantly smaller carbon footprint than steel, ceramic or concrete products (TELLNES et al., 2017). In addition to it, since trees absorb CO₂ from the atmosphere and store or sequester carbon in their biological structure, wood generates lower environmental impact in comparison to other construction materials. Therefore, wood products have become an interesting alternative to several traditional construction solutions, being a “trendy” building material in the 21st century.

Even though wood products pass through some forms of rapid degradation due to their biological origin, given the proper design, construction, and maintenance, they can be as durable as other construction materials such as steel and concrete (FOLIENTE, 2000).

1.2. BRACATINGA

The wood used in this research was bracatinga (*Mimosa scabrella* Benth), a native species of great presence in the forest landscape of Southern Brazil (FRANCK FILHO, 2005). It is a hardwood species, with 4 to 18 m in height and 20 to 30 cm in diameter at breast height (DBH), reaching up to 29 m in height and 50 cm or

more in DBH in adulthood. Its wood density is moderate (0.65 to 0.81 g/cm^3) at 12 and 15% humidity (CARVALHO, 2003).

Bracatinga is known for its speed to form forests and presents a short rotation, having a surprising growth in the first six years of life. In traditional forests, the most common cutting ages are 6 to 8 years old. Due to its characteristics, it is used very little to manufacture straight wood pieces. Thus, it is applied mainly as shoring in the construction industry and as fuel firewood. Many rural producers cultivate it as an income alternative. The selling price of firewood is low, compared to other common forest species in the region, such as *Pinus elliottii* and *Eucalyptus viminalis* (EMBRAPA, 1988).

Most bracatinga forests do not have certifications such as FSC (Forest Stewardship Council) due to the limitations imposed by their low added value. Nonetheless, since they are majorly of secondary origin and managed by humans, it can be stated that it is relatively easy to obtain management certifications and that certified natural forests have been significantly increasing in Southern Brazil (ALVES et al., 2011 and STEENBOC et al., 2011). It is worth mentioning that, in order to avoid encouraging deforestation, the sustainability of this wood is only valid when it is originated from plantations or from sustainable management, with the proper certification by the FSC or another recognized entity (DI GIROLAMI, 2018).

During cutting, the straightest stems are separated and sectioned in lengths of 3 to 5 m to be employed as construction shoring. It is not uncommon for the shoring extraction to be performed before the final cut, at 5-6 years old, to meet the financial needs of the owner (EMBRAPA, 1988). Concerning the pieces that were employed in the construction industry, collection and recycling chains have been operating in large cities in Southern Brazil, mainly to transform them into firewood. Figure 2 illustrates one of the bracatinga pieces that was used in the research.



Fig.2: Bracatinga shoring at the UFPR Panel Laboratory.

Source: The authors.

Within this context, owing to environmental and economic aspects, the use of a local tree species to manufacture pressed boards is extremely interesting, as it has low cost and is easily replanted and recycled. Therefore, it fits perfectly within the objectives of a circular economy, which promotes the responsible and cyclical use of resources, contributing to the sustainable development, in accordance with the recommendations of the European Promotional Products Association (EPPA), Basic Works Requirement 7 (BWR-7) (EUROPEAN COMMISSION, 2016).

Given these facts and their physical characteristics, wood-based materials have now been considered a promising resource for the construction of buildings in the 21st century. Wood products can be locally manufactured, with minimal transport costs and in an environmentally friendly manner (ROBERTS, 2020).

1.3. ADHESIVE

The lignin-phenol-formaldehyde adhesive used in this research is produced from the partial replacement of phenol by the lignin exceeded from the wood pulping process. Therefore, it uses raw material from a non-fossil renewable source and from industrial production scraps, as well as reduces the use of components synthesized with phenol mixed with conventional adhesives (DIAS 2014; ZHANG et al. 2013; BERTAUD et al. 2012; RAMIRES 2010; TEODORO 2008). The replacement of phenol by

lignin in the phenol-formaldehyde adhesive may vary from 15% (GOTHWAL, MOHAN AND GHOSH, 2010) up to a maximum proportion of 30% (KOUISNI et al. 2011).

Therefore, this study aimed to evaluate the feasibility of producing molded boards of bracing wood particles glued with lignin-phenol-formaldehyde resin as a wall panel component for contemporary buildings.

1.4. CARBON FOOTPRINT OF WOOD PRODUCTS

CO₂ emissions from wood products for use in the construction industry have two approaches. Firstly, there are always emissions related to obtaining raw material and manufacturing the product, even if it is simple sawn timber. Emissions can occur during planting, harvesting, and processing. Overall, products manufactured more industrially have higher emission factors (EF) (RUUSKA, 2013). Secondly, wood products must be divided into those that have long-term use in the construction – e.g. doors, windows, floors, ceilings, and roofing structures – and temporary products – such as molds, wood scraps, shoring, and hoarding.

For temporally used products, emissions that occur in the degradation of the wood employed must also be considered. The wood degradation causes its oxidation, a reaction through which the carbon contained in plant tissues combines with the oxygen in the atmosphere to form CO₂. This process happens in an eventual burning or biological degradation in contact with the air (INGERSON, 2009). Emissions must be determined considering that the total carbon contained in the wood is oxidized and converted into CO₂eq. The carbon content (CC) of the different wood species ranges from 0.40 to 0.45 (OLIVEIRA et al. 2011). To calculate the amount of CO₂eq emitted, equation 1 is employed.

$$\text{Mass of CO}_2\text{eq emitted} = \text{Wood weight} \times \text{CC} \times 3.667 \quad (1)$$

The value 3.667 is the ratio between the carbon atomic mass and the molecular mass of carbon dioxide.

On the one hand, for temporally used wood products, production EF plus emissions from its degradation must be considered in order to calculate emissions. On the other, for wood products with long-term use, there is no need to calculate emissions from their degradation; however, emissions from their production EF must be considered. These emissions must be reported in items A1 to A3 of the Life Cycle Assessment (LCA) (ISO 14040:2006 and ISO 14044:2006).

Regarding wood products, the mass of the CO₂ sequestered and fixed by the wood (CO₂ uptake) as stored

carbon must also be considered, and its amount must be the same that will eventually be emitted by its degradation. The standards ISO 14040:2006 and ISO 14044:2006 recommend that the amount of CO₂ with regards to the stored carbon in products of non-fossil origin should be mentioned in item D (Benefits and loads beyond the system boundary, Reuse-Recovery-Recycling potential) of the LCA studies. A final evaluation of the impact of the product on the greenhouse gas emission can be conducted by subtracting the stored carbon from the production emissions.

Taking bracing as an example – which has a CC of 0.44 of its mass (OLIVEIRA et al., 2011) –, the amount of CO₂ stored will be 1.61 times the mass of bracing wood.

Moreover, when observing the values of the emissions and stored carbon, it is clear that wood products store much more carbon than they emit (RUUSKA, 2013). Thus, the sustainable planting/management rotation of wood along with the use of wood in products for long-term applications or use is an extremely efficient manner to remove carbon from the atmosphere.

II. MATERIAL AND METHODS

Firstly, the form by which the board prototypes were manufactured is described, and then, the evaluation of how these boards impact on global warming is explained.

2.1. THE PRODUCTION OF BOARD PROTOTYPES

Based on the definition and detailing of the system [Mold x Molding x Final product] used for the manufacture of molded boards of wood particles, the following parameters were evaluated: particle mat forming in the three-dimensional mold, heat transfer from the mold to the composite, demolding, product forming, detail reproduction, and surface finish. Figure 3 presents the molds of marine grade aluminum used to manufacture molded boards as a wall panel material, and figure 4 illustrates a section of the wall panel assembly, resulting from the overlap of some contiguous components.

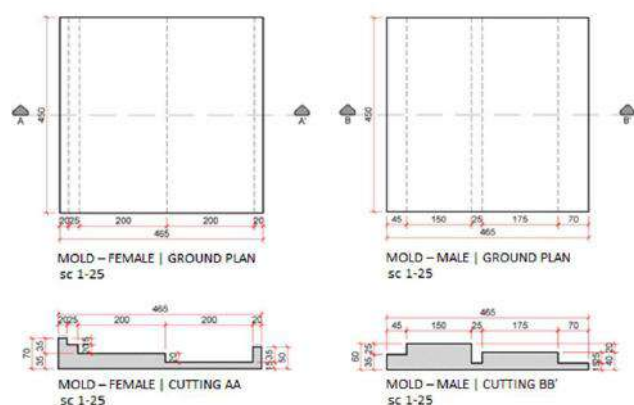


Fig.3: Ground plans of the male and female board molds for board production.

Source: The authors.

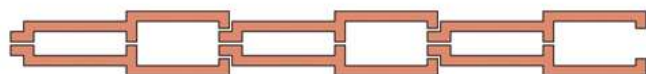


Fig.4: Section of the wall panel assembly, resulting from the overlap of some contiguous components.

Source: The authors.

The materials used in the molded board manufacture were bracinga wood particles and lignin-phenol-formaldehyde adhesive. Bracinga wood was obtained from construction shoring, which had a diameter between 10 and 15 cm and a length of 300 cm. The experimental lignin-phenol-formaldehyde (LPF) adhesive was supplied by a paper and pulp company in the state of São Paulo, and its calculated solid content was 49.4%. The lignin-based adhesive was produced with the replacement rate of 25% of phenol, according to the manufacturer.

To generate bracinga particles, struts were processed in a disc chipper to be transformed into chips (primary reduction), with a nominal thickness of 0.7 mm. Once they were air-dried, the chips were processed in a hammer mill to be converted into particles (secondary reduction), using sieves with 12 mm and 6 mm meshes.

After milling, the particles were sieved in an automatic classifier, with a 30 mesh (0.60 mm) sieve, to remove "fines". Then, the particles were dried in a conventional kiln at 103°C up to 3% humidity and were stored in plastic packaging to minimize the absorption of humidity from the environment.

After weighing the components based on the nominal density (ND) of 0.800 to 1.00 g/cm³, the resin content of 12%, and the paraffin emulsion of 1%, six prototypes were

manufactured, and the final form of the molded boards was evaluated and adjusted.

To produce molded boards, the parameters presented in Table 1 were adopted.

Table 1. Experimental design for the product prototype.

Resin type	Nominal density of the product	Resin content	Pressing time	Pressing temperature	Specific pressure
Lignin-phenol-formaldehyde (LPF)	0.80 to 1.00 g/cm ³	12%	15 min	180°C	80 kgf/cm ²

Source: The authors.

In order to facilitate the demolding process and prevent the composite from adhering to aluminum, a demolding product was spread over the mold surface. After the deposition of the particles, the pieces were manually pre-pressed to accommodate them. Following the cold pre-pressing, the mold was positioned in the previously heated press. Once in contact with the press platens, the aluminum of the mold began to heat up. Then, the temperature of the particle mat was monitored using a thermostat until its central portion reached the approximate value of 110°C. Upon reaching the determined temperature, the 15-minute pressing countdown commenced. After the established pressing time ended, the mold was removed from the press and demolded.

2.2. BOARD CHARACTERIZATION

Specific specimens were prepared for the characterization tests of the board material. They had ND of 0.75 g/cm³ and 0.95 g/cm³ and were pressed for 15 minutes. In order to perform verifications and comparisons, the European standard EN 312:2010 and the Brazilian standard NBR 14810-2:2013 were employed. When these standards had not presented limits or comparative values, references from the literature were used. Initially, the densities were measured and the compaction ratios (CR) were evaluated, based on the bracinga wood density of 0.52 g/cm³. Water absorption (WA) and thickness swelling (TS) values were also measured after 2 and 24 hours of immersion in water. The mechanical properties evaluated by means of the static bending test were modulus of rupture (MOR) and modulus of elasticity (MOE). The following tests were also performed: perpendicular tensile (PT), edge screw withdrawal resistance (SWRe), and surface screw withdrawal resistance (SWRs).

To analyze the results, the verification of the data normality was adopted through the identification of

outliers, and to evaluate the homogeneity of variances, Bartlett's test was applied. Analysis of variance (ANOVA) was applied in the statistical analysis to verify the significant effects of treatments at a 5% probability of error. Tukey's test was also applied to compare means, in case of significant differences between treatments, at a 95% probability level.

Six board prototypes were molded and visually evaluated for surface quality, form, and apparent density of the pieces. The observed response variables consisted of characteristics of the molding process such as heat transfer of the mold, product consolidation, demolding, detail reproduction, and surface finish.

2.3. BOARD EFFECTS ON GREENHOUSE GAS EMISSIONS

To calculate the amount of carbon fixed in the wood particle board studied, the amount of carbon present in the wood and in the fraction of the resin composed of lignin (residue from the pulp industry) was considered. Both bracing particles and lignin are natural products from planting trees, thus their carbon does not origin from fossil. Calculations were conducted considering the unit of one square meter of the board based on the results of the mean prototype mass. The prototypes had a continuous section of 0.40 m of useful width, and a mass of 8.05 kg per meter of length.

To calculate the carbon present in bracing particles, the species CC (0.44), published by Oliveira et al. (2011), and the mean particle mass per square meter of the board (87%) were considered. In addition to it, to estimate the carbon present in the resin, the following characteristics were evaluated: content of resin present in the board (12%), mass of resin solids (10%), lignin content of the resin (25%), and carbon content of the lignin molecule – $C_9H_{10}O_2$, $C_{10}H_{12}O_3$, $C_{11}H_{14}O_4$ (66.65%)

The results of these calculations are always presented in the form of CO_2 mass, even though the mass of the chemical element carbon present in wood and lignin is determined. The transformation from carbon to CO_2 is executed by means of multiplying the results by 3.667, which is the mass ratio between a CO_2 molecule and the atomic mass of the chemical element carbon.

To calculate the production emission factor (EF) of the bracing board studied, its production EF per kg was estimated considering the EF of a similar industrial product in HDF (High-Density Fiberboard) since it is an industrialized product. The production EF of HDF boards from Fritz EGGER GmbH & Co. OG (Germany) was used as a basis. The industrial product used as a reference has a density of 0.900 g/cm^3 – similar to the one of the board

studied in this research –, and its mass is composed of 82% wood particles, 5 to 7% water, 11% urea-formaldehyde (UR) glue, and less than 1% paraffin.

III. RESULTS AND DISCUSSIONS

3.1. RESULTS OF THE MOLDED BOARD PROTOTYPES

The best results were obtained by forming the particle mat in the horizontal position, inside a forming box, and by positioning the female mold underneath the male one, as presented from figure 5a to 5d.



Fig.5: Molding images of the particle mat forming.

Source: The authors

After demolding and cooling, the prototypes were squared and had their height reduced to 15 cm (figure 6a and 6b). Figures 7a and 7b illustrate the molded components after squaring and cutting.



Fig.6: Squared prototype.

Source: The authors



Fig.7: Molded components after squaring and cutting.

Source: The authors

The mean density values obtained from the prototypes ranged between 0.781 g/cm^3 and 0.977 g/cm^3 . This difference can be attributed to the loss of material in the particle mat forming and in the prototype pressing, to the return of thickness due to the prototype swelling after pressing and cooling, and to the consequent increase in volume and reduction in density.

Regarding the mat forming, satisfactory results were observed in the mold horizontal position. The prototype (#1) presented low densification and poor formation in the vertical position, especially regarding the connecting flaps.

3.2. RESULTS OF THE BOARD CHARACTERIZATION

Boards with ND of 0.750 g/cm^3 presented mean density values ranging from 0.730 g/cm^3 to 0.740 g/cm^3 , and all boards with ND of 0.950 g/cm^3 had the density value of 0.910 g/cm^3 . CR mean values varied from 1.40 to 1.44 for boards with ND of 0.75 g/cm^3 and from 1.75 to 1.76 for boards with ND of 0.95 g/cm^3 . These values are in accordance with Moslemi's (1974) minimum recommendation of 1.30.

Concerning the mean values of WA for boards with ND of 0.95 g/cm^3 , the results for 2 h and 24 h were, respectively, 6.71% and 23.24% of the increase in mass. These results demonstrated statistically significant differences; however, the standards EN 312:2010 and NBR 14810-2:2013 do not specify requirements for WA testing.

TS mean results after 2 hours of immersion were 4.23% (ND of 0.75 g/cm^3) and 18.70% (ND of 0.95 g/cm^3), and after 24 hours, they were 23.24% (ND of 0.75 g/cm^3) and 44.49% (ND of 0.95 g/cm^3). These results also demonstrated statistically significant differences. Regarding TS, the aforementioned standards specify that structural boards to be used in wet conditions (P5), with a nominal thickness between 13 and 20 mm, must meet the TS maximum value of 10% after 24 hours. No comparative values of WA and TS were found in the literature for structural boards manufactured with humidity-resistant resin. However, the mean values for TS after 24 hours obtained in this research were lower than the results found

in studies that used pine boards manufactured with urea-formaldehyde resin.

The mean results for the static bending tests of MOR and MOE were, respectively, 25.41 MPa and 30.83 MPa for ND of 0.95 g/cm^3 . With regards to MOR and MOE results, statistically significant differences were found; however, all boards with ND of 0.95 g/cm^3 met the minimum requirement of 16 MPa for MOR and 24.00 MPa for the MOE, according to the standard EN 312:2010.

PT mean values ranged from 0.69 to 1.58 MPa. These results also had statistically significant differences; however, all of them presented mean values higher than the minimum value of 0.45 MPa, recommended by the standard EN 312:2010.

Boards with ND of 0.95 g/cm^3 had the SWRe mean value of 2879 N, and the SWRs mean value of 2574 N. The results of these two tests demonstrated statistically significant differences between the boards tested.

Even though no comparative values were found in the literature for the mechanical properties of structural boards manufactured with humidity-resistant resin, the results of this study were satisfactory in comparison to those presented by researchers for pine structural boards manufactured with urea-formaldehyde resin.

3.3. MOLDED BOARD RESULTS REGARDING GLOBAL WARMING

Based on the bracing particle mass of 17.51 kg/m^2 of the board and the CC of 0.44, the carbon mass present in these particles was calculated for 7.71 kgC/m^2 of the board. The corresponding fixed CO_2 mass was $28.26 \text{ kgCO}_2/\text{m}^2$.

The calculated resin mass was 2.42 kg/m^2 of the board, and the lignin mass contained therein weighted 0.060 kg/m^2 . From this value and the percentage of carbon in lignin (65.65%), the carbon mass fixed in the resin was determined. The result was 0.040 kgC/m^2 , and the corresponding fixed CO_2 mass was $0.148 \text{ kgCO}_2/\text{m}^2$. Thus, the total CO_2 fixed (or CO_2 uptake) by the board in the wood and the resin, was $28.41 \text{ kgCO}_2/\text{m}^2$ of the board.

In order to estimate the production emissions of the board, the EF per kg obtained from the literature and the mean mass of the particle board prototypes were used, resulting in an EF of $13.31 \text{ kgCO}_2\text{eq/m}^2$.

A final balance is achieved by subtracting the amount of emissions from the amount of fixed or sequestered carbon, and the favorable balance of $15.10 \text{ kgCO}_2/\text{m}^2$ is reached.

IV. CONCLUSIONS

Based on the design of a wall panel component, prototypes were manufactured for a qualitative evaluation of the production process and of the results obtained.

The greatest difficulty found in manufacturing the prototypes was the particle mat forming, initially formed by the mold in the vertical position and deposition of particles glued by the upper portion of the set, which resulted in low densification of the prominent parts. By forming the particle mat in the horizontal position, with the aid of a manual pre-pressing using a hydraulic press, there was a significant improvement in the densification of the prominent parts, as well as in the product as a whole. This fact resulted in a better reproduction of mold details and surface finish.

The prototypes that presented the highest mean density were the ones that resulted in products with better surface finish and detail formation (connecting flaps). The densities obtained met the requirements of the Brazilian standard NBR 14810-2:2013 (Medium density particleboards), for structural boards for use in humid conditions (type P5).

In general, the prototype boards met the parameters of the European standard EN 312:2010 and the Brazilian standard NBR 14810-2:2013.

As for the ecological impact of the carbon footprint, the final balance of carbon emissions and carbon fixation or sequestration was presented, resulting in a favorable value of 15.10 kgCO₂/m². Thus, products molded with wood particles and lignin-phenol-formaldehyde adhesive can provide excellent results.

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Determination of Performance Point of Stability Improvement of the Multistoried Building using Different Grade of Concrete in Beams at Different Levels over Soft Soil: A Review

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Abstract— This paper is based on the study of diverse research paper of diverse researchers which are used diverse soil types. On the bases of hard, medium and soft soil different researchers used in a variety of structure construction so that it get reaction against the lateral loads. Based on the study it concluded that the maximum researcher is worked on the medium soil taken as a reference. The utmost amounts of research are seismic activity basis in it and few are also wind limitation basis. Under building design somehow focussed on the grade of concrete. The constancy is more in hard soil and moderate in medium soil and the foundation adoptability is more necessary in soft soil. To make sure the structure is with stand alongside all the load are acting on the structure such as self-weight of the structure, live loads & lateral loads such seismic activity and wind forces. The first steps constituent of construction is foundations which are resting on the soil bed below it. The soil having different properties and phases in it. As per Indian earthquake code provision the soil may be Soft, Medium and Hard Soil and also classified based on the zone wise. So it significant to analysis structure the four different soil types phase because the landscape and strata of soil surface are differ as per the different site conditions.

Keywords— Different Grades, Lateral load, Multistoried building, Stability improvement.

I. INTRODUCTION

Structures are subject to diverse types of lateral loads such as seismic activity & wind loads. The performance is differing with type of soil. The kind of consist as solid soil, medium & soft soil. The fondness of different soil type when seismic waves as they pass through the soil layer. When a structure is exposed to an earthquake, it impact with the foundation & soil mass. Thus changes the movement of the earth. This shows that the type of soil, & also based on type of structure, affects the movement of the whole system of earth structures. Because seismic waves are transmitted from the earth, they consist of modify in the properties of the soil and work in diverse ways according to the equivalent properties of the soil.

Vibrations that bother the earth's plane caused by waves generated in the earth are called earthquakes. It is said that earthquakes do not execute human life, but structures that are not built taking into account the forces of a seismic activity. Presently, earthquake-resistant

structures in India attach great significance to person safety. India is a subcontinent with more than 60% of the area in a seismic activity prone area.

Most buildings built in India are designed with everlasting, semi-permanent moving loads in brain. But an seismic activity is a random weight that leads to demise, but it also violates the social circumstances of India. The degree to which the structural reaction alters the characteristics of seismic movements observed at the base level depends on the relative mass and stiffness properties of the soil and structure. Thus, the physical property of the foundation atmosphere is an significant factor in the earthquake reaction of the structures it supports.

The future demand of each city will eventually contribute to attracting populace and living demand. This requirement leads to the development of a multi-story building. To oppose lateral forces and stay in place, tall structures need stability with or without any improvement in the same soil type. Optimization of stability. The issue

of high construction stability has now become a major issue as communities approach cities that provide them with amenities. Along with the stability issue, another thing is optimization that maintains the efficiency of the massive structure and its load on the soil that ultimately carries it. Concrete is mainly the indisputable and necessary material that is used in construction to develop infrastructure around the world.

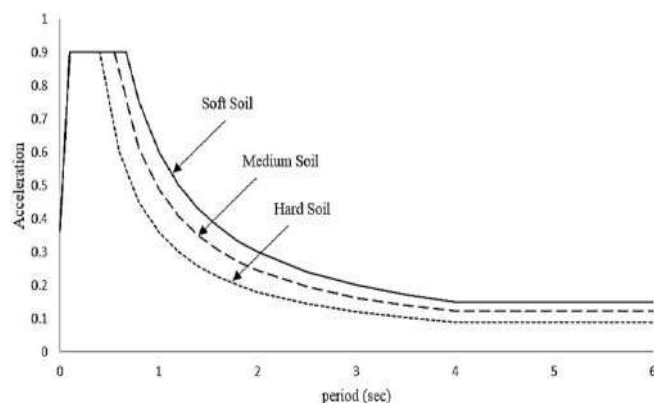


Fig. 1: Curvature between Acceleration vs. Time period of hard, medium and soft soil.

The curve is basically shown the response of earthquake. The response is in terms of vibration analysis of the structure. The vibration phenomena are taken place with structural natural time period and acceleration generated on it. The three curves are drawn in it. Hard soil is below bottom curve shown that less time and acceleration are achieved through it. Similarly the soft soil curve having maximum value so that responses are more in acceleration and time period terms. Medium soil exhibit in between them. These type of condition are vary with the site area and locality of the soil type. Hence it is important to study about stability based on hard, medium and soft soil.

II. LITERATURE REVIEW

The following literature papers are studied for the study and knowledge of Stability analysis of multi-storey building. The main emphasis on the soil type. The review on the literature is as follows:

In this Project, the state of human comfort in a high-rise building under wind excitation is estimated using the peak acceleration estimate using the Indian standard code IS 875 (part 3): 2015. Consider four different frame pipes of a high-rise circular structure having G + 20, G + 30, G + 40 and G + 50 with different conditions, that is, a normal plate, a secondary beam, a waffle plate and a ribbed plate are taken. A typical round floor with a diameter of 50 m

and symmetrical in plan in both main directions. Then, using ETABS-2013 software, the maximum displacement is estimated by dynamic building wind analysis using the corrosion factor method. Using maximum bias, the Acceleration Peak will be calculated using IS-875 (Part 3); 2015 for various structural conditions of scaffold pipes and construction modes. The peak acceleration obtained in the analysis is compared with the reference data provided by Smith. S.B. and the Coull book and human comfort perceived level are calculated for the Indian tertiary level of the described location of India, from which the evaluation of the effective high-rise building under dynamic wind load is analyzed (Arvind Vishwakarma & Savita Maru(2019))

In the current era or scenario, the G + 12 structure located in zone III is considered for analysis. The analysis is carried out for seismic zone III. The structural model is analyzed and compared with different porch locations for seismic zone III according to IS 1893-2016 for analyzing the response spectrum. Results are assessed for offset, line offset, baseline offset, etc. Results are obtained and presented as plots and tables for the seismic zone. A building with a porch exposed to seismic effects with seven different locations, based on the analysis results, was obtained for seven locations of a multi-storey building. The results show several results: maximum displacement at location 7, maximum basic shear at location 1, maximum axial force at location 6, maximum column shear force at location 1, maximum location 1 of the column bending moment, beam shear force. (Abrar Ahamad, Ankit Pal & et. al.(2020))

This article provides a short description of determining the best porch location with the help of staad-pro. The analytic approach is used under it. The article aim is seismic waves effect . staad-pro approach is used under it. This article concludes that it is really important to use analytical methods before building multi-story buildings in seismic and non-seismic areas. After studying all the documents, we can easily understand the importance of analytical methods. We can easily calculate the effect of seismic loading using programs such as staad pro and E-tabs before the construction of multi-storey buildings. Calculation and modeling is the main purpose of the conclusion (Abrar Ahamad, Ankit Pal & et. al. (2020))

In this era of multi-story building design and architectural vision, a new idea is required. The diverse competitors surrounded by them made the construction with their own choice, as well as market demand and a multi-story structure, perform extremely important work in innovative and new fields. This should explain the complexity of the production of the region, along with the

architectural and structural point of view. Composite and varied floor arrangements on similar substrates require reliability with a constructive approach. These types of structures are the Twin Tower structure used in this modern globe. In this study, outcome evaluation parameters such as floor displacement and drift are derived from the props of the multi-story structure of the twin tower located in Zone III earthquakes, earthquakes impact the structure under 5 different shapes, and studied with Staadpro assistant software design (**Mahendra Kumawat, Ankit Pal & et. al.(2020)**)

The structure is now ready with a lot of modern traditions such as tall construction, etc., and there the need is met with fresh modernization and latest thoughts. Many associated innovators have used them to build a structure with their own alternative as well as market demand. The parameter estimates for consequences such as floor displacement and drift are derived from the foundations of any multi-story structure located in an earthquake. Zone III, earthquake effects affect the building under 7 different best sized columns to reduce baseline displacement. For base shear reduction, use the best column size of columns with the same concrete class in a multistory building under seismic loading to study base shear reduction and verify with the E-Tabs design software alliance (**Aasif Khan, Ankit Pal(2020)**)

The current work shows the literature survey of various researchers who have been contributing in this field. Conclusions with the outline of the proposed work are provided at the end of the work. It conclude the above literature review, it is found out that it is necessary to introduce stiffness increasing members in tall structures to increase the lateral load handling capacity. Various researches already done till now in terms of stability improvement. Since one side of the current theme is to increase overall stiffness to resist lateral load but the other side is; that it increases overall construction cost. To maintain these two things, wall belt supported system plays a major role. Hence wall belt supported system should be implemented in tall structures. The upcoming proposed work shows various wall belt stability cases with different grades of concrete with different thickness. The optimum case of stability by comparing all the decided cases of different thickness will be implemented and shown in upcoming papers (**D. K. Upadhyay & S. Jamle (2020)**)

The shear wall belt system so introduced to make the tall structure stiff and the lateral movement of the same will be reduced. To demonstrate this, total 10 tall structures are prepared and analyze it by applying the wall belt of different thickness of different grades. After deep comparative analysis, it has been found out that Building

case B7 emerges as the best wall belt grade stability case. maximum displacement in X direction has a minimum value of 314.063 mm for Building case B7 and value of 166.992 mm obtained same in Building B7. The values are more in Building case B0 when shear belt is not used then it drastically decreases since stiffness is more when shear belt is used. Base shear values increases with increase in additional member in a structure. Building case B0 seems lesser value of base shear. Building case B4 and B7 seems lesser value of shear forces with a value of 3317.0919 KN. Maximum Axial Forces in Column for all Wall Belt Stability Cases seems lesser in Building case B7 with a minimum value of 4922.3212 KN. Shear forces in column increases with increase in additional member in a structure and behaves same as base shear parametric value (**D. K. Upadhyay and S. Jamle (2020)**)

The current work is going to show the stability criteria of changing the grades of beams without altering the size at various floor levels. Total 6 cases of the current theme created and analyzed with the help of software approach after then result is compared. Result shows that the increase of stability has seen in Case BS3 and BS4 and would be recommended whenever this type of stability activity performed (**Bhagwat Mahajan, Sagar Jamle(2020)**)

As the current study carried out a comparative and understandable behavior of the multistoried building column component with regular and irregular grade of concrete. A software analytical approach is used for the analysis of total five similar building models with same and different grades. Different cases show its different behavior and define its own importance of grade change. At last conclusions have drawn for the efficient and final case that shows optimal location of grade change in concrete columns in a symmetric structure. Grade location case T shows least parametric values after comparison with other grade location cases (**Romesh Malviya Sagar Jamle (2020)**)

The current work demonstrates the destructive effects of earthquake over a multistoried building. For this, Total 12 shear wall stability case residential apartment building models are prepared and are assumed to be located at seismic zone III with shear wall located at its core. These models have different shear wall thickness viz. 0.140m, 0.160m, 0.180m and 0.200m combined with M20, M30 and M35 grades of concrete. Observing all the parameters, for making the multistoried building more stable, it is necessary to increase the thickness of shear wall members with higher concrete grade (**Manoj Patidar, Sagar Jamle (2020)**)

The present study describes about group action of pile group, modeling of four piles were taken for study. In study, spacing between pile groups are taken as 2.5D and 3.5D (D-Diameter of pile). 0.8 is the diameter of four pile group. Different pile arrangements are taken such as rectangular, square, staggered; diamond 1 and diamond 2. Analysis for different shapes of pile groups are done by RS method using software approach. bending moment, Displacement, Shear force and three types of stresses are evaluated under the analysis of models (**Mansi Jajoriya, Arvind Vishwakarma & et .al. (2020))**).

The paper is based on the study of pile group. The modelling is based on the of four piles groups is carried out taking space between them as 2.5 and 3D. The dia. of piles is 0.6 and the dia. of the group of eight piles is 0.4, the form chosen to organize the group of piles is Rect., Square, 2 types of Diamond and staggered pattern. The analysis of the different groups of shape piles will be carried out using the RS method based on STAAD.Pro. Parameters such as displacement, SF and BM are taken into account for the pile group analysis. The paper concluded that other than regular grouping rectangle and diamond pattern is also play efficient role when square model is not to be preferred as per site conditions (**Mansi Jajoriya, Arvind Vishwakarma & et, al. (2020))**

The aim of the present study is to compare the behavior of multi-storeyed building of conventional R.C.C., having flat slab with or without shear walls and to analyze the effect of building height on the performance under earthquake forces. Also effect of with or without shear wall for flat slab building on seismic behavior with varying thickness and varying position of shear wall are studied. In this work, the effects of seismic forces in zone V on these buildings are also carried out. For this, G+9, G+18, G+27 and G+36 Storeyed models, each of plan size 20X20m are selected. For stabilization of the variable parameters, shear wall are provided at different locations. To study the effect of different location of shear wall on flat slab multi-storey building, static analysis (Equivalent Static Analysis) in software STAAD Pro is carried out for zone V. The seismic parametric studies comprise of lateral displacement, storey drift, drift reduction factor and contribution factor (**Sagar Jamle, Dr. M.P. Verma & Vinay Dhakad et, al.(2017))**

Observing all the parameters, the main aim of this work has achieved with lessening the Base Shear parameter in both X and Z direction in residential cum commercial (G+18) multistoried building under seismic loading. Building beam case BCC4 observed and obtained as efficient case for beam change cases at different levels and should be recommended when this type of approach

will be adopted in any earthquake zones. On other hand, Building column case CC4 observed and obtained as efficient case for column change cases at different levels and should be recommended when this type of approach will be adopted in any earthquake zones. After deep analytical approach, it has been found and studied that base shear beam reduction case BCC4 observed and obtained as efficient case for both beam change cases and column change cases at different levels and should be recommended when this type of approach will be adopted in any earthquake zones. Keywords: Base Shear Reduction, Beam cases, Bending Moments, Column cases, Concrete Grade, Displacement, Dual System, Multistoried Building, Shear Force, Shear Wall (**Ankush Nagar, Sagar Jamle et,al.(2020))**

The use of the shear wall at corners focuses the view of structural stability in present era and its use as dual system in a multistoried structure, since the major focus is to reduce the lateral loads acting on it. The research topic to reduce the lateral load in the current trend has increasing day by day. This trending expansion leads to the result in safe high rise structures. To contribute something in this, the current work shows the survey of the research works presented in shear wall usage and concrete core topics in dual structures as per Indian Standards. This study deals with the comparative analysis of the research trend on the current topic and after the survey, comprehensive outcomes are provided in conclusions that forms the objectives of the additional study. The main focus is to check the dual system with grade change in concrete with fixed thickness of shear wall members at corners that has going to be a major part of the study for upcoming proposed work. (**Shahdab Khan, Sagar Jamle et, al.(2020))**

The reduction of the overall budget of the project leads to the cost effective one and there should be such criteria of reduction of the cost in different manner. To make economic structure without losing the stiffness criteria, the work has been performed in two stages. The former one is building with single shear wall core and the latter one is building with dual core shear wall; the entire work has performed with four different phases. In first phase total 5 buildings that are modeled with different openings in single core types shear wall and then second phase performs the analysis procedures of the same. The third phases have total 6 buildings that are modeled with different openings in dual core types shear wall and then fourth phase performs the analysis procedures of the same. The result analysis has been performed and then conclusions are drawn. Building with 25% opening area in single core type shear wall and 50% opening area in dual

core type shear wall performs well to reduce the cost of the project. Due to Seismic effects, for single core structures, building core case 5 shows best parametric values among all. Similarly, for dual core structures, building core case 6 shows best parametric values among all. (**Gagan Yadav, Sagar Jamle et.al. (2020)**).

III. CONCLUSIONS

The following conclusions are made based on the above research papers The belt truss & outrigger system most accepted method for withstanding under lateral loads.

1. The Model category is based on the moment resisting framed type mostly other than this hull core; shear wall & belt also used by some of researchers.
2. Comparative study of soil types with different zone of earthquake.
3. Medium soil placed result are moderate under moderate magnitude, soft soil are results having more magnitude and lesser results are gets in hard soil structure.
4. Comparative study of soil types with different zone of earthquake.
5. The most researcher worked on medium type of soil. So that it os medium range adopted for the ansysis
6. The result taken as building frame are displacement, bending & overturning moments, base shear for earthquake based so that rigidity of the structure.
7. The results are varying with change in the structural frame type.
8. Shear wall play an important role in the rigidity of the building.
9. Grade of concrete also play important role in the strengthen of the structure.
10. Static approach and linear dynamic approach is adopted.

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Effect of Expressive Therapies on Sleep Disorders in Hyperfrequent elderly of Primary Health Care

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Abstract— The study aimed to verify the efficacy of expressive therapies (ET) in sleep disorders in hyperfrequent elderly (HE) of Primary Health Care (PHC). Quasi-experimental study, with 69 elderly people assisted at PHC in a metropolitan region of the Midwest, divided into two groups: intervention (elderly with high attendance) and control (low-frequency elderly). Sleep questionnaires were used: Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), Insomnia Severity Index (ISI) and STOP-bang (SB), in addition to the investigation of sociodemographic variables, anthropometric and health service-related. For data analysis, chi-square tests, multivariate analysis of variance and Wilks' Lambda test were used, considering $p \leq 0.05$. The intervention group (IG) showed a decrease in PSQI scores ($p = 0.003$), ESE ($p = 0.006$), IGI ($p < 0.001$), SB ($p = 0.002$) with significant differences between groups. ET were effective in the female and male IG, attenuating sleep disorders. Thus, by reducing sleep disorders in the group of HE people with the use of non-pharmacological intervention in PHC, it is possible to improve sleep quality and, consequently, reduce the use of health services, reducing financial costs for the health system public.

Keywords— Complementary therapies, Elderly, Motor Activity, Primary Health Care, Sleep.

I. INTRODUCTION

Sleep disorders have an impact on sleep quality during senescence, due to changes in structure and an increase in the duration of the more superficial stages of sleep. Thus, it is necessary to know the changes associated with aging, in order to define the clinical conditions of sleep in the elderly person as normal or pathological [1, 2, 3].

With population aging, there is likely to be an increase in the prevalence of sleep disorders. However, even with the incidence, prevalence and intensity of sleep disorders increasing with age, chronological age is not an independent predictor of future disorders [4, 5, 6], however, the literature points to sex as a major impact factor for the development of sleep disorders as age advances, with greater vulnerability in female, due to the

influence of the physiological and cyclical hormonal variability of the female organism [7, 8].

Sleep disorders have multifactorial causes affecting 25 to 30% of the adult population, which can consist of primary or secondary conditions, representing a serious risk to public health. They are risk factors for the elderly population, estimating that 50% of this age group have symptoms related to sleep [6, 9, 10]. A systematic review study, point out that among the elderly, sleep duration is associated with an increased risk of mortality from all causes, and long-term sleep is correlated with cardiovascular mortality [10].

In Primary Health Care (PHC), the gateway to elderly care [11, 12], sleep assessment is incipient. Studies related to sleep in PHC in the elderly population is of great

relevance, as it will provide subsidies for early diagnosis and treatment through non-pharmacological measures, minimizing consequences on poor quality sleep and serious repercussions on the global health of the elderly.

The hypothesis of the current research is that expressive therapies minimize sleep disorders in elderly hyperfrequent of PHC. To guide the research, the following question was asked: are expressive therapies effective in decreasing sleep disorders in elderly hyperfrequent of PHC?

The aim of the current study is to verify the efficacy of expressive therapies in reducing sleep disorders in PHC hyperfrequent elderly, stratified by sex.

II. MATERIALS AND METHODS

This is a quasi-experimental study, carried out from January 2018 to January 2020, at the Basic Health Unit (BHU) belonging to the metropolitan area of the Federal District.

For the initial screening of the study, 160 elderly people who had medical care in 2017, at the BHU, were included as participants in the research. The sample was divided into two groups: intervention group, with hyperfrequent individuals; and control group, with non-hyperfrequent individuals. Hyperfrequent individuals were considered, the 10% who had the highest number of medical consultations in the last 12 months, the definition most used in national and international studies [13, 14, 15, 16], and non- hyperfrequent, those 10% less frequently in medical consultations in the same period.

The inclusion criteria in the sample were: age 60 years or older, being registered at the BHU of Granja do Torto, medical care in 2017 at the same BHU, availability to answer the questionnaires applied and to participate in expressive therapy sessions and signature of the informed consent form. Exclusion criteria were: visual, auditory or language deficits, which hindered communication, medical diagnosis of stroke, depression (in treatment) or dementia, 25% or more absences in expressive therapy sessions, and cognitive deficit, measured in the Mini Mental State Examination (MMSE).

In the MMSE, cutoff points were used according to schooling: 17 for illiterate, 22 for one and four years, 24 for five to eight years, and 26 for nine or more years of schooling [17]. The elderly who scored below the cut-off point were excluded from the survey.

The selected elderly people were invited, by telephone, to attend the BHU of Granja do Torto, and a meeting was scheduled to explain the objectives of the study. After the clarifications, the participants signed the Free and

Informed Consent Form and the research was conducted according to the ethical principles contained in the Declaration of Helsinki and Resolutions 466/12 and 510/2016.

Data collection was performed through questionnaires that addressed: demographic variables (sex and age), anthropometric variables: body mass index (BMI) based on measurements measured by weight and height, and cervical circumference calculated at the base of the neck at the height of the cricothyroid cartilage (in men with prominence it was measured below it), according to the criteria Ben-Noun [18], and sleep variables.

The questionnaires on sleep disorders applied were:

- Pittsburgh Sleep Quality Index (PSQI), created by Buysse et al [19], in the version translated and validated in Portuguese by Bertolazi et al [20], who assesses the quality and sleep disorders related to the last 30 days. The sum of the scores of seven components generates global PSQI scores, which indicate: 0 to 4 points, good sleep quality, 5 to 10 points, poor sleep quality and above 10 points indicate the presence of some sleep disorder. Good sleepers comprise patients who obtain final scores between 0 and 4 points and bad sleepers correspond to those with a final score equal to or greater than 5 points.
- Epworth Sleepiness Scale, developed by Johns [21], translated and validated for use in Portuguese by Bertolazi et al [22], used to assess excessive daytime sleepiness. The global score ranges from zero to 24 points, with scores above 10 suggesting the diagnosis of excessive daytime sleepiness.
- Insomnia Severity Index, developed by Bastien et al [23], with cross-cultural adaptation for use in Brazil and validation performed by Castro [24], assesses the degree of severity of insomnia with the following score: from 0 to 7, did not reach criteria for insomnia; from 8 to 14, mild insomnia; from 15 to 21, moderate insomnia; and from 22 to 28, severe insomnia.
- Stop Bang was developed by Chung et al [25], validated in Brazil by Duarte et al [26], and the final score of this instrument varies from zero to eight points. The sum between zero and two points indicates low risk of obstructive sleep apnea (OSA), while three to four points indicate intermediate risk and five to eight points high risk.

After applying the instruments for sleep assessment, the presence or absence of sleep disorders was quantified.

The hyperfrequent elderly were submitted to expressive therapy (ET) sessions, twice a week, with an average duration of two hours, for 24 weeks. The exercises proposed in the ET sessions were adapted from biodance, a

system of integration and human development oriented towards the expression of human potential through dance, communication exercises and integrative experiences induced by music [27].

The following lines of experience of biodance were used: vitality / identity, affectivity, creativity and transcendence [28]. The exercises of the vitality line were synergistic, melodic and celebratory walks; vitality games; looking games; fluidity exercises; progressive activation wheel and rhythmic dances [27, 28, 29]. In the exercises to stimulate creativity, seed dance, yang dance, yin dance were performed, in addition to creative games that will seek to rescue joy such as the playful dance in pairs or looking games. In the line of affection we had: the wheel of lull, the wheel of communion, affective meetings in feedback, lap, fraternal hugs, walking with confidence and walking with affective motivation; and in the line of transcendence, a circle of reverence and baptism of light were performed [27, 28, 30].

In the ET sessions, music from the time of the youth of the hyperfrequent elderly was used, taking into account their sound preferences and trying, whenever possible, to use sung songs (in Portuguese), in addition to the popular songs chosen by the elderly participants, erudite songs were used in the sessions, with the aim of producing emotions of love, affection and happiness, dancing with these songs.

The control group (non-hyperfrequent elderly) did not perform any type of scheduled regular activity during the 24 weeks in which the ET intervention was performed. After this period, both groups were reevaluated with the instruments to verify sleep variables.

The data were processed and analyzed using the SPSS software, version 22.0, duly registered for the research. Initially, descriptive statistics were performed, with measures of central tendency and dispersion (mean and standard deviation) and qualitative measures by relative and absolute frequencies. Then, the Shapiro Wilk test was applied in order to verify the normality of the data. Pearson's chi-square test was used to analyze the association between groups (intervention and control) and

sociodemographic characteristics. For comparison between the pre and post intervention moments, multivariate analysis of variance was used for repeated MANOVA measurements (two groups x two moments) and the Wilk Lambda test was applied. For all tests, the significance level of $p \leq 0.05$ (5%) was considered as a positive indicator of statistical significance.

The research was submitted to the Research Ethics Committee of the Catholic University of Brasilia (REC / CUB) under CAAE: 57587516.9.3001.5553 and approved according to opinion No. 1,861,003 on December 12, 2016, being a subproject of the integrated project called "Hyperfrequent elderly people in Primary Health Care: influence of expressive therapies on the frequency of consultations and sleep disorders."

III. RESULTS

160 elderly people who had medical care in 2017 at the PHC of Granja do Torto were admitted to the study. However, only 70 elderly people met the eligibility criteria, with 33 distributed in the intervention group (elderly with high attendance) and 37 in the control group (low-frequency elderly). Fig. 1 represents the flowchart of the sample selection used in the study.

The 69 elderly people were divided, according to sex, into four groups: in group one, 22 elderly women (31.9%) hyperfrequent female (HF), group two, 10 elderly people (14.5%) hyperfrequent sex male (HM), group three, 28 elderly (40.6%) non-hyperfrequent female (NHF); and in group four, 9 (13.0%) non-hyperfrequent male (NHM).

The predominant age group in the female and male hyperfrequent elderly and in the female non-hyperfrequent elderly was 70 to 79 years, while in the non-hyperfrequent elderly, in the male sex, the age group from 60 to 69 years and 70 to 79 predominated. years. No significant differences were found in the age variable between the groups (Table 1).

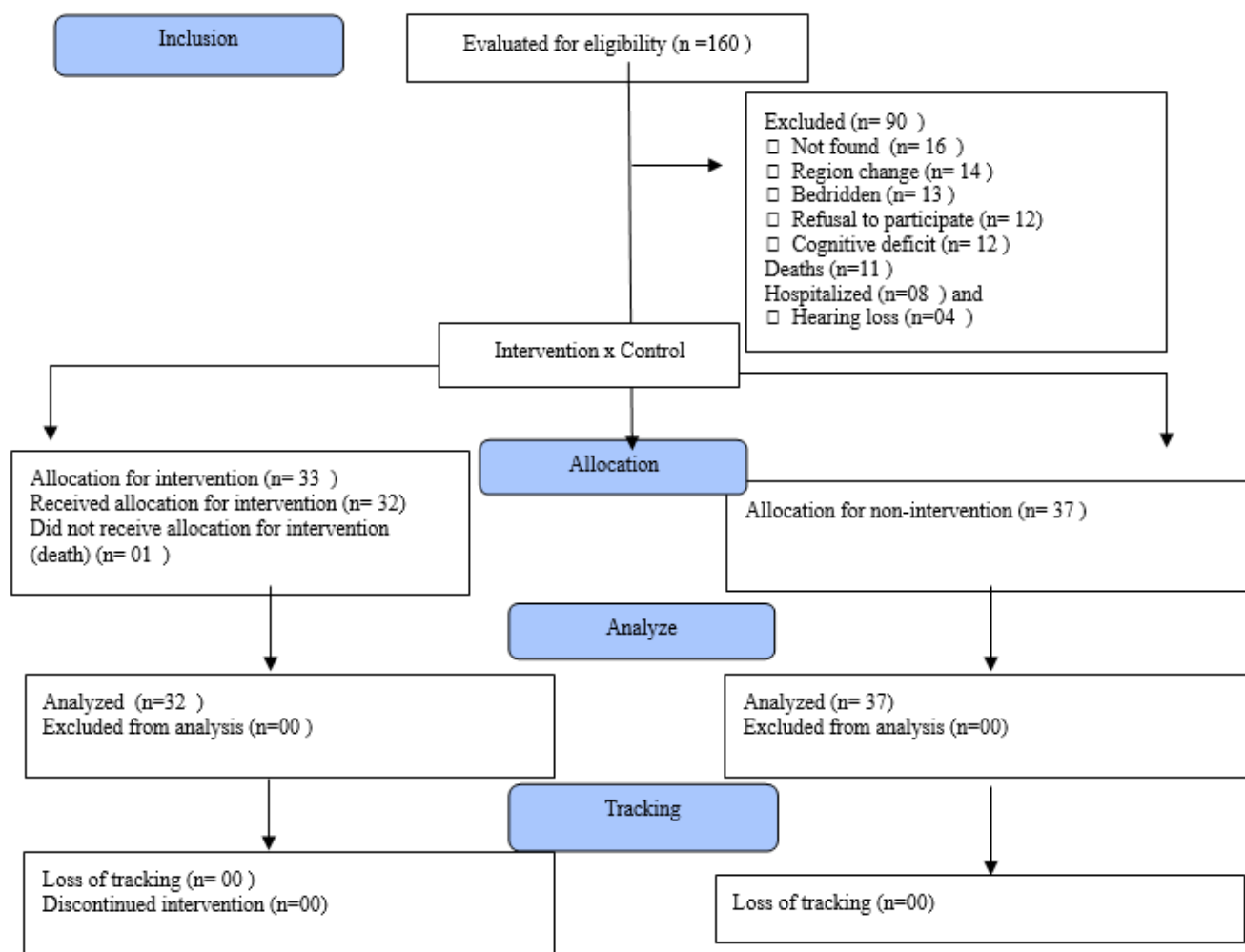


Fig. 1: Flow diagram of the study selection process.

Table. 1: Classification of the age group of elderly users of PHC in Granja do Torto, according to sex, Brasília, DF, Brazil, 2018-2020.

VARIABLE	Hyperfrequent		Non-hyperfrequent		p-value
	HF	HM	NHF	NHM	
	n (%)	n (%)	n (%)	n (%)	
Age (years)					0.23
60-69	3 (13.6)	4 (40.0)	15 (53.6)	4 (44.4)	
70-79	14 (63.6)	6 (60.0)	10 (35.7)	4 (44.4)	
80-89	4 (18.2)	0 (0.0)	3 (10.7)	1 (11.1)	
90 or more	1 (4.5)	0 (0.0)	0 (0.0)	0 (0.0)	
Mean (± standard deviation)	75.1±6.8	71.3±5.7	69.2±6.82	71.3±6.8	
Total	22 (100.0)	10 (100.0)	28 (100.0)	9 (100.0)	

Abbreviations: HF = Female hyperfrequent; HM = Male hyperfrequent; NHF = non-hyperfrequent female; NHM = non-hyperfrequent male. ** Significant association ($p \leq 0.05$) - Chi-square test.

As for the assessment of sleep disorders, there was a significant difference in sleep quality ($p = 0.02$) and in excessive daytime sleepiness ($p = 0.02$) between groups. Hyperfrequent had a higher prevalence of poor sleepers, both in female (90.9%) and in male (90.0%), with a significant difference ($p = 0.03$) (Table 2).

As for insomnia, among the 32 hyperfrequent, 11 (15.9%) presented, being in the feminine and masculine sexes, respectively, 5 (22.7%) and 2 (20.0%) with light intensity and 3 (13, 6%) and 1 (10.0%) with moderate intensity. Of the 37 non-hyperfrequent elderly, 9 (13.0%) had insomnia, 4 (14.3%) and 1 (11.1) with mild degree, and 2 (7.1%) and 1 (11.1) of the moderate type, in the feminine

and masculine sexes, respectively. No significant difference was found between the degrees of insomnia between the groups (Table 2).

As for the risk of obstructive sleep apnea (OSA), the prevalence of high risk for OSA was 27.3% in HF, 20.0% HM and 17.9% in NHF, with no significant difference between groups (Table 2).

Regarding the presence of sleep disorders, 19 (86.4%) and 10 (100.0%) of the elderly who were hyperfrequent and 18 (64.3%) and 8 (88.9%) of the non-hyperfrequent elderly, of the sexes male and female respectively, had some sleep disorder (Insomnia and / or Sleep Apnea Syndrome) with significant difference between groups ($p = 0.05$) (Table 2).

Table. 2: Sleep changes, according to sex, in the 69 elderly people from the Basic Health Unit of Granja do Torto, Distrito Federal, 2018-2020.

VARIABLES	Hyperfrequent		Non-hyperfrequent		p-value
	HF n (%)	HM n (%)	NHF n (%)	NHM n (%)	
Sleep quality					0.02*
Good sleep quality	2 (9.1)	1 (10.0)	11 (39.3)	1 (11.1)	
Poor sleep quality	10 (45.5)	7 (70.0)	9 (32.1)	7 (77.8)	
Sleep disturbance present	10 (45.5)	2 (20.0)	8 (28.6)	1 (11.1)	
PSQI					0.03*
Good sleeper	2 (9.1)	1 (10.0)	11 (39.3)	1 (21.7)	
Bad sleeper	20 (90.9)	9 (90.0)	17 (60.7)	8 (88.9)	
Insomnia Severity Index					0.98
Absence of insomnia	14 (63.6)	7 (70.0)	21 (75.0)	7 (77.8)	
Mild insomnia	5 (22.7)	2 (20.0)	4 (14.3)	1 (11.1)	
Moderate insomnia	3 (13.6)	1 (10.0)	2 (7.1)	1 (11.1)	
Severe insomnia	0 (0.0)	0 (0.0)	1 (3.6)	0 (0.0)	
Epworth Sleepiness Scale					0.02*
Normal	12 (54.5)	5 (50.0)	23 (82.1)	3 (33.3)	
Abnormal (Excessive daytime sleepiness)	10 (45.5)	5 (50.0)	5 (50.0)	6 (66.7)	
Risk of Obstructive Sleep Apnea (OSA)					0.34
Low risk of OSA	5 (22.7)	1 (10.0)	11 (39.3)	4 (44.4)	
Intermediate risk of OSA	11 (50.0)	7 (70.0)	12 (42.9)	5 (55.6)	
High risk of OSA	6 (27.3)	2 (20.0)	5 (17.9)	0 (0.0)	
Present Sleep Disorder (Insomnia and / or OSA).					0.05

No	3 (13.6)	0 (0.0)	10 (35.7)	1 (11.1)	14 (20.3)
Yes	20 (86.4)	10 (100.0)	18 (64.3)	8 (88.9)	55 (79.7)
Total	22 (31.9)	10 (14.5)	28 (40.6)	9 (13.0)	69 (100.0)

Abbreviations: HF = Female hyperfrequent; HM = Male hyperfrequent; NHF = non-hyperfrequent female; NHM = non-hyperfrequent male. PSQI = Pittsburgh Sleep Quality Index. ** Significant association ($p \leq 0.05$) - Chi-square test.

Table 3 shows the average values of measures of sleep disorders in the two assessment periods, before and after the intervention, expressive therapies, with their respective means and standard deviation. The ET intervention significantly reduced the PSQI scores (pre-intervention: 9.8 ± 4.1 ; post-intervention: 7.7 ± 4.7), indicating a significant improvement in sleep quality ($p = 0.003$). In addition, it was effective in mitigating excessive daytime sleepiness ($p = 0.006$). The IGI scores decreased after the intervention,

which indicates a lower severity of insomnia in the intervention group (hyperfrequent elderly), with a significant difference ($p < 0.001$). Significant changes were also observed in the SB scores (Pre-intervention: 3.5 ± 1.1 ; Post-intervention: 3.1 ± 1.0), with a significant difference ($p = 0.002$). A significant decrease in the scores of the PSQI, ESS, ISI and SB was observed in the male and female sex of the elderly with high frequency after intervention (Table 3).

Table.3: Multivariate analysis of sleep disorders, before and after application of the Expressive Therapies intervention, in the 69 elderly people at the Basic Health Unit of Granja do Torto, Distrito Federal, 2018-2020.

Variables	Hyperfrequent (Intervention group)		Non-hyperfrequent (Group control)		p-value
	Pre intervention	Post intervention	Pre control	Post control	
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	
PSQI	9.84 \pm 4.10	7.75 \pm 4.73	7.51 \pm 4.88	9.05 \pm 4.28	0.003
ESS	9.81 \pm 5.28	7.75 \pm 5.29	7.86 \pm 4.94	9.46 \pm 5.28	0.006
ISI	6.25 \pm 5.48	5.25 \pm 4.85	5.84 \pm 6.04	10.0 \pm 6.22	<0.001
SB	3.59 \pm 1.18	3.16 \pm 0.92	3.16 \pm 1.32	3.84 \pm 1.65	0.002

	Female hyperfrequent (Intervention group)		Non-hyperfrequent female (Group control)		p-value
	Pre intervention	Post intervention	Pre control	Post control	
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	
PSQI	10.5 \pm 4.31	8.68 \pm 5.09	7.32 \pm 5.01	8.79 \pm 4.45	0.03
ESS	9.55 \pm 5.48	7.55 \pm 5.44	6.86 \pm 4.60	8.68 \pm 5.59	0.01
ISI	6.27 \pm 5.95	5.82 \pm 5.50	5.71 \pm 6.46	9.64 \pm 6.24	0.007
SB	3.45 \pm 1.22	2.95 \pm 0.89	3.29 \pm 1.43	3.57 \pm 1.64	0.06

	Male hyperfrequent (Intervention group)		Non-hyperfrequent male (Group control)		
	Pre intervention	Post intervention	Pre control	Post control	
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	
p-value					
PSQI	8.4 \pm 3.34	5.7 \pm 3.16	8.11 \pm 4.64	9.89 \pm 3.85	0.01
ESS	10.4 \pm 5.06	8.2 \pm 5.18	11.0 \pm 4.87	11.89 \pm 3.37	0.24
ISI	6.20 \pm 4.56	4.0 \pm 2.82	6.22 \pm 4.79	11.11 \pm 6.37	0.002
SB	3.90 \pm 1.10	3.6 \pm 0.84	2.78 \pm 0.83	4.67 \pm 1.50	0.002

Abbreviations: SD = standard deviation; PSQI = Pittsburgh Sleep Quality Index; ESS = Epworth Sleepiness Scale; ISI = Insomnia Severity Index; SB = STOP-Bang.

IV. DISCUSSION

In the sample of 69 elderly people in the current study, in relation to sleep quality, assessed by questionnaires in a subjective way, among the 32 hyperfrequent elderly, 9.1% and 10% of female and male, respectively, had good quality sleep, being classified as good sleepers. A significant difference was observed in the subjective assessment of sleep quality between groups, according to sex, indicating higher levels of poor sleep quality in hyper and non-hyperfrequent in male. Studies by Vieira [31] and Costa et al [32] corroborated this finding, and in these surveys, 84.4% and 75% of elderly PHC users, respectively, presented scores indicating poor sleep quality. Silva et al [33] and Monteiro [34], analyzing 65 elderly people living in the community, found that 63% and 69.4%, respectively, showed poor quality sleep. In disagreement with the findings of the current research, Guimarães et al [35], studying urban elderly people, showed higher rates of altered sleep patterns in women. The poor quality of sleep interferes with the general health status of the elderly, causing an increase in morbidity and mortality rates and negative outcomes in cognitive functions [36, 37, 38]

There was an emphasis on insomnia in female hyperfrequent elderly (36.3%). According to Hara et al [39] and Lopes et al [40], insomnia occurs in the Brazilian population from 32.9% to 82.3% of the elderly, with prevalence in female. Sectional studies estimated a high prevalence of insomnia ranging from 10 to 50% of patients followed by PHC [41, 42, 43].

In the current study, excessive daytime sleepiness was higher in the elderly male (50.0% in hyperfrequent and 66.7% in non-hyperfrequent) with a significant difference. National studies showed 24.0% to 55.6% of the elderly with excessive daytime sleepiness, however, in the studied populations, female predominated, and in the current study the sexes were analyzed separately [44, 45, 46, 47]. Thus, the presence of excessive daytime sleepiness and poor sleep quality can have a negative impact on the health and quality of life of the elderly.

In the present study, a high risk of Obstructive Sleep Apnea was found in 27.3% of elderly female, with no significant difference between groups. In the study by Burgos and Carvalho [48], a higher prevalence of OSA was found in elderly male. A systematic review study, conducted by Senatrana et al [49], showed that the prevalence of OSA varies widely due to the methodological heterogeneity of the studies, increasing with advancing age and being prevalent in male.

In the current study, the presence of sleep disorders (SD) was high in hyperfrequent elderly (27.5% in female and 14.5%, male), these being more frequent in 53.6% of hyperfrequent female and not hyperfrequent, with significant difference between the groups. In the study by Moreno et al [50], 44.9% were found with SD in general, this being more frequent in female (51.5%), in line with the current study.

In the current study, expressive therapies provided a significant improvement in the quality of sleep, insomnia, excessive daytime sleepiness and sleep apnea of

hyperfrequent elderly, pointing out its effectiveness when used for this purpose.

Expressive therapy works as a complementary therapeutic instrument, being characterized by group activity involving music and physical activity (dance / movement), as a comprehensive care strategy (care for the disease, health and life) and door to dialogue, working the body through choreographies created with music, performed in different areas and contexts such as health, education, institutions and the community, stimulating creative, creative, imaginative, reflective and prospective activity, covering all age groups, genders and at different stages of life [51, 52, 53].

Music, since the beginning of humanity, has been part of the culture of all individuals, considered an avenue of self-expression and present in all times, being used as a health promotion factor and pointed out as a therapeutic means since ancient times [54, 55, 56, 57, 58]. It has recovered meaning in the lives of the elderly, being identified by Hays and Minichiello [59] by six categories: identity and self-understanding; connection with you and with others; well-being, therapy and health; emotions; stimulation, fantasy and motivation; and beauty, aesthetics and spirituality. These authors show that, through research conducted with Australian elderly people in a community, music contributed to positive aging and helped participants to maintain a sense of well-being, as their meaning was directly related to their life experiences.

In the current study, music was used as a therapeutic resource for hyperfrequent elderly, with significant improvement in sleep disorders. The repertoire used was composed primarily of songs that recalled the youth years of the elderly, in agreement with the studies by Moser [60] and Magno [61]. Activities performed with music for the elderly provide a rescue of experience between the past and the present, leading them to participate effectively in the social group. Research shows that music has a significant effect on the elderly, of a psycho-emotional, social and physical nature, providing this group with the power to listen, sing, speak, walk and dance. It is complementary therapy with a relevant degree in prevention, promotion and treatment until the rehabilitation of individuals [62, 63, 64].

In the study by Leão et al [65], music was used as a complementary intervention for pain relief, sleep disorder, loneliness, stress and social isolation. Musical sounds can calm, leaving the patient at ease, inducing him to sleep and providing tranquility [66]. In the study with elderly people from Amaral [67], music promoted pain relief and the musical experiences provided relaxation, relief, courage,

joy, tranquility and drowsiness, resulting from the countless situations arising from the hospitalization process. A Meta-analysis study, showed that music can be effective in the treatment of acute and chronic sleep disorders, helping to improve the quality of sleep in diversity of populations, including the elderly living in the community and the elderly hospitalized with different age groups and cultural backgrounds [68]. These findings are in agreement with the data from the current study, in which the application of expressive therapies, using music, improved the quality of sleep and led to a decrease in sleep disorders.

Together with music, in the current study physical activity was used through dance, associating music and diverse movements. These activities enabled the elderly to establish new meanings for life, bonds of friendship, interaction, socialization and growth of relationships when meeting new people, strengthening the social support network. The participants of the present study reported that, after the intervention with expressive therapies, they were able to sleep in a few minutes, reducing insomnia, daytime sleepiness and improving the quality of sleep, reports confirmed through the application of the index of severity of insomnia and the scales of Pittsburgh and Epworth.

Within the scope of health promotion, dance is an expressive physical activity, with movements guided by music, being considered the most complete activity for the elderly, as it provides beneficial effects in maintaining muscle strength, balance, aerobic power, support, balance and body movements. It contributes to change in lifestyle, as dancing awakens positive emotions, pleasure and socialization, improving health and, thus, keeping the elderly motivated to develop such an activity, considered a promoter of quality of life [69, 70, 71].

Thus, non-pharmacological interventions, through physical activity, must be organized according to the needs and preferences of each individual, in order to be maintained regularly in all life cycles, so that he has gains in quality of life. and increased longevity [72]. Studies by Chen et al [73], Durcan et al [74] and Akbari Kamrani et al [75], corroborate by proving that physical activity as a resource for the prevention and treatment of chronic non-communicable and disabling diseases, with a positive effect to improve sleep quality and quality of life, keeping the elderly physically active, contributing to healthy aging.

Thus, as the prevalence of sleep disorders increases with aging and the widely used method is pharmacological intervention, which can have a negative impact on the sleep of the elderly, more appropriate forms of treatment

are necessary with the adoption of non-pharmacological measures, considering that the sleep is an essential factor for the elderly population, with benefits in physical and mental health, providing a better quality of life [6, 76].

One of the limitations of the study was the absence of national and international studies that assess the impact of expressive therapies on elderly people with sleep disorders, which are practically nonexistent, making it difficult to compare the results obtained related to the object of the current study.

V. CONCLUSION

Intervention program through expressive therapies in male and female hyperfrequent elderly, proved to be effective, as a complementary therapy in the therapeutic scope, minimizing sleep disorders, being of great relevance for the prevention, promotion and recovery of health of the elderly population assisted in PHC with interdisciplinary practices and a holistic approach, in addition to being a low-cost, non-invasive and non-pharmacological intervention with the possibility of implantation in primary care services.

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Maternal Perception about the benefits of the Kangaroo Method to the Newborn before the Covid-19

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Abstract— Objective: was to know the perception of mothers about the benefits of the kangaroo method in a maternity teaching hospital. **Method:** It was a descriptive study with qualitative approach, at least 10 mothers were interviewed according to the demand of internment in the kangaroo infirmary, in a childhood maternity of reference in the State of Pará in the period of October to November of 2019. **Results:** It was evident that the mothers have knowledge about the benefits of the kangaroo method for the baby, being possible to identify in the interviews with the mothers, however, every strategy already implanted needs evaluations through researches, therefore it was possible to identify the limitations, about the difficulties experienced about the practice of the kangaroo method. **Conclusion:** Thus the method is still a strategy of dissemination of knowledge and empowerment of mothers in the care of their baby, during the process of the kangaroo position for weight gain and the following hospital discharge.

Keywords— Benefits of the kangaroo method, Mother-son, Premature newborn.

I. INTRODUCTION

The Kangaroo Methodology stands out as a new model of care that inserts the family in the treatment of the newborn, in order to humanize the care, focused on the neonatal period, receives this denomination due to the vertical position of the Newborn (NB) on the breast of parents or relatives, starting with the touch and progressively evolving to the kangaroo position (skin-to-skin contact), respecting the limits of parents and NB (Brazil, 2011).

Through this methodology, studies demonstrate the perception of mothers about the benefits of the Kangaroo Method (MC), as performed in a maternity ward in Fortaleza - EC, which describe it as a tool that can provide benefits such as: progressive weight gain, strengthening the mother-child bond. Clearing up the doubts common to the care of the premature newborn (RNPT) and increasing the participation of mothers, contributing to the success of the method (Campos, Carvalho, Rolim & Alencar, 2008).

This strategy is divided into three stages, aiming at the humanization and participation of parents in neonatal care; the first stage begins at the prenatal stage of high-risk pregnancy, followed by admission of the newborn into the neonatal ICU; in the second stage the baby remains continuously with its mother and the kangaroo position is performed most of the time and; the third stage is characterized by monitoring the child and the family in the outpatient clinic and at home until it reaches a weight of 2,500g (Heck et al., 2016).

Moreover, these stages ensure the benefits for mother and baby, and through the method start to develop the affective bonds, consonant the experience in this sensitive period, which is significant for the experience of affection, the skin to skin contact between the two, starts to be slow and then progressive and helps to control the thermal temperature, encourages breastfeeding and increases the affective bond between them (Zirpoli et al., 2019).

The choice of this subject is justified by the need to know the importance of the knowledge of mothers about the benefits that the kangaroo method provides among the mother-child bionym. This study aims to inform that the kangaroo method is a health promotion tool, where it is possible to promote the interaction of mothers in the care of newborns. Therefore the objective was to know the perception of mothers about the benefits of the kangaroo method in a mother-child teaching hospital.

II. METHOD

It is a descriptive study with a qualitative approach. The research was carried out at Fundação Santa Casa de Misericórdia do Pará (FSCMP), a reference hospital located in the metropolitan region of Belém-PA, the scenario of the study was in the kangaroo infirmary where the 2nd stage of the Kangaroo Method is carried out.

The interview with the mothers of the newborns was carried out at an appropriate time and place, where the approach of these mothers at the bedside of the infirmary kangaroo was done, a device was also used to record the testimonies and the interviews were carried out according to the demand for hospitalization, that is, it depended on new hospitalization of newborns in the infirmary and the mother having practiced the kangaroo position with her baby.

The survey was conducted from October to November 2019. The participants of the study consisted of a non-probabilistic and randomized sample of at least 10 mothers who were older and younger of the babies who were in continuous permanence in Kangaroo Infirmary, the names of the participants were identified by pseudonym of the research and alpha-numeric as demonstrated below term Mother1, Mother2, Mother3 and so on. In the inclusion criteria it was used: mother under age with 12 to 17 years old in this case the mothers under age signed the Term of Free Informed Consent (TALE) and the legal responsible

of the minor signed the Term of Free and Informed Consent (TCLE) consenting the participation of their daughter in the research, and the mothers who are already over 18 years old signed the TCLE, who were in continuous permanence in the Kangaroo Infirmary and performing the MC.

Were excluded mothers with psychiatric history or important complications in postpartum, being the mother of a newborn with congenital malformations, being the mother of a newborn in the ICU with a history of severe pathologies, or the absence of the genitor in the follow-up of the newborn using the kangaroo method and the absence of the person responsible for the minor at the time of the study. For the analysis of textual content data, incessant and with scientific rigor using the Bardin method, which consisted of three phases; Pre-analysis, Exploration of material, treatment of results, inference and interpretation (Bardin, 2016).

The ethical procedure of this research was submitted to and approved by the FSCMP Ethics and Research Committee, under the report number 3,612,649 and CAAE 19492719.5,0000,5171. All the ethical guidelines in accordance with resolution 466/12 for conducting research with human beings were respected and ensured. The participants of this study have been registered their consent through the TCLE, the TALE and the Term of Authorization for the Use of Image and Sound for research purposes.

III. RESULTS

The evidence found in this research through the perception of the mothers before the coronavirus pandemic (covid-19), reveal that the kangaroo method is still a practice that guarantees several benefits for the newborns, however, every strategy already implanted needs evaluations through researches, therefore it was possible to identify the limitations according to the maternal reports during the interviews, about the difficulties experienced about the practice of the kangaroo method.

During the survey when asked about "what benefits has the practice of the Kangaroo Method brought to your baby?" they answered that the kangaroo position brings benefits to the baby, such as weight gain, and ensuring a good development, making it reach the appropriate weight to receive hospital discharge and also the bond between mother-child, creating affectionate bonds as in the speech of mothers 6, 12 and 19.

"The kangaroo is very important in helping to gain weight (...) in the baby's development (...)" [mother 6].

"I think (...) my contact with him gets bigger, right? the link between the two of us also so he can be warmed up and gain more weight" [Mother 12].

"And I think it's the main weight gain, because lately she does the Kangaroo Method is she gained a lot of weight in two days, things that was the weight she gained in a week in the ICU, with two days she gained like 180g in two days what was in the ICU she gained like this 80g in one week it took a lot" [Mother 19].

Other important aspects observed were that the practice of the kangaroo method improved the temperature of the newborn inpatient, this made the mothers confident in handling their child and making possible the stability of the respiratory rate due to the body to body contact in the vertical position with the mother. As the following lines show:

"Look when I started doing the kangaroo (...) her temperature changed that she was too cold and she got much smarter than she was" [mother 7].

"Look, I think it warms me up, it helps his temperature, (...)" [mother 20].

"(...), the baby is born prematurely and we don't have a way to hold it and in this body to body we feel more comfortable with the child, we feel good until we breathe, they stay quiet and we breathe for them" [mother 10].

Regarding mothers' perception of "practicing kangaroo position and how many times during the day/week?", mothers' statements are directed at the number of times they stay in the kangaroo position during the time of hospitalization for weight gain and others have reported that they perform the kangaroo position, but not quite often, as evidenced in the following statements:

"Twice every day especially when the child arrives they come with very low weight there so he can pick up weight faster (...)" [mother 10].

"We do it twice a day in the morning and afternoon or do it all morning or do it all afternoon every day (...)" [Mother 6]

"Once in a day, you can't do it every day, I do it when I want" [mother 14]

"Look, today hasn't been any yet, but once again (...), I don't do it every day" [mother 31].

As regards "what are the difficulties of this method?", at first some verbalized difficulties related to the environment because it was a closed place and as a consequence they lost track of time as regards the timetable.

In addition, most of these mothers came from the Intermediate Care Unit (NICU) or the Neonatal Intensive Care Unit (NICU), because they only kept their babies hospitalized, receiving the care of the multi professional team and the presence of the mother was part-time, so they could go out to solve their personal problems, others sought to rest and stay with the other children who were in the care of their relatives, they felt at ease because they knew that their children were being well cared for.

In the kangaroo infirmary the mother has to stay continuously with her baby providing the care, through this they felt that they were stuck in the infirmary without being able to go to their homes and there is a break in their daily activities, as shown in the following speech:

"The first of all so I think I felt was staying here, not being able to go home is very uncomfortable, even though I'm with her and everything, but very bad to be away from home" [Mother 19].

Another difficulty is the fear of manipulating her concept, difficulties in putting it in her lap, thus, a challenge for her to be able to handle her underweight son, because it is known that this contact is a part of the process to realize the Kangaroo Method.

"(...)The difficulty we have when the child is born like this is the catch that differs from a 3kg child to a 1k 200g child (...)" [Mother 10].

It is important to point out the difficulty as to the necessary mooring for the kangaroo bag, because they could not do it alone, needing the help of the professionals and also on the clothes model, because they did not feel comfortable wearing that garment.

"So, it's very uncomfortable to look like this here, even if you're trying to make it look nice here, it doesn't look good" [mother 19].

It can be seen in some reports about the difficulty in the beginning when they arrived at the kangaroo infirmary, before going through this process they always had the help of someone in the family, for example their mothers and now they no longer had this help at that moment, being only a mother-child and when they faced the reality of living something new that is the practice of the kangaroo position, this affected their emotional state, filling them with doubts, uncertainties, insecurities about how they

would take care of their babies, all reflected in the production of breast milk. As stated in the following speech:

"It's tying the knot, everything's new, you have to keep an eye on it all the time, you can't sleep properly" [mother 2].

"The difficulty is when I'm going to tie up, sometimes I can't tie up by myself (...)" [mother 9].

"And I always had my mother very close to me to help me in everything, and here is me and him, so for me it was much more difficult, it's horrible on both days of Saturday and Sunday I cried the psychologist had to call my mother, my mother had to spend Saturday here, my milk went away" [mother 16].

It is worth mentioning that all these difficulties mentioned by these mothers in this research end up generating limitations to develop the care of the baby, as in the realization of the kangaroo position, because to occur this link / bond between mother-child both need to be well physically and psychologically, especially in relation to the balanced emotional state.

IV. DISCUSSION

The experience of the MC brings numerous benefits, perceived and reported by the mothers themselves, such as the construction of the bond, the approach with the baby favors growth and development, allows quiet sleep, in addition to the security that the Method provides for mothers in the care of the baby and the pleasure in the consolidation of the maternal role (Menezes, 2017).

Regarding the benefits of skin-to-skin contact, such as increased rates of exclusive maternal breastfeeding, stability of vital signs, weight gain, lower rates of readmission to the Intermediate Care Unit (NICU) and lower chance of death during hospitalization in very low birth weight newborns (Alves, 2019).

On the other hand, for Pinheiro and collaborators (2019), they highlight that in fact the Kangaroo Method influences the physiological aspects of newborns such as body temperature, respiratory rate due to skin to skin contact. In Pereira's (2016) study, the perception of mothers among several benefits of the Kangaroo Method highlights the overcoming of fear related to handling the premature and providing the feeling of safety when touching it, which was also observed in this study.

Other benefits studied and verified are: the increase of the mother-child bond, favor the stimulation of breastfeeding, increases the competence and confidence of parents in the handling of their baby, guarantees thermal control and reduces the length of hospital stay (Dantas et al., 2018)10.

Based on Pereira's (2016) studies, he also states that the Kangaroo Method, as a philosophy of integral and humanized care for newborns at risk, broadens the focus beyond skin-to-skin contact, and integrates a set of practices (techniques, relationships and environment) aimed at minimizing the stress of the newborn, providing comfort for a smoother and more respectful transition, and especially bringing together and involving the family.

Since the Kangaroo Method is a great proposal of humanized attention to the newborn low weight, bringing with it many advantages and benefits, among them the improvement in exclusive breastfeeding; adequate weight gain (Santos; Filho, 2016). These benefits are found in this study.

According to Mendes et al., (2015) the mother and baby should remain in joint accommodation, performing the kangaroo position for as long as possible. The use of the MC in the infirmary takes place in the second stage of the process, a moment that intensifies the maternal presence through the care of the newborn (Klossowski et al., 2016).

The studies of Testoni, Aires & Luana, (2018), show that the proximity with the preterm baby favors the exchange of affection and the establishment of the bond between mother and her child, feeling your child, in your lap, for mothers is the realization of motherhood.

Thus, the Ministry of Health recommends that it should be durable and frequent, because the time in the kangaroo position should be defined by the desire of the parents and the baby and the pleasure it will provide to both, but each time the baby goes to the position, it emphasizes that it should remain for at least one hour, so that it can receive its benefits (Brazil, 2016).

Following the related bias about maternal limitations, other studies assert that one of the difficulties reported by mothers was to never have the experience of being a premature mother, the place also represents a challenge for each one of them for being with a newborn in the Kangaroo, this can mean the occurrence of fears, desires, emotions, peculiar meanings of this experience and also the presence of hope and expectations regarding the return home, with their healthy son (Freires; Augusto, 2018), as it was evident during the realization of this research.

Another study with the same results as above is from the reference hospital of the Center-West of Minas Gerais, highlighting the insecurity that they develop in this first contact, mainly due to the little knowledge of family members about this possibility of care, corroborate for the insecurity of parents in performing the Kangaroo Method, (Gesteira et al., 2016).

Therefore, it is fundamental the assistance of the professional to pass on the appropriate guidance to the mothers who are in a kangaroo infirmary, because they experience difficulties in promoting skin to skin contact with their premature baby, they feel insecure to perform one of the stages of the Method due to the clinical picture of the newborn and because it is an environment that takes them to new challenges (Freitas; Augusto, 2018).

Other authors assert about this perception of maternal feelings in relation to participation in the kangaroo method because they are far from contact with the family, they feel uneasy because it is not their family environment and this can cause confusion and fear and can interfere with the stage of this tool and the possible involvement of mothers in newborn care (CAMPOS, et al., 2008).

V. CONCLUSION

Through this research it was possible to verify that the mothers have knowledge about the benefits of the kangaroo method, being reported in the interviews, being possible to identify in the conversations with the mothers the benefits of the method practice, in which the majority highlights as benefits the weight gain, stability of the body temperature, the increase of the respiratory rate and strengthening of the mother-child binomial, thus this vertical position left the newborns calm, comfortable and warm.

Maternal difficulties were also identified in the practice of the MC. For this reason, proposals are proposed that make it possible to elaborate strategies such as: workshops of group activities to allow the exchange of experiences between mothers, the nursing professionals to create conversation wheels to develop attentive listening, about the maternal feelings the worries that arise from being in a place far from your family environment of the people of your daily life, depending on the answers to your doubts, limitations, this professional will be able to propose instruments such as playful activities capable of solving the difficulties.

Implement a supervision program to evaluate possible difficulties acquired during the implementation of the Method so that they do not influence its effectiveness, and

when identified can be overcome with any of the strategies already mentioned. Haja, considering that the MC is a humanized neonatal assistance becoming as a health promotion tool, because it is of great relevance for the reduction of premature newborn mortality.

However, amidst the many events that have taken place in the world in recent months, a doubt arises as to how mothers are using this tool during the covid-19 period? Since before the pandemic there were already some challenges, as was evidenced in the reports of the mothers, in addition to all this scientific knowledge there is the possibility to emerge the tendencies to teach being a new look to care-educate through the educational technologies.

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Physics-Based Transfer Learning and Artificial Intelligence

Machel M. A. Allen

Abstract— *The Product forms a brain-to-machine-interface (BMI) that facilitates direct brain-control. The Product is designed to facilitate direct control of space/surface vehicles without the use of the limbs. This works perfectly for persons having a handicap that hinders motor skills or for health persons who may prefer not to use limbs. The operators of this device can issue instructions to these vehicles with direct input from the brain. The Vehicles will receive instructions to direct its movement and operations. Users will be able to connect wired or wirelessly to the vehicles.*

Keywords— *Artificial Intelligence, BMI.*

I. INTRODUCTION

Transfer learning (TL) is a research problem in machine learning (ML) that focuses on storing knowledge gained while solving one problem and applying it to a different but related problem. Physics-Based Transfer Learning is where one trains a model to perform one task and then uses the information/knowledge acquired in the completion of another task. It deeply involves the transferal of information from one experience and applying such to another situation under a similar heading. This greatly will improve efficiency of a learning agent. For example, knowledge gained while learning to recognize cars could apply when trying to recognize trucks...reusing or transferring information from previously learned tasks for the learning of new tasks.

II. THE HUMAN BRAIN: NEURO-TRANSMITTANCE

The brain exhibits localization of functional areas, in that each brain region has a specific role, in sense. Most animal behaviour demands the collaborative and motor control areas of the brain and the activities of sensors. As the brain sensors undergo modification, the communication among brain areas adjusts depending on circumstances. When a new person is met, memorization his or her face (encoding information) takes place, however when seeing the person again his or her face becomes recognizable and several events are associated with this person hence information retrieval. With the respective synaptic transmission between neurons, information processing is brought into effect. It is important to grasp that synaptic modulation can change communication among brain domains.

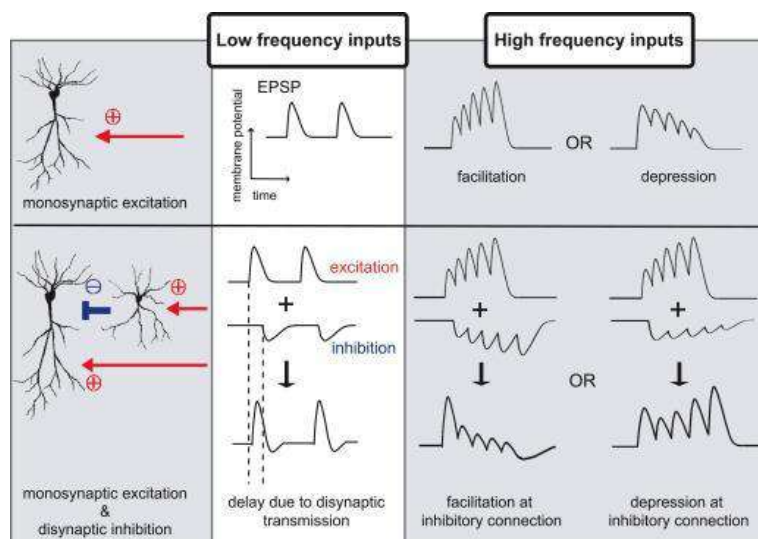
Dopamine, serotonin, or acetylcholine are critical in the brain's state-dependent modulation. These neurotransmitters/neuromodulators are conjured and dispatched from specialized neurons (small in number) located in forebrain, mid-brain and brain-stem of the brain. Synaptic contacts with varied areas of the brain are made with long-range neuro-transmitting connections. Neuromodulators dispatched from synaptic terminals are able to travel over 10 μm and acts on receptors distanced from release sites. Neuromodulators released from synaptic terminals are also capable of diffusing over substantial distances ($>10 \mu\text{m}$) (volume transmission; Venton et al., 2003; Zoli et al., 1998). [1] The information from neuromodulation/ neuro-transmitting neurons are propagated to large area(s) of the brain at the apparent cost of spatial selectivity. As such, activity changes in a small number of neurons can exert a broadcast influence on many brain areas, coordinating a functional change across areas (Hasselmo, 1995). [1]

The activities of the brain are recognized as varied frequencies of multiple oscillations in electroencephalograms. There have been studies linking brain functions with specific oscillatory activities. These oscillatory activities are not just epiphenomena, but the brain appears to utilize them for information coding (Engel et al., 2001; Varela et al., 2001). [1][5] Selecting activities locked in phases and information binding in the cortex of the brain, are typical examples. Brain oscillations is vital in the regulation of information traffic. Therefore, it is necessary to assess neural network and the manner in which they respond to frequency stimulation.

The proportion of the postsynaptic response effected as a result of presynaptic excitation is internally dependent on stimulation frequency in monosynaptic transmission. The

magnitude of the postsynaptic response evoked by presynaptic stimulation is intrinsically dependent on stimulation frequency (Markram et al., 1998). [1] In the delivery of several stimuli within close periods of time, the size of postsynaptic nerves increases in size, a condition called paired-pulse depression. Both presynaptic and postsynaptic mechanisms have been implicated in these

processes. [1] Changes in neurotransmitter provides possibility of readily dischargeable reservoirs of synaptic vesicles. Postsynaptic receptor desensitization (Koike-Tani et al., 2008). [1] Frequency-dependent modulation of synaptic transmission has been proven to be brought into effect by the mobility of postsynaptic receptors.



(Erin M. Schuman, 2008)

Fig. 1: Brain Synaptic Nerves

Dopamine is a neuromodulator responsible for playing a crucial roles learning, motor control and memory along with addictive behaviour development. Most dopaminergic neurons are based in two nuclei, substantia nigra compacta and the ventral tegmental area. Exciting of these neurons in animal learning has been well characterized in mammals. Schultz and colleagues examined the live activities of dopaminergic neurons in certain tasks for training. In the study conducted, the activity of dopaminergic neurons seems to display internal expectations and outcomes for anticipation of failure. Hence, the dopamine system gives information with respect to environmental stimuli for information capture and synthesis.

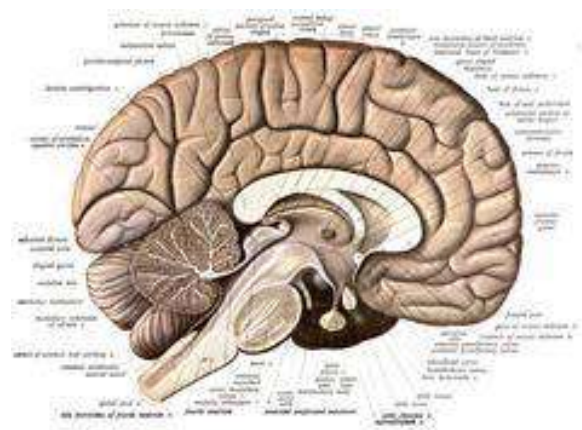


Fig 2: Brain Midsection

III. THE PRODUCT: BMI CONTROLLER

With the above scientific data/information in perspective, the design of the BMI Controller is such that human safety is paramount while fulfilling its objective.

The Controller is designed as such that there will be an implantation of a micro-processing device/receptor in the midsection of the brain (just at the surface (can be on either hemisphere)) to enhance its capability to receive signal output from the brain.

This chip will have receptors made of polyvinyltoluene/polystyrene plastic with a length between 0.2mm to 1cm (size depends on brain density of the

subject). The reason for choice of those plastics is that they are flexible which is a positive because they create leverage to facilitate easy brain movements without negative side effects (eg. Seizures). Also, evidential research has proven that photons are very high in these plastics and when placed with fiber, the photons increase by over 15%.

Subsequent laser cooling on the dipole-allowed 1S_0 -to- 1P_1 transition at 461 nm and the dipole-forbidden 1S_0 -to- 3P_1 transition at 689 nm allowed us to load a new ensemble of atoms into the optical lattice roughly every 2 s. [3]

This is significant as it allows for scalability and improves bandwidth through the increase of wavelengths on the fiber.

The atoms were spread over roughly 1 mm along the cavity axis, corresponding to around 2000 occupied lattice sites. [3]

At 698 (813) nm, the 4-cm-long cavity mode had a waist size of 74 (80) μm ...100 μK , the frequency of axial (radial) motion in the trap was 170 kHz (270 Hz), giving a Lamb-Dicke parameter $\eta = 0.16$ in the axial direction. [3]

These plastic receptors will then be connected/attached to a fiber-based sheath with silicon coating. These become effective as it will facilitate greater throughput in conversion from binary to analog and vice versa because there will be greater capabilities to create/draw data buses in nanometric context on the circuit while matching wavelengths will exist on the analog side of the device.

For the $|e\rangle$ to $|g\rangle$ transition studied here, $C = 0.33$, and the single-photon Rabi frequency was $2g = 2 \times 2\pi \times 3.7$ Hz for a maximally coupled atom. [3]

From what studies show, we will be able to acquire a bandwidth of 10nHz (Nano-Hertz) from these receptors, and also able to achieve more. This fully surpasses the 10 Micro-Hertz threshold for general neuro-communication.

Sample Analog to Digital Conversion:

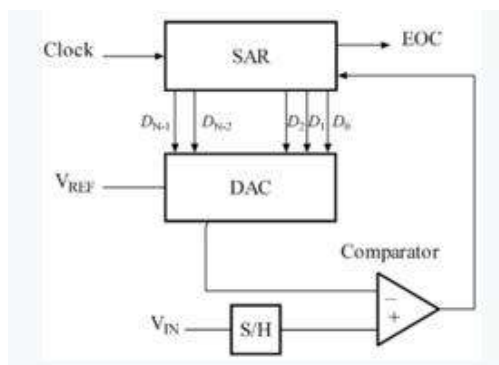


Fig. 3: ADC Block Diagram

Key

DAC = digital-to-analog data converting device

EOC = conversion's end

SAR = successive approximation register

S/H = sampling and holding circuitry

V_{in} = volt inputted

V_{ref} = volt referenced

The micro-processing device/ receptor will connect wired or wireless to an external device attached to the subject's ear or place of choice. There will be a hard (burnt-in) and soft address to facilitate security concerns. Therefore, the internal chip will only communicate with that specific external device unless they are officially programmed otherwise. With respect to data communication, 5G (and higher) data communication will be required to guarantee proper sync between internal and external device. The BMI device will use the same to make communication with the Avionic Systems.

IV. THE BMIC ARCHITECTURE

The Brain-Machine-Interface Controller consists of the Micro-processing Implantation and an External Device, these have option of speaking wired/wirelessly with each other and the External Device to speak wired/wireless with an external control (computer terminal/interface or machine). The Micro-processing Implantation consists of Stimulation, Electrode Diagnostics, Power Management, Analog Amplifiers, Analog-to-Digital Converters, Processing Logic, Radio Frequency (RF) Transceiver and/Sensor Feedback. This connects to a Charging and Data Transfer Coil, which Connects to an External Device (effectively a wearable computer) that relates wired/wirelessly to a computer terminal.

The Cable Connectors will be placed just under the scalp. The External Device consists of an Operating System (preferably Linux), (1TB) Hard Drive (Solid State), Microprocessor (Intel 7th Generation Pentium Processor), Bio-Sensors, Input Device (Both Bio-Sensors and Input Device work to detect a computer terminal and position cursor on the screen through mental operations on the part of the user), (DDR 4) Random Access Memory (RAM), Battery Power (Lithium Ion, 4800mAh, 11.1 volts), Global Position System (that user could determine their location and also the Manufacturer or whoever the user gives express permission to) and Radio Frequency (RF) Transceiver (5G (and higher) similar to the one above).

The Manufacturer would have the right based on user request to remotely troubleshoot any technical issues that may develop during use of the Device and the greater Controller (where necessary), or user could go in for in-person fixtures to the Controller and Device. However, the BMIC would be programmed as such to automatically raise a flag in the event of any technical issues that may develop during use of the Controller and Device.

The Microprocessing Implantation consists of twelve (12) Application-Specific-Integrated Circuits (ASICs) each containing 500 to 1000 electrodes. This results in 6, 000 to 12, 000 individually programmable amplifiers and 6,000 to 12,000 channels overall. This will enhance better reception of analog signals to the brain and transmission of signals thereto. The Language of choice is C++. Overall, there will be four (4) Microprocessing Implantations in the brain and as a result 24,000 to 48,000 electrodes from the Sensors to the External Device.

4.1 STIMULATION

Brain stimulation therapies can play a role in treating certain mental disorders...therapies involve activating or inhibiting the brain directly with electricity.[5] The electricity is applied through electrodes inserted in the head or placed on the scalp of the subject. It is possible also for electricity to be induced through the use of magnetic propagations to the head. This is beneficial because it has been proven to help persons with neurological disorders. From the Scientific Data/Information presented under "THE HUMAN BRAIN: NEURO-TRANSMITTANCE", the synaptic nerves respond to different frequency levels. Hence, the Stimulation Engine would be so designed that 6 ASICs (with their respective electrodes) would be placed among monosynaptic nerves and 6 ASICs (with their respective electrodes) would be placed among disynaptic nerves.

When the sensors detect communication from the synaptic nerves the Microprocessor Implantation will detect such lapses and is automatically configured to generate the appropriate frequencies to stimulate such nerves. From research disynaptic nerves responds best to frequencies in the range of 50 to 200 Hertz, while monosynaptic nerves respond best to frequencies in the range of 10 microhertz and lower. In disynaptic nerve communications lapse, the Stimulation Engine will generate 50 to 200 Hertz to stimulate activity. It will do this over a 30 second to 2 minutes period. It will automatically increase by the tens until positive responses are detected. While in monosynaptic nerve communications lapse, the Stimulation Engine will generate in the range from 10 microhertz to 10 nanohertz to stimulate activity. The

Stimulation Engine in this situation will do continuous (non-time specific) frequency propagation until positive responses are detected.

The reason for the above approach, is that research has shown that monosynaptic nerves respond best to low continuous frequencies and disynaptic nerves respond best to short periods of high frequencies. Even though low frequency monosynaptic nerve(s) stimulation does trigger disynaptic nerve(s), the disynaptic nerves themselves respond to higher frequencies.

General Formula:

$$S_{AM} = -0.5[\cos(2\pi(f_c + f_m)t) + \cos(2\pi(f_c - f_m)t)], \quad (1)$$

$$S_{FM} = \sin(2\pi f_c t + M \sin(2\pi f_m t)) \quad (2)$$

Where AM is Amplitude Modulation, FM is Frequency Modulation, f_c is Carrier Frequency, f_m is Message Frequency, t is period (in time) and M is Modulated Signal.

4.2 AMPLIFIERS AND ANALOG-TO-DIGITAL CONVERTERS

An electronic amplifier is an electronic system that increase voltages. The system's power supply provides the energy required for amplification. A perfect amplifier does not interfere with the input signal. The output is an exact reproduction of the input signal but of increased pitch. It is a live quadripole based on active component(s), for example, transistor and operational amplifier.

Electronic amplifiers are implemented in most electronic circuits. They are able to give rise to electrical signals, in the case of a sensor's output, to a level of voltage that can be used by the rest of a given system. They can also improve the maximum power that a system has available and can provide to power to a charge such as a speaker and radio antenna.

The Application of Laplace and Fourier Transform

Laplace and Fourier Transform are used in conjunction with each other to mitigate against the Nyquist Effect and bring sinusoidal (and other types of) waves to its pure form. Signals are amplified using Laplace Transform and hence exceeding the threshold to overcome noise/attenuation on a channel(s). Fourier Transform is then used to sub-divide sinusoidal waves (and also other types of waves) into periods of time. Here signals are looked at introspectively to remove any other electromagnetic interference and extract data for

digitization and hence conveying an accurate representation of analog data in binary form.

The processing of the analog waves occurs 100 picohertz. The Microprocessor Implantation accepts 80, 000 samples per second (80 milliseconds or 80 Megabits per second) and process them using 16 Core Computers. This Operation overall happens so fast that the brain will not recognize.

The Nyquist Theorem is a principle in the digitization of analog signals. For analog-to-digital conversion (ADC) to result in a faithful reproduction of the signal, the analog waveform must be taken frequently. The Nyquist Effect is when signals become halved when they exceed a threshold (that a system is unable to keep up with).

Any analog signal has several frequency elements. An example, the sine wave where all energy is concentrated at one frequency. Analog signals have complex wave forms with varied frequency elements. The highest frequency measurement dictates the bandwidth for that analog signal. Frequency is proportional to bandwidth, if all other considerations remain the same.

The Nyquist Theorem for a given analog signal f_{\max} is at least $2f_{\max}$. The sampling converter from continuous to non-continuous signal is actuated by a clock (or pulse generating device). If the sampling rate is less than $2f_{\max}$, the highest frequency components are not guaranteed be correctly represented in the digitized output. When such a digital signal is converted back to analog form by a digital-to-analog converter, it does not return to its original analog signal or even near so. This undesirable condition is an aliasing/distortion.

The Nyquist-Shannon sampling theorem serves as a fundamental bridge between continuous-time signals and discrete-time signals. It establishes an appropriate situation for a sample rate that permits a discrete sequence of samples to capture all the information from a continuous-time signal of bounded/limited bandwidth.

The theorem is applicable to a class of mathematical functions having a Fourier transform that is zero outside of a certain region of frequencies. It is anticipated that when a continuous function reduces to a discrete sequence, it returns to a continuous function, the fidelity of the result depends on the sample rate of the original signals.

The theorem for experimentation (or sampling) is designed so that no information is lost and that the actual fidelity for the class' hierarchy to certain bandwidth is band-limited. It shows the sampling as an expression of the bandwidth for specific hierarchy of function(s). The theorem is effectively a formula for the reconstruction of the original

continuous-time or analog function from collected waveforms.

Perfect reconstruction is probable even when the sample-rate criterion is not satisfied, given other limitations on the signal are established. In some situations, where the sample-rate criterion is not met, using additional constraints allows for estimated reconstitution. The fidelity of these reconstitutions can be verified and quantified with Bochner's theorem.

RADIO FREQUENCY (RF) TRANSCEIVER:

With carrier aggregation (CA) and advanced-MIMO techniques, the New Radio (NR) devices can attain up to several Gb/s peak data-rate. The demand of high bandwidth has created a need for exploring high-frequency spectrum over 3GHz, while sustaining legacy Long Term Evolution (LTE) bands for LTE-NR dual connectivity (EN-DC). Since User Equipment (UE) requires small form-factor and low power consumption, a single-chip RF transceiver is essential to cover both NR and legacy protocols, simultaneously. This integrated CMOS (complementary metal-oxide-semiconductor) Radio Frequency Integrated Card (RFIC) that supports multimode and multiband applications including all the legacy 2G, 3G, 4G and stand-alone/non-stand-alone sub-6GHz 5G NR features.

According to the Third Generation Party Project (3GPP) (release 15) standards, 5G NR (New Radio) is able to operate in two frequency bands, that is, FR1 and FR2. A transceiver (TRx) operating in Time Division Duplex (TDD) mode at 3.5 GHz (FR1 band) is chosen for analysis. A band pass filter is a very essential component in wireless transceiver (TRx) systems. The system specification and Radio standards requirement are stated in detail by the Filter's specification. Filters play a major role in making the system more immune to unwanted radio signals, improving the selectivity of the receiver and rejecting spurious harmonic noise generated within the system.

The Tx chain contains a cascade of driver amplifier that conditions the input signal, a Band Pass Filter (BPF) operating at the desired frequency band, and a power amplifier (PA) to improve the pitch of signals to a required level for the antenna to transmit. The Rx chain consists of a low-noise amplifier (LNA) to increase the signal power to an appropriate level for detection with the Band Pass Filter as a digital attenuator for adjusting the gain of the system and also an amplifier (AMP) for processing the signals. The antenna is joined to the Tx and the Rx chain through a single pole double throw (SPDT) RF switch. In

conjunction, a directional coupler (DC) can be placed after

the antenna for supervision and standardization purposes.

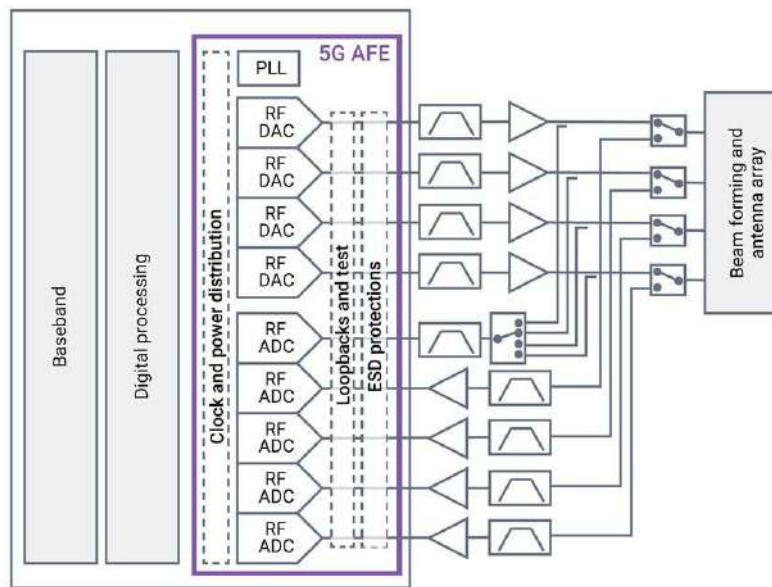


Fig. 4: 5G Radio Frequency (RF) Transceiver Configuration

ELECTRODE DIAGNOSTIC:

The medical electrode passes ionic current's energy to the (human) body as electrical current that can be used for medical purposes.

Medical electrodes allow for fundamental verification of internal ionic current. This yields a radical test for varied nervous, muscular, ocular, cardiac, and other illnesses that would have otherwise required surgery to establish. Muscular examinations may disclose evidence of diminished muscle fiber(s) and reveal muscle disorders and neurologically-based illnesses along with discovering whether or not muscles are weak. The electrodes are inexpensive, easy to control, can be disposable or sterilizable and very unique in the task they perform. The main purpose of the electrode is to create proper electrical communication between the patient and the apparatus used to measure and/or record activity.

PROCESSING LOGIC:

This coordinates all the activities of the Microprocessor Implant Device. Processing Logic is a ruggedized computer used for industrial automation. These controllers provide automation of a specific function/process and as well a complete manufacturing operation.

The Processing Logic receives information from connected sensors or input devices, processes the data, and triggers outputs based on pre-programmed parameters. Depending on the inputs and outputs, a Processing Logic can monitor and record run-time data such as machine productivity or operating temperature, automatically start and stop

processes, generate alarms if a machine malfunctions, and more. Processing Logics are a flexible and robust control solution and are adaptable to any application.

POWER MANAGEMENT:

The Power Management System is designed according to Advanced Configuration and Power Interface (ACPI). ACPI is an open standard that Operating Systems use to discover and configure hardware components to perform power management operations such as putting unused components to sleep and perform status monitoring.

The Power Management System is used to: reduce overall energy consumption, prolong battery life for portable and embedded systems, reduce cooling requirements, reduce noise and reduce operating costs for energy and cooling.

Lower power use means lower heat dissipation (leading to systems stability) and less energy use and that reduces costs and reduces negative impacts on people and the environment.

SENSOR FEEDBACK:

Sensor is a device, module, machine, or subsystem whose purpose is to detect events or changes in its environment and send the information to other electronics, frequently a computer processor.[12]

The Sensor(s) relating to the Microprocessor Implantations are used for interfacing with the Electrodes causing the External Device to speak with the Microprocessor Implantations and vice versa. This is different from the Bio-Sensors in the External Device which are used to interface with the computer terminal.

Table: Specifications Of Microprocessor Implants

Channels	24, 000 to 48, 000
Root Mean Square Noise	7.2 microvolts
Amplifier/Analog-Digital-Converter Power	3.3 microwatts
Spike Detection	2,000 nanoseconds
Stimulation Resolution	0.2 microamperes and 3.0455 microseconds
Die Size	4 x 5 mm

V. COMPUTER TERMINAL

This specialized terminal will facilitate all the needs of the user. This terminal will relate with the servers responsible for the Guidance, Navigation and Control (GN and C) Sub-System, the Electrical Power Sub-System (responsible for providing and storing electrical energy, user can use it to adjust lighting in the space vehicle) and the Thermal Control Sub-System (responsible for regulating temperature throughout the space vehicle).

The user can connect with the computer terminal via an USB cable or wirelessly. The terminal will consist of soft controls placed on the screen. All controls for the space vehicle will be on the screen of this terminal. The user will have the luxury of utilizing soft buttons, textboxes, etc. to enter and commit commands. The screen will have options to which server the user wants to switch to or login to (may incorporate a special window that pops up with the information and GUI for that server).

There will be an option for the user to change controls, for example from input via textboxes to a soft toggle or lever control on the screen, that is, when maneuvering the vehicle. The user will be able to log into the Electrical Power Sub-system to adjust lighting and any authorized electrical needs. The user will be able to log into the Thermal Control Sub-system to adjust the temperature throughout the vehicle. The terminal will have camera footages displaying every aspect of the space vehicle.

5.1 Guidance, Navigation and Control (GN and C) Sub-system

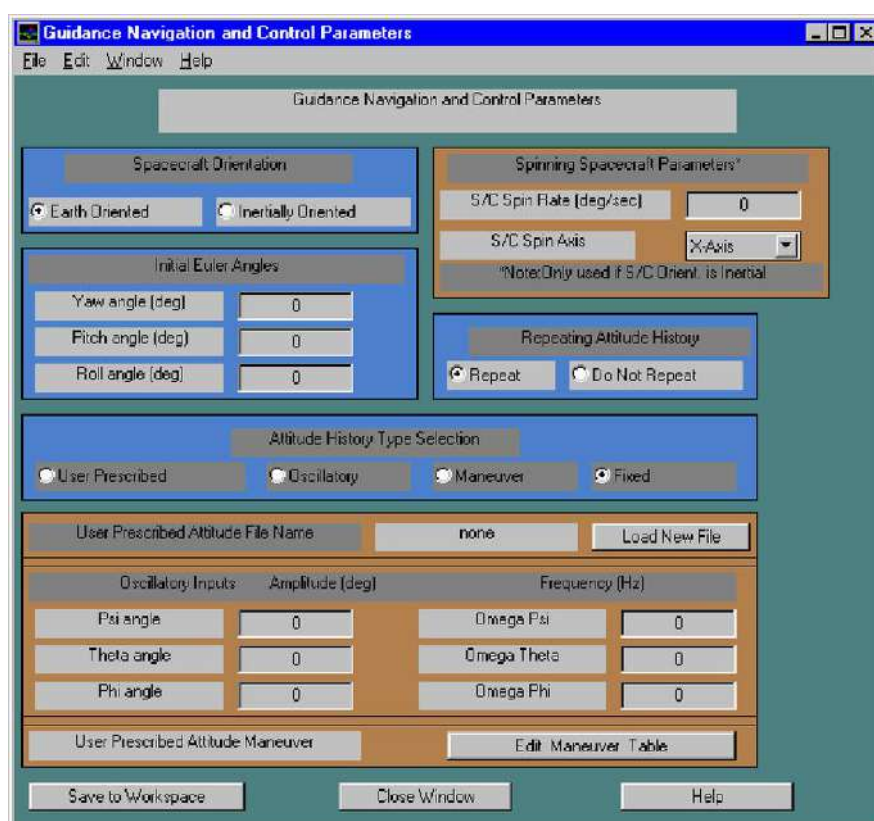


Fig. 5: GN and C Sub-system

When the user attempts to change the speed and orientation of the space vehicle, a window displaying the effect of the proposed move will appear. The user will see how the

vehicle would appear once the command has been committed and a possible warning the user should brace for.

Then the user has the option to commit the command or to make changes. For continuous motion controls, for example, a steering, in place of such, the user can enter (double) floating point numbers, (if not using soft controls (eg. Toggle Control)) to input data.

The user will have control over the engines of the vehicle collectively or individually. This becomes important in cases where spacecraft needs to perform Soyuz Rendezvous and docking to facilitate proper docking and to avoid collisions and possible errors when attempting to dock. This is also important when disengaging from dock to allow for smooth transition and movement away from the International Space Station (ISS) or any docking facility.

The GN and C also known as AOCS (Attitude Orbit Control System) is responsible for the orientation, position, velocity and angular velocity (navigation) of the space vehicle. It is responsible for force and torque (control) along a trajectory as defined in the Guidance Function. It measures the current state of the space vehicle and inspects the data from the sensors and it interfaces with the actuator hardware and applies the required forces and torques.

Sensor measurements are usually corrupted with sensor noise, drift and biases, the Navigation Function has a filter to correct the attenuation present in the measurements. In the absence of sensors to measure all the dynamical states, the navigation tool reconstructs some states to measure the hardware. This is done through Sensor Fusion and Robotic Applications and Stochastic Filtering Techniques (such as variations of Kalman Filters – regular, extended and unscented).

The Kalman filter uses a system's dynamic model...known control inputs to that system, and multiple sequential measurements...to form an estimate of the system's varying quantities.[13]

The predicted and update functions in the extended Kalman filter (EKF) could be either linear or non-linear functions. In the case, they are non-linear, these functions are very distinguishable.

$$\begin{aligned}x_k &= f(x_{k-1}, u_k) + w_k \\ z_k &= h(x_k) + v_k\end{aligned}\quad (3)$$

The function f is usually used to calculate the state transition of previous estimate and the function h to calculate the observational model. However, the Jacobian matrix (of partial derivatives) is used to compute the covariance directly.

In each period of time, the Jacobian is evaluated with current forecasted conditions. These matrices are possible

in the Kalman filter equations. This procedure fixes a nonlinear function around the present approximated value.

When the predicted and update functions f and h are very non-uniform and the extended Kalman filter gives a poor judgement. In lieu of the state transition and observation models propagating output(s) non-linear. The unscented Kalman filter (UKF) uses unscented transformation (UT) to select minimal sigma points around the average, considered a very deterministic sampling technique. Those set of sampling points are spread throughout non-linear functions from which new average and covariance estimates are then produced.

The resulting filter depends on the set of sigma points used and the way in which the transformed statistics of the UT are calculated. It should be remarked that it is always possible to construct new UKFs in a consistent way. In certain cases, the resulting UKF more accurately approximates the true mean and covariance.

This can be verified with Monte Carlo sampling or Taylor series expansion of the posterior statistics. This technique typically removes the requirement to explicitly calculate Jacobians, which for complex functions can be a complicated task in itself or may not even be impossible (especially when those functions are not differentiable).

The Guidance Function specifies the desired dynamical states either in a waypoint as a function of time or Trajectory Generator that will smooth out the transition between the waypoints. It also calculates the error between the desired states and estimated states to compute the trajectory tracking error between these states and feed the signal to the onboard Controller. This is to ensure the required torque be applied to the different actuators onboard the space vehicle and that the vehicle follows the desired trajectory.

The GN and C Sub-system also facilitates reconfiguration while the spacecraft is in orbit.

VI. CONCLUSION

Artificial Intelligence (AI) is intelligence demonstrated by machines as it relates to the natural intelligence displayed by humans beings. AI Machines are any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals. AI is often used to describe machines (or computers) that emulate cognitive functions that humans associate with the human mind, that is, problem solving and learning.

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Chemical composition and repellency activity of essential oil from desert date seeds against the red flour beetle

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Abstract—This study aimed to determine the chemical constituents and repellency activity of essential oil from *Balanites aegyptiaca* (desert date) against adults of *Tribolium castaneum* (red flour beetle). The essential oil was extracted by hydrodistillation and tested for repellent activity against the pest at different concentrations, 8, 4, 2 and 1%, locally made repellency equipment was used for repellency test. The essential oil was analyzed by gas chromatography-mass spectrometry (GC-MS). The analysis results of GC-MS showed a high percentage of oleic acid (94.93%), 6-octadecenoic acid (2.38%) and n-hexadecanoic acid (1.59%). The repellent effect against the pest was observed in all tested essential oil concentrations, the highest concentration (8%) scored the highest percentage of repellent effect (89.95%). The results observed that insect repellency rate increased with the increase in essential oil concentration. The study revealed that the essential oil of desert date possesses repellent activities against adults of red flour beetle which may be used to control the pest.

Keywords—Essential oil, repellent effect, red flour beetle, GC-MS, insects.

I. INTRODUCTION

Insects have emerged on the surface of the earth more than 400 million years ago (El Minshawy and Hegazi, 2001). The majority of insects are very useful to human and environment; some insects are parasitoids or predators on other harmful pests such as *Amphibulus venator* (Klug) prey on *Tribolium castaneum*, some produce important products like honey, silk and medicinal substances. However, less than 0.5 percentage of insect species are harmful insects (pests), and only three orders: Coleoptera, Lepidoptera and Psocoptera contain species are considered as major pests of stored products (Sallam, 1999).

Pests of stored products are currently divided into primary and secondary pests. Primary pests which able to attack whole, unbroken grains, for example, Khapra beetle (*Trogoderma granarium*), granary weevil (*Sitophilus granarius*) and rice weevil (*Sitophilus oryzae*). Secondary pests attack only damaged grain, milled products and dust

such as red flour beetle (*Tribolium castaneum*), confused flour beetle (*Tribolium confusum*) and saw-toothed grain beetle (*Oryzaephilus surinamensis*). These insects can cause many of damage for stored food and grains, for example, loss of weight and quality of products (Rees, 2004; Nayak and Daglish, 2018; Emery and Cousins, 2019 and Yaseen et al., 2019).

The pesticides the major method to control these pests. However, this method have many problems such as toxicity to non-target organisms and unsafety for the environment. Botanical extracts are considered new safe alternative to pesticides, in particular, essential oils, because most of them are not or are slightly toxic to man and animal, safe and will not contaminate the environment. Many previous studies proved the insecticidal and repellent effect of essential oils from different plant against stored product pests. Olivero-Verbel et al. (2010) observed that the essential oils of *Cymbopogon citratus* and *Eucalyptus citriodora* have

good repellent effect against *Tribolium castaneum*. The essential oils of *Mentha microphylla* act as fumigation and in contact against the adults of *T. castaneum* and *Sitophilus oryzae* (Mohamed and Abdelgaleil, 2008). Simalary, the essential oils from *Psidium guajava* and *Schinus terebinthifolius* are more effective as fumigant on adults of *T. castaneum* (El-Sabrou et al., 2019). Hence, to continue in this field to find plant can be used to control the pests, this study aimed to investigate the repellent effect of essential oil from *Balanites aegyptiaca* against *T. castaneum* and to determine the chemical compounds of the oils by Gas chromatography–mass spectrometry (GC-MS).

II. MATERIALS AND METHODS

2.1. Extraction of the essential oil

Mature fruits were collected from naturally grown desert date tree at Omdurman, Khartoum, Sudan. The hard shell of the fruits were broken to obtain the seeds, then the seeds were crushed into fine powders by an electric blender. A weight of 200 grams seeds powder were subjected to hydrodistillation for 3 h in a Clevenger type apparatus to produce the plant oil (López *et al.*, 2011 and Nenaah, 2014). The obtained oil was kept in vials and placed in a refrigerator until used.

2.2. Insect

The red flour beetle cultures were reared under laboratory conditions at 30 ± 2 °C and $65 \pm 8\%$ RH. Adult insects one week old were selected and used for the repellency test.

2.3. Repellency test

We designed locally repellency equipment according to Berndt (1963) to test the repellency effect of the essential oil against the red flour beetle. Four concentrations of the essential oil viz. 8, 4, 2 and 1% were prepared in acetone. The tested concentrations were applied on petri dishes and distributed randomly in the repellency equipment peripheral holes, including the control. Two hundred of red flour beetle insects were introduced in a petri dish and placed in the central hole of the repellency equipment (Elamin and Satti, 2013). After 24 h, the numbers of insects were calculated for each test hole and the control hole and recorded, the experiment was repeated for two consecutive days to get three counts. Consequently, the recorded data of the insects were analyzed to compute the repellency or attractancy efficacy of each concentration based on Leonard and Ehrman formula (1976):

$$A = \frac{No - Nb}{Nt}$$

Where; A = repellency (-) or attractancy (+); No = number of insects in the test hole; Nb = number of insects in the control hole; Nt = the number of insects in test and control holes. The output of this equation ranges from -1 (100% repellent) to + 1 (100% attractant) when compared to the control.

2.4. Gas Chromatography–Mass Spectrometry analysis

The essential oil of the plant was analyzed by means of the GC-MS system (7890B/5977A, Agilent, USA). A capillary column HP-5MS (30m_ 0.25mm ID, df ¼ 0.25 mm) was utilized (Ren *et al.*, 2019). The following temperature program was set for analysis: oven temperature was initially 40 °C for 3 min and kept at 250 °C at 5 °C/min. the pure Helium (flow rate 1 ml/min) was used as carrier gas. The mass spectrometer was executed by the MS system (5977A MSD, Agilent, USA). The temperature of ion source was 270 °C, and 300 °C for transmission line. The chemical compounds were identified by comparison the mass spectrum of the unknown component with the spectrum of the known components in the National Institute of Standards and Technology library.

2.5. Statistical analysis

The obtained data of insects in each treatment were analyzed by one-way (ANOVA). Level of significant differences were selected to be at $P < 0.05$. Duncan's Multiple Range Test was used.

III. RESULTS AND DISCUSSION

3.1. Repellency effect

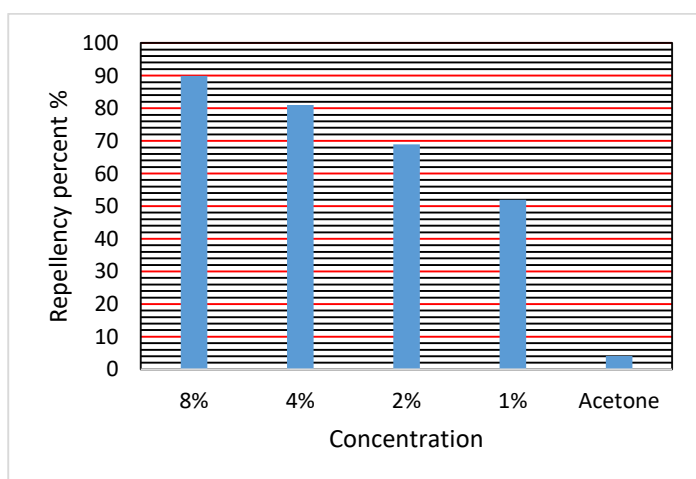
The percentages repellency of the essential oil against *T. castaneum* are presented in the figure and mean of insects in treatment \pm SE in Table 1. All concentrations obtained highly significant repellent effect against the pest compared with the control. The highest percentage of the insects repellent was 89.95% at 8% concentration, followed by 81.00% at 4% concentration. This result is similar to which was recorded by Al-Jabr (2006) who observed that *Matricaria chamomilla* reflected 84.73% repellent percentage at 1% concentration against *T. castaneum*. This little difference could be attributed to the type of the plant and bioassay methods. The repellent effect may be due to high quantity and/or good quality bioactive compounds in the essential oil such as fatty acids as have been confirmed by GC-Mass results. According to Zhu *et al.* (2018) Coconut fatty acids have strong repellency activities against mosquitoes, ticks, biting flies and bed bugs. Moreover, numerous of studies

demonstrated the repellency effect of the essential oils against *T. castaneum* from other plants, for example, *Helianthus petiolaris*, *Artemisia* species, *Ricinus communis*, and *Satureja* species (Liang et al., 2017; Salem et al., 2017; Taban et al., 2017; Anabel et al., 2019). It's clear that the increased concentration led to increased repellent effect. This result agreed with Cao et al. (2018) who reported that the repellent effect of the *Evodia lenticellata* Huang essential oil against *T. castaneum* and *Lasioderma serricorne* increased with the increase in concentrations.

3.2. GC-MS analysis results

The gas chromatography/mass spectrometric analysis results for the essential oil from desert date seed are presented in Table 2. The major components were oleic (9-octadecenoic) acid (94.93%), 6-Octadecenoic (Petroselaidic) acid (2.38%) and n-hexadecanoic (palmitic) acid (1.59%). No data are available on chemical profile of the essential oil from seeds of this plant. However, many fatty acids such oleic acid, palmitic acid were detected in essential oils from seeds for other plants. According to Koufan et al. (2020) the essential oil of *Argania spinosa* (L.) Skeels seeds contains oleic and linoleic acids. Similarly, palmitic and oleic acids were identified from essential oils from seeds of *Zanthoxylum schinifolium* by Oh and Chung (2014). The main fatty acid components of essential oils of *Magnolia grandiflora* seeds are methyl linoleate, methyl oleate and palmitic acid as reported by Ali et al. (2020).

IV. FIGURES AND TABLES



The figure. Percentage of repellency of *B. aegyptiaca* essential oil against *Tribolium castaneum*.

Table 1. Percentage repellency of *B. aegyptiaca* essential oil against *Tribolium castaneum*, during October 2019.

Treatments	Mean ($\bar{X} \pm S.E.$) insects/treatments
Essential oil 8%	0.67 \pm 0.33a
Essential oil 4%	1.33 \pm 0.33a
Essential oil 2%	2.33 \pm 0.33ab
Essential oil 1%	4.00 \pm 0.58b
Acetone	11.67 \pm 0.67c
Control	12.67 \pm 0.88c

*Values represents mean of three replications with 10 insects each.

*Means followed by same letters are not significantly different from each other at $P < 0.05$ level ($F^{5, 12} = 80.847$).

Table 2. Chemical constituents in the essential oil from desert date seeds.

No.	Name of Compound	Molecular Formula	R.T.(Min)	Peak Area %
1	Indole	C ₈ H ₇ N	23.25	0.06
2	Hexadecanoic acid (palmitic acid)	C ₁₆ H ₃₂ O ₂	43.52	1.59
3	Oleic Acid (9-octadecenoic)	C ₁₈ H ₃₄ O ₂	46.66	94.93
4	9,12-Octadecadienoic acid z,z-(linoleic acid)	C ₁₈ H ₃₂ O ₂	50.29	1.10
5	6-Octadecenoic acid (Petroselaidic acid)	C ₁₈ H ₃₄ O ₂	50.55	2.38

V. CONCLUSION

The study detected that the essential oil from desert date have strong repellency activity against the red flour beetle. However, further studies are necessary to investigate its efficacy on the pests in grain storage. Moreover, some fatty acids such as palmitic and oleic acids were detected in the essential oil. Hence, more researches are needed to isolate, identify and characterize

the active ingredients responsible of the repellency effects and its evaluation on the pest and test for safety on humans.

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Correlates of Entrepreneurial Skills: An Assessment to College Students Enrolled in Entrepreneurship Course

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Abstract— One of the objectives of the Higher Education Institutions (HEIs) is to develop a competent and substantial number of entrepreneurs in the economy of the nation. This study described the important skills that entrepreneurship students need to learn: strategic planning, communication, reputation management, financial management, relationship management, and problem solving. The study also described the correlation between the profile of respondents and the important entrepreneurship important skills which are strategic planning, reputation management, financial management, relationship management, and problem solving. This study used the quantitative descriptive research method. There were a total of 132 college students (63 males and 69 females) who were enrolled in Bachelor of Science in Entrepreneurship. Gathered data were analyzed through descriptive statistics such as frequency, weighted mean and bivariate correlation.

Keywords— *Entrepreneurship, Entrepreneurial Skill, Management, Strategic Planning.*

I. INTRODUCTION

One of the objectives of the Higher Education Institutions (HEIs) is to develop a competent and substantial number of entrepreneurs in the economy of the nation. Attaining higher rates of economic growth and innovation requires entrepreneurship (Oosterbeek et al., 2010).

Entrepreneurial education will be aimed at equipping entrepreneurs and prospective entrepreneurs with the skills required to meet the complexities of planning and implementing a new business venture (Elmuti et al., 2012).

The subject of entrepreneurship is increasingly being incorporated internationally as a core component of higher education (Heikkinen & Stevenson, 2016). Entrepreneurship education has had a positive effect on career-related outcomes (Solomon & Matlay, 2008). Graduates in all types of employment situations may benefit from entrepreneurial experience, in particular skills in management and leadership (Frank, 2007).

The leadership skills that could be built to potentiate the students' entrepreneurial potential while leading their teams have been defined by the entrepreneurs and classified as

skills in entrepreneurship, management and leadership (Sousa, 2018). In order to build and promote supply and entrepreneurship in youth programs and events, education should be refined (Undiyaundeye & Otu, 2015).

In lieu of these insights, the researcher would like to assess the college students enrolled in entrepreneurship course and correlate their entrepreneurial skills.

II. CONCEPTUAL FRAMEWORK

Entrepreneurs need to learn the skills needed to access additional venture capital, and they should learn how to choose from a variety of investment approaches that can affect their chances of success (Cooney, 2012).

Integrating the development of entrepreneurship skills into the university curriculum would give students the ability to integrate and organize all business management components, and will also encourage entrepreneurial mentality and empower students to set up their business projects on graduation (Emaikwu, 2011).

Direct selling, which is included in the curriculum of Bachelor of Science in Entrepreneurship, highly develops

marketing skills for students that act as a bridge for students into the entrepreneurial world (Santos, 2020).

III. OBJECTIVES OF THE STUDY

This study described the important skills that entrepreneurship students need to learn: strategic planning, communication, reputation management, financial management, relationship management, and problem solving. The study also described the correlation between the profile of respondents and the important entrepreneurship important skills which are strategic planning, reputation management, financial management, relationship management, and problem solving.

IV. METHODOLOGY

This study used the quantitative descriptive research method, as it is often paired with compare and contrast calculation, description, interpretation, and evaluation (Stone et al., 2008). The researcher distributed survey questionnaires which adapted Likert-scale type responses (Vagias, 2006) to a total of 132 college students (63 males and 69 females) who were enrolled in Bachelor of Science in Entrepreneurship. Gathered data were analyzed through descriptive statistics such as frequency, weighted mean and bivariate correlation.

V. RESULTS AND DISCUSSIONS

Table 1. Profile of the Respondents

Factors	<i>f</i>	%
Age		
18	17	12.90
19	19	14.40
20	16	12.10
21	24	18.20
22	26	19.70
23	30	22.70
Total	132	100.00
Mean = 20.86		
Sex		
Male	62	47.00
Female	70	43.00
Total	132	100.00
Year Level		
First	16	12.10
Second	37	28.00
Third	36	27.30
Fourth	43	32.6
Total	132	100.00

With Personal Experience in Business		
<i>Yes</i>	67	50.80
<i>No</i>	65	49.20
Total	132	100.00
Has Family Business		
<i>Yes</i>	68	51.50
<i>No</i>	64	48.50
Total	132	100.00

Table 1 shows the profile of the respondents in terms of age, sex, year level, with personal experience in business, and has family business. There were a total of 132 student-respondents (62 males and 70 females) with a mean age of 20.86 ranging from 18 – 23 years old. A big number of student-respondents came from fourth year level having a frequency of 43 (32.60%). In terms of with personal

experience in business, 67 or 50.80 percent of the student respondents answered 'Yes' and 65 or 49.10 percent answered 'No'. Likewise, 68 (51.50%) respondents answered that their family has a business and the remaining 64 (48.50%) respondents answered that their family has no family business.

Table 2. Strategic Planning Skills

Statements	Mean	Verbal Interpretation
1. When starting a new task or project, I gather a great deal of information before going ahead.	2.81	Agree
2. I plan a big project by breaking it down into smaller tasks.	2.61	Agree
3. I do things that need to be done before being asked to by others.	3.20	Agree
4. I am as concerned about meeting my weekly goals for my yearly goals.	3.42	Strongly Agree
5. I know how to achieve my set goals according to my plan.	3.58	Strongly Agree
6. I am confident when making plans.	3.30	Strongly Agree
General Weighted Mean	3.15	Agree

LEGEND 3.25 – 4.00 *Strongly Agree*
 2.50 – 3.24 *Agree*

1.75 – 2.49 *Disagree*
 1.00 – 1.74 *Strongly Disagree*

Table 2 shows the result of the strategic planning skills of the respondents. Based on the result, the respondents got a general weighted mean of 3.15 which has a verbal interpretation of "Agree". To highlight, the respondents strongly agreed that they know how to achieve my set goals according to their plans (*mean* = 3.58). They strongly agreed that they are concerned about meeting their weekly goals as

for their yearly goals (*mean* = 3.42). Also, they are confident when making plans (*mean* = 3.30; *strongly agree*). The results imply that the students enrolled in BS Entrepreneurship course possess skills in strategic planning where they know making plans, starting meetings, and setting goals.

Table 3. Relationship Management Skills

Statements	Mean	Verbal Interpretation
1. I do not spend much time thinking how to influence others.	3.02	Agree
2. I am happy to do someone else's work if necessary to get the job done on time.	2.96	Agree
3. I get important people to help me accomplish my goals.	2.74	Agree
4. I am as concerned with the feedbacks from others.	3.14	Agree
5. I try several times to get people to do what I would like them to do.	2.82	Agree
6. I get others to support my recommendations.	3.17	Agree
General Weighted Mean	2.98	Agree

LEGEND	3.25 – 4.00	<i>Strongly Agree</i>	1.75 – 2.49	<i>Disagree</i>
	2.50 – 3.24	<i>Agree</i>	1.00 – 1.74	<i>Strongly Disagree</i>

Table 3 presents the relationship management skills of the respondents which showed that respondents got a general weighted mean of 2.98 which has a verbal interpretation of “Agree”. The respondents showed that they get others to support their recommendations (mean = 3.17) and, also, that

they are concerned with the feedbacks from others (mean = 3.14). This imply that the respondents’ skill in relationship management is present. The respondents consider other people as necessary part of their journey as future entrepreneurs.

Table 4. Problem Solving Skills

Statements	Mean	Verbal Interpretation
1. I prefer situations in which I can control the outcomes as much as possible.	3.33	Strongly Agree
2. I deal with problems as they arise, rather than spend time trying to anticipate them.	3.36	Strongly Agree
3. When faced with major difficulties, I quickly go on to other things.	2.99	Agree
4. I weigh my chances of succeeding or failing before I decide to do something.	3.23	Agree
5. I focus on facts when dealing with problems.	3.10	Agree
6. I am able to handle stressful situations.	2.92	Agree
General Weighted Mean	3.16	Agree

LEGEND	3.25 – 4.00	<i>Strongly Agree</i>	1.75 – 2.49	<i>Disagree</i>
	2.50 – 3.24	<i>Agree</i>	1.00 – 1.74	<i>Strongly Disagree</i>

Table 4 shows the problem solving skills of the respondents. The result showed that the respondents got a general weighted mean of 3.16 which has a verbal interpretation of “Agree”. The respondents strongly agreed that they deal with problems as they arise, rather than spend time trying to anticipate them (mean = 3.36), and, also, they strongly

agreed that they prefer situations in which I can control the outcomes as much as possible (mean = 3.33). Based on the results, this may imply that problem solving skill is present showing that the respondents were able to handle problems and make decisions.

Table 5. Reputation Management Skills

Statements	Mean	Verbal Interpretation
1. If I break a promise, I must apologize, but don't let this become a pattern.	2.82	Agree
2. I make fair decisions	3.10	Agree
3. I care for the person in a non-judgmental way	3.42	Strongly Agree
4. I give credits to where it is due.	3.14	Agree
5. I do not make excuses if something bad happen	2.84	Agree
6. I respect people around me.	3.13	Agree
General Weighted Mean	3.07	Agree

LEGEND	3.25 – 4.00	Strongly Agree	1.75 – 2.49	Disagree
	2.50 – 3.24	Agree	1.00 – 1.74	Strongly Disagree

Table 5 shows the reputation management skills of the respondents where they got a general weighted mean of 3.42 and a verbal interpretation of “Strongly Agree”. To emphasize, the respondents strongly agreed that they care for the person in a non-judgmental way (mean = 3.42). This

result shows that the respondents were able to manage their reputations as a skill of an entrepreneur which pertains to holding one's integrity.

Table 6. Financial Management Skills

Statements	Mean	Verbal Interpretation
1. I stay on my budget or financial plan.	2.89	Agree
2. I save money from my allowance.	3.31	Strongly Agree
3. I keep a written record of my daily expenses.	3.23	Agree
4. I only buy the things I need the most.	3.39	Strongly Agree
5. I keep financial goal plans.	3.27	Strongly Agree
6. I know how to handle my on hand money.	3.23	Agree
General Weighted Mean	3.22	Agree

LEGEND	3.25 – 4.00	Strongly Agree	1.75 – 2.49	Disagree
	2.50 – 3.24	Agree	1.00 – 1.74	Strongly Disagree

Table 6 shows the financial management skills of the respondents. Based on the result, respondents got a general weighted mean of 3.22 and a verbal interpretation of “Agree”. The respondents strongly agreed that they only buy the things I need the most (mean = 3.39). Further, they also

strongly agreed that they save money from their allowance (mean = 3.31) and they keep financial goal plans (3.27). This result implies that respondents show skills in managing their finances which were shown in handling their money and budget based their plans and to keep it on record.

Table 7. Correlation of Respondents' Profile and Their Entrepreneurial Skills

	1	2	3	4	5	6	7	8	9	10
1. Age	1									
2. Sex	.001	1								
3. Year Level	.914**	-.018	1							
4. With Personal Experience in Business	-.112	.107-	.062	1						
5. Has Family Business	.143	.063	.127	-.026	1					
6. Strategic Planning	-.029	.034	-.048	-.084	.643**	1				
7. Relationship Management	.047	.014	.009	0.38	.597**	.543**	1			
8. Problem Solving	-.026	.112	-.037	-.012	.666**	.618**	.543**	1		
9. Reputation Management	.022	.059	-.001	-.030	-.120	-.148	.618**	.802**	1	
10. Financial Management	-.158	-.195*	-.160	-.026	.643**	.543**	-.148	-.145	-.158	1

** $p < .01$

Sex: 1-Male 2-Female

Personal Experience: 1-Yes 2-No

* $p < .05$ Has Family Business: 1-Yes 2- No

Table 7 shows the significant relationship between and among the respondents' profile and their entrepreneurial skills. Result shows that a positive significant relationship was found between family business and strategic planning ($r=.643$), relationship management ($r=.597$), problem solving ($r=.666$), and financial management ($r=.643$), all at $p<.01$. The results imply that if the respondents have a family business they have more skills in strategic planning, relationship management, problem solving, and financial management as compared to those respondents who do not have a family business. A positive significant relationships were also found between strategic planning and relationship management ($r=.543$), problem solving ($r=.618$), and financial management ($r=.543$) at $p<.01$. These mean that the higher the skills of the respondents in strategic planning is the higher they also have the skills in relationship management, problem solving and financial management. Likewise, positive correlations were present between relationship management and problem solving ($r=.543$) and reputation management ($r=.618$) at $p<.01$ stating that the

higher the skills in relationship management is the higher skills in problem solving and reputation management the respondents have. Same with, positive significant relationship found between problem solving and reputation management ($r=.802$, $p<.01$). On the other hand, a negative correlation was found between sex and financial management ($r=-.195$, $p<.05$) which implies that male respondents have higher financial management skills as compared to female respondents.

VI. CONCLUSIONS AND RECOMMENDATIONS

Entrepreneurial skills were determined among college students who are taking up BS in Entrepreneurship course and how these were related to the students' personal profile. Based on the result, it was concluded that Financial Management skill was the highest among the entrepreneurial skills that the students have. On the other hand, Relationship Management skill was least skills the students have. Having family business has a significant relationship to the

entrepreneurial skills that the students must possess. Sex of the respondents was also related to financial management wherein males are more skilled in financial management.

In lieu of the foregoing conclusions, it was recommended that students should not only focus on developing in one skills only to become an entrepreneur as they graduate from their course. In relation, the school must provide an assessment as to the student's skills and aptitude is aligned to the course, BS Entrepreneurship, they will take. Though, having a family business matters in developing such skills as entrepreneur, not all students came from a family that can afford to manage a business. It is recommended that in substitute, there must be a training ground for students to develop the needed skills by providing programs and partnerships to entrepreneurial agencies. Finally, further studies is recommended to determine other factors that contribute to the development of the entrepreneurial skills among the BS Entrepreneurship students.

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Program, Project, Business and Social Action – Impact Assessment

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Abstract— This article presents and discusses the SROI - Social Return on Investment, an important methodology used to assess the socioeconomic and environmental impact of a program, project, business or social action, carried out in poor communities and aimed at vulnerable populations, in view of its transformation. It addresses concepts, principles and the step by step of its execution, as a way to subsidize actors from public, private and non-governmental organizations, when there is a need to present to the society and the financial institutions, the cost-benefit non-monetized of the investments made for the realization of the intervention. The research to obtain the data was qualitative analytical, looking for classic and contemporary authors who approach the subject. The conclusions point to the increasing need to scientifically evaluate social actions, in order to qualify entrepreneurial organizations and also satisfy funding agencies.

Keywords— Impact assessment; SROI; Theory of Change.

I. THEORETICAL FRAMEWORK - HISTORY

The idea of writing this article came up in the Professional Master's Degree in Rural Extension at UNIVASF - Federal University of Vale do São Francisco, during the classes of the discipline Social Projects, an opportunity in which students linked to Non-Governmental Organizations for a long time and, consequently, executing the mission of its institutions through projects financed by national and international organizations, manifested the

difficulty in effectively evaluating the results obtained with the actions carried out, including to meet the requirements of the sponsors.

Although this practice has been required in countries in Europe and the United States since the 1960s, in Brazil it is still an unusual tool, either due to the lack of knowledge on how to do it, or due to the wrong understanding of the actors when they do not measure the legitimacy of this intervention in rendering accounts to the financing agency,

for whom, evaluating the project is an essential condition in obtaining data that will determine the effectiveness of the strategies used and the impact produced, allowing to improve the process.

Studies by Pinto et al (2019), point out that, from a base of 579 social impact businesses in Brazil, 31% do not have defined impact indicators; 28% have indicators, but do not measure them formally and 28% do not think it necessary to measure the impact generated by their work, leaving only 13% of businesses that have a formal impact measurement process. By impact, the effect resulting from an action under certain conditions is being considered here, that is, the intentional or unintentional changes resulting from the intervention, which can be both positive and negative. In the impact assessment, it is possible to prove whether the proposed objectives were fully or partially achieved and, more than that, to establish a cause and effect relationship between the intervention, identified by the selected indicators, whose purpose is to monitor the activities that the project, program or social business carries out with the ultimate goal of generating impact. Indicators are also necessary for the analysis of the impact itself, whether for measuring quantitative or qualitative aspects.

Development projects, stimulated since the Second World War for the reconstruction of the defeated countries and the movement of decimated economies, still remain the main instruments for promoting social, economic and socio-environmental changes, however, the objectives today are focused on reducing poverty and sustainable environmental preservation, through much more effective and efficient control instruments, requiring the participation of the subjects involved and multidisciplinary interventions. In the Brazilian case, the resumption of democracy in the mid-1980s, ignited the flame in organized civil society, to create different ways of intervening in the social reality of poor communities, with a view to their transformation, arising from there, non-governmental organizations to act in the voids left by the state. These organizations have played relevant roles with the most vulnerable populations and excluded from public policies, but they are currently facing difficulties in raising funds to continue developing their purposes, both due to the global situation of scarcity of financial resources, and the low professionalization of their actors. with regard to the ability to prove to its financiers the impacts resulting from the investments they have made. This text aims to contribute to this discussion, pointing out some useful elements for scientific evaluation of projects, programs, businesses or social actions.

There are dozens of methodologies applied to the impact assessment of social projects, however, in this article, the principles and know-how of SROI - Social Return on Investment (Social Return on Investment), which is a methodology widely applied by funding agencies, will be addressed. to measure the non-financial impact of a project, program, business or social action, in comparison with the amount invested (PEIXOTO et al, 2016), hearing from participants the history of social transformation generated by the intervention, such as quality improvement of life in the educational, cultural, information, health, housing, job and income generation and economic aspects, if that is the objective. It is, therefore, a cost-benefit analysis, recognized by the United Kingdom Cabinet Office, very conducive to organizations to evaluate intangible aspects, difficult to be observed and directly measured, but which account for everything that is relevant by “ stakeholders ”, that is, the beneficiaries. SROI's concern is to measure non-monetary value, generating information based on quantitative, qualitative and financial data, capable of explaining the changes that have occurred.

II. SROI METHODOLOGY- SOCIAL RETURN ON INVESTMENT

Table 1

Principles and Stages of Sroi	
<ul style="list-style-type: none"> Involve stakeholders Understand what has changed Valuing the things that matter Only include what is material Not taking ownership of the results of others Be transparent Check the results 	<ol style="list-style-type: none"> 1.Establish the scope and key stakeholders 2.Map Results 3.Establish the results and performance indicators assign them value 4.Understand the impact 5.Calculate SROI 6.Report

SOURCE: SROI Guide

The SROI methodology, as noted in TABLE 01, is based on seven principles:

According to Lazzarini (2018), stakeholders are people or organizations that participate in social action and are affected positively or negatively by the changes resulting from this action. In practice, the important thing is to choose the key stakeholders for listening, dispensing with all the actors involved. Key stakeholders should be

understood as those members who demonstrated, during the entire execution of the intervention, an interest in the problems raised, discussing about them; giving an opinion; bringing the contradictory when the positions placed as the best do not convince them; presenting alternatives capable of solving problems. Therefore, it is necessary to have a clear idea of what to evaluate, based on the initial objectives and their adaptations when, in the middle of the course, there was a need for changes in planning. Then, a mapping of the results brought by the stakeholders, ranking each one by assigning a value that should start from the most important to the least relevant, all in the view of those involved and to establish the impact. It is important at this stage to assess whether that result would occur in any way, regardless of social action, or whether it was only evident due to the project. To do so, input, output and measurable results must be established for each result. Finally, the calculation of the SROI is calculated by the sum of all benefits; the subtraction of the negative impacts detected and the comparison of the result with the investment, returning the conclusions evidenced, whatever they may be, positive or negative, clarifying that, in the case of social projects, the benefits are hardly expressed in monetary units and imputing values nutritional, educational, health, housing, well-being, leisure, recreation, etc. it implies fixing a price for subjective issues that involve human life and tend not to be monetized (LAZZARINI, 2018).

The important thing is not to lose sight of the fact that resources destined to operate social changes need to be spent effectively, ensuring satisfaction for both entrepreneurs and financiers, hence the metric chosen to demonstrate the results should not be based on the number of beneficiaries, for example. example, but in the changes brought by the project to the lives of the populations involved. Change is what should matter. As stated by Barros and Lima (2012), it is not enough for stakeholders to demonstrate satisfaction with the project or program. The financiers of the action need to be convinced that each currency unit allocated to the actions has generated a positive impact evidenced by important changes in the life of the population. Sustainability, characterized by its continuity, will depend on 100% of this understanding.

The SROI tool gained strength in 2007, when the UK government invested valuable resources so that the concept and guidelines for this evaluation method were better structured, but it was in 2009 that the method was consolidated when used by a consortium led by Social Value UK, publishing the guide for using the methodology, whose purpose is to assess impacts of funded projects. It is a methodology that seeks to give objectivity to a subjective

impact (LAZZARINI, 2018). Monetization is not the focus itself. The focus is on identifying change.

In Latin America, it is still common to find projects and policies with clearly unattainable objectives, however, as there is no evaluation, governments do not incur political costs because they do not reach the specified goals and reap the bonus of the promise. Results-oriented management requires the definition of more realistic goals and targets; specifying the means to achieve them; the design of a clear strategy to be followed; an assessment of the instruments available and the difficulties in mobilizing them; the allocation of authority and responsibilities among partners; the setting up of an information system consistent with the management needs and the definition of learning mechanisms that allow incorporating the lessons learned in the management decision process (IICA, 2010).

The Theory of Change, which presents itself as an essential foundation in the application of SROI, is a description that explains what will happen in the project's trajectory, between the beginning and its end. Once the long-term goals of the planned social action are defined, the activities to be carried out to achieve the objectives are identified. During the process of creating the "path of change", participants are required to question their assumptions about change and how activities can be tested to determine whether the key assumptions are strong enough to guarantee expected results (IICA, 2010).

In the design of the Theory of Change, six steps must be accomplished:

- Identify long-term goals;
- Map and connect the preconditions or requirements necessary to achieve these objectives and explain the necessary conditions;
- Identify the basic assumptions about the context;
- Identify the interventions that your initiative will carry out to create the desired change;
- Develop indicators to measure your results and evaluate the performance of your initiative;
- Write a narrative to explain the logic of your initiative.

When fulfilling these steps in the design of the project, program, business or social action path, some benefits can be accounted for in its execution, such as:

- More reliable results, in view of the clarity of the hypothesis raised
- Visual representation of the change that you want to achieve with the intervention

- Indicators described in a measurable way, ensuring the measurement of results
- Consensus among stakeholders on what should be done to ensure results
- Definition of the complexity of the intervention

In the construction of the Theory of Change, the logical framework can be used, which is a tool that allows actors to visualize how inputs and activities lead to certain results, facilitating the assessment of the impact that one wishes to achieve (LAZZARINI, 2018).

Before we even start the step by step in the execution of the SROI, we will do some reflections on what is a social project, which according to Armani (2003), is a “planned social action, structured in objectives, results and activities based on a limited amount of resources (human, material and financial) and time”. In this same understanding, Millar & Haal (2013), state that Social Projects are a way of organizing actions to transform a given social reality or some institution. These are temporary activities, with beginning, middle and end, carried out in groups and designed to bring about changes that produce a real contribution to a particular community or social cause. Usually, the executing institution raises funds to accomplish what is intended. The Social Project enhances citizenship and social awareness, making society more egalitarian. Peixoto et al (2016), states that the use of SROI is essential for social organizations, not only to demonstrate its value as an institution, but also for the role they can play in obtaining financing for their projects. This, not to mention that this tool has received a lot of attention due to a combination of its controversial approach, where it claims to be holistic and comprehensive, but uses a monetized language, combined with qualitative narratives, to express the different types of value created.

In the view of IICA - International Institute of Agricultural Sciences, Social Projects are planned undertakings that consist of a set of interrelated and coordinated activities to achieve specific objectives within the limits of a stipulated budget and time period. It is the most operational unit of planning, focused on development, which also requires reflection. Development according to Amartya Sen (2000), can only be defined in this way if it brings human evolution, with dignity and happiness for the population. He states: “(...) development consists in eliminating deprivations of freedom that limit people's choices and opportunities to exercise their condition predominantly as agents of their own change” (SEN, 2000).

III. THE KNOWLEDGE - DOING SROI - SOCIAL RETURN ON INVESTMENT

According to White (2011), in the application of SROI, the following must be observed steps:

3.1.The first step when applying the SROI method is to build a group of control or comparative, in order to verify if the group not participating in the Intervention achieved in the same time equal conditions, worse or better than stakeholders.

3.2.The second step consists of the work plan and the identification of the stakeholders, who are the beneficiaries of the project, program, business or actions that will be the focus of the evaluation. It is time to determine the about what really needs to be assessed and which actors are to be ears, considering all those who were affected by the changes, positive or negative, intentional or unintentional. It's a tool which seeks solutions to complex social problems, defining the indicators that will measure progress and results of change. In this perspective, the theory of change must be subjected to a validation empirical and a demonstration of its social impact, although action may generate unforeseen impacts.

3.3.The next step is to define and assign proxy financial values. That process is generally called “social and / or environmental valuation”, in which a monetary value is estimated to be attributed to environmental impacts and social. Such impacts, although full of value for society, do not bring a market price, only the value that the goods represent for people, varying from group to group. For example, the price of a kilo of meat is much easier to be priced by the market than a house, which will be evaluated considering the built area, location, materials, the number of rooms, etc. Reach a price setting for social value it is a subjective and complex process, but it is possible to be done, based on group consensus.

3.4.In the fourth step, benefits and costs are financially subtracted to determine the real value of the evaluated assets. For example, value of space in terms of rent, even if it is assigned or owned;hours of volunteer work, considering market value, etc.

3.5.When the objective is also to assess the environmental impact, due to catastrophes and environmental and human health damage resulting from the technologies whose harmful effects were not assessed before their introduction to the market, it is very important to carry out risk assessment.

Due to environmental impacts, the following concepts are being considered: “Any change in the physical, chemical and biological properties of the

environment, caused by any form of matter or energy resulting from human activities that, directly or indirectly, affect: I - health, the safety and well-being of the population; II - economic and social activities; III - the biota; IV - the aesthetic and sanitary conditions of the environment; V - the quality of environmental resources”(BRASIL, 2009).

For Veranez (2016), “studies are carried out to identify, predict, interpret and prevent the environmental effects that certain actions, plans, programs or projects can cause to health, human well-being and the environment, including alternatives to the project or action, and assuming public participation”. The results of this assessment should be taken to the authorities in order to minimize its negative impacts on the population.

IV. SOME CONSIDERATIONS

It is increasingly recurrent for governments, investors and society in general, the requirement for organizations that receive funding in order to execute a program, project, business or social action, to promote an impact assessment at the end of the interventions, as a important tool capable of legitimizing spending and demonstrating to society its contribution to the transformation process of the populations involved.

The choice in this article by SROI - Social Return on Investment, was due to its proven effectiveness in measuring the non-financial impact of interventions, in comparison with the amount invested, with the speech of stakeholders as the parameter main to determine the results, having the clarity of its complexity, considering that the SROI's concern is to measure non-monetary value, generating information based on quantitative, qualitative and financial data, capable of explaining the changes that occurred.

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Google Trends search and the coronavirus contagion

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Abstract— Since December 2019, the world has been facing the advance of coronavirus. As of early April, over two million people have been infected and almost 80 thousand died. As we are dealing with a pandemic, it is expected that people seek information on different themes related to the disease. One of the most usual ways to seek information is through the Google search engine. Using time series econometric procedures, the aim of this paper is to analyze the existence of causality between the number of Google searches on the word coronavirus and the number of cases of infected people. The results we found show that the spread of the disease Granger-causes Google searches on coronavirus. On the other hand, Google searches do not impact the number of infected people.

Keywords— coronavirus, google trends, causality, time series.

I. INTRODUCTION

Since December 2019, the world has been facing the advance of coronavirus. As of early April, over two million people have been infected and almost 80 thousand died. These numbers show that the disease has both a high speed of transmission and high lethality. During this short time, the reaction of governments and people is extremely varied. Countries like China and South Korea, for example, have taken urgent measures to contain the spread of the disease. On the other hand, countries like Italy and Spain were less cautious, leading to a higher number of infected and deceased people. A World Health Organization report from April 1st reveals that every country has at least one case of coronavirus infection. Therefore, we are facing a disease that has quickly spread throughout the world.

As we are dealing with a pandemic, the media—through its many outlets—has been dedicating countless news and feature stories on coronavirus, whose purposes are varied. One such purpose is to track the evolution of the disease in different countries. A second one is to analyze public policies that countries have been implementing to fight the disease. A third is related to the economic impacts of the disease. Beyond these, the media also has the duty of raising awareness for people to adopt measures to avoid infection.

In this complex scenario, it is expected that people seek information on different themes related to the disease. One of the most usual ways to seek information is

through the Google search engine. Besides offering websites on search results, Google also keeps a record of all the search terms and makes that data available through Google Trends, where it is possible to verify how much a particular term has been searched on a scale of 0 to 100.

Employing Google Trends in research is becoming increasingly popular. Jun, Yoo, and Choi (2018), for instance, have analyzed 657 research papers that made use of Google Trends. These authors indicated that the research themes are quite broad, including information technology, health, medicine, and economics.

Althouse, Ng, and Cummings (2011) used Google Trends to predict dengue incidence in Singapore and Bangkok. Butler (2013) compared the growth of influenza levels with influenza-related searches on Google Trends. Tkachenko et al. (2017) noted that it is possible to improve surveillance of Type 2 diabetes with Google Trends.

However, Carvellin, Comelli, and Lippi (2017) showed that Google Trends is less reliable to predict the epidemiology of relatively common illnesses with low media coverage and relatively rare illnesses. Therefore, according to the authors, illnesses that get more media coverage have a bigger impact on Google Trends.

On the specific case of coronavirus, Strzelecki and Rizun (2020) analyzed the relationship between the spread of the disease and searches on Google Trends, and noted that Google Trends had predicted the contagion worldwide. Hu et al. (2020) showed a slightly positive

correlation between Covid-19 on Google Trends and the daily number of people infected with SARS-CoV-2 on most of the analyzed countries. Additionally, Husnayain, Fuad, and Su (2020) claim that Google Trends could potentially define the right time and place for practicing appropriate risk communication strategies to the coronavirus-affected population.

By making use of daily data, our goal is to analyze the existence of causality between the number of Google searches on the word *coronavirus* and the number of cases of infected people. We hypothesize that a higher number of infected people would spark an interest on the disease. On the other hand, we also hypothesize that better-informed people would be more careful and avoid getting infected.

II. DATA AND METHODOLOGY

The number of people infected by day was obtained from Our World in Data (<https://ourworldindata.org/coronavirus-data>). We analyzed the period from January 1st 2020 to April 16th 2020. Additionally, we downloaded data of the volume of coronavirus search queries from Google Trends. Google Trends has its own metric of data, in which the numbers are equivalent to the relevance of searches. A value of 100, for instance, is equivalent to the peak popularity of a term. A value of 50 means that the term has half that popularity. A value of 0 means that there was not enough data about the searched word.

Estimation procedures

According to Mills (2019), consider the multivariate dynamic regression model

$$\mathbf{y}_t = \mathbf{c} + \sum_{i=0}^p \mathbf{A}_i \mathbf{y}_{t-i} + \sum_{i=0}^q \mathbf{B}_i \mathbf{x}_{t-i} + \mathbf{u}_t \quad (1)$$

where $\mathbf{y}'_t = (y_{1,t}, y_{2,t}, \dots, y_{n,t})$ and $\mathbf{x}'_t = (x_{1,t}, x_{2,t}, \dots, x_{k,t})$ are vectors of endogenous and exogenous variables, respectively. $\mathbf{c}' = (c_1, c_2, \dots, c_n)$ is a vector of constants. The terms \mathbf{A}_i and \mathbf{B}_i are sets of $n \times n$ and $n \times k$ matrices, respectively. $\mathbf{u}'_t = (u_{1,t}, u_{2,t}, \dots, u_{n,t})$ is a vector of innovations or errors, whose variances and covariances are serially uncorrelated, so that $E(\mathbf{u}_t, \mathbf{u}'_s) = \mathbf{0}$ for $t \neq s$, where $\mathbf{0}$ is an $n \times n$ null matrix.

If (1) does not contain exogenous variables—that is, if the model can be written as

$$\mathbf{y}_t = \mathbf{c} + \sum_{i=0}^p \mathbf{A}_i \mathbf{y}_{t-i} + \mathbf{u}_t \quad (2)$$

then there is simply a p th order autoregression; the dependent variable is determined by its own lag operators.

An alternative and perhaps simpler way of writing (2), proposed by Greene (2003), is through matrix notation of the form

$$\mathbf{y}_t = \begin{bmatrix} c_1 \\ c_2 \end{bmatrix} + \begin{bmatrix} \alpha_1 & \alpha_2 \\ \beta_1 & \beta_2 \end{bmatrix} \mathbf{y}_{t-1} + \begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix}$$

In this case, $\mathbf{y}'_t = (y_{1,t}, y_{2,t})$, $\mathbf{c}' = (c_1, c_2)$, $\mathbf{A}_i = \begin{bmatrix} \alpha_1 & \alpha_2 \\ \beta_1 & \beta_2 \end{bmatrix}$, $\mathbf{e} \mathbf{u}'_t = (u_{1,t}, u_{2,t})$.

In both (2) and (3), it is assumed that all time series are stationary. These equations are p th order vector autoregressions (in (3), $p = 1$), or $VAR(p)$ for short. In (2), the presence of nonzero off-diagonal elements in \mathbf{A}_i implies there is a dynamic relationship between the variables. Mills (2019) notes that such a dynamic relationship is known as Granger causality, which is seen as a prediction mechanism; in other words, when $y_{r,t-i}$ values are useful to forecast y_s present values. On the other hand, if $y_{s,t-i}$ values can also forecast y_r , these two variables are said to have feedback. We can apply a Wald statistics, based on the chi squared distribution, to test if $y_{r,t-i} \rightarrow y_s$ and $y_{s,t-i} \rightarrow y_r$.

Applying VAR requires determining the lag order p empirically, usually through sequential testing. Akaike's Information Criterion (AIC), Hannan and Quinn Information Criterion (HQIC), and Schwarz's Bayesian Information Criterion (SBIC) are alternative ways to establish lag order.

As stated previously, the time series needs to be stationary; in other words, the time series cannot contain a unit root. If a non-stationary time series can become stationary after being differenced d times, such a time series is integrated of order d . The Augmented Dickey–Fuller test (ADF) verifies whether a time series is integrated or not, according to the following hypotheses:

- Null hypothesis: a unit root is present, or the time series is non-stationary, or it has a stochastic trend;
- Alternative hypothesis: the time series is stationary with a deterministic trend.

III. RESULTS

We analyzed a total of 107 observations, from January 1st through April 16th, as seen on Table 1. During this period, the mean value of infected people was almost 19 thousand, and the maximum value nearly reached 90 thousand.

Table 1: Descriptive statistics of the variables

Variable	N. observations	Mean	Std Deviation	Minimum	Maximum
People infected	107	18,971.06	29,260.86	0	89,349
Google Trends index	107	32.76168	31.40	0	100

Source: the authors.

The Google Trends index on *coronavirus* had a mean value of 32.7, on a scale of 0 to 100. We note that a 100 value means the most searches on a single day. A 50 value means 50% of that amount.

Figure 1 shows the progression of both the number of infected people and searches on Google. Both graphs, at first glance, behave similarly. The graph on the left side of the picture, which depicts the number of infected people, presents a small increase at the outset. In

early February there is a 15-thousand cases surge, followed by a drastic return to the sub-five-thousand cases baseline. We imagined this could be an error; however, other data sources presented the same surge. From late February, we can see the continuous and fast rise in the number of cases. April 11th had the highest number of infected people in a single day. After this peak value, the curve fell slightly, but did not establish a trend.

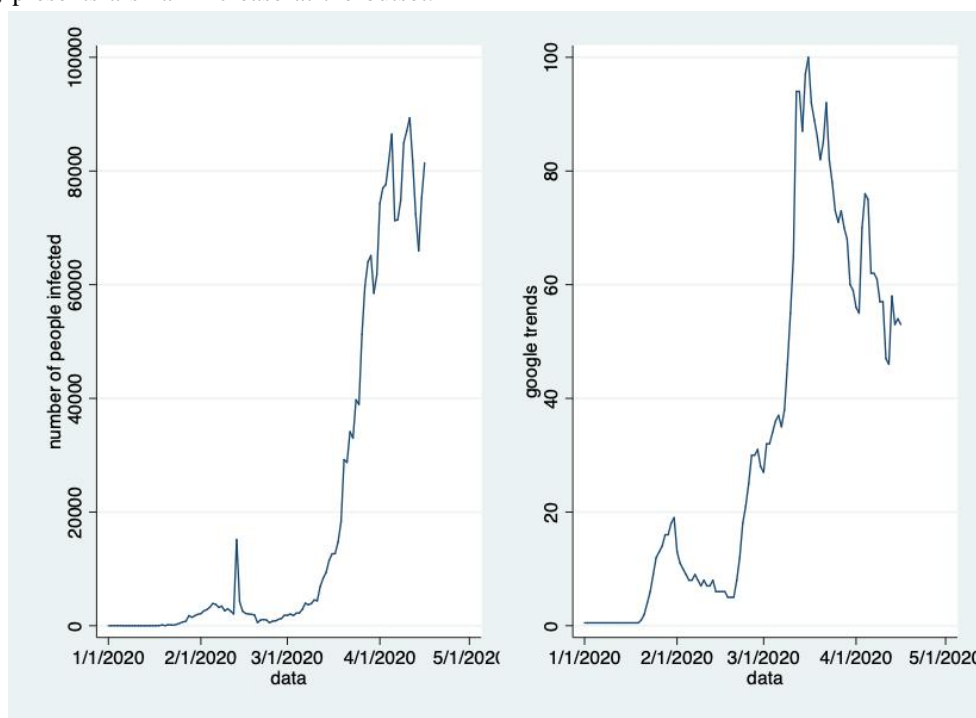


Fig.1: Number of infected people and Google Trends index

Source: the authors.

The graph on the right-hand side of the picture shows that, from the beginning of January until its third week, there were practically no Google searches on the coronavirus. From the last week of January, the number of searches increases until a peak on January 31st. Afterwards, we see a decrease until the last week of February, when the curve

starts to show a clear rising trend. The maximum value occurred on March 16th and, from that day, there is a downward trend which nevertheless shows some fluctuation.

Figure 1 clearly shows that both time series are not stationary; that is, their statistical characteristics, such

as mean, variance, autocorrelation, etc. are not constant throughout time. Non-stationary time series are also characterized by the presence of a unit root, show trends of growth or decline, as well as other patterns, such as seasonal cycles. Even though the graph points that the series are non-stationary, ADF test confirmation is

necessary. Table 2 shows the results of that test. The second column presents the results for the original variable. The null hypothesis in the ADF means that the time series has a unit root and, therefore, is non-stationary. The values in the second column cannot reject the null hypothesis and, therefore, the series is non-stationary.

Table 2: Augmented Dickey–Fuller test for unit root

Variable	Original variable	First difference
Number of infected people	0.8340 (0.9922)	-9.189*** (0.0000)
Google Trends index	-1.007 (0.7407)	-8.020*** (0.0000)

Source: authors' estimation.

As we discussed briefly in the methodology section, time series models require that the series be stationary, and one way of ensuring that is through differencing. If the resulting time series remains non-stationary, it should be differenced again. We differenced the time series and tested them to check if the first differencing was able to render it stationary. The third column in Table 2 shows that

the values are statistically significant and, therefore, we reject the null hypothesis that the series is non-stationary.

Once the time series is rendered stationary, the next step is to estimate the model for auto regression vectors. In order to do so, we need to identify the lag order. Table 3 shows different tests for this process.

Table 3: Lag order selection according to different criteria

lag	FPE	AIC	HQIC	SBIC
0	4.6e+08	25.6331	25.6546*	25.6862*
1	4.6e+08	25.6130	25.6774	25.7723
2	4.8e+08	25.6705	25.7778	25.9359
3	4.5e+08	25.5927	25.7431	25.9643
4	4.6e+08	25.6182	25.8112	26.0958
5	4.9e+08	25.6748	25.9109	26.2587
6	4.7e+08	25.6411	25.9201	26.3312
7	4.3e+08	25.5386	25.8605	26.3349
8	3.6e+08*	25.3742*	25.7391	26.2766
9	3.7e+08	25.3956	25.8034	26.4042

*indicates lag order selected by the criterion.

FPE: Final Prediction Error

AIC: Akaike Information Criterion

HQIC: Hannan and Quinn Information Criterion

SBIC: Schwarz's Bayesian Information Criterion

Source: authors' estimation.

The choice of a lag order is based on the lowest value in each test. The results in Table 3 reveal that the tests are inconclusive. Both HQIC and SBIC yield a preferred model with just an intercept and no lags (lag 0). With lag 0, we suggest that the VAR model might not fit the data adequately. On the other hand, both FPE and AIC yielded a preferred lag order of 8. Therefore, we estimated our model with lag 8: VAR(8).

The results of our estimation of the VAR model are presented on the top portion of Table 4 (Panel A). The

bottom portion of the table (Panel B) shows the results of the Granger causality test. Through the VAR model, we estimated two equations. On the first one, the dependent variable is the number of infected cases, and the independent variables are the lagged values of infected cases (for 8 periods) and the lagged Google Trends index(GT). In this equation, we note that only some of the lagged cases variables are statistically significant, and none of the lagged GT variables are statistically significant.

Table 4: Estimated coefficients of the VAR model and Granger causality test

Panel A - VAR Model		
D_cases	cases _t	GT _t
_cons	-65.13593 (-0.16)	1.070754* (1.91)
cases _{t-1}	-0.1767816* (-1.84)	-0.0003578*** (-2.66)
cases _{t-2}	-0.1358221 (-1.47)	0.0001758 (1.36)
cases _{t-3}	-0.1771852* (-1.94)	-0.0001217 (-0.95)
cases _{t-4}	0.0431984 (0.44)	-0.0001734 (-1.26)
cases _{t-5}	0.0514191 (0.51)	-0.0002405* (-1.71)
cases _{t-6}	0.3347749*** (3.65)	-0.0001951 (-1.52)
cases _{t-7}	0.4634997*** (4.69)	0.0000194 (0.14)
cases _{t-8}	0.4141888*** (3.89)	0.0002497* (1.67)
GT _{t-1}	12.84894 (0.18)	0.327297*** (3.27)
GT _{t-2}	63.63167 (0.84)	-0.2278228** (-2.14)
GT _{t-3}	-91.37502 (-1.17)	0.2947302*** (2.69)
GT _{t-4}	-5.409178 (-0.06)	-0.2142141* (-1.78)
GT _{t-5}	29.45973	0.1752193

	(0.34)	(1.46)
GT _{t-6}	29.04265 (0.34)	-0.0606839 (-0.51)
GT _{t-7}	134.5903 (1.63)	0.060728 (0.53)
GT _{t-8}	100.8649 (1.26)	-0.2795573** (-2.49)
Panel B - Granger causality		
cases do not Granger-cause GT	19.442 ** (0.013)	
GT does not Granger-cause cases	11.069 (0.198)	

*Significance at the 10% level.

**Significance at the 5% level.

***Significance at the 1% level.

Source: authors' estimation.

The second estimated equation has GT as a dependent variable, and lagged GT and lagged number of cases as independent variables. For this second equation, both the lagged GT values and the lagged number of cases forecast the present behavior of the GT variable.

As for the Granger causality test (Panel B), we reject the null hypothesis that the number of cases does not cause GT at the 5% significance level. In other words, the number of cases raises awareness or sparks interests in coronavirus, and that leads people to search for information on Google.

On the other hand, we do not reject the hypothesis that GT does not cause cases. This means that searching for information on Google does not impact the number of people infected.

IV. CONCLUSION

As early discussed, coronavirus is spreading rapidly throughout the world. Up to the conclusion of this research paper, the maximum number of infected people in one day occurred on April 11th, with nearly 90 thousand new cases. After this peak, there has been a slight decrease accompanied by a lot of fluctuation.

Google searches about coronavirus have also grown, with the peak value occurring on March 16th, 26

days before the peak of new daily infected cases. We also noted that there was a stronger downward trend after the peak value on Google searches than on new coronavirus cases.

The results we found show that the spread of the disease Granger-causes Google searches on coronavirus. On the other hand, Google searches do not impact the number of infected people. Unlike the results of Strzelecki and Rizun (2020) and Husnayain, Fuad, and Su (2020), the results we obtained show that the Google Trends index is not a good predictor in the case of coronavirus, precisely because of the non-causality relationship. This might be related to the scope of the analysis, which in this case is global. However, the mismatch between the progression of the disease and Google Trends data might point to a certain degree of torpor on the part of the population, possibly due to the big exposition the coronavirus is getting in the media. Therefore, it would be more appropriate to explore specific themes, such as methods of coronavirus prevention. In this sense, a more accurate analysis of Google Trends data might define more efficient strategies of communication aimed at reducing the number of infected people.

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Evaluation of chlorhexidine /polydopamine antimicrobial coatings on the Ti-7.5 Mo alloy surface - in vitro studies

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Abstract— Titanium and its alloys are widely used in biomedical applications because of their excellent properties such as high corrosion resistance, biocompatibility and mechanical properties. One of the applications is in dental implants and usually presents failures due to infectious processes caused by the formation of a biofilm layer on the implant surface. The biofilm structure makes it difficult to treat these infections, leading to the development of new surface modification techniques, in order to prevent the adhesion of microorganisms to the implant surface. The objective of this study was to evaluate the efficiency of a Ti7.5Mo alloy surface coating with a natural polydopamine (PDA) polymer associated with a bactericidal agent, chlorhexidine (CHX). The surfaces were characterized using contact angle (AC) and surface energy. Cytotoxicity using adipose derived stem cells and antibacterial behavior using *Staphylococcus aureus* and *Candida albicans* were evaluated. Both groups coated with this antibacterial system acted efficiently in combating the formation of *C. albicans* and *S. aureus* biofilms without causing cytotoxic effect on stem cells derived from adipose tissue. Therefore, the coating of the Ti-7.5Mo alloy with polydopamine and chlorhexidine is a promising application for biomedical devices aimed at reducing the formation of biofilms and, consequently, the reduction of postoperative infections.

Keywords— Titanium alloy; Nanotube TiO₂; Chlorhexidine; Polydopamine.

I. INTRODUCTION

Among the available materials for dental implants application stand out titanium (Ti) and its alloys, due to its excellent biocompatibility and mechanical properties such as high strength, low density and high corrosion resistance [1]. However, one of the major causes of implants failure is related to the biofilm formation and infectious processes. The biofilm structure complicates the treatment of these infections [2]. At the time of implant introduction, bacteria such as *Staphylococcus aureus* and *Escherichia coli* can adhere and proliferate on its surface and forming a biofilm [3]. Immediately after the implant introduction, a layer formed by proteins such as fibrinogen, fibronectin and collagen, covers the implant surface and promotes the floating bacteria adherence, which form a biofilm later.

The biofilm infection is difficult to treat because biofilm blocks the macrophages penetration and the systemic antibiotics, promoting greater bacterial survival [4].

Currently there is a growing interest in research aimed at functionalizing titanium surfaces with a focus on accelerating bone healing and preventing bacterial adhesion. The intention is to reduce the bacterial colonization likelihood of the implant surface during surgery [2, 5]. Several studies related to the development of antibacterial coatings on metal surfaces have already been performed and have effectively eliminated the infection and biofilm formation [6, 7]. Among the antibacterial agents studied are chitosan, silver, and chlorhexidine [8, 9, 10, 11, 12].

Chlorhexidine is an antiseptic compound with high antibacterial action, with an effective action against a wide variety of gram-positive and gram-negative microorganisms, besides inhibiting the action of some fungi and enzymes [13]. In dentistry, chlorhexidine is used in various oral hygiene products such as mouthwashes, toothpastes, topical antimicrobial agents and is also used for general skin cleansing and as a pre-operative preparation. Its antibacterial action can be attributed to a rupture of the bacterial cell membrane, which interferes with the adhesion of this bacteria. Due to its cationic nature, it is highly significant in oral tissues, leading to an electrostatic attraction with the various oral surfaces that carry negative charge [14]. Chlorhexidine and its water soluble derivative, chlorhexidine digluconate, have been widely used to control biofilms in teeth, being so far the most effective treatment due to its several advantages: high antimicrobial capacity and ability to inhibit glycosidic and proteolytic activities and reduce the action of matrix metalloprotease in most oral bacteria. Chlorhexidine is also retained by dentin hard tissues and its is an effective irrigator to prevent root canal reinfection due to coronal leakage [2].

In addition to these antibacterial coatings, titanium coatings with a polymeric material for the drugs controlled release are indicated as a possible solution to prevent biofilm growth. Between these polymers include the polydopamine with excellent properties of biocompatibility and biodegradation, besides high elasticity modulus and hardness [15]. This polydopamine is spontaneously formed by the oxidation of dopamine in alkaline solutions and has a chemical binding mechanism based on its amine and catechol functional groups that are responsible for the continued release of any drug incorporated into it [16]. These polydopamine coatings may be used for the the drugs controlled release as hollow permeable polydopamine capsules for small molecules or incorporation of the drug directly into the film [15].

The objective of this study was to evaluate the efficiency of a Ti7.5Mo alloy surface coating with a natural polydopamine (PDA) polymer associated with a bactericidal agent, chlorhexidine (CHX). The surfaces were characterized using Fourier-transform infrared spectroscopy (FTIR), contact angle (AC) and surface energy. Cytotoxicity using adipose derived stem cells and antibacterial behavior using *Staphylococcus aureus* and *Candida albicans* were evaluated.

II. MATERIALS AND METHODS

2.1 PROCESSING OF THE SAMPLES

To obtain the Ti-7.5Mo alloy, commercially pure metals were used in sheets: titanium CP (Sandinox) and molybdenum 99.99% (Sigma Aldrich). The Ti7.5Mo alloy was melted in an arc furnace with an inert atmosphere, copper crucible cooled with water. The ingots were homogenized under vacuum at 1100°C for 24 h to eliminate chemical segregation and were cold-worked by swaging (FENN), producing an 8 mm rod. Due to the hardening caused by forging, the bars were subjected to the solubilization heat treatment at 950 ° C for 2 hours, followed by rapid cooling in water. Discs with 3 mm thickness were cut on the Isomet 4000. The samples were sanded with silicon carbide sandpaper with granulation up to 1200, polished with colloidal silica, washed with deionized water and immersed in an ultrasonic bath with anhydrous alcohol for 5 minutes.

The samples were divided into three groups: sanded (S), coated with polydopamine associated chlorhexidine (ACH) and coated with polydopamine and immersion in chlorhexidine (ICH). A solution of 2.0 g / l polydopamine in 10 mM Tris-HCl, pH 8.6 was prepared. For the group (ACH), 10 ml of chlorhexidine (2%) were added to the polydopamine solution in a 1: 1 ratio, stored for 24 hours in a dark environment to avoid degradation by light and dried for 24 hours at room temperature. For the group (ICH), the samples were immersed in this polydopamine solution for 24 hours, dried for 24 hours in a desiccator, immersed in 10 ml of chlorhexidine (2%) for 30 minutes and dried at room temperature.

2.3. SURFACE CHARACTERIZATION

The wettability characteristics of the surface were evaluated by contact angle using the sessile drop technique, on a Ramé-Hart 300-F1 Goniometer. The experiments were carried out in ambient conditions, considering the average value of three measurements, at different places in the samples. The surface energy was calculated using two different liquids, deionized water (polar liquid) and ethylene glycol (apolar liquid) using DROP image software.

2.4 CYTOTOXICITY ANALYSIS

2.4.1 ADIPOSE DERIVED STEM CELL CULTURE

Adipose Derived Stem Cells were donated by Dr. Kimberly Cox-York from the department of Food Science and human Nutrition at Colorado State University. The cells were cultured at 37 °C and 5% CO₂ in growth media consisting of MEM-Alpha Modification Media, GE Life Science-Hyclone with 10 % of Fetal Bovine Serum (FBS)

and 1% of penicillin/streptomycin (Sigma). The growth media was changed every other day. To the tests on surfaces the cells were detached using 0,25% Trypsin-EDTA, centrifuged at 1000 rpm for 10 mins. Following centrifugation the cells were counted at concentration of 1×10^4 , using Neubauer chamber and Trypan Blue. Cells were seeded on all surfaces in 24 well plates.

2.4.2. TOXICITY

Cytotoxicity was investigated after 1 day of initial culture using Lactate Dehydrogenase-LDH Cytotoxicity Assay Kit (QuantiChrom). Cytotoxic compounds often compromise cell membrane integrity by inducing apoptosis or necrosis. LDH is a stable cytosolic enzyme that with membrane damage is released into the cellular environment. Therefore, LDH is often measured to evaluate the presence of tissue or cell damage. The cells were incubated at 37 °C for 4 h in α -MEM and 160 μ l of reagent per well. After 4 h, 100 μ l of supernatant was transferred into a 96-well plate. The optical density of solution was measured at 500 nm using a spectrophotometer (FLU Ostar Omega; BMG Labtech, Durham, NC).

2.4.3 CELL VIABILITY

The cell viability was measured after 1 and 7 days of culture using Alamar Blue Assay Reagent (Promega). Adhered cells were incubated at 37 °C for 4 hrs in fresh α -MEM and 10% of Alamar Blue Reagent. The Alamar Blue Reagent is an oxidized form redox indicator that is blue in color. When incubated with viable cells, the reagent changes color from blue to red. After 4 hrs the optical density (OD) of solution was measured at 570 nm and 600 nm using a spectrophotometer (FLUO-star Omega; BMG Labtech). The percentage reduction of Alamar Blue was calculated as described by the company instructions.

2.4.5. CELL ADHESION AND PROLIFERATION

After 1 and 7 days of initial culture the cell adhesion and proliferation were investigated by fluorescence staining with Rhodamine Phalloidin (actin-cytoskeleton) at 70 nM, and 4' 6-diamidino-2-phenylindole DAPI (nucleus) at 300 nM. The surfaces were removed from the growing media, washed with PBS and fixed with 3,7% of formaldehyde for 15 mins at room temperature. To permeabilize the cells, the surfaces were incubated with 1% of Triton-X100 for 3 mins, and then washed with PBS. The surfaces were incubated in rhodamine-phalloidin stain at a concentration of 70 nM for 30 mins at room temperature. After 25 mins of rhodamine-phalloidin staining, DAPI was add at concentration of 300 nM for 5 mins. All the solution was aspirated and the surfaces were then washed with PBS and imaged using a Zeiss Imager-

A2 fluorescence microscope. The number of adhered cells on the surfaces was determined from 10X DAPI stained images by counting the nuclei. These analysis were performed using "Analyze Particles" feature embedded in the ImageJ software. The cell coverage was determined from 10X Rhodamine Phalloidin stained images. These analysis were performed using "Masks" feature embedded in the ImageJ software.

2.5 ANTIBACTERIAL ANALYSIS

The antibacterial action of cloroxidine-impregnated samples were evaluated against *Candida albicans* (ATCC 18804) and *Staphylococcus aureus* (ATCC 35688). For each strain a standard suspension with optical density equivalent to 106 cells / ml was prepared. *C. albicans* strains were seeded on Sabouraud agar (Difco, Detroit, USA) and *S. aureus* on brain / heart infusion (BHI) agar (Difco, Detroit, USA) and incubated at 37°C for 24 h .

After the incubation time, the cells were suspended in sterile saline (sodium chloride 0.9% (NaCl)) and counted in a spectrophotometer (B582, Micronal, São Paulo, Brazil). The optical density and wavelength parameters used were 0.284 and 530 nm for *C. albicans*; and 0.620 and 398 nm for *S. aureus*.

Previously to biofilm growth, the samples were sterilized and incubated at 37 °C for 48 hours at partial pressure 5% CO₂, with 2 ml Brain Heart Infusion broth (BHI, Difco, Detroit, USA) supplemented with 5% sucrose and inoculated with 0.1 ml of the microbial suspension to be analyzed.

After the incubation period, samples containing the biofilms were washed twice with 2 ml of 0.9% NaCl and sonicated (Sonoplus HD 2200, 50 W. Bandelin Eletronic, Berlin, Germany) for 30 seconds to disperse the biofilms. Biofilm suspensions were serially diluted in 0.9% NaCl to give dilutions of 10⁻¹ to 10⁻⁵ times the original concentration.

Aliquots of 100ul of each dilution were seeded in duplicate in Sabouraud Agar (Difco, Detroit, USA) with 50 mg / L chloramphenicol for *C. albicans*; and Mitis Salivarius agar (Difco, Detroit, USA) supplemented with 0.2 IU / ml of bacitracin (União Química, São Paulo, Brazil) and 15% sucrose for *S. aureus*. The plates were placed in a bacteriological incubator for 48 hours at 37 °C. After incubation for 48 h, the number of colony-forming units per milliliter (CFU / ml) was determined. The results were log-transformed (log₁₀) and analyzed by analysis of variance (ANOVA) and Tukey's test.

III. RESULTS AND DISCUSSION

3.1. SURFACE CHARACTERIZATION

To study the effect of polydopamine and chlorhexidine films on the wettability of the Ti-7.5Mo alloy surface, contact angle and surface energy measurements were performed. Hydrophobic surfaces have a contact angle greater than 90° , while on hydrophilic surfaces this angle is less than 90° .

Table 1 shows the contact angle and surface energy values. It is observed that the sanded sample had a higher contact angle (102.92°) and a hydrophobic behavior. After the polydopamine and chlorhexidine coating, the contact angle decreased and the wettability changed, making the ACH surface hydrophilic (61.27°) and the super hydrophilic ICH surface (43.92°). This super

hydrophilicity of the ICH surface occurred due to the exposure of the Ti-7.5Mo substrate for 24 hours only the polydopamine, since the chlorhexidine was added after these 24 hours of polymerization. The surface energy for the ACH samples ($47.64 \pm 0.24 \text{ mJ m}^{-2}$) and for ICH ($57.72 \pm 0.34 \text{ mJ m}^{-2}$) show a polar behavior, which is very promising for biomedical applications. It has been reported that polydopamine is capable of transforming hydrophobic surfaces into hydrophilic ones [17, 18]. According to Ball et al., (2011) [19] the complex structure of a polydopamine film on a metallic substrate or hydrophobic increases water penetration and renders the surface more hydrophilic. In another study, on hydrophobic substrate the surface energy of polydopamine was also evaluated and demonstrated that polydopamine coatings are essentially of polar nature and hydrophilic [20].

Table 1 – Contact angle and surface energy of samples

Sample	Contact angle ($^\circ\text{C}$)		Surface energy
	Deionized water	Ethylene glycol	
Ti7.5Mo - S	102.92 ± 0.51	84.37 ± 0.26	18.31 ± 0.11
Ti7.5Mo - ACH	61.27 ± 1.48	9.18 ± 0.09	47.64 ± 0.24
Ti7.5Mo - ICH	43.92 ± 0.62	17.61 ± 0.03	57.72 ± 0.34

3.2. CYTOTOXICITY ANALYSIS

The ability of the substrates to stimulate adhesion and proliferation was assessed by fluorescence analysis and labeling of the cell nucleus with DAPI. Figure 1a shows the nuclei DAPI-labeled and blue-stained, and the actin filaments present in the cytoskeleton labeled with Rhodamine-phalloidin and stained red. The image shows cells adhered to the substrate, with well preserved and elongated cytoskeleton on all treatments. Figure 1b shows the quantitative analysis of the number of cells by counting the nuclei labeled with DAPI. It was possible to verify that there was a significant proliferation of day 1 to day 7 of the ADSCs incubated with the substrate Ti 7.5 Mo-S. Treatments Ti 7.5 Mo-ACH and Ti 7.5 Mo-ICH maintained the same number of cells when we compared day 1 and day 7. Study of Swiatkowska et al 2016, demonstrates that human cells may have suppressed growth when in contact with clorexidine, data that corroborates with our study [21].

The cytotoxicity test was performed by measuring the Lactate Dehydrogenase (LDH) present in the medium. LDH is an enzyme that is released in the medium when the membrane is damaged. Figure 2a shows that the different

treatments did not provide an increase in LDH release in the medium, indicating that the substrates were nontoxic to the ADSCs.

Viability was analyzed using the Alamar Blue test. This test evaluates the ability of viable cells to metabolize the reagent [22,23]. Figure 2b shows that there was no significant difference in the metabolism of the reagent by cells on the different substrates on day 1, indicating a homogeneous viability between treatments. On day 7 there was a significant decrease in cellular activity for treatments Ti 7.5 Mo-ACH and Ti 7.5 Mo-ICH compared to the Ti 7.5 Mo-S. However, when we compared day 1 and day 7, the cells maintained the same behavior for treatments Ti 7.5 Mo-ACH and Ti 7.5 Mo-ICH. Together the tests of LDH and Alamar Blue demonstrate that besides being nontoxic, the substrates allow the maintenance of the ADSCs in all treatments. These data corroborate with the result of cell count.

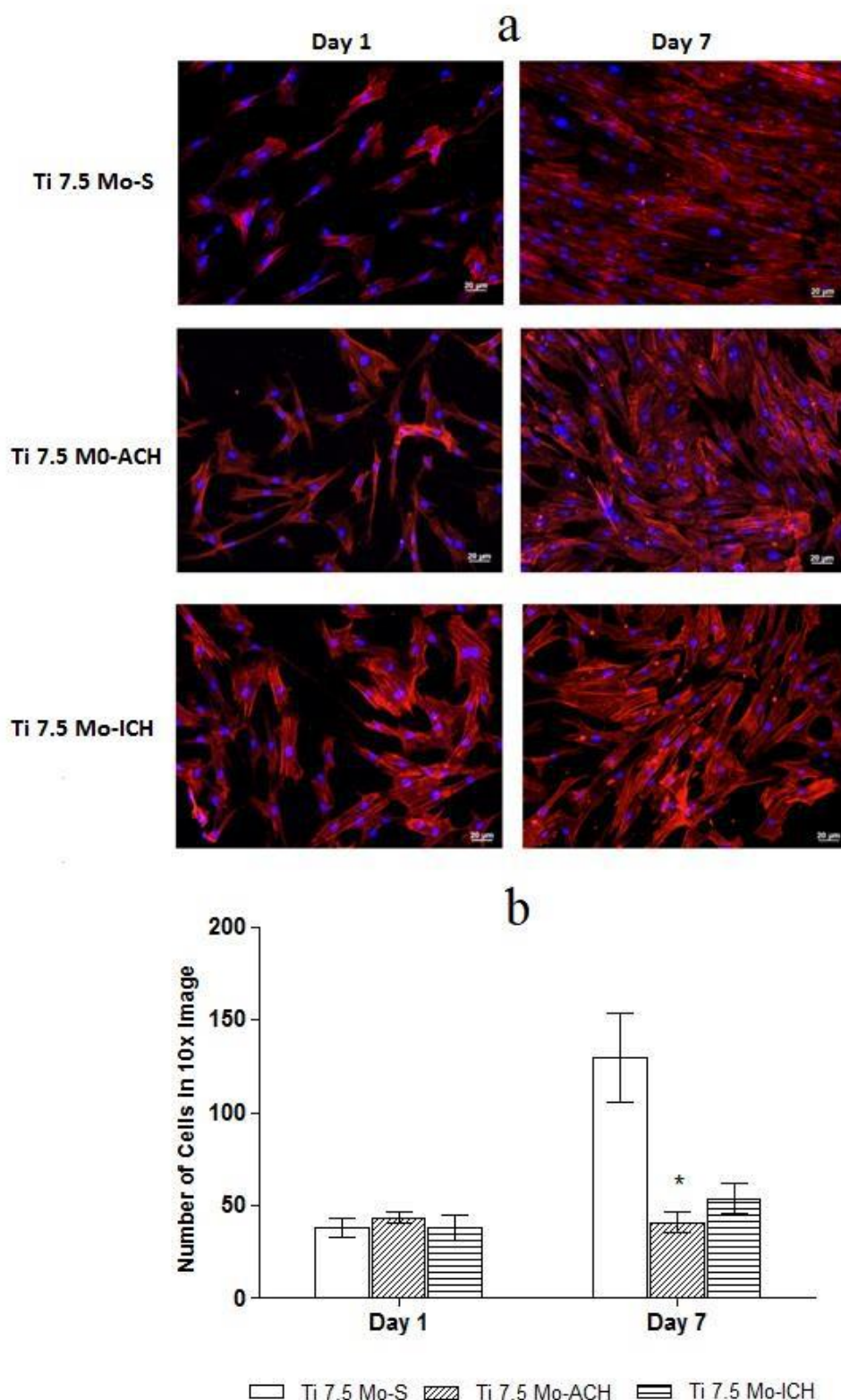


Fig.1 - Representative fluorescence images (10x) of ADSCs stained with DAPI and rhodamine/phalloidin on on Ti 7.5 Mo-S, Ti 7.5 Mo-ACH and Ti 7.5 Mo-ICH after 1 and 7 days of culture (a); ADSC counts on Ti 7.5 Mo-S, Ti 7.5 Mo-ACH and Ti 7.5 Mo-ICH after 1 and 7 days of culture. The data presented is mean \pm SD. (*) $p < 0.05$ using one-way ANOVA test and Tukey HDS to multiple comparisons, SPSS 13.0 software (b).

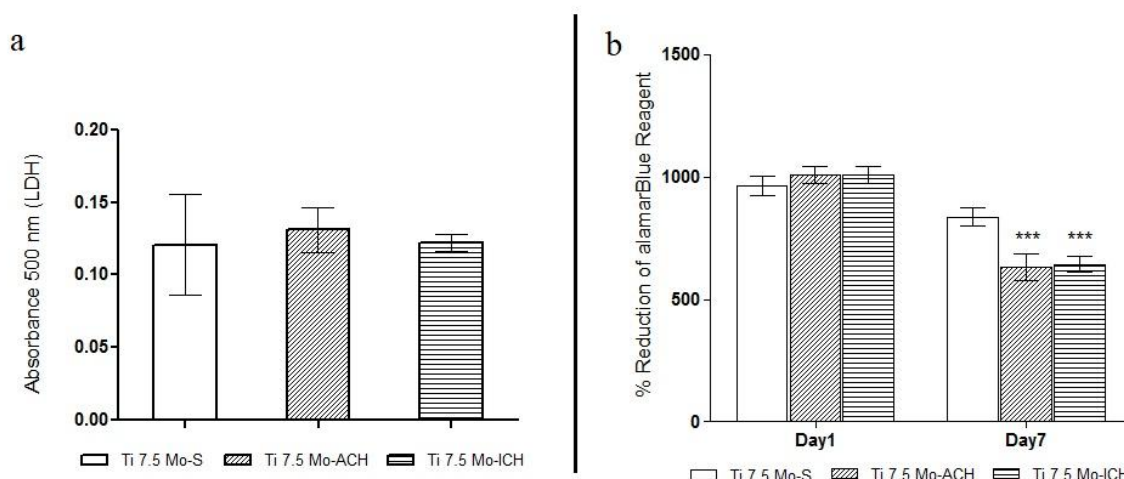


Fig. 2 - Cell toxicity measured by LDH assay on Ti 7.5 Mo-S, Ti 7.5 Mo-ACH and Ti 7.5 Mo-ICH 1 day of culture. The data presented is mean \pm SD using one-way ANOVA test and Tukey HDS to multiple comparisons, SPSS 13.0 software (a); Cell Viability measured by Alamar Blue Cell Viability Assay on Ti 7.5 Mo-S, Ti 7.5 Mo-ACH and Ti 7.5 Mo-ICH after 1 and 7 days of culture. The data is presented as mean \pm SD. (***) $p < 0.001$ using one-way ANOVA test and Tukey HDS to multiple comparisons, SPSS 13.0 software (b).

3.3. ANTIBACTERIAL ANALYSIS

Bacterial adhesion was evaluated by the multi-species biofilm growth (*Candida albicans* and *Streptococcus aureus*) for 48 hours. Figure 3 shows the scanning electron microscopy image with the formation of the multi-species biofilm on the surface of the samples studied.

Figure 3 shows the chlorhexidine action effect incorporated in the sample surface in the *C. Albicans* and *S. aureus* biofilms formation. On the Ti7.5Mo - S sample surface it is possible to visualize the dense and continuous biofilm formation, with agglomerated colonies covering the entire surface (Figure 3a). For the samples coated with PDA and CHE, the biofilm formation is visibly smaller. The Ti7.5Mo - ICH samples (Figure 3c) showed a surface with a dispersed and less dense biofilm compared to the Ti7.5Mo - S samples, while the Ti7.5Mo - ACH samples (Figure 3b) presented a lower biofilm formation among the investigated conditions, with smaller and more dispersed colonies.

By the analysis of scanning electron microscopy images, there is a reduction in biofilm formation for both Ti-7.5Mo-ACH and Ti-7.5Mo-ICH groups (Figure 3 (b) and 3 (c)) and these results corroborate Cortizo et al (2012)

[2] which demonstrated that the addition of small chloroxidine doses in polymer coatings causes a reduction in the biofilm layer. In addition, Toté et al 2010 [24] reported that the viability of *S. aureus* biofilms is reduced by 84% in the presence of chlorhexidine and the cells response to the antimicrobial treatment is related to their location within the biofilm structure. Less dense biofilms present less heterogeneous responses, and the eradication of this biofilm is easier.

As an antiseptic compound, the chlorhexidine is capable to inhibit the glycosidic and proteolytic activity, action of several matrix metalloproteinases and the activity of bacterial collagenase. In addition, it has a high antibacterial action, with an effective action against a wide variety of gram-positive and gram-negative microorganisms, attacking the cytoplasmic contents and allowing the intracellular compounds to escape, which finally leads to bacterial death, besides inhibiting the action of some fungi and enzymes [25,26].

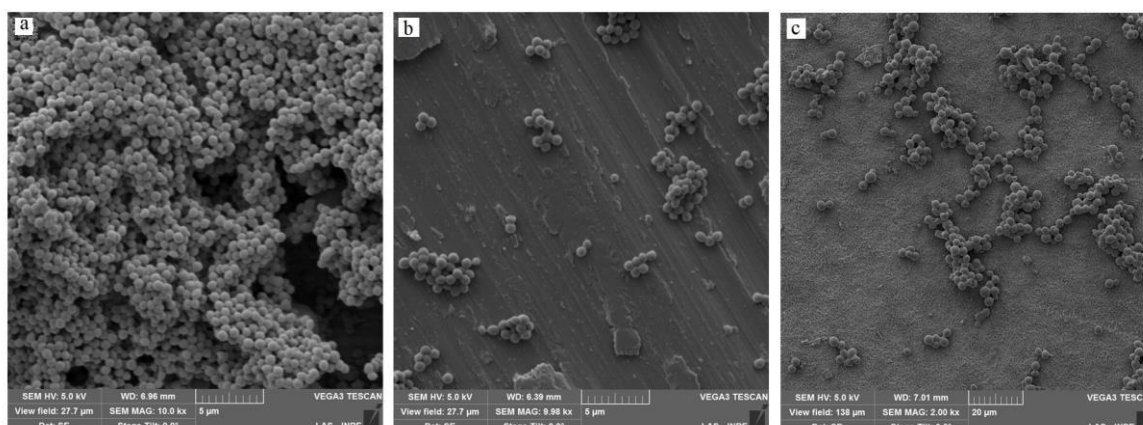


Fig.3 - Scanning electron microscopy with the biofilm formation of *S. aureus* and *C. albicans* on the samples surface studied. Ti-7.5Mo-S (a); Ti-7.5Mo-ACH (b); Ti-7.5Mo-ICH (c).

The antibacterial action of the samples impregnated with chlorhexidine was evaluated by determining the number of colony forming units per milliliter (CFU / ml) of *C. albicans* and *S. aureus*. The results were log-transformed (log10) and analyzed by analysis of variance (ANOVA) and Tukey's test.

The mean values and standard deviation of the CFU / ml (log10) obtained in the experimental conditions tested for each biofilms group are shown in Table 2.

The mean values for *C. albicans* and *S. aureus* indicate that Ti-7.5Mo-ACH group presented a better result in relation to the others. However, to assert this result with greater security, a hypothesis test was performed considering that the average of CFU / ml for three groups are the same ($H_0: \mu I = \mu II = \mu III$). The null hypothesis (H_0) was tested by analysis of variance (ANOVA) and the Tukey test.

Table 2 – Means values (CFU log10) and p values obtained for the biofilm

Group	Microbial biofilms CFU log ¹⁰			
	<i>C. albicans</i>	p value *	<i>S.aureus</i>	p value *
Ti-7.5Mo-S	6.933	0.703	7.461	0.919
Ti-7.5Mo-ACH	5.466	0.746	3.305	0.813
Ti-7.5Mo-ICH	6.726	0.355	6.866	1.605

Tables 3 and 4 indicate the differences between the means of the groups and the value P. It was considered that a P value <0.05 indicated a significant statistically difference.

The lower P value, the greater security in denying H_0 . We can say with a high level of reliability that for both microorganisms the Ti-7.5Mo-ACH group differs from Ti-7.5Mo-ICH and Ti-7.5Mo -S, with a lower average CFU.

Therefore, the surface coating with polydopamine and associated chlorhexidine (Ti-7.5Mo-ACH) resulted in a significant decrease in biofilm growth for *C. albicans* and *S. aureus* both groups. However, the treatment with polydopamine immersed in chlorhexidine (Ti-7.5Mo-ICH) presented an lower average than the control group (Ti-7.5Mo-S), but this difference is not statistically significant.

Table 3 – Tukey Test of *S. aureus* biofilm

Ti-7.5Mo-S		
	Averages difference	P value
Ti-7.5Mo-ACH	-4.156 ± 0.5831	0.0000
Ti-7.5Mo-ICH	-0.595 ± 0.5831	0.5725
Ti-7.5Mo-ACH		
	Averages difference	P value
Ti-7.5Mo-ICH	-3.561 ± 0.5831	0.0000

Table 4 – Tukey Test of *C. albicans* biofilm

Ti-7.5Mo-S		
	Averages difference	P value
Ti-7.5Mo-ACH	-1.371 ± 0.3128	0.0007
Ti-7.5Mo-ICH	-0.148 ± 0.3331	0.8972
Ti-7.5Mo-ACH		
	Averages difference	P value
Ti-7.5Mo-ICH	-1.223 ± 0.3244	0.0031

IV. CONCLUSION

In this work, it was possible to perform the incorporation of chlorhexidine on the Ti-7.5Mo alloy surface by polydopamine polymerization. This coating allowed an increase in the surface wettability, making it hydrophilic. Both groups coated with this antibacterial system acted efficiently in combating the formation of *C. albicans* and *S. aureus* biofilms without causing cytotoxic effect on stem cells derived from adipose tissue. Therefore, the coating of the Ti-7.5Mo alloy with polydopamine and chlorhexidine is a promising application for biomedical devices aimed at reducing the formation of biofilms and, consequently, the reduction of postoperative infections.

ACKNOWLEDGEMENTS

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Diagnostic analysis for TB: A comparative study between Bacilloscopy, Culture and PCR (Gene-Xpert) techniques

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Abstract— The presented study aims to make a comparative analysis regarding the diagnosis of *M. tuberculosis* performed through Bacilloscopy, Culture and PCR exams held at the Clinical Pathology laboratory at HUGG - Rio de Janeiro/ Brazil from May to December 2015. Analyzing the effectiveness and efficiency of PCR, compared to Bacilloscopy and Culture exams. The results reveal a higher occurrence in males between 19 and 59 years of age. The results also show a sensitivity and specificity of the PCR, compared to bacilloscopy, 100% and 90% respectively and kappa index of 0.76. Regarding culture, Gold Standard, the PCR obtained a sensitivity of 100% and specificity of 93% and a kappa of 0.78, which shows a very good agreement between the exams and proves that the PCR technique is effective for the diagnosis of tuberculosis. The results of this study corroborate previous studies and provide important information for health managers, emphasizing the importance of agility in the diagnosis of tuberculosis for the treatment of patients with tuberculosis. It is recommended that more health units use this diagnostic method for the benefit of the patient who may already leave the health unit diagnosed and with treatment started.

Keywords— *Mycobacterium tuberculosis*, PCR, Tuberculosis.

I. INTRODUCTION

Tuberculosis (TB) is one of the oldest diseases of humanity and it is a severe problem of Public Health, considered by WHO the most significant health problem worldwide.

Although Tuberculosis is a disease that has been recorded for six thousand years, only in the last fifty years has science been able to help patients concerning treatment. Six decades after the cure for the disease was found, tuberculosis still kills millions of people annually. (Kozakevich & Da Silva, 2016)

According to WHO in 2014, there were 9.6 million new TB cases, 5.4 million among men, 3.2 million women and 1 million children. There were also 1.5 million deaths from Tuberculosis (1.1 million were among HIV-negative and 0.4 million among HIV-positive), of which approximately 890,000 were men, 480,000 were women and 140,000 were children. The number of TB deaths is unacceptably high. With timely diagnosis and correct treatment, almost everyone with TB can be cured. (WHO, 2015).

WHO aims to develop the health of all people as much as possible. One of its actions is to monitor Tuberculosis

around the world, as well as to disseminate recommendations for treatments and controls. (Procópio, 2014)

Brazil is one of the WHO member countries and cooperates with information related to public health. With this, the Ministry of Health tries to comply with all recommendations for diagnosis, treatment and control regarding Tuberculosis and other diseases of public health importance. (Marques, 2018)

From 2000 to 2014, WHO reported that 43 million lives were saved through effective diagnoses and treatments. (Roquete, 2017)

Tuberculosis is an infectious disease whose etiologic agent is the bacterium *M. tuberculosis*. Its infection occurs, most commonly, through the infected individual's cough, speech or sneeze. (Nogueira, 2012).

Each patient with pulmonary Tuberculosis that is not treated can infect an average of 10 to 15 people per year. Some factors contribute to the spread of the disease, such as poverty and poor income distribution, SIDA,

malnutrition, poor sanitary conditions and high population density. (MinasGerais, 2006)

There are some tests for the diagnosis of Tuberculosis, but the most used are bacilloscopy and culture. According to ANVISA (2004), bacilloscopy consists of visualizing the bacteria through a microscope and the slide, which must be correctly stained. This consists of a quick procedure, but with risks of failure, due to human manipulation. Culture consists of a medium that favors the controlled growth of bacterial colonies and allows visualization, this procedure is more accurate than bacilloscopy. However, it is a very time-consuming procedure since the bacteria takes up to 60 days to grow.

Due to the possible failures and the long delay in the diagnosis of Tuberculosis and the fact that it is a highly infectious disease, there is a need to accelerate the diagnostic process.

According to Lira (2012), tuberculosis control consists of an early and effective diagnosis associated with adequate treatment, however, conventional methods have limitations, such as low sensitivity and late results. For this reason, molecular methods have been proposed for the diagnosis of several infectious diseases.

Pinhata (2014) corroborates that the rapid and accurate diagnosis is essential for tuberculosis control and that, to speed up the tuberculosis diagnosis process, the molecular method in PCR is recommended.

Because of the statements above, the present study aims to analyze the effectiveness and efficiency of the diagnoses of *Mycobacterium tuberculosis* obtained through PCR, bacilloscopy and culture in patients at the Hospital Universitário Gaffrée-Guinle – UNIRIO, in the city of Rio de Janeiro, belonging to the state of RJ - Brazil, from May 2015 to December 2015.

The present study hypothesizes that the PCR diagnostic method will be useful and agile in the diagnosis of Tuberculosis, favoring the doctor who will get the diagnosis faster and the patient, if he is identified with positive tuberculosis, he can leave the hospital with the appropriate treatment.

II. METHOD

The present study is an applied research, the aims are explicative and has a qualitative and quantitative approach. This research is also classified as prospective. Data were collected through biological samples from participating patients who were admitted to the Hospital Universitário Gaffrée-Guinle – UNIRIO/ RJ, with suspected pulmonary tuberculosis who had a persistent

cough of more than two weeks and who agreed to participate in the research by signing the informed consent form, from May to December 2015. The samples were subjected to laboratory tests such as PCR, bacilloscopy and culture and were performed in the Clinical Pathology laboratory of the Hospital Universitário Gaffrée-Guinle.

The research project was submitted to analysis by the Research Ethics Committee of Universidade Salgado de Oliveira and approved under number 1184022.

The sample was of the probabilistic type and had 154 participants.

Biological samples of the following types were collected: sputum, lavage bronchus, urine, CSF, gastric lavage, lymph nodes and other tissues and sediments, in these volunteers. These samples follow to Clinical Pathology laboratory of the Hospital Universitário Gaffrée-Guinle where they underwent three types of diagnostic analysis: bacilloscopy, culture and PCR.

In the bacilloscopy technique, the slide was prepared, and after preparation, the search for *M. tuberculosis* was done through visualization of the stained bacillus through an optical microscope.

In the Culture technique, the biological sample was fluidized; decontaminated and sown in solid egg-based culture medium (Löwenstein-Jensen) and stored at a temperature between 35 to 37 ° C for multiplication, in a period of up to 8 weeks.

In the PCR procedure, the biological sample was treated with the reagent for biological sample in the MTB-RIF kit suitable for the PCR (Genexpert). It was inserted into the cartridge, which also appears in the MTB-RIF kit and after this procedure the cartridge was placed in the PCR device (Genexpert) for reading that occurs within 2 hours.

The data obtained were tabulated using Microsoft Office Excel for Windows software version 2011, Graph Pad Prism software, and analyzed according to the three types of tests performed and the variables: sex, age, positive and negative for tuberculosis.

In the comparative analysis to evaluate the performance of the diagnostic techniques, the Qualitative Test was applied, which is used to know the quality of a diagnostic test and comprises the following items: Sensitivity, Specificity, Prevalence Positive Predictive Value, Negative Predictive Value and Kappa Index.

Kappa Index (k): it is used to verify the reliability of a test and through the k index, which is an advance in relation to the general agreement rate. It is an adjusted agreement indicator, as it takes into consideration the due agreement chance. The k reports the proportion of non-random

agreement (in addition to that expected by the chance) between observers or measures of the same categorical variable, and its value ranges from "minus 1" (complete disagreement) to "plus 1" (total agreement). If the measure agrees more repeatedly than expected by the chance, then the k index is positive; if the agreement is complete, then $k = 1$. Zero indicates the same as readings taken at random. According to Landis and Koch (1977) the agreement between methods will be:

- Bad when the kappa index is less than 0.20,
- Weak when between 0.21 - 0.40,
- Moderate when between 0.41 - 0.60,
- Very good when between 0.61 - 0.80
- Excellent when greater than 0.80.

Parameters used to assess the diagnostic performance of the techniques (figure 1)

Sensitivity (S): is the probability of a test being positive in an infected or sick person, that is, it translates the percentage of infected or sick people correctly diagnosed by a positive test. The sensitivity corresponds to the proportion of the test's true positives: $a / (a + b)$.

Specificity (E): it is the probability of a test being negative in an uninfected or non-sick person, that is, it translates the percentage of non-patients correctly identified by a negative test. Specificity corresponds to the proportion of the test's true negatives: $d / (c + d)$.

Prevalence or Probability Pre-test: the proportion of sick individuals or the probability of individuals being sick, regardless of the test result: $p = (a + c) / n$.

Positive Predictive Value (PPV): it is the probability of an individual having the disease when the test is positive: $a / (a + c)$.

Negative Predictive Value (VPN): it is the probability of an individual not having the disease when the test is negative: $d / (b + d)$. The Predictive Value is determined by the sensitivity, specificity and prevalence of the disease in the tested population. The more sensitive the test, the better its negative predictive value. The more specific the test, the better its positive predictive value.

Diagnostic Efficacy, Accuracy or Precision: it is the test's ability to correctly classify the most significant number of individuals assessed as truly sick and healthy: $(a + d) / (a + b + c + d)$.

Padrão Ouro			
		Positivo	Negativo
Teste	Positivo	a	c
	Negativo	b	d
Sensibilidade:		$\frac{a}{a + b}$	
Especificidade:		$\frac{d}{c + d}$	
Valor Preditivo Positivo:		$\frac{a}{a + c}$	
Valor Preditivo Negativo:		$\frac{d}{b + d}$	
Eficácia do Teste:		$\frac{a + d}{a + b + c + d}$	

Fig. 1 - Parameters used to evaluate the performance of diagnostic methods.

Source: Landis e Koch, 1977

III. RESULTS

From the sample of 154 volunteers who underwent the three types of diagnostic tests (BAAR, Culture and PCR), it was possible to observe the following results:

3.1 The characteristics of the patients

In the study, it was verified the relation of the examinations performed with sex, where it was found that 70 individuals (45%) are female and 84 individuals (55%) are male.

These data corroborate with those found by Lira (2012) in his study on tuberculosis diagnosis with real-time CRP,

who also observed a higher occurrence of suspected Tuberculosis in men, 58% and 42% in women.

Regarding age, one volunteer was in the age group up to 19 years old (child and youth), 101 volunteers were in the age group from 20 to 59 years old (adult) and 52 volunteers were in the age group older than 60 years old (older).

According to Lima et al (2008) the average age of the 160 patients in their study was 40.0 ± 12.8 years (range, 19-78 years).

According to Silva (2002), this frequency follows the national standart of disease incidence, that is, the most productive phase of the population.

3.2 Comparison between techniques and biological sample

The number of positive and negative tests was also observed according to the technique used. Where in the bacilloscopy technique, it was positive for 11 exams and negative for 143. In a Culture (gold standard) severalf 15 positive and 139 negative exams were observed, and in PCR, 24 exams were positive and 130 negative. (Table 1)

Table 1 - Tuberculosis diagnosis table according to the three techniques used.

	BAAR	CULTURA	PCR
POSITIVE	11	15	24
NEGATIVE	143	139	130
TOTAL (n)	154	154	154

Source: author data

The type of biological sample (material collected) used for the diagnosis of Tuberculosis varied widely. It was used: Subcutaneous aspiration (12 samples), biopsy (2 samples) sputum (88 samples), bronchial lavage (34 samples), cerebrospinal fluid - CSF (10 samples), lymph node (3 samples) pleural fluid (5 samples), abdominal secretion (1 sample), tracheal secretion (5 samples), saliva swab (1 sample) and urine (4 samples).

According to the National Tuberculosis Control Program (2015) the recommended biological samples are sputum, induced sputum, bronchoalveolar lavage, CSF, lymph nodes, other tissues and gastric lavage.

Kox et al (1994) used a sputum blood sample, spinal brain fluid, pleural fluid, fistula fluid, pus and feces for the detection of *M. tuberculosis* DNA in patients with positive TB confirmed by culture. Moreover, they observed that DNA was amplified by the PCR technique, concluding that biological materials from different sites can be used in the PCR technique.

3.3 Results obtained by different tuberculosis diagnostic techniques

The rate of positivity obtained by reading the bacilloscopy technique was 7%, that is, 11 positive participants were detected for *M. tuberculosis* among the 154 individuals evaluated.

The positivity rate obtained by reading through culture was 10%, that is, 15 positive participants for *M. tuberculosis* were detected among the 154 individuals evaluated.

The rate of positivity obtained by reading through the PCR technique was 15%, that is, 24 positive participants for *M. tuberculosis* were detected among the 154 individuals evaluated.

In the evaluation of the results obtained by the 3 techniques (bacilloscopy, culture and PCR), of the 154 volunteers, 129 volunteers obtained the same negative result in the 3 techniques and 11 volunteers obtained the same positive results in the 3 techniques, with 14 volunteers who disagreed between the results as described in table 2 below.

Table 2 Comparison of the results of Bacilloscopy (BAAR), Culture (LJ) and PCR

Exame Results	Total (n)
BAAR (-), LJ (-), PCR (-)	129
BAAR (+), LJ (+), PCR (+)	11
BAAR (-), LJ (-), PCR (+)*	11
BAAR (-), LJ (+), PCR (+)	2
BAAR (-), LJ (+), PCR (-)	1
BAAR (+), LJ (-), PCR (+)	0
TOTAL	154

Source: author data

Confirmation of tuberculosis through diagnostic methods remains a significant challenge. According to Palomino (2005), the best method of diagnosing pulmonary TB is analysis based on a clinical, radiological and microbiological combination.

According to Redner (2015) when bacilloscopy and culture are negative and PCR positive, the sample may be of the paubacillary type. The patient may actually have TB or the *M. tuberculosis* bacillus is present, but this bacillus is "dead".

In this study, two patients were observed in which smear microscopy was negative and culture and PCR were

positive. According to Redner (2015), this result is considered positive for TB.

It was also observed examination where bacilloscopy and PCR were negative, but the culture was positive. According to Redner (2015), this result is considered paubacillary case or the mycobacterium is not part of the tuberculosis complex.

No case was observed in which bacilloscopy and PCR were positive, while culture was negative. Redner (2015) explains that this case can occur in positive cases for TB, paubacillary cases, or when there are *M. tuberculosis* bacilli, but these are dead.

3.4 Comparative evaluation between the results obtained by the bacilloscopy and PCR techniques

When comparing the results of the PCR test with the results obtained by bacilloscopy, it is observed that

the bacilloscopy technique did not detect 29 participants with positive samples by PCR. There was no positive bacilloscopy examination that was not negative by PCR. The positivity rates obtained by the techniques, 8.6% for bacilloscopy and 19% for PCR.

These proportions showed a statistically significant difference ($p < 0.0001$)*.

The Sensitivity observed in this comparison was 100% and the Specificity was 90%. Efficacy or Accuracy is 91%, VPP is 45% and VPN is 100% and Prevalence is 15%.

According to Chimara and Ferrazoli (2009), the reliability of the bacilloscopy reading depends on the laboratory professional's experience, the quality of the biological sample, and the bacillary load present in the biological sample.

According to Redner (2015) when PCR results in a positive diagnosis and bacilloscopy results in a negative diagnosis (29 cases) the sample may contain mycobacteria, however, this may not be from the Tuberculosis Complex (MNT), the sample may be paubacillary or the patient has TB.

According to Soares (2011) the higher the sensitivity, the greater the VPN, that is, the greater the probability of having a negative result, there will be no disease.

3.5 - Comparative evaluation between the Culture and PCR techniques

The results of the PCR assay were compared with those obtained by the Culture technique. PCR was concordant in 15 positive samples by Culture. The PCR assay positivity rate was 19%, while the culture positivity rate was 11.5% ($p < 0.0001$)*.

A high sensitivity of 100% and specificity of 93% and Efficacy of 93% were also observed. The VPN was 100% and VPP was 60% and Prevalence was 16%.

According to Redner (2015) when the PCR results in a negative diagnosis and the culture results in a positive diagnosis (2 cases), the sample may be paubacillary or Mycobacteria may not be from the Tuberculosis Complex (MNT). Moreover, when PCR results in a positive diagnosis and Culture results in a negative diagnosis (23 cases) the sample may also be paubacillary or the bacillus is present, but "dead" or the patient does have TB.

According to Soares (2011) the greater the specificity, the greater the PPV, that is, the higher the probability of having a positive result of having a disease.

3.6 Evaluation of the performance of the PCR in comparison to the methods of Bacilloscopy and Culture.

The PCR performance was evaluated using the Bacilloscopy technique alone and the Culture technique alone. The PCR showed sensitivity of 100%, 90% of Specificity and Kappa Index of 0.76 when using Bacilloscopy as a comparison. When Culture was compared, the PCR obtained sensitivity of 100%, specificity of 93% and Kappa index of 0.78, which means that the agreement between the methods was excellent.

According to Soares (2011) the higher the prevalence, the higher the VPP and the lower the VPN, that is, the more frequent a disease is, the more likely it is to find true positives (increasing the value of the VPP), but it is also more likely to find false negative (decreasing the VPN). This is not the case in the present study.

According to Lima et al (2008) in their comparative research of Bacilloscopy with PCR, kappa of 0.54 and when compared to Culture with PCR, found a kappa of 0.78.

IV. CONCLUSION

The kappa index showed that the results found by the PCR are in good agreement with the results found by the culture, which leads to the conclusion that the methods are equivalent.

False-positive and false-negative results are generally associated with paubacillary biological samples, biological samples contaminated with other types of mycobacteria, but not of the TB complex or the presence of *M. tuberculosis*, however "dead".

This study allowed us to conclude that the PCR, due to its high sensitivity has an excellent negative function for the exam.

The culture is currently the gold standard test, but it takes 45 days to be ready, the bacilloscopy takes a few hours and the PCR, a maximum of two hours.

Based on this study, it is possible to say that the PCR presents the necessary conditions for the standard gold for the diagnosis of Tuberculosis.

This study allows to recommend the competent authorities and the Ministry of Health, to make PCR as a standard test to identify tuberculosis.

However, further studies in this area and more significant acquisition of this method in other hospitals, in the coming years, can be configured as a benefit for both health managers and doctors and the population.

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Application of EdTech in Tanzania: Effectiveness of Radio and Television in Teaching and Learning amid COVID-19 Pandemic

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Abstract— On March 2020 school and university going students experienced termination of classes. The statement declared by the Tanzania prime minister honourable Kassim Majaliwa required all primary and secondary schools to postpone learning for a month and one day later universities were also asked to suspend studies and other activities. It was necessary to do so because of the novel coronavirus disease 2019 named by World Health Organisation as COVID-19 a pandemic that had spread and hit more than 150 countries. This paper intended to attain two major objectives, one was to explore the effectiveness of radio and television in handling teaching and learning process as an alternative adopted to ensure that students continue to be engaged in learning. Second, to examine the capabilities of the country through the Ministry of Education, Science and Technology to continue teaching and learning during the time of classroom disruption. The authors made a case study where radio and television platforms were adopted for teaching and learning. The results show that the transition from classroom teaching and learning to teaching and learning through radio and television stations platform was not effective. Similarly, the study shows that the government has demonstrated incompetence in running and monitoring the programme mostly in terms of programme preparation and implementation. However, this experience has built a solid foundation for the future cases, when the country, facilitators, students and parents will be more arranged than now.

Keywords— EdTech, Teaching and Learning, COVID 19, Radio and Television.

I. INTRODUCTION

EdTech is a short form for education technology which refers to an integration of information technology (IT) in education to create more learning experience. It is an industry that includes devices such as computers, tablets, website and other internet based services and other technologies aiming to improve teaching and learning at home, classroom or elsewhere (Peterson, 2016). Similarly, EdTech is defined as the study and ethical practice of handling learning to improve performance by creating, using and managing technological process and resources appropriately (Molenda & Januszewski, 2008). It evolved from the early application of teaching and learning tools and have quickly expanded in recent years to integrate such devices as mobile technologies, social networking, flipped class rooms cloud computing and many more

(Huang et al., 2019). The emergence of EdTech in the past decade has generally changed learning behaviour while making education close to every individual.

The severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) or COVID 19 as termed by WHO is rapidly spreading from its origin in Wuhan, a city in Hubei province in the peoples' republic of China to the rest of the world (Wang et al., 2020). The first COVID-19 death case was reported on 11th January 2020 and in short period of time an increasing number of cases were reported in other provinces of the country. In a rapid succession Thailand, Japan and South Korea reported infection cases from the people returning from Wuhan China (Singhal, 2020). Recently, the number of new cases in China has been decreasing whereas there has been a recorded exponential increase in other countries such as Italy, Spain, South

Korea, Turkey, Iran, Spain, United States of America, Germany and France. It is reported that 20% of those infected were in acute condition, 25% have recovered and 3310 (3010 in China and 297 in other countries have died) (Singhal, 2020). By 21st April 2020 the total infected accounted 1,683,877 of which 660,713 (26.24%) have recovered and 173,445 (6.89%) have died. Tanzania recorded the first confirmed imported case on 16th March, 2020 in Arusha. Until 23th April, 2020 the confirmed cases of infected raised up to 254 of which 233 are active, 10 have died and 11 recovered. Most of these confirmed cases are in Dar es salaam, Zanzibar and Arusha (Wolrdometer, 2020).

Tanzania has responded to UNESCO's call for all countries to ensure continuity in learning process during this crisis of COVID-19 pandemic. According to UNESCO the crisis has affected more than 90% of the world's learners due to closure of schools, colleges and universities (Singhal, 2020). It is reported that the total number of learners in Tanzania affected due to termination of studies following the outbreak of COVI-19 pandemic is 13,861,603(UNESCO, 2020).

Status: Country wide

Affected learner:	13,861,603
Females:	6,925,442
Males:	6,936,161

School type	Females	Males	Total
Pre-Primary	702,786	720,082	1,422,868
Primary	5,065,100	5,046,571	5,766,653
Secondary	1,056,495	1,091,968	2,148,466
Tertiary	65,588	113,010	178,598

Source: Educational Disruption and Response (UNESCO report)

The learning process was officially suspended on 17th March 2020 just one day after the first infected person was confirmed in Arusha. One of the vigorous steps taken by the government to reduce the spread of infections was to close all educational institutions for a month. Closure of educational institution has been extended to further notice due to rising number of infections. Generally, the situation has affected education system in the country and equally affected pupils' psychology regarding academic issues. Education system in Tanzania hugely is based on conventional classroom education where students are required to go to school from Monday to Friday. Following

this situation, the government through the Ministry of Education, Science and Technology planned to facilitate learning via unconventional mode a responsibility carried by Tanzania Institute of Education (TIE). In response to disrupted classes due to COVID-19 pandemic many countries have turned their school system to online learning via a learning management system (LMS) or virtual teaching platforms. It is important to note that during this period of time according to the situation conventional teaching and learning is nearly impossible due to weak health systems, therefore opting for online education is inevitable (Desai et al., 2008). This method of learning has been and is continuing to take various features depending on the capacity of the country and technological development to apply information technology (IT) in education. In Tanzania for example teaching is offered through radio stations and televisions while in other countries online portal, google meet, zoom, WeChat, QQ, Ding Talk and several other platforms are used. To ensure that learning on line takes place the most important things are the internet connection, computers, radios, smartphones or televisions are available to students.

In this study, the author will discuss the effectiveness of unconventional learning in Tanzania schools during this critical crisis of COVID-19 taking primary school pupils and secondary school students in Morogoro municipal as samples. Results of the first week of unconventional learning implementation will be discussed as a study case.

II. LITERATURE REVIEW

Number of people in the community believe that a quality education is attained by attending physical classes at school and complete number of days stipulated in the formal curriculum. The alternative learning such as home schooling, distance learning or correspondence education are regarded as inferior. For example, there was a time in the past not very distant past in Tanzania where people believed distant learning such as education provided by Open University of Tanzania was inferior but in a recent period the University is enrolling a big number of students than many universities in the country. Essentially, emergence of technology in education has changed the way we perceive education and has finally changed approach to education as well as teaching and learning. The new learning media is currently attracting more learners because it provides learners with cost efficient and its flexible option(Berman, 2008). Materials are now made available at a click of a button using either computers or mobile devices like smart phones or tablets. Technology

has generally made education accessible at any time and place be it at home, office, school or park.

2.1. Learning via Radio and TV

Education via radio and television refers to medium using formal delivery of certain course materials (Cauchemez et al., 2014). Radio and TV are typically used as means to supplement learning materials and often allows interactions through telephone. National and community radios and televisions have for a long period of time used as tools for disseminating education. The recent emergence of education technology has improved the way of learning through radios and television.

Immediate or later after the outbreak of the COVID-19 pandemic many countries especially in the West shifted from conventional teaching and learning to online mode. This transition was made to provide education opportunities for students while schools are temporary suspended. In developed countries radio and television programs were set to assist students in remote areas who cannot access other learning platforms due to poor internet connection. On the other hand, it was necessary for the Ministry of Education in many developing countries Tanzania in particular to embrace radio and television because of low level of technology and economy to quickly transfer to online learning.

2.2. Experience from China

It is well known that China is one among countries with outstanding experiences of education disruptions leading to schools' closure. The SARS epidemic which occurred in 2003 created a significant negative impacts on education causing millions of students losing studies due to temporary closure of schools (Zeng et al., 2005). The 2008 winter influenza season hit Hong Kong an administrative region of China leading to closure of schools. In 2009 following the outbreak of H1N1 Flu which affected several people around the planet education was disrupted causing China to close all schools (Cowling et al., 2008). The recent closure of schools due to Coronavirus 2019 (COVID-19) pandemic has taken long period of time to resume studies compared to other education disruption ever occurred in China.

While the government struggles to curb the spread of Coronavirus in the country and ensuring school going

students continue to learn despite schools closure the Chinese Ministry of Education initiated the disrupted classes/undisrupted learning aiming at providing flexible online learning. The online learning to accommodate over 270 million students all over the country from their home (Huang et al., 2020). The approach of flexible learning can be carried out at different levels for example using teaching and learning management, institutional management and operational management (Casey & Wilson, 2005). On 17th February, 2020 the government of the Peoples Republic of China through the ministry of education opened its online learning platform. It is reported that on the first day the platform had more than 8 million clicks involving millions of users from 31 regions of China (Huang et al., 2020).

To ensure that the online learning takes place successful several initiatives were taken including preparation of learning resources, teaching and learning methods, services to teachers and learners and cooperation between government, schools and enterprise. For example the Handan city of Hebei province through Handan Education Bureau supported the program by helping teachers to improve their online skills and providing resources to both students and facilitators (Huang et al., 2020). It is obvious that the online learning program requires intensive preparation and funding as well. Both teachers and students need training, resources, time and encouragement. Considering complicity of implementing a such program in a heterogeneous population of about 1.43 billion communication between the ministry, parents, students and other stakeholders should not be loose rather be kept intact.

The Chinese government through the Ministry of Education coordinated 22 online platforms which offered 24,000 online courses that were made available for students to access free of charge (Huang et al., 2020). Several educational platforms were initiated and used by students from their home. These technological based platforms differed from one area or province to another. The following table adopted from the handbook on facilitating flexible learning during educational disruption shows these technological platforms used in China during COVID-19;

Table 1. Technological Platforms used in China during the COVID-19

No	School	Platform	Communication tool	Apps
1	Wuhan Yucai Experimental Primary school	Wuhaneduyun	WeChat, QQ, Ding Talk	Tencent Class
2	Wuhan Wuchang District Sandao Street Primary School	Wuhaneduyun	WeChat, QQ, Ding Talk	Tencent Class
3	Wen Zhou Experimental Middle School	UMU	Ding Talk	
4	Baiyangdian High School at Xiang'an District	Xinkaoyun	Ding Talk	
5	Xiaoxita High School at Yichang Wuyi District	Zhixue	Ding Talk	
6	RDFZ Sanya School		WeChat, QQ, Ding Talk	
7	Beijing No. 8 High School		Tencent Meeting	Yuanfudao
8	BaGu Primary School in Sichuan Liangshan	Xuexi	WeChat, QQ, Ding Talk	
9	The Asian-Pacific Experimental School of Beijing Normal University	Seewoo Cloud Platform	WeChat, QQ, Ding Talk	

Source: Handbook on facilitating flexible learning during education disruption, 2020

The learning tools were chosen based on the nature of the subject, usability, flexibility, accessibility and conveniences. Live streaming classes were also used to promote teaching and learning interactions. To facilitate live streaming classes several technological tools were used. Some of these tools are; Rain-classroom, Tencent ketang, Chaoxing learning App, CCtalk, Welink, ZOOM, FEISHU, icourse, edX, Coursera and Udacity. Similarly, social media platforms like WeChat, WhatsApp, Facebook and Skype were also used for learning (Huang et al., 2020).

China with a population estimated to be 1.43 billion where about 44.2% of the total population living in rural area faced similar problem of education disruption resulting from outbreak of COVID-19 pandemic. Having realised a challenge of internet access in some of the rural areas, the government requested China Education Television to broadcast subjects and similar resources via TV channels so as to fulfil the needs of studying from their homes. It is stated that four channels of China Education TV broadcasted about 75 subjects to primary and middle school classes across the country (Huang et al., 2020).

2.3. How Tanzania encompasses Radio and TV in Teaching and learning

The education system of the country is basically traditional oriented from primary school education to tertiary education while some universities have both traditional and

online learning curriculum though the later mode has not been used seriously. While many of parents, teachers, students and other people in the community are still frown upon the proposition of online learning when school, colleges and universities are closed, the government has taken a rigorous effort to make sure learning continues at home through online system, in the hope of not losing out too much. Tanzania like other countries all over the world particularly Africa has encompassed radio and TV in a provision of education during this period of crisis. Other countries resorted to radio and TV program as alternative to learning include Kenya, Uganda, Ethiopia, Egypt, Senegal, South Sudan, South Africa and Cape Verde just to mention few. In many countries radio and television were in use even before COVID-19 pandemic but today their use are more extensive and wider. For example the department of basic education in South Africa has been providing educational television program for some years past (Burns, 2019). These countries have put a lot of efforts on the use of radio and TV to support students who do not have access to other form of online resources like digital resources and convenient due to its cost efficiency. Thomas (2001) argues that in many parts of the world, medias such as radio and television are still the only way through which instructors can reach a mass audience, instantaneously at low cost (Thomas, 2001).

To curb this situation the Tanzania Institute of Education (TIE) on 17th April 2020 inaugurated online learning via radio and television to save pupils at primary school and secondary school students. The program started on 27th April, 2020 through the State television channel and other channels such as Azam TV, Channel Ten, Zanzibar Broadcasting Cooperation (ZBC), Global TV and Gel TV. Beside the TV channels there were 34 radio stations including the state radio station, Clouds FM and other community radio stations across the country that accepted to broadcast the ongoing educational programme.

The Institute of Education (TIE) prepared alternative lessons to be broadcasted for learners starting from pre-primary school to secondary school. These lessons were not designed for the purpose of completing curriculum but rather for revision during this crisis.

III. METHODS

3.1. Research design

This study adopted case study design method to examine effectiveness of education technology in teaching and learning. To understand well some multifaceted events in any social group a well-structured case study applies (Yin, 2003). The case study method in research is very significant mostly in issues related to education (Gülseçen & Kubat, 2006). The study focused on the first week of the programme implementation subject to teaching and learning through radio and television. Essentially, the study used a single case study to explore contemporary life experience in a specified context with restricted number of incidents as argued by (Zainal, 2007).

3.2. Data collection

In collecting data the study adopted self-administered questionnaire disseminated online. The questionnaire was administered in May, 2020 after the first week of the programme implementation so as to examine participation of students and parents. In this study a randomized sample of 86 parents/guardians were involved in the survey. The data collected were used in determining parents' understanding and involvement in the programme and measuring effectiveness of the radio and television in learning. Similarly, the data collected through administered questionnaire were used to explore capability of the government in providing an online learning. In this study, questions about awareness on radio and television programme, awareness of learning time table and date of learning commencement were considered as indicating factors to attain both objectives.

IV. FINDINGS AND DISCUSSION

The data were collected during the first week of the programme implementation. To help students and parents prepare for the upcoming programme, one week before the commencement of the programme, the lessons time tables were shared to community. The widely spread lesson time tables were shared by the Ministry of Education, Science and Technology in collaboration with the specific media such as the State TV channel (TBC), the State Radio Station (TBC) and Azam TV channel as shown on appendices.

The findings of this study show that teaching and learning through Radio and Television programme in Tanzania aligns with the UNESCO call for all countries to ensure that learning continues regardless school closure due to COVID-19. However, its effectiveness to attain the purpose is less compared to traditional classes.

4.1. Awareness, Preparation and Readiness

The study through self-administered questionnaire found that many parents, students and teachers as well were not aware about online learning programme initiated by the government up to when this study reached them. Since they were not aware particularly parents and students it is obvious that no preparation for learning was made. The total number of 87 respondents (parents/guardians) who were asked if they were aware of this programme following the statement made by the general secretary Ministry of Education, Science and Technology said they were not aware (84.4%), only 11.6% were aware of the programme. A cross examination from this finding shows that many students did not catch up lesson in the first week of commencement as they were not aware. Probably it is this study that inculcated them awareness, thus made them prepare for the next sessions.

It is surprising to see that majority of teachers who in this study considered as parents/guardians were not aware (65.1%), other respondents were business men (20.9%) and others (14%). It was expected that parents' teachers would be the first cadre to be aware than any other. Furthermore, these parents/guardians were not aware of when the programme started. When they were asked about specific date declared by the Ministry of Education, Science and Technology as a commencement of the programme majority of them said they did not know (58.8%), respondents mentioned wrong date (29.4%), only few parents/guardians were aware of the specific date (11.8%). Similarly, majority of parents had not seen the programme timetable (59%) compared to those who had programme timetable (41%). This implies that the responsible organs such as the Ministry of Education, Science and

Technology, Tanzania Institute of Education, Regional and District Educational units did not propagate well the programme to the community. This result suggests that many parents did not engage their children to take part in the online learning programme at the first week of the programme implementation.

4.2. Infrastructure

To examine effectiveness of the programme the study explored general infrastructure employed to facilitate learning. Radios and Televisions as the media used was examined as part of the infrastructure. The study shows that majority of parents have television sets (44%) followed by those who own both television and radio (41.7%), those who own radio (3.610.7%) and those who don't own neither television nor radio (10.7%). It is however important to note that customary practice among Tanzanians shows that many people who own both radio and television sets, most of the time connect radio to television set to utilise radio speakers for a desired sound. It is seldom to find people listening to radio when it is connected to television set. The learning programme time table shows that pre-primary and primary school pupils learn through TBC radio station and they are the majority (65%) compared to secondary school students (35%) yet most of the parents have television sets than radio. This implies that big number of pupils are not following the lesson. Furthermore, there is an issue of power beside having television sets and radio. Tanzania is one of African countries having unstable power supply, frequent power cut and many households particularly rural areas are not connected to power supply. This means one may have radio and television sets but due to power problem cannot use them.

4.3. Supervision

The programme requires close supervision of parents or guardians especially primary school pupils. Parents have to assist learners in various ways including setting radio station or Tv channels broadcasting appropriate lesson, making sure that learners are seriously following the lesson, reminding learners general preparation, helping learners to solve some problematic areas noted from the lesson and correcting activities done by learners after the lesson.

With respect to learner's supervision, the study shows that parents who were aware of their children following up the lesson on TV and Radio were many (48.8%), parents who were not aware (39%) while parents who were not sure (12.2%). This result may superficially indicate that parents were supervising their children but in fact less of them did not supervise their children because the data show that

majority of parents had no lesson time table (59%). Similarly, responses of parents on the question required them to mention specific radio station or Tv channel their children listen or watch for the lesson indicated that majority of parents did not know (38.5%), parents who mentioned Azam TV (32.1%), TBC television (20.5%), Channel ten (7.7 %) and TBC radio (1.3 %). It was expected that many parents would mention radio station because most of the lessons for pre-primary and primary school pupils were broadcasted by TBC radio station.

4.4. Subject content

Referring to the timetables shared by the Ministry of Education, Science and Technology in collaboration with mass media such as TBC radio and television, Azam TV and Channel Ten it can be realised that the programme was not set to cover curriculum but a revision of what was already taught at school. There are few subjects and specific topics shown to go through during this education disruption. The finding shows imbalance of subjects allocation in the timetable and seems not to consider levels of learners particularly among primary school pupils. For example, TBC radio station learning timetable indicates that the programme takes 160 minutes a day but there is a single lesson covering 80 minutes to 140minutes (Refer figure 1). Figure 1 shows that on 3rd March, 2020 the lesson titled listening to story covered the total 140 minutes. Besides, this lesson involved all classes from standard I to standard VII. This is obviously that the subject matter may not fulfil the interest of all students, either the lower classes or upper classes were bored by the lesson. In fact, merging the lower class pupils like standard I and II with upper class pupils is likely undermining them academically as there is no way the lesson can be harmonized.

V. CONCLUSION

Teaching and learning through radio and television is not a new programme in Tanzania, it has been there for some years but with less community attention. This study examined effectiveness of the programme during the first week of its implementation following schools closure. The present study shows that in the first week of the programme implementation majority of parents and students were not aware of online learning and how it was organised as a result their participation was very low. The data indicate that students who have benefited from this programme in the first week of implementation are; few (52.4%), very few (35.3%), many (8.1%) and half of all students (4.2%). With respect to the data the programme was not effective. As a new experience in our context the

government has shown rigorous efforts to ensure that the programme go on regardless of several setbacks such as, low awareness of the community, limitation of technology, low media coverage with little time allotted to scheduled lessons, and poverty among the community that constrains some parents from purchasing radio or television sets.

VI. RECOMMENDATIONS

Based on the above conclusions, it is important for the government to review its education systems and begin long-term planning and build online education systems so that we are ready for the future education disruption. Furthermore, the online education have to be developed and set parallel to the existing traditional form of learning as an essential component of education system and students start training education technology. Lastly but not the least, the department of technology should introduce national Learning Management System (LMS) and virtual learning platforms to complement the current practice of learning through radio and television.

VII. IMPLICATIONS FOR FURTHER STUDIES

This study has shown the potential effect of EdTech as adopted by Tanzania during the health crisis resulted from COVID-19 pandemic. The findings of this study have opened a new line of similar studies. It is expected that other researchers will consider investigating effectiveness of radio and television in teaching and learning during the whole period of schools closure. Similarly, the results of study can further be authenticated by contemplating a broader study through qualitative and quantitative data so as to give a deeper understanding of effectiveness of radio and television in learning. It would also be of interest for researchers to examine application of education technology in Tanzania as one of the current issues in education in the developing countries.

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APPENDICES

 WIZARA YA ELIMU, SAYANSI NA TEKNOLOJIA KUPITIA TAASISI YA ELIMU TANZANIA (TET) 								
RATIBA YA VIPINDI REDIO TBC TAIFA 								
TAR/MDA	8:00-8:20	8:20-8:40	8:40-9:00	9:00-9:20	9:20-9:50	9:50-10:20	10:20-10:50	10:50-11:20
27/4/2020	Pre-Primary Kuheshimiana	STD I-VII Kusikiliza Hadithi Sehemu ya 8	STD VII English Listening	STD I-VII Kusikiliza Hadithi Sehemu ya 3	FORM IV Chemistry Non-Mental	STD I-VII Kusikiliza Hadithi Sehemu ya 11	FORM II Biology Nutrition	STD I-VII Kusikiliza Hadithi Sehemu ya 12
28/4/2020	Pre-Primary Kujenga Dhana ya wakati	STD I-VII Kusikiliza Hadithi Sehemu ya 14	STD VII Kiswahili Alama za Uandishi	STD I-VII Kusikiliza Hadithi Sehemu ya 17	FORM IV Geography Introduction to research	STD I-VII Kusikiliza hadithi sehemu ya 18	FORM II Chemistry Atomic	STD I-VII Kusikiliza Hadithi Sehemu ya 19
29/4/2020	Pre-Primary Kumudu Kazi za kisanii	STD I-VII Kusikiliza Hadithi Sehemu ya 20	STD VI Kiswahili vitendawili methali na nahau	STD I-VII Kusikiliza Hadithi Sehemu ya 21	FORM IV Geography stages of Conducting Research	STD I-VII Kusikiliza Hadithi sehemu ya 24	FORM II Chemistry Hydrogen	STD I-VII Kusikiliza Hadithi Sehemu ya 25
30/4/2020	Pre-Primary kutunza Alya zetu	STD I-VII Kusikiliza Hadithi Sehemu ya 26	STD VI Maarifa ya jamii Hali ya Hewa	STD I-VII Kusikiliza Hadithi sehemu ya 27	FORM IV Geography Research Data and field Research	STD I-VII Kusikiliza Hadithi Sehemu ya 30	FORM II Physics Moment of Force	STD I-VII Kusikiliza Hadithi Sehemu ya 32
1/5/2020	Pre-Primary Kutunza Mazingira	STD I-VII Kusikiliza Sehemu ya 33	STD VI Sayansi ya Kinga ya mwili	STD I-VII Kusikiliza Hadithi Sehemu ya 34	FORM II Geography Water Management	STD I-VII Kusikiliza Hadithi Sehemu ya 35	FORM I Physics Force	STD I-VII Kusikiliza Hadithi Sehemu ya 37
2/5/2020	STD I-VII Kusikiliza Hadithi Sehemu ya 39	STD I-VII Kusikiliza Hadithi Sehemu ya 40	FORM I English Listening	STD I-VII Kusikiliza Hadithi Sehemu ya 41	FORM VI History Nationalism	STD I-VII Kusikiliza Hadithi Sehemu ya 41	FORM III History Colonial Economy	STD I-VII Kusikiliza Hadithi Sehemu ya 42
3/5/2020	STD I-VII Kusikiliza Hadithi Sehemu ya 43	STD I-VII Kusikiliza Hadithi Sehemu ya 44	STD I-VII Kusikiliza Hadithi Sehemu ya 45	STD I-VII Kusikiliza Hadithi Sehemu ya 47	FORM IV Social and Welfare Associations	STD I-VII Kusikiliza Hadithi Sehemu ya 48	STD I-VII Kusikiliza Hadithi Sehemu ya 49	STD I-VII Kusikiliza Hadithi Sehemu ya 50
NB: Wazazi na Walezi wawahimiza Watoto kusikiliza vipindi wakati huu wako Nyumbani.								
 wizara_elimuTz tie_tanzania  taasisi ya elimu wizara_elimutanzania  www.Facebook/moestvt  Taasisi ya elimu Tanzania								
Tembelea Tovuti yetu: www.tie.go.tz 								

Fig.1: Tanzania Broad Casting Cooperation (TBC) Radio station
 Time table for Pre-primary, Primary and Secondary schools


WIZARA YA ELIMU, SAYANSI NA TEKNOLOJIA
kupitia TAASISI YA ELIMU TANZANIA


RATIBA

YA VIPINDI VYA MASOMO

KUPITIA TELEVISHENI





SIKU	SOMO	MADA	DARASA	MUDA
JUMANNE	BIOLOGY	Growth and development	Kidato cha IV	4:00
	GEOGRAPHY	Research data	Kidato cha IV	4:32
	MATHEMATICS	Probability	Kidato cha IV	5:03
	PHYSICS	Radioactivities	Kidato cha IV	5:30
	ENGLISH	Poetry	Kidato cha IV	6:30
	CIVICS	Democracy	Kidato cha II	8:30
	BIOLOGY	Nutrition	Kidato cha II	9:00
	CHEMISTRY	Intro - Oxygen	Kidato cha II	9:30
	MATHEMATICS	Quadratic equation	Kidato cha II	10:00
JUMATANO	BIOLOGY	Nutrition(food test)	Kidato cha IV	4:00
	GEOGRAPHY	Human population	Kidato cha IV	5:00
	MATHEMATICS (BAM)	Areas and perimeters	Kidato cha IV	5:33
	ENGLISH	Poetry	Kidato cha IV	6:03
	PHYSICS	Force and equilibrium	Kidato cha II	6:30
	GEOGRAPHY	Water management for economic development	Kidato cha II	8:30
	BIOLOGY	Nutrition, food substance	Kidato cha II	9:00
	CHEMISTRY	Preparation of oxygen	Kidato cha II	9:30
	MATHEMATICS	Solving quadratic equation by factorization	Kidato cha II	10:00
ALHAMISI	BIOLOGY	Genetics	Kidato cha IV	4:00
	GEOGRAPHY	Characteristics of human population	Kidato cha IV	4:30
	BIOLOGY	Nutrition-food substance	Kidato cha II	5:00
	CHEMISTRY	Hydrogen	Kidato cha II	5:35
	MATHEMATICS	Pythagorous theorem	Kidato cha II	6:00
	KISWAHILI	Aina za maneno B	Darasa la VII	6:32
	ENGLISH	Coordinating ideas	Darasa la VII	7:02
	KISWAHILI	Kutumia alama za pandishi na matumizi ya herufi kubwa	Darasa la IV	8:00
	HISABATI	Kuzidisha	Darasa la IV	8:30
	SAYANSI	Afya na mazingira	Darasa la IV	9:00
	SOCIAL STUDIES	Ancient feudal societies	Darasa la IV	9:30
	ENGLISH	Time telling	Darasa la IV	10:00

Pia katika Taasisi ya elimu

Elimu ni Kazi

www.tie.go.tz

Fig.2: Azam Television

Time table for primary Schools (Standard IV&VII) and Secondary schools (Form II&IV)



**WIZARA YA ELIMU SAYANSI NA TEKNOLOJIA
 PAMOJA NA OFISI YA RAIS TAMISEMI KUPITIA
 BARAZA LA MITIHANI LA TANZANIA (NECTA)**

**RATIBA YA VIPINDI VYA MARUDIO YA MASOMO KWA MAANDALIZI YA
 MTIHANI WA TAIFA WA KIDATO CHA SITA KUPITIA TELEVISHENI YA TAIFA TBC1**



TAR/MDA	4:00 – 5:00 Asubuhi	5:01 – 6:00 Asubuhi	6:01 – 7:00 Mchana	7:01 – 8:00 Mchana
27-04-2020	PHYSICS: VIBRATIONS AND WAVES	KISWAHILI: MATUMIZI YA SARUFI	ECONOMICS: THEORY OF FIRM	GEOGRAPHY: SIMPLE SURVEY AND MAP MAKING
28-04-2020	ADVANCED MATHS: PROBABILITY	ENGLISH: LANGUAGE SKILLS	CHEMISTRY: ENERGETICS	ECONOMICS: NATIONAL INCOME
29-04-2020	BASIC APPLIED MATHS: ALGEBRA	KISWAHILI: MATUMIZI YA SARUFI	COMMERCE: CONCEPT OF STOCK EXCHANGE	GEOGRAPHY: STUDY OF SOIL
30-04-2020	CHEMISTRY: ENERGETICS	ENGLISH: INTRODUCTION TO LANGUAGE	ECONOMICS: THEORIES OF DEMAND AND SUPPLY	KISWAHILI: MATUMIZI YA SARUFI
01-05-2020	PHYSICS: VIBRATION AND WAVES	GEOGRAPHY: WATER MASSES	ADVANCED MATHS: PROBABILITY	BASIC APPLIED MATHS: PROBABILITY
02-05-2020	CHEMISTRY: HALOGEN DERIVATIVES OF HYDROCARBONS	HISTORY: NEO- COLONIALISM	ENGLISH: APPRECIATING LITERARY WORKS	KISWAHILI: MAENDELEO YA FASIHI SIMULIZI



*Fig.3: Tanzania Broad Casting Cooperation (TBC) Television programme
 Time table for Advanced Secondary Schools (Form VI)*

Environmental-economic assessment of lignocellulosic residual from the Legal Amazon for conversion in biochars and bioproducts for biorefineries

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Abstract— Biochars are emerging ecological products that show excellent properties in areas such as carbon sequestration, soil improvement, bioremediation, activated carbon and bioenergy. These interesting materials can be synthesized from a wide variety of sources derived from waste, including lignocellulosic biomass waste. In this work, biochars were produced from residues from the Brazilian Amazon, such as green coconut, babassu and Brazil nuts. The synthesis of biochars was performed under pyrolysis conditions with a fixed time of 3 h and temperature variation of 250 °C (T_1) and 400 °C (T_2). Yields of biochar production >85%, carbon contents >56%, and oxygen contents >20% and calorific values >23 MJ.Kg⁻¹, demonstrate that biochars produced from residual biomass can be used as activated carbon and also as fertilizers in soils, thus adding value to such residues. Besides, the biomasses used were characterized and the achieved remarkable yields of fermentable sugars, reaching up to 70% in cellulose hydrolysis, which can be useful in the production of bioproducts. In addition, the efficient use of these biomasses will positively impact the productive chains involved, benefiting society, generating employment, income, Besides as mitigating an environmental liability.

Keywords— activated carbon, fermentable sugars, hydrolysis, Pyrolysis.

I. INTRODUCTION

Biomass is an abundant and renewable resource, since, it comes as residual from economic conversion processes. Has been widely used, as raw material for the chemicals production and excellent energy supply, as a biofuel [1,2,3].

The main process involving biomass are hydrolysis and pyrolysis. For hydrolysis, the use of acid-catalyzed (diluted and/or concentrated), in mild conditions (<200 °C), is favorable to hydrolysis the hemicellulose, or in drastic conditions (high temperature), the chemical bonds, from cellulose fraction, glycosidic bonds β -(1→4), are break. Consequently, this process can be optimized according to the time, temperature and type of catalyst, in order to

increase the yield of the desired final product [4,5,6]. Meanwhile, pyrolysis is performed according to the desired results. Slow pyrolysis, for example, is preferred to increase the yield of biochar; fast pyrolysis is to increase the yield of bio-oil [7]. Both are thermochemical processes carried out at a temperature of around 500 °C, in an oxygen-free environment [8].

Biochar is a solid by-product of pyrolysis and has been attracting attention. Due to a large surface area and special characteristics, like the functional oxygen groups, mineral fractions and aromatic carbon, playing a fundamental role in chemical adsorption. The adsorption property of the biochar makes it is a promising candidate for immobilizing

many types of contaminants, including heavy metals [9,10].

In addition, lignocellulosic biomass can be converted into fermentable sugars, mainly glucose and xylose, via the hydrolysis process [11], which can be used as a carbon source to produce, for example, bioethanol [12], levulinic acid (LA), formic acid (FA), 5-hydroxymethylfurfural (HMF) and furfural (FF) [13, 14]. The extraction of lignin occurs as a residue of hydrolysis, which can be used to generate heat, bio-oil and activated carbon [15,16,17].

In this context, the aim of this study was to determine the use of lignocellulosic residues (biomass) deposited from Amazon forest as an alternative energy source and its bioproducts, through the evaluation of biochar production and fermentable sugars from a green coconut, babassu and Brazil nut shell.

II. MATERIALS AND METHODS

2.1 Raw Material

Four raw materials were used to produce biochar: green coconut mesocarp (MC), babassu mesocarp (MB), Brazil nut shell pericarp (PC) and Brazil nut shell endocarp (EC). All samples were obtained in the Northern region of Brazil.

The green coconut residue (*Cocos nucifera*) was obtained from the commercial disposal of the raw material, after the withdrawn of liquid albumen (coconut water). The Brazil nut shell (*Bertholletia excelsa*) residues, were supplied by EMBRAPA Amazônia Oriental, and babassu (*Orbignya phalerata*) supplied by Tobasa Bioindustrial.

The collected samples were dried at room temperature, then in an oven at 50 °C, crushed in a knife mill (Wiley type TE-650/1), sieved at 0.354 mm (45 mesh), and then stored in flasks for further analysis. All tests were performed in duplicate.

2.2 Biomass characterization

2.2.1 Chemical analysis

The samples were characterized according to the standard procedures of the American Society for Tests and Materials (ASTM).

2.2.1.1 Moisture content

The moisture content was determined (ASTM D3173 / D3173M-17) for 1 g of the ground and sieved sample, heated to 105 ± 5 ° C in an oven (Solid Steel SSD 110L) with air circulation for 12 h [18]. Then, it was placed in a desiccator for 20 min to be cooled and the moisture content was according to Equation (1):

$$\text{Moisture (\%)} = \frac{M_i - M_v}{M_i} \times 100 \quad (1)$$

Where, M_i is the initial mass in grams of the sample; M_v is the mass of the sample in grams after heating.

2.2.1.2 Ash content

The ash content was determined in accordance with ASTM D3174-12, in which 1g of the ground and sieved sample will be left in a muffle at a temperature of 600 ± 50°C for approximately 4 h [19]. The difference between the initial and final weights provide the ash content, which can be determined according to Equation (2):

$$\text{CZ (\%)} = \frac{M_i - M_v}{M_i} \times 100 \quad (2)$$

Where, M_i is the initial mass in grams of the sample; M_v is the mass of the sample in grams after heating.

2.2.1.3 Volatile matter content (VM)

The volatile matter content (VM) was determined according to ASTM D3175-20. The analysis consists of using 1 g of the previously dried sample and placing it in a muffle at 800 ± 10°C for 8 minutes [20]. After this time, the sample is placed in a desiccator to be cooled, for 60 min, then weighed. VM content according to Equation (3):

$$\text{VM (\%)} = \frac{M_i - M_f}{M_i} \times 100 \quad (3)$$

Where, M_i is the initial mass in grams of the sample; M_f is the mass of the sample in grams after muffle oxidation.

2.2.1.4 Fixed carbon content (FC)

The fixed carbon content is an indirect measure and was determined according to Cai et al. [21], Equation (4):

$$\text{FC (\%)} = 100 - (\text{Moisture} + \text{Ash} + \text{VM}) \quad (4)$$

Where, Moisture is the moisture content; Ash is the ash content; VM is the volatile matter content.

2.2.2 Extractives

The extracts were extracted using the Soxhlet apparatus. Approximately 3g of each sample was used. The reaction time was 8 hours, with 190 mL of 95% ethanol (v/v). The extractive content was determined according to the protocol of the National Renewable Energy Laboratory [22]. Afterwards, the samples were placed in petri dishes for 48 h to dry. Extraction mass and the initial mass (raw sample) were weighed and applying the Equation (5) to determine the extractives:

$$\text{Extractives (\%)} = \frac{\text{extraction mass}}{\text{mass of raw sample}} \times 100 \quad (5)$$

2.2.3 Acid Hydrolysis

The determination of carbohydrates and lignin were carried out using the standardized procedures of the NREL [23]. Thus, the acid hydrolysis of the sample was with 72% sulfuric acid and placed in a thermostatic bath at 30°C for 1 h.

Then, 84 mL of water was added and placed in the autoclave (Phoenix) at 120°C for 1 h. The samples were vacuum filtered (LT 65, Limatec, coupled), separating the liquid fraction for analysis of structural carbohydrates and acid-soluble lignin (ASL) and the solid to obtain the content of acid-insoluble lignin, also called Klason lignin (LK).

2.2.3.1 Lignin content

For analysis of ASL the method used was UV-Vis spectroscopy (HACH/Germany, DR5000) with a wavelength of 294 nm in 4% H₂SO₄ (m/v) white solution. For KL, the solids retained in filter crucibles were taken to an oven at 105 °C for analysis of acid insoluble residues (AIR) and then subjected to a temperature of 575 °C to measure acid insoluble ash (AIA). By difference of AIR and AIA, the insoluble lignin KL was obtained. From the sum of KL + ASL, Total Lignin (TL) was determined [23].

2.2.4 Determination of polysaccharides: Cellulose and Hemicellulose

In order to measure the fibrous component of biomass (Hemicellulose and cellulose), the determination of neutral detergent fiber (NDF) and acid detergent fiber (FDA) was performed. For the FDA fiber content, approximately 0.6 g of the dry and defatted sample were weighed, placed in a non-woven fabric bag, which was digested with H₂SO₄ at 1.25%, using the fiber digester model Marconi® MA-444/CI at 90°C. In the NDF, approximately 0.6 g of the dry and defatted sample (after extraction) was weighed, placed in a tissue bag of non-woven fabric, which were digested in 1.25% NaOH using the fiber digester model Marconi® MA-444/CI at 90 °C. After digestion, the samples were dried in an oven at 105°C until reaching the constant weight [24]. The moisture-free content of hemicellulose was estimated by the difference between NDF and FDA.

2.2.5 Analysis of fermentable sugars: monomeric sugars

The fermentable sugars, glucose, xylose and arabinose, in the liquid fractions of acid hydrolysis were determined using a PerkinElmer Series 200 chromatography equipment, equipped with the Phenomenex Rezex ROA-Organic acid H⁺ column (8%), and refractive index detector model RID-10A brand Shimadzu. The volume of the injected sample was 20 µL in constant temperature at 60

°C. The mobile phase used was H₂SO₄ acid (5mM) with a flow of 0.6 mL min⁻¹. The concentrations of glucose, xylose and arabinose produced in the reactions were identified using the retention times of the D-glucose (Sigma-Aldrich, PA), xylose (Sigma-Aldrich, ≥ 99% purity) and arabinose (Sigma-Aldrich, ≥ 98% purity), calculated from the 6-point calibration curves (R² > 0.99).

The monomeric sugars concentrations, glucose, xylose and arabinose were determined as described by Lu et al. [25], using Equation (6). For the calculation, the correction factor of 0.88 (or 132/150) was used for C-5 sugars and 0.90 (or 162/180) for C-6 sugars according to the NREL methods [23].

$$\text{Sugar content (\%)} = \frac{\text{monomeric sugar} \times v \times F}{m} \times 100$$

(6)

Where, *monomeric sugar* is the concentration in (g/L) of hexose or pentose; *m* is the mass of the biomass used (g); *v* is the final net volume of the acid hydrolysis process (L); *F* is the correction factor.

2.3. Bioproduct content

The maximum yields of levulinic acid (LA), formic acid (FA) and furfural (FF) were estimated from the fermentable sugars obtained during the hydrolysis process, using Equations (7), (8) and (9), as Rambo et al. [26].

$$\text{LA (\%)} = 0,5 \times \text{hexoses \%} \quad (7)$$

$$\text{FF (\%)} = 0,5 \times \text{pentoses \%} \quad (8)$$

$$\text{FA (\%)} = 0,2 \times \text{hexoses \%} \quad (9)$$

2.4. Biochar production

2.4.1. Pyrolysis procedure

The pyrolysis of the samples was carried out in a muffle furnace (Digimec FHMP) at different temperatures: 250 °C and 400 °C, with an increase of 5 °C min⁻¹. Upon reaching the desired temperature, the samples stay in the muffle for 3 h, then cooled in the desiccator and weighed to calculate the biochar production. To carry out the treatment's porcelain crucibles (Chiarotti M-26) were used, these were filled with biomass and sealed in order to decrease O₂ during thermal degradation [27].

2.4.2. Pyrolyzed product

The yield of pyrolyzed product (PY) was calculated from the ratio between produced biochar (mPB) and initial dry biomass (mIB), according to Bueno [28], Equation (10).

$$\text{PY(\%)} = \frac{m_{PB}}{m_{IB}} \times 100 \quad (10)$$

The pyrolyzed product (PP) was calculated by average of two pyrolysis in the same temperature ($n=2$). The experimental error was smaller than 0.5% by weight.

2.5. Biochar characterization

The basic guidelines for standard methods and properties of the biochar were followed the International Biochar Initiative - IBI (version 2.1) [29].

2.5.1. Elementary analysis and Calorific value

The determination of the contents of carbon (C), hydrogen (H), nitrogen (N) and sulfur (S) was using the elementary analysis (Vario Macro CUBE – Elemental), and the oxygen (O) content was estimated according to ASTM D3176-15 [30].

The higher calorific value (HCV) was determined according to NREL/TP- 433-7965 [31], Equation (11), where A is ash.

$$HCV (MJ.Kg^{-1}) = 0.3491 \times C + 1.1783 \times H + 0.1005 \times S - 0.1034 \times O - 0.0151 \times N - 0.0211 \times A$$

(11)

2.5.2. pH

The pH of the biochars was determined in water, with the digital pH meter (AKSO, AK90). The method was to add distilled water (ratio of 1:20 m/v), mixed to form a homogeneous suspension over the sample and after 1.5 h measure the pH [32].

2.5.3. Functional groups

The technique Fourier-transform infrared spectroscopy (FTIR - Agilent Cary 630) was used to identify the functional groups on the biochar surface. The samples were scanned in two replicate runs. Spectral data were measured as absorbance (A) according to the equation: $A = \log_{10}(1/R)$, where R is the reflectance applied in the wavenumber from 4000 to 650 cm^{-1} (mid-infrared region) with 4 cm^{-1} resolution and 32 scans. The final spectrum was obtained by averaging the two replicate spectra per sample.

2.6. Activation of biochar

Activated carbon was produced from the biochar obtained from pyrolysis. The biochar was immersed in a solution of zinc chloride - $ZnCl_2$, at a concentration of 10% (m/v) in the ratio of 1:5, covered with a plastic film and rest for 24 h. Following the protocol, after that time, the samples were washed with distilled water and dried in an oven at 110 °C. The washed material was placed in a crucible, sealed and pyrolyzed in a muffle furnace (Digimec FHMP) at 600 °C for 2 h. After pyrolysis the activated carbon was washed with a solution of hydrochloric acid - HCl (2 moles. L^{-1}), to remove of $ZnCl_2$

and unclog the pores. Finally, the sample was dried in an oven at 110 °C for 24 h [33].

2.7. Economic analysis

The economic analysis was estimated in order to assess the viability of the production process, on a commercial scale, for the activated biochar, levulinic acid, formic acid and furfural. Considering only the investments and gross income, excluding the industrial reality. The calculation is based on the cash flow of inputs and outputs (Input-output) assuming the current market value [34]. The current market value was used for the bioproducts obtained and the reagents used. In contrast, zero cost for used waste was considered [35].

2.8. Statistical analysis

To statistically compare the positive and negative relationship between the calorific value and the chemical composition of the biomasses, Pearson's correlation coefficients (r) were observed. The r value can vary from -1 to +1, where values close to +1 indicate a significant positive relationship, values close to -1 translate into high negative correlations and 0 means that there is no interaction. Generally, values above ± 0.6 mean that there is a considerable correlation between the variables [36]. The figures and statistics were created in the Origin 8.0 program (OriginLab Corporation, USA, 2012).

III. RESULTS AND DISCUSSION

3.1 Physical-chemical characterization of raw biomass

The results of moisture, ash, volatile matter and fixed carbon of the raw samples are shown in Table 1, as well as the majority chemical composition of the lignocellulosic biomasses (cellulose, hemicellulose and lignin).

It is worth mentioning that the composition of these constituents varies from one species of biomass to another and even within a single species of plant, age, climatic conditions, soil characteristics, mode and storage location. In addition, different methodologies can be used in the chemical characterization of biomass, which can result in divergent values [4,37].

According to Chouhan Singh and Sarma [38], the volatile matter content implies an increase in the amount of bio-oil production via pyrolysis. Low moisture content (<14%) and ash (<7%) mean a higher yield in the production of bioproducts, increasing the efficiency of the process and preventing secondary reactions during hydrolysis. In addition, excess moisture in the biomass can

reduce the calorific value [39]. The low levels of extracts favor the formation of gas and coal [40].

The majority chemical composition of the studied biomasses is similar to those reported in the literature. When characterizing the green coconut residue, Mariano et al. [41] obtained contents of 35.45% cellulose, 43.90% hemicellulose and 18.16% lignin. Castro et al. [42] quantified for babassu residue 16.07% (w/w) of hemicellulose, 6.94% (w/w) of cellulose and 26.58%

Table 1: Chemical characterization of the raw biomass

Analysis (%)	Raw sample			
	MC	MB	PC	EC
Moisture	5.22 ± 0.02	7.25 ± 0.07	13.90 ± 0.00	11.35 ± 0.70
Ashes	2.82 ± 0.04	1.70 ± 0.14	6.75 ± 0.49	0.90 ± 0.28
VM	90.78 ± 0.28	86.70 ± 0.14	75.02 ± 0.71	77.45 ± 0.35
FC	1.18 ± 0.01	4.40 ± 0.01	4.15 ± 0.01	10.40 ± 0.01
Cellulose	30.50	33.55	2.35	23.33
Hemicellulose	30.61	34.11	50.82	23.12
Lignin	26.64	29.97	42.70	50.25
Extractives	12.16	2.37	4.13	3.33

Caption: MC: mesocarp of green coconut; MB: babassu mesocarp; PC: Brazil nut shell pericarp; EC: Brazil nut shell endocarp; VM: Volatile Materials; FC: Fixed Carbon.

(w/w) of lignin. For biomass of Brazil nut shells, Bonelli et al. [43] found holocellulose contents of 48.5%, 59.4% of lignin and 3.4% of extractives.

The results confirm that the studied biomasses are a source of valuable carbohydrates and the extraction in quantities of these compounds may be commercially viable. Fig. 1 shows the content of glucose, xylose and arabinose obtained from the liquid fraction of acid hydrolysis. Glucose values range from 13.5–22.5% (0.518–0.86 g L⁻¹), xylose from 3.7–28.3% (0.14–1.1 g L⁻¹) and arabinose from 0.62–25.75% (0.02–1.0 g L⁻¹).

Mariano et al. [41] obtained in the liquid hydrolyzate of the coconut residue mainly C5 and C6 sugars such as fructose (27.93%), glucose (20.38%), xylose (12.91%) and arabinose (8.53%), after 60 minutes of hydrothermal pretreatment followed by acid hydrolysis with 3% H₂SO₄. Using Brazil nut shells, Morales et al. [44], obtained 8.6% glucose, 7.9% xylose and 3.1% arabinose, under the same

acid hydrolysis condition used in this work, with 72% sulfuric acid. For the hydrolysis of mesocarp babassu, López et al. [45] obtained high levels of glucose (up to 44 g L⁻¹) and xylose (up to 19 g L⁻¹).

3.2 Bioproducts

The estimated potential of lignocellulosic raw materials for the production of high value-added bioproducts from fermentable sugars obtained in hydrolysis are shown in Fig. 2. Glucose was found in greater quantity in the husk of green coconut, resulting in the estimate of LA and FA in quantities of 11.22% and 4.50%, respectively. In relation to pentoses, the highest percentage was found in the babassu mesocarp (xylose content of 28%), favoring furfural yield (27%). The lowest yields of LA, FF and FA were in the pericarp of the Brazil nut shell pericarp (PC).

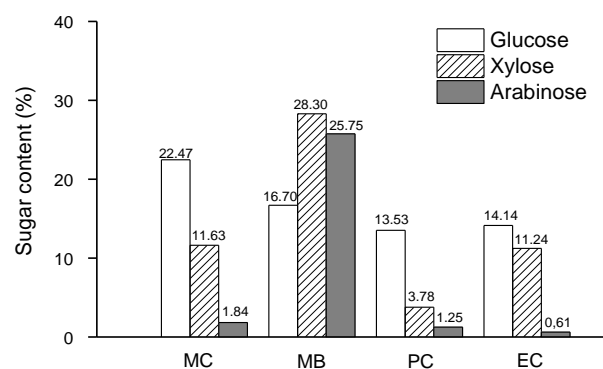


Fig. 1: Glucose, xylose and arabinose content obtained from the acid hydrolysis of the green coconut mesocarp (MC), babassu mesocarp (MB), Brazil nut pericarp (PC) and Brazil nut endocarp (EC).

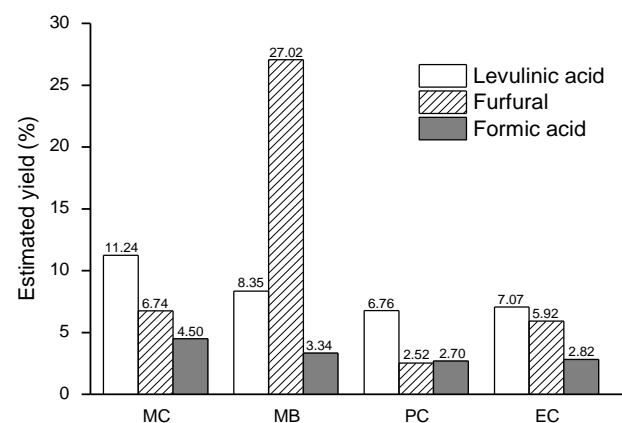


Fig. 2: Estimated yield of levulinic acid (LA), furfural (FF) and formic acid (FA) for the green coconut mesocarp (MC), babassu mesocarp (MB), Brazil nut shell pericarp (PC) Brazil nut shell endocarp (EC).

The literature for the yields of LA, FF and FA are demonstrated in Table 2. The estimated income of LA was higher than predicted by Sweygers et al. [4] for bamboo

biomass, in a reaction catalyzed with 0.37 M HCl, for 3 h, at 160 °C. For coconut biomass, the estimated FF value was close to that presented by Rambo et al. [26]. The PA content was lower than those mentioned in table 2.

Table 2: Literature results for experimental yields (%) of levulinic acid (LA), Furfural (FF) and formic acid (FA).

Biomass	Yield (%)			Literature
	LA	FF	FA	
Coconut husk	17.5	7.0	8.5	[26]
Pequi	23.7	65	–	[46]
Coffee beans	47.0	–	29	[47]
Corn cob	–	–	42.5	[48]
Bamboo	10.13	2.75	–	[04]

Although studies on the bioproducts in question for Brazil nut shell and babassu biomass have not been found, Cinelli et al. [49] presents results for the production of ethanol from babassu starch (glucose), 83% efficiency in converting starch to ethanol. In addition to ethanol, xylose can also be used for the production of xylitol, using specialized yeasts (DASGUPTA et al., 2017) and 5-hydroxymethylfurfural (HMF) [14], for example. The use of waste generated after the hydrolysis process also reveals the potential for producing activated carbon with a high surface area (542.0 m².g⁻¹) [17].

3.3 Pyrolysis yield

Biochar is a valuable input in the most diverse industries and stands out among the main products obtained after the pyrolysis process. In this study, the biochar produced had yields greater than 80% (Fig. 3).

The values obtained were higher than those reported by Gonzaga et al. [50] and Siengchum et al. [51] who found an average yield of 45% and 25.4 - 38.3% for the coconut husk biochar, in pyrolysis of 500 °C and 400–650 °C, respectively. However, the results were similar to that reported by Tsai et al. [52] of 75% for pyrolysis of coconut biomass at 400 °C, Ghosh et al. [53] obtained a 17% biochar yield from the babassu mesocarp in pyrolysis at 750 °C. Regarding chestnut shell, Jiang et al. [54] obtained a yield of 44.31% by weight when pyrolysed at 750 °C.

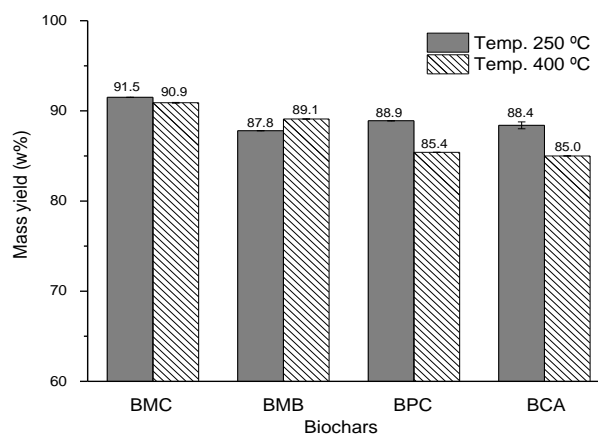


Fig. 3: Mass yield of the biochar of the green coconut mesocarp (BMC), the babassu mesocarp (BMB), the Brazil nut shell pericarp (BPC) and the Brazil nut shell endocarp (BEC) produced at different pyrolysis temperatures from raw biomass.

The yield of the residual solid from pyrolysis, according to Tsai et al. [52] show a decreasing trend as the pyrolysis temperature and the waiting time increase, where the formation of liquid and gaseous products occurs. According to Ortiz et al. [55] degradation reactions in pyrolysis with temperatures around 300 °C produce higher yields of biochar. Novak et al. [56] attributed the decrease in biochar yield to the dehydration of hydroxyl groups and thermal degradation of cellulose and lignin structures. Abe et al. [57] report that cellulose and hemicellulose are decomposed at around 180-250 °C, producing organic acids and phenolic substances.

3.4 Biochar characterization

The basic results needed to assess the utility of the biochar for use in the soil, as well as, elemental chemical composition, atomic proportions (H / C and [(O + N)/C]), ash content and higher calorific value (HCV), improved yield of biochar (BMC, BPC and BEC BMB 250 °C and 400 °C) are shown in Table 3. In this study, biochars were not compared to each other.

Biochar produced from green coconut and Brazil nut shell are classified as *Class 2* and babassu *Class 1*, with organic carbon content (C_{org}) between ≥ 30% and <60% and ≥ 60%, respectively [29]. According to Lima et al. [58] the percentage of carbon present in the BMB-400 °C justifies, by itself, the use of this residue as a carbon source, similar to commercial activated carbons (75-85%).

Table 3: Physical and chemical characteristics of the biochar obtained from the fractions of green coconut, babassu and Brazil nut shell.

Biochars	Elementary composition (%)					Ash (%)	Atomic relationship			pH	HCV MJ.Kg ⁻¹
	C	H	N	O	S		H/C	O/C	C/N		
BMC-250 °C	59.36	5.56	0.81	29.38	0.31	4.58	1.12	0.37	62.86	6.9	24.15
BMB-400 °C	73.27	3.77	0.73	20.13	0.15	1.96	0.62	0.20	86.03	6.8	27.90
BPC-250 °C	56.48	6.01	0.55	34.55	0.17	2.24	1.27	0.46	88.02	7.3	23.19
BEC-250 °C	57.98	5.88	0.57	33.33	0.18	2.07	1.21	0.43	87.18	7.1	23.69

Caption: BMC: Biochar mesocarp of green coconut; BMB: babassu mesocarp biochar; BPC: Brazil nut pericarp biochar; BEC: Brazil nut endocarp biochar. C: Carbon or C_{org}; H: Hydrogen; N: Nitrogen; O: Oxygen; S: Sulfur; pH: Hydrogenionic potential; HCV: Higher Calorific Value.

The values of the elemental chemical composition of the biochar BPC-250°C and BEC-250°C are similar to those found by Bonelli et al. [43] for the Brazil nut residues. For the coconut mesocarp biochar (BMC-250 °C) the results were inferior to those presented by Bispo et al. [59] for coconut pyrolysis at 700 °C. The values for the babassu biochar (BMB-400 °C) were similar to those reported by Lopes et al. [60] for a sample of the babassu coconut endocarp.

The atomic ratio H/C indicates the degree of aromaticity of the biochar [61]. Thermochemically processed materials that have an H/C value greater than 0.7 (BMC-250 °C, BPC-250 °C and BEC-250 °C) can be thermochemically "altered", but are not considered thermochemically "converted" [29], preserving part of its original organic residues, such as CH₂ and fatty acids, lignin (aromatic nucleus) and cellulose (polar fractions) [62]. This property shows good biochar stability and its potential as a carbon sequestration agent in the soil [63]. In addition, Wei et al. [61] demonstrated that the H/C value can be a potential indicator for the mechanism of adsorption of organic contaminants. The BMB-400 °C biochar is the only one within the required standards (<0.7).

The O/C ratios show that BMB-400 °C (0.2) is theoretically the most stable biochar, followed by BMC-250 °C (0.37), BEC-250 °C (0.43) and BPC-250 °C (0.46). According to Spokas [64], biochar with an O/C molar ratio of less than 0.2 are typically the most stable, with an estimated half-life of more than 1000 years; molar ratio O/C of 0.2-0.6 has an intermediate half-life (100-1000 years); and, the biochar with an O/C ratio greater than 0.6 has a half-life in the order of 100 years.

The C/N ratio for the biochar produced are between 50-100. This ratio (C/N) is an important parameter, as it strongly influences the response of the availability of phosphorus (P) and nitrogen (N) in the soil. Gao et al. [65] report that the application of biochar increased the available P by 45% and microbial biomass of P by 48%. In addition, applications of biochar in combination with organic fertilizer have shown significant potential to improve the availability of inorganic N in the soil. However, these effects of biochar on soil are inconsistent, as each combination of biochar/soil type requires additional characterization to better predict nutrient retention and release [50]. The pH values found demonstrate that the biochar obtained are neutral in nature (6.8-7.3) and therefore indicated for use in the soil [29] and for the purpose of raising the pH [63].

The HCV results obtained were in the range of 23.2 - 27.9 MJ.Kg⁻¹, revealing the energy potential of these residues as solid fuels, since the calorific capacity of these biochar is similar to that of bituminous coal (27- 33 MJ.Kg⁻¹) [66]. The results found for the higher calorific value are consistent with those reported in the literature Jiang et al. [54] when the nut shells were pyrolyzed at 250 °C and 750 °C, they obtained calorific value of the biochar of 18.88 MJ.kg⁻¹ and 35.48 MJ.kg⁻¹, respectively. The calorific value of the coconut biochar was 23.68 MJ.kg⁻¹ at a pyrolysis temperature of 600 °C [67]. For babassu, Ranucci et al. [68] report calorific values between 36-45 MJ.kg⁻¹.

Fig. 4 shows the Pearson's correlation *r* between the calorific value of biochar and the biomass physical-chemical composition. The results revealed that, for the parameters of the next analyzes (moisture, volatile matter-VM, fixed carbon and ash content), only the VM can affect the calorific value. Lu et al. [69] points out that calorific value results mainly from combustion of organic

compounds such as CF and VM. Therefore, the low content of CF obtained confirms this negative relationship. Brand [70] states that the calorific value decreases with high ash content, since mineral materials (ash) do not participate in the combustion process. In addition, low fixed carbon content and high ash yield are associated with low fuel quality [71]. The calorific value also decreased when the moisture content is high [72].

Evaluating the contents C, H, N, S and O, a positive correlation was found between the HCV and the content of C and N, the others showed a negative correlation. According to Protásio et al. [73] there is a tendency for HCV to be associated with higher percentage values of H and C. On the other hand, Ozyuguran et al. [74] demonstrate that H and S contents do not improve the performance of biomass calorific values. Protásio et al. [73] establish an inverse relationship between the O content, as the results in the present work. Huang et al. [75] state that high oxygen values decrease the calorific value. Ozyuguran et al. [74] concluded that only two parameters, including carbon and an extra element, nitrogen or oxygen, are ideal for predicting HCV.

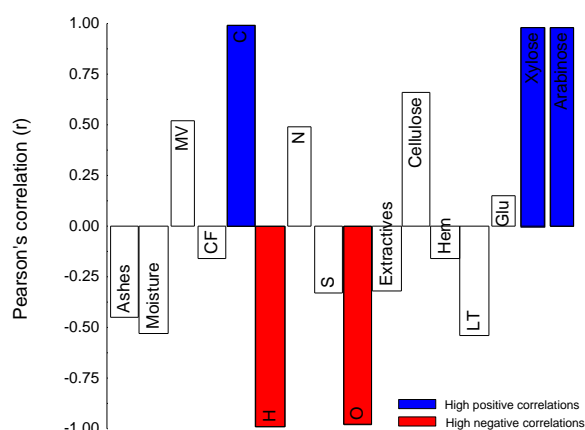


Fig. 4: Pearson's correlation between the physical-chemical composition and the calorific value the green coconut (BMC), babassu (BMB) and Brazil nut shell (BPC and BEC) biochars. VM: Volatile Materials; CF: Fixed Carbon; C: Carbon; H: Hydrogen; N: Nitrogen; S: Sulfur; O: Oxygen; Hem: Hemicellulose; LT: Total Lignin; Glu: Glucose.

Correlations based on structural chemical composition (cellulose, hemicellulose, lignin and extractives) are not viable due to the variation in the properties of the components [73]. However, the content of cellulose, hemicelluloses and lignin release energy in burning [76]. Only cellulose showed a positive relationship with HCV,

probably due to its decomposition rate that occurs mainly in the range of 200 - 340 °C, while lignin decomposition occurs almost throughout the pyrolysis (340 - 900 °C) [54]. According to Guo et al. [77] the extracted biomass decomposes at 250 - 400 °C and has greater activation energy. The sugar content had a positive relationship with the HCV, corroborating with Rambo et al. [26].

3.5 Functional groups

The results of the FT-IR analysis of the biochar produced are shown in Fig. 5. The biochar under analysis have characteristics bands in the region between 3800 - 2700 cm^{-1} , which are attributed to the stretching vibration of the hydroxyl groups (OH) and CH. The BMC-400 °C sample showed a wide peak in this region with increasing temperature, as did the BPC-400 °C sample which a sharp peaks at 3829 cm^{-1} , 3739 cm^{-1} and 3620 cm^{-1} . Jiang et al. [54] suggests the increase in temperature a large number of hydroxyls were reacted. Isitan et al. [78] attributes the peaks to the release of H_2O due to the breakdown of hydroxyl groups of the aliphatic groups.

The 2800-3000 cm^{-1} region is associated with asymmetric and symmetrical elongations in the methyl ($-\text{CH}_3$) and methylene ($-\text{CH}_2$) groups [79]. The 1704 -1612 cm^{-1} bands represented the stretching vibration of the carboxyl groups ($\text{C}=\text{O}$) between hemicelluloses and lignin [80,81]. Bands between 1605 - 1510 cm^{-1} (stretching vibration $\text{C}=\text{C}$) are associated with the position of the lignin band [82]. BPC showed sharp peaks in this region with an increase in temperature to 400 °C. According to Brito et al. [79] these bands indicate an increase in aromaticity, due to the thermal decomposition of lignin.

The 1025 cm^{-1} and 890 cm^{-1} bands are attributed to the CH_2 scissor stretching and COC stretching into cellulose, respectively, these bands being sensitive to the amount of crystalline and amorphous cellulose [81]. In the literature have reported that functional groups containing oxygen, nitrogen and sulfur, in general, are prevalent in processes that involve adsorption of different types of compounds, including heavy metals [79,83]. Functional groups with these absorption bands are observed in the BPC and BEC at 400 °C, in the region of 2400-1800 cm^{-1} .

3.6 Approximate economic analysis

The average yield for obtaining Biochars (BCV, BMB, BPC and BEC) was 91%, 88% 87% and 86% respectively, which corresponds on average to 880 kg of biochar produced, for each ton of biomass (Table 4). The market value considered for the gross biochar was US\$ 0.23 per Kg for charcoal of industrial use, according to Secretariat of Finance, Ordinance No. 611/2015 from the State of Pará-Brazil [84].

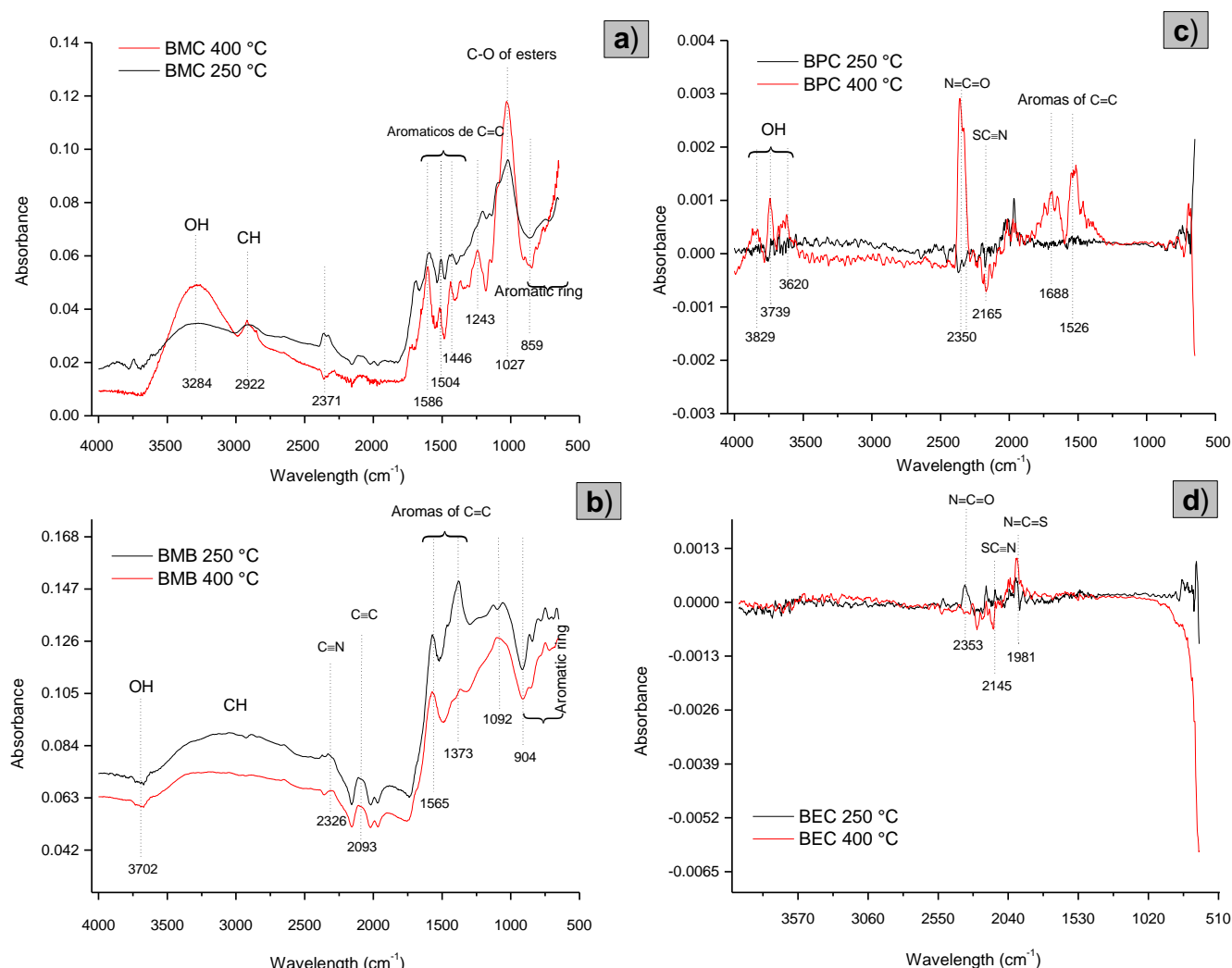


Fig. 5: Biochar spectra: Identification of functional groups by FTIR.

The activated biochar, from 10 g of biochar immersed in a solution of zinc chloride - ZnCl_2 , at a concentration of 10%, a maximum yield of biochar was obtained after activation of 82%, 84%, 86% and 88%, for BCV, BMB, BPC and BEC biochar respectively, which corresponds to 850 kg of activated carbon. The price of high purity

industrial activated carbon according to the catalog of a major supplier (Activated Charcoal Norit ®- Sigma Aldrich) is US\$ 93.10 /kg. For the present study, a low to intermediate purity coal is considered, with a cost of US\$ 20.00 /kg.

Table 4: Approximate economic balance of biochar and activated carbon.

BIOMASS	OUTPUT			INPUT			
	Conc. (1)	Quantities processed	Values (US\$)	Biochar	Values (US\$)	Activated biochar	Values (US\$)
MC	-	1 t	-	910 Kg	209.30	746 Kg	14,920.00
MB	-	1 t	-	880 Kg	202.40	739 Kg	14,780.00
PC	-	1 t	-	870 Kg	200.10	748 Kg	14,960.00
EC	-	1 t	-	860 Kg	197.80	757 Kg	15,140.00

ZnCl ₂	10%	3,000 L	400.35	-	-	-	-
TOTAL			400.35		809.60		59.800,00

TOTAL BALANCE (Output-Input) for Biochar = US\$ 809.60

TOTAL BALANCE (Output-Input) for Activated biochar = US\$ 59,399.65

(1) concentration.

According the expenses with inputs, the consumption of electric energy, and considering that the biomass used does not have a market price, a total income of up to US\$ 59,399.65 can be obtained from the biochar produced. The economic benefits can also be obtained from the sale of bioproducts. In relation to LA, FF and FA, the theoretical yield possible to obtain is 11.24%, 27.02% and 4.5% respectively, which can reach considerable commercial values according to Table 5.

The use of these residues (coconut mesocarp, babassu mesocarp, Brazil nut shell pericarp and Brazil nut shell endocarp) also brings social benefits, how to income generation, social and labor inclusion for low-income people involved in the production chain of these bioproducts, in addition to the economic recovery of this residue [85,86].

Table 5: Marketable bioproducts estimated from biomass hydrolysis.

BIOPRODUCTS	BIOMASS				VALUE* (US\$)
	Estimated yield (%) and estimated mass yield (g)				
	MC	MB	PC	EC	
Levulinic acid	11.24 (0.97)	8.35 (0.72)	6.76 (0.58)	7.07 (0.61)	70.00 Kg
Furfural	6.74 (0.58)	27.02 (2.35)	2.52 (0.21)	5.92 (0.51)	117.00 Kg
Formic acid	4.50 (0.39)	3.34 (2.29)	2.70 (0.23)	2.82 (0.24)	131.00 L

*Commercial value obtained at Sigma-Aldrich.

Successful initiatives to transform lignocellulosic waste into business opportunities can be found in different segments of the Brazilian agrobusiness [86]. The Tobasa Bioindustrial, for example, develops projects for the full use of babassu in the Amazon forest. The Biorefinery has 150 employees and 1,500 extractivists as partners in the process of industrializing various products derived from babassu, including activated carbon [87].

IV. CONCLUSION

The results found revealed the potential of the residues of green coconut, babassu and Brazil nut shell in biorefineries. The processes employed made the use of these biomasses more efficient and competitive, with the production of a greater variety of bioproducts.

The acid hydrolysis process enables the subsequent bioconversion of fermentable sugars (glucose, xylose and arabinose) and added-value bioproducts, levulinic acid

(LA), furfural (FF) and formic acid (FA), which are valuable chemical inputs in several sectors industry.

The thermochemical conversion of the biomass of green coconut, babassu and Brazil nut shell with the objective of producing biochar is an alternative, viable process, for the full use of these raw materials, with the generation of inputs of economic interest, and can be used as solid fuel, soil conditioner and bioremediation. In addition, the process contributes to the mitigation of the environmental problem of final disposal of this waste.

Therefore, the efficient use of these biomasses (green coconut, babassu and Brazil nut shell), points to the enormous social, economic and environmental potential. Added to this, product diversification, will for a fact have positive impacts on the various productive chains involved, benefiting society, generating employment and income, in addition to reducing environmental impacts. However, it is necessary to reflect on public policies that encourage the development of technologies and systems

that contribute to the management and energy use of these residues in biorefineries, in order to stimulate the participatory and social inclusion aspects.

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Avifaunistic study in mangrove areas in a stretch of the São Caetano de Odivelas – Pará coast

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Abstract— The knowledge of the coastal avifauna is essential to understand the dynamics of the coastal ecosystem along the northern coast of Brazil, which is considered an area of high priority for the conservation of regional biodiversity. The Equatorial Region includes the coast of the States of Rio Grande do Norte to Amapá, and the coast of the States of Maranhão, Pará and Amapá is made up of mangroves, an ecosystem of transition between the terrestrial and marine environments, subject to the tidal regime, this ecosystem on the Amazon coast is of paramount importance because the States of Pará and Maranhão represent 57% of the mangroves in Brazil. This research aimed to determine the occurrence of resident and migratory coastal species, as well as their ecological importance and use in the mangrove ecosystem, the study site was São Caetano de Odivelas, in the locality of São Miguel, the methods of data collection used were: visual observation with the method by estimation in larger populations and open ornithological networks linearly from 6:00 a.m. to 11:00 p.m. and from 3:00 p.m. to 6:00 p.m. for two consecutive days totaling the sample effort amounted to 1.080 net hours. The results showed that 72 species of birds were recorded distributed in 27 families and 11 orders, being these residents, seasonal visitors from the northern hemisphere and other endemic to Brazil. It is concluded that there are several species recorded on the coast in São Caetano de Odivelas - Pará, such as endemic species, residents, and other seasonal visitors.

Keywords— Amazon, Brazil, Conservation, Avifauna, Mangrove forest.

I. INTRODUCTION

The mangrove forest is one of the ecosystems with the greatest socioeconomic and ecological importance and one of the most productive on the planet. It presents high soil fertility, permanent humidity and high temperatures that generate favorable feeding, reproduction, and protection conditions for many marine species of commercial interest. The environment reduces the vulnerability of the coastal zone to global climate changes, such as changes in rainfall and temperature regimes, an increase in extreme events such as storms and extreme high tides, an increase in the average sea level in the coastal zone and an increase in the concentration of carbon dioxide [17,07,31].

The mangrove forest is defined as "a coastal ecosystem, of transition between terrestrial and marine environments, characteristic of tropical and subtropical regions, subject to tidal regimes" [45]. The global distribution of the mangrove forest reaches 137,760 km², while in Brazil it is extremely significant for its extension and distribution

along the coastline occupying an area of 11,144 km² [28]. Brazil has 120 conservation units with mangroves in the interior (55 federal, 46 State and 19 municipal, of which 83% are for sustainable use and 17% for full protection) covering an area of 1,211,444 hectares, which represents 87% of the entire ecosystem in Brazil [31]. The northern region has more than 80% of the national mangrove areas, concentrated in the States of Amapá, Pará and Maranhão.

The Brazilian Amazon coast has the largest and most developed mangroves in the country, and all this magnitude is reflected in the diversity of habitats produced and, consequently, in the abundance of species of flora and fauna that occur in the mangroves in this region of Brazil [23]. This region constitutes one of the main routes of migratory bird species, highlighting, in the North of Brazil, the Amapá coast, the Pará salt marshes and recesses due to its extension, habitat diversity and productivity [37]. The Charadriiformes (blowpipes, batuíras, gulls and trintaréis) correspond to the group of birds with the highest

representation of northern migrant species and colonies of Ciconiiformes [44] using the coastal strip during their life cycle, for reproduction and obtaining food, because it provides the necessary resources for the continuation of biological processes such as feather seedlings, to later return to their areas of origin, thus completing their biological cycle, reproduction and landing area, being indicators of environmental conditions [09,16,11].

These environments present characteristic avifauna, with restricted species and reproductive strategies strongly influenced by the environmental conditions of the mangrove. This ecosystem is also used as nesting areas by colonies of several species of birds, with a strong hierarchical disposition in the occupation of the best places by the species considered stronger, such as the genus *Ardea* [33,47]. It is possible to observe all the phases of the reproductive process in the nest area, with a gradient that includes from couples in pre-nuptial ceremonies to pairs with already grown puppies. Adults can move at considerably long distances to capture food for the offspring.

In the neotropics the species of birds well represented in the mangrove area are among the stork families (Ciconiidae), herons and punches (Ardeidae) and spoonbills (Threskiornithidae), being represented by about 10 species almost all colonial. Several species of Neotropical Passeriformes demonstrated a trophic relationship with productivity in the mangrove swamp. The importance of mangrove food resources for this group, where data with different arthropod taxa show a temporal pattern like the pattern of abundance of Passeriformes during the annual cycle in mangrove areas in Venezuela. Studies highlight the importance of these environments for the conservation and maintenance of avifauna [02,42,54,04,23,26,05,06,18]. In this context the research aimed to determine the occurrence of resident and migratory coastal species, as well as their ecological importance and use in the mangrove ecosystem.

II. MATERIAL AND METHODS

São Caetano de Odivelas is part of the Northeast region of the State of Pará and its main city is located at 00 °44 ' 33 'S and 48 ° 01' 03'W (SEPOF, 2011). It is limited to the north with the Atlantic Ocean; to the east with the municipality of Curuçá; to the west with the municipality of Vigia. It has an area of 724.10 km², including its urban center and 41 communities. It has a territorial area of 743.4 km², with a population density of 22.72 inhab./km² and a population of 16,891 inhabitants according to IBGE estimates for 2010.

The vegetation found in the region are: restinga vegetation, mangrove vegetation, floodable natural field vegetation and secondary vegetation [39]. Mangrove vegetation is typically composed of tidal plains under the influence of brackish water, or fluvial marine plains, with ideal physiography for the formation of this vegetation, since they constitute marshy or muddy areas, covered by water during flood tides and discovered at ebb tides, also receiving water from river and underground drainage [40].

The data collection period was six months, being carried out from April 2015 to July 2016. For the census, it was considered the counting one by one when the population was small and, in the large one, the method by estimation was used, when a group of 10 is "mentally photographed" and the rest of the birds are counted by group of 10 [22]. The identification of coastal birds was performed at a specific level with the aid of Tasco binoculars (10X25) and specific identification guides [16].

Ten ornithological nets (2.5 x 12 m; mesh 36 mm) were used, which were positioned linearly in the mangrove. The nets were opened from 6:00 a.m. to 11:00 a.m. and from 2:00 p.m. to 6:00 p.m. inspected every 45 minutes) were simultaneously monitored [21,13]. The captured specimens, after identification, were released near the capture sites and the sample effort totaled 1,080 net hours. The classification and taxonomic order to compose the list of registered bird species followed the 12th edition of the Brazilian List of Birds, published by the Brazilian Committee of Ornithological Records [08].

The Frequency of Occurrence (FO) of the species registered per expedition was calculated. The FO was defined as the percentage of the number of individuals of a species in relation to the total individuals counted. The frequency was calculated with the number of visits in which the species was found over the number of visits made, multiplied by 100. The species were categorized as regular: present in more than 50% of the visits, sporadic: between 25 and 50% and occasional: in less than 25% of the species in the visits.

III. RESULTS AND DISCUSSION

The Neotropical region has a high diversity of birds and it is essential to expand the knowledge about the composition and richness of the bird population of a region to contribute to local ecological studies and migration groups. Birds represent about 38% of the vertebrate fauna associated with mangrove forests around the world, which makes this ecosystem essential for maintaining the diversity of this group. There are a variety of adaptations in birds that allow diverse feeding habits, such as frugivorous,

granivorous, insectivorous, nectarivorous, carnivorous, piscivorous, detritivorous or necrophagous and omnivorous. Birds represent an important group for maintaining the ecological balance of an area, since they act as seed dispersers, pollinating agents, population regulators and are also bioindicators of conservation [10]. The Neotropical region has a high diversity of birds and it is essential to expand the knowledge about the composition and richness of the bird population of a region to contribute to local ecological studies and migration groups.

In the community of São Miguel, 72 bird species were recorded distributed in 27 families and 11 orders. Resident species, seasonal visitors from the northern hemisphere and endemic to Brazil (Table 01). The data corroborates the studies carried out in the Resex Mãe Grande Curuçá where 36 families and 70 bird species were recorded [12] and demonstrates its importance for the conservation of this group, since in Brazil 35 families and 86 bird species are recorded that use the mangrove forest in some way throughout its biological cycle [52]. At Rio de Janeiro, 31 bird species were recorded distributed in 18 families on the Pombeba island [51].

Table.1: List of bird species registered in the mangrove forest on the island of São Miguel, Municipality of São Caetano de Odivelas - Pará, held between April 2015 and July 2016.

Taxon name	Common name	Frequency	Register	Status
Anseriformes				
Linnaeus, 1758				
Anatidae Leach, 1820				
<i>Amazonetta brasiliensis</i> (Gmelin, 1789)	Marrecã	sporadic	O	R
Ciconiiformes				
Bonaparte, 1854				
Ardeidae Leach, 1820				
<i>Nyctanassa violacea</i> (Linnaeus, 1758)	savacu-de-coroa	regular	O	R
<i>Cochlearius cochlearius</i> (Linnaeus, 1766)	Arapapã	regular	O	R

<i>Ardea alba</i> Linnaeus, 1758	garça-branca-grande	regular	O	R
<i>Ptilerodius pileatus</i> (Boddaert, 1783)	garça-real	regular	O	R
<i>Egretta tricolor</i> (Statius Muller, 1776)	garça-tricolor	regular	O	R
<i>Egretta thula</i> (Molina, 1782)	garça-branca-pequena	regular	O	R
<i>Egretta caerulea</i> (Linnaeus, 1758)	garça-azul	regular	O	R
<i>Nyctanassa violacea</i> (Linnaeus, 1758)	savacu-de-coroa	regular	O	R
<i>Butorides striata</i> (Linnaeus, 1758)	socozinho	regular	O	R
Threskiornithidae				
Poche, 1904				
<i>Eudocimus ruber</i> (Linnaeus, 1758)	guará	regular	O	R
<i>Mesembrinibis cayennensis</i> (Gmelin, 1789)	coró-coró	sporadic	O	R
<i>Theristicus caudatus</i> (Boddaert, 1783)	curicaca	sporadic	O	R
Ciconiidae				
Sundevall, 1836				
<i>Ciconia maguari</i> (Gmelin, 1789)	maguari	regular	O	R
Cathartidae				
Lafresnaye, 1839				
<i>Cathartes aura</i> (Linnaeus, 1758)	urubu-de-cabeça-vermelha	regular	O	R
<i>Cathartes burrovianus</i> Cassin, 1845	urubu-de-cabeça-amarela	sporadic	O	R
<i>Coragyps atratus</i> (Bechstein, 1793)	urubu-de-cabeça-preta	regular	O	R

Falconiformes						(Molina, 1782)					
Bonaparte, 1831						quero					
Pandionidae						<i>Charadrius collaris</i>					
Bonaparte, 1854						batuíra-de-coleira					
<i>Pandion haliaetus</i>	águia-pescadora	regular	O	SV		Vieillot, 1818	regular	O	R		
Accipitridae						Scolopacidae					
Vigors, 1824						Rafinesque, 1815					
<i>Elanoides forficatus</i>	gavião-tesoura	occasional	O	R		<i>Calidris alba</i>	maçarico branco	sporadic	O	SV	
(Linnaeus, 1758)						(Pallas, 1764)					
<i>Rupornis magnirostris</i>	gavião-carijó	regular	O	R		<i>Actitis macularius</i>	maçarico-pintado	sporadic	O	SV	
(Gmelin, 1788)						(Linnaeus, 1766)					
<i>Buteo swainsoni</i>	gavião-papagaio	occasional	O	R		<i>Numenius phaeopus</i>	maçarico-galego	sporadic	O	SV	
Bonaparte, 1838						(Linnaeus, 1758)					
Falconidae Leach, 1820						<i>Arenaria interpres</i>	vira pedras	regular	O	R	
<i>Milvago chimachima</i>	carrapateiro	regular	O	R		(Linnaeus, 1758)					
(Vieillot, 1816)						<i>Calidris minutilla</i>	maçariquinho	sporadic	O	SV	
Gruiformes						(Vieillot, 1819)					
Bonaparte, 1854						<i>Tringa melanoleuca</i>	maçarico-grande-perna-amarela	sporadic	O	SV	
Rallidae						(Gmelin, 1789)					
Rafinesque, 1815						<i>Tringa semipalmata</i>	maçarico-de-sobre-branco	sporadic	O	SV	
<i>Aramides mangle</i>	saracura-do-mangue	regular	O	R, E		(Gmelin, 1789)					
(Spix, 1825)						<i>Tringa flavipes</i>	maçarico-de-perna-amarela	sporadic	O	SV	
<i>Gallinula chloropus</i>	frango-d'água-comum	regular	O	R		(Gmelin, 1789)					
(Linnaeus, 1758)						<i>Tringa solitaria</i>	maçarico-solitário	sporadic	O	SV	
Eurypyidae Selby, 1840						Wilson, 1813					
<i>Eurypyga helias</i>	pavãozinho-do-pará	regular	O	R		<i>Calidris himantopus</i>	maçarico-pernilongo	sporadic	O	SV	
(Pallas, 1781)						(Bonaparte, 1826)					
Charadriiformes						<i>Calidris minutilla</i>	maçariquinho	occasional	O	SV	
Huxley, 1867						(Vieillot, 1819)					
Charadriidae						Sternidae Vigors, 1825					
Leach, 1820						<i>Sternula antillarum</i>	trinta-réis-	sporadic	O	R	
<i>Vanellus cayanus</i>	batuíra-de-esporão	regular	O	R							
(Latham, 1790)											
<i>Vanellus chilensis</i>	quero	regular	O	R							

Lesson, 1847	miúdo	c				(Da Silva Maia, 1843)	flor-verde				
<i>Sternula superciliaris</i> (Vieillot, 1819)	trinta-réis-anão	regular	O	R		<i>Amazilia fimbriata</i> (Gmelin, 1788)	beija-flor-de-garganta-verde	regular	C	R	
<i>Phaetusa simplex</i> (Gmelin, 1789)	trinta-réis-grande	regular	O	R		Coraciiformes					
<i>Sterna hirundo</i> Linnaeus, 1758	trinta-réis-boreal	occasional	O	R		Forbes, 1844					
Rynchopidae						Alcedinidae					
Bonaparte, 1838						Rafinesque, 1815					
<i>Rynchops niger</i> Linnaeus, 1758	talha-mar	regular	O	R			martim				
Columbiformes						<i>Megaceryle torquata</i> (Linnaeus, 1766)	- pescador-grande	regular	C	R	
Latham, 1790							martim				
Columbidae Leach, 1820						<i>Chloroceryle americana</i> (Gmelin, 1788)	- pescador-pequeno	regular	C	R	
<i>Columbina passerina</i> (Linnaeus, 1758)	rolinha-cinzenta	regular	C	R			martim				
<i>Columbina talpacoti</i> (Temminck, 1811)	rolinha-roxa	sporadic	C	R		<i>Chloroceryle inda</i> (Linnaeus, 1766)	- pescador-damata	sporadic	C	R	
<i>Leptotila verreauxi</i> Bonaparte, 1855	juriti-pupu	regular	C	R		Piciformes Meyer & Wolf, 1810					
<i>Leptotila rufaxilla</i> (Richard & Bernard, 1792)	juriti-gemedeira	regular	C	R		Picidae Leach, 1820					
<i>Geotrygon montana</i> (Linnaeus, 1758)	Pariri	regular	C	R		<i>Campephilus melanoleucos</i> (Gmelin, 1788)	pica-pau-de-topete-vermelho	sporadic	O	R	
Psittaciformes						Passeriformes Linné, 1758					
Wagler, 1830						Dendrocolaptidae					
Psittacidae						Gray, 1840					
Rafinesque, 1815						<i>Xiphorhynchus spixii</i> (Lesson, 1830)	arapaçu	sporadic	C	R	
<i>Amazona amazonica</i> (Linnaeus, 1766)	curica	regular	O	R		Thamnophilidae					
Apodiformes Peters, 1940						<i>Swainson, 1824</i>					
Trochilidae vigors, 1825						<i>Thamnophilus aethiops</i> Sclater, 1858	chocalisa	sporadic	C	R	
<i>Thalurania furcata</i> (Gmelin, 1788)	beija-flor-tesoura-verde	regular	O	R		<i>Myrmotherula axillaris</i> (Vieillot,	choquina-de-flanco-	regular	C	R	
<i>Polytmus theresiae</i>	beija-	regular	O	R							

1817)	branco				
Formicariidae Gray, 1840					
<i>Formicarius colma</i> Boddaert, 1783	galinha-do-mato	sporadic	O	R	
Tyrannidae Vigors, 1825					
<i>Pitangus sulphuratus</i> (Linnaeus, 1766)	bem-te-vi	regular	C	R	
<i>Mionectes oleagineus</i> (Lichtenstein, 1823)	abre-asas	regular	C	R	
<i>Tyrannus melancholicus</i> (Vieillot, 1819)	suiriri	regular	C	R	
Turdidae Rafinesque, 1815					
<i>Turdus rufiventris</i> (Vieillot, 1818)	sabiá-laranjeira	regular	C	R	
Thraupidae Cabanis, 1847					
<i>Tachyphonus rufus</i> (Boddaert, 1783)	pipira-preta	regular	C	R	
<i>Ramphocelus carbo</i> (Pallas, 1764)	pipira-vermelha	regular	C	R	
<i>Conirostrum bicolor</i> (Vieillot, 1809)	figuirinha-do-mangue	regular	C	R	
Pipridae Rafinesque, 1815					
<i>Chiroxiphia pareola</i> (Linnaeus, 1766)	tangará-falso	occasional	C	R	
<i>Manacus manacus</i> (Linnaeus, 1766)	rendeirã	occasional	C	R	
Thraupidae Cabanis, 1847					
<i>Thraupis episcopus</i> (Linnaeus, 1766)	sanhaçu-da-Amazônia	regular	C	R	
<i>Thraupis palmarum</i> (Wied, 1823)	sanhaçu-do-coqueir	regular	C	R	

o

Sporophila angolensis (Linnaeus, 1766)

Curió regular C R

Type of register: C = capture; O = visual observation; Status R = resident, SV = seasonal visitor from the northern hemisphere, and E = endemic species of Brazil

The Scolopacidae family had the highest richness with 15% of the species (n: 11), followed by Ardeidae with 13% (n:09), Columbidae 7% (n:05), Sternidae with 6% (n:04) Threskiornithidae, Cathartidae, Charadriidae, Alcedinidae, Accipitridae, Trochilidae, Tyrannidae and Thraupidae each one with 4% (n:03) Rallidae, Thamnophilidae, and Pipridae with 3% each (n:02) and Anatidae, Ciconiidae, Falconidae, Rynchopidae Pandionidae, Psittacidae, Eurypygidae, Picidae, Dendrocolaptidae, Formicariidae, and Turdidae with 1.5% each (n:01). The Scolopacidae family obtained the highest number of species (10) of seasonal visitor from the northern hemisphere. Migrations are seasonal movements at various geographical scales (local, regional, intercontinental, etc.), whose routes include a breeding area. Each year, thousands of birds that breed in the northern hemisphere move to various locations in the south, fleeing the boreal winter. The birds identified as migrants correspond to representatives of the Charadriidae and Scolopacidae families. The species of these families are basically related to the beach, but can be observed in flooded environments, such as swamps and mangroves (Graphic 1).

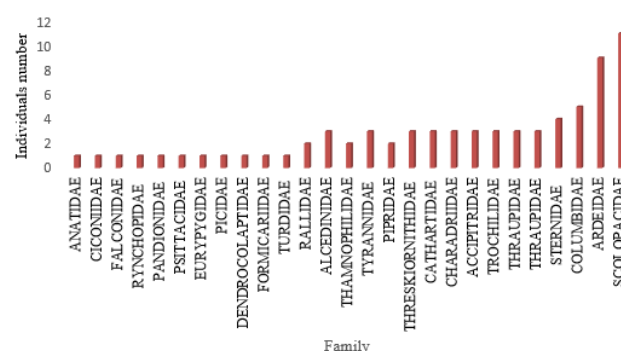


Fig.1: Number of species present in the families of birds registered on the island of São Miguel in the municipality of São Caetano de Odivelas - Pará, held between April 2015 and July 2016.

The Charadriidae family is distributed along the coast of Brazil, in the intertidal zone of beaches and mangroves, with displacement between these landscapes by the continuous movement in search of food both migratory

species and residents [05]. The birds feed on the invertebrates of the entomofauna of these habitats, the abundance of the organisms that constitute the food of these birds obeys seasonal cycles, and the peaks of this abundance occur in fixed periods, which makes it possible to synchronize the timing of the arrival of the birds in their "conditioning areas" adjusted to coincide with these peaks of food.

The exchanges between different areas within the landscape have the same ecological function as the more restricted movements between the spots that concentrate food in the same area [27,34]. Another factor can be the variation in scale and time of the density of invertebrates [29,22], and foraging by cohesiveness can quickly decrease the number of local invertebrates. When the abundance of local prey decreases, beach birds move to areas where the food density is higher, such as mangroves.

The protection of migratory birds is linked to the preservation of their breeding, feeding and resting sites. The loss or alteration of wintering and resting sites of these birds may result in the reduction and even the local extinction of some species or the decrease of the population. In this context, the conservation of the mangrove swamp on the island of São Miguel represents a fundamental area for species especially of the Scolopacidae family, with record *Actitis macularius* (April/August 2015 and February/March 2016), *Tringa solitaria* (April/December 2015), *Tringa melanoleuca* and *Calidris minutilla* (February/March 2016) and *Numenius phaeopus* (October 2015), it is necessary to highlight the importance of the quality of the habitats used as resting and feeding points for migratory birds, especially those that cross great geographical barriers during their movements [32].

The family Threskiornithidae (Ciconiiformes Order) includes 13 genera and 32 species of birds widely distributed around the globe, except in Antarctica, highlighting the ibis and spoonbills. They have long and curved beaks, long legs and neck, characteristics that contributed to the occupation of flooded environments and a diet based on aquatic species such as small crustaceans, larvae, mollusks, fishes, and crabs [48]. The Ciconiiformes of the northern coast of Brazil occupy both the continental wetlands, such as the Baixada Maranhense, and the mangroves where about 10 species occur, almost all of which are colonial, which can be monospecific or mixed. Coloniality has provided the development of scientific studies on development, reproductive strategy, and puppy diet due to high detectability. Several species of Ciconiiformes have their reproductive strategy strongly influenced by the specific conditions of the mangrove swamp, either by their spatial configuration in the form of

micro-habitat along a saline gradient or by seasonal variations in the abundance of resources [12].

The Ardeidae family consists of herons and punches and has as remarkable characteristics the long neck and legs; the straight and long beak, higher than wide, almost always pointed and in most cases with the presence of serrations for the capture of fish. The species *Ardea alba* (white-great-egret) presents greater daytime activity, of solitary habit, as in groups or flocks. It presents a diet composed of fish, invertebrates, reptiles, and amphibians, being predominant the consumption of fish. In foraging for food capture, it moves slowly walking in the water, near the margin to the location of the prey [30]. *Ardea alba* can form numerous nests, lay two to three blue-grey colored eggs and the incubation period is 25 to 26 days [19,25].



Fig.2: A. *Ardea alba* (garca-branca). B. *Nyctanassa violacea* (savacu-de-coroa).

Eudocimus ruber, the guará is a representative of the Threskiornithidae family and is closely related to mangrove environments on the Brazilian coast [47,50]. In Brazil it is distributed in two disjointed populations, one in the North, in the State of Pará and the State of Maranhão [47,15] and another in the South, particularly in the State of São Paulo [48]. The carcinophagous species, such as *Eudocimus ruber*, are more dependent on marine resources and present a smaller laying size, about two eggs, which indicates an optimizing strategy for resources and the production of offspring [12].

On the island of São Miguel about 1500 reproductively active individuals of *Eudocimus ruber* were registered in the period from April to June 2015. The first study on the guará colonies was carried out between the mouth of the Orinoco and the Amazon, on the Amapá coast [50]. Later research in Viseu-PA [43] and on Cajual-Maranhão island [41] recorded the presence of nests of this species. In the State of Santa Catarina, after decades of absence, there were reports of the presence of reproductive activity in late 2012 [14].

The guarás were mostly observed sharing foraging and dormitory sites with other species. The sharing of feeding areas is known for several species of estuarine birds, and there is a general pattern of distribution for each one at the

foraging site. The guardians remain relatively more aggregated, while the *Egretta thula*, *Ardea alba* and *Nyctanassa violacea* are more isolated.



Fig.3: *Eudocimus ruber* (guará).

The genus *Cathartes* covers the necrophagous birds of the New World Vulture family (Cathartidae). There are three species classified in this genus. All species have featherless heads with bright colored skin (yellow or orange on the yellow-headed vulture, and bright red on the red-headed vulture). *Cathartes aura* has been frequently recorded in mangrove swamps, this species also occurs in forests, open lands, farms and on roadsides, captures small vertebrates on shallow flights and steals eggs from herons in nests. It sleeps in large flocks on dry trees and feeds on carcasses and, thanks to its keen sense of smell, is usually the first of vultures to find them. It also feeds on locusts and small fish; it appreciates fruits such as avocado and palm coconuts and stirs up fresh cattle manure for food.

The Alcedinidae family has a wide geographic distribution, occurring in tropical and subtropical zones, near aquatic environments [47]. Kingfishers are characterized as birds with colorful and bright plumage, robust body, relatively large head, short neck, short tongue, long beak, robust and pointed. The species *Megaceryle torquata*, also known as martim-pescador-grande or ariramba is the largest representative of this family, measures approximately 42 centimeters and weighs from 305 to 341 grams. This species was recorded more frequently in the rainy season, in this period there is an increase in soil humidity, which facilitates the construction of the nests, in addition to the increase in food supply. Another species recorded was *Chloroceryle inda*, martim-pescador-da-mata, this species feeds on fish, batrachios and crabs that it catches by diving from low perches in the mangrove vegetation near the water.



Fig.4: A. *Chloroceryle inda* (martim-pescador-da-mata).
B. *Megaceryle torquata* (martim-pescador-grande).

Passeriforme birds are often cited in lists of bird species associated with mangroves [35,36,24,46,03]. In a study carried out in mangroves in the eastern State of Pará, the authors registered nine species of Passeriforme birds, which represented 50% of the inventoried species [35], while in another study 12 species were registered in mangrove areas in the island of Canela, Bragança, Pará [46]. In the island of São Miguel in the Municipality of São Caetano de Odivelas, the number of species belonging to the order of Passeriforme birds, was represented by 21 % of the species (n:15), demonstrating that this taxonomic group has an effective association with the mangrove ecosystem and, consequently, should exert some direct influence on the available resources and the dynamics of this ecosystem.

The arapaçus belong to the family Dendrocolaptidae formed by 14 genera, where 43 known species are classified in Brazil. The group is typical of the Neotropical regions of the New World, with distribution from southern Mexico to central Argentina. They are insectivorous birds that feed on insects preferentially crickets, cockroaches, ants, termites and beetles. Occasionally they also consume small amphibians or reptiles and only in conditions of extreme scarcity do they feed on fruits or seeds. The *Xiphorhynchus spixii* was registered in the study area and its distribution covers the Brazilian Amazon to the south of the Amazon River, extending south to Mato Grosso and east to Maranhão. It is also found in Colombia, Ecuador, Peru and Bolivia. It lives alone or in pairs, often accompanying mixed flocks of birds, and only eventually run ants.

Tyrannidae constitute the largest family of birds in the western hemisphere, where they occur exclusively, distributed from north to south of the American continent, with greater concentration in the Tropical region. This group gathers a wide diversity, totaling 413 species and constituting about 18% of the Passeriforme species in South America. In Brazil they occupy all types of landscape, most of which are arboreal and woodland, feeding essentially on insects and arthropods, but some species are frugivorous, granivorous and carnivorous [48].

The species *Mionectes oleagineus* of the Tyrannidae family was the most representative having an omnivorous diet composed of insects, mainly of the orders Hymenoptera, Coleoptera and Hemiptera, being complemented by fruits, mainly by the species: *Myconia ciliata* (Melastomataceae), *Virola surinamensis* (Myristicaceae), *Spermacoce verticillata* (Rubiaceae), *Phthirusa micrantha* (Loranthaceae), *Symphonia globulifera* (Clusiaceae), *Solanum crinitum* (Solanaceae), *Myrcia fallax* (Myrtaceae).

The pyrids are fruit-eating species of understory, present in general wide geographic distributions and high population densities, being found in the Amazon region the greatest richness of species per biome or ecoregion of the neotropics [01]. This family stands out for presenting a mating system in flocks, in which males are grouped in places or traditional flocks to execute cooperative exhibitions. The female of *Manacus manacus* (lace maker) was registered, a relatively small bird (15 - 18 g) with a diet composed predominantly of fruits. They play an important role in seed dispersal, removing them from areas of high population density, near the mother-plant and places of intense predation by insects and mammals receiving in return nutritional content, play an important role as vectors in seed dispersal in the Neotropical region [48].



Fig.5: A. *Mionectes oleagineus* (abre-asas). B. *Manacus manacus* (rendeira).

Representatives of the Thamnophilidae family are distributed in the Neotropical region and reach their greatest diversity in the Amazon basin. *Thamnophilus aethiops* (flat brook) is also known as xorró, measuring about 16 cm long and weighing 23 g. The male has a general dark grey coloration with the top of the head black and the female is brown with the lower part lighter. His diet is composed of insects and arthropods, including Aranea, Scorpiones, Chilopoda and Isopoda.

For a long time, scientists focused mainly on the conservation of terrestrial ecosystems, because among other reasons their impacts were directly observed. In a silent and less perceptible way, coastal zones, seas and oceans around the world also gradually suffered the effects of the expansion of occupation and anthropic uses. Among

the main causes for the loss of coastal biodiversity were loss of habitat, contamination of continental waters by agrochemicals and fertilizers used in agriculture, toxic industrial waste [20] and human waste without treatment or partially treated, capture of fishing resources (fish, mollusks, crustaceans and algae) in quantities greater than their capacity for reproduction and climate change.

The coastal and marine ecosystem is home to a significant variety of living beings, and provides essential services for human survival, such as food, climate maintenance, water purification, flood control and coastal protection. The mangroves, in turn, present high structural and functional diversity, acting, together with the estuaries, as exporters of biomass to the adjacent systems, this system works as a place of refuge, rest, feeding and reproduction of several taxa of marine and terrestrial life, including birds.

IV. CONCLUSION

The Neotropical region of mangrove on the island of São Miguel, found along the coast of São Caetano de Odivelas - Pará, presents a high diversity of endemic, resident, migratory birds, and other seasonal visitors. Thus, it is necessary to expand the knowledge about the composition and richness of the bird species, in order to contribute to local ecological studies and migratory groups. According to the methodology used, it could be concluded that there were several bird species registered in the region, being those belonging to the Brazilian or migratory bird species, such as those of the Scolopacidae family. Thus, the maintenance of the mangrove swamp on the island of São Miguel is fundamental as a way to conserve these species, since it serves as habitat, resting point, and feeding point for birds, especially those that cross great geographical barriers during their displacement.

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Analysis of Project Acceleration with CPM Method and PDM on Housing Development Project in Maluku 3 West Seram

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Abstract— In the development process of a construction project frequent unwanted things such as delays in the work on the project. Many factors cause the delay, one way to anticipate the acceleration. In doing acceleration, cost and quality factors must be considered, in order to obtain the optimum cost and quality within the required standards. Housing Development Projects have been selected for research studies because of delays in implementation. Critical Path Method and PDM can be used to perform scheduling of project implementation with the consideration that this method is more effective and efficient. Optimization of time and costs obtained from the Crash Program with Network Planning methods PDM system by adding hours of work on each job accelerated. The acceleration is done on the job dilintasan slope critical with the lowest cost. Results of the analysis showed the total budget of the project cost under normal conditions of Rp15,229,000,000.00 with implementation duration of 120 days, in the alternative condition after crashing with the addition of maximum working hours for four hours obtained for Rp15,218,910,720.73 or less 0.07% of the total budget cost of the project on the condition normal and duration of project implementation gained 115 working days or sooner 4.17% of the normal duration.

Keywords— Cost slope, Crashing, Critical Path, PDM.

I. INTRODUCTION

There are three components of the success of a construction project, including the factors of cost, quality and time. In a period that has been provided, a contractor must be able to manage construction projects systematically in order to achieve success in accordance with the project plan. But in reality, the operator of the project contractor can not complete the work within the time planned.

Problems are often found in field is the delay time of execution. Delays in result by several things including, land issues, design changes, delays in the auction, as well as weather conditions in the field. Delays that exceed the limit will be penalized in the form of a fine of 1/1000 of the contract value per day, according to Presidential Decree No. 54 of 2010 Article 120. Then the project implementers will attempt to shorten the duration of the project, so the project completion time can be in accordance with the plan. One effort to shorten the duration of the project is to accelerate the implementation of the,

In this study, the authors conducted a case study on the Maluku 3 Flats Construction Project located in the village of Ety, Piru city, West Seram district with a contract value of Rp. 15,229,000,000.00 and implementation time is 120 calendar days. This building is planned for 3 floors with a capacity of 168 people. The problem in this development project was chosen because it was delayed in its implementation, the author will conduct an analysis of the acceleration of project completion with the Analysis Method that will be used namely the CPM (Critical Path Method) and PDM (Precedence Diagram Method) and Project crashes. The purpose of this research is to accelerate project implementation time by determining the critical trajectory of a project so that it can be done to reduce the maximum duration with the most economical cost of activities that are still possible to be reduced.

II. LITERATURE REVIEW

2.1 Understanding Project

Projects can be interpreted as a temporary activity that takes place within a limited period, with a particular resource allocation and is intended to produce a product or deliverable that quality criteria have been outlined clearly. The scope of these tasks can be a plant, the manufacture of new products or implementation of research and development.

2.2 Project Scheduling

Scheduling can be defined as the time available for the implementation of each part in order to completing a project such that achieved optimal results, taking into account the existing limitations.

a. Techniques In Scheduling

Broadly speaking scheduling techniques can be classified into:

1) Bar Chart Methods (Gantt Chart)

Bar Chart Gantt introduced by Hendry I. and Frederick W. Taylor in early 1917. The bar chart is a set list of activities that are organized into columns vertical direction. Column horizontal direction indicates a time scale. When start and end of an activity can be seen clearly, while the duration of the activities described by the length of the bars.

No.	Job Order	Week												
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Foundation work													
2	Concrete works													
3	Kap's job													
4	Attic Work													
5	Plastering Work													
6	Floor job													
7	Door work													
8	Painting Work													
9	Equipment Work													

Fig.1: Example Bar Chart

2) CPM Method (Critical Path Method)

In this method of work (activity) is symbolized by two arrows, while the node as a marker of start and end of a job. The relationship between activities in the form of relationship possible only finish to start. In this method known as the "dummy" which is a facility that can be considered as an activity that does not exist duration.

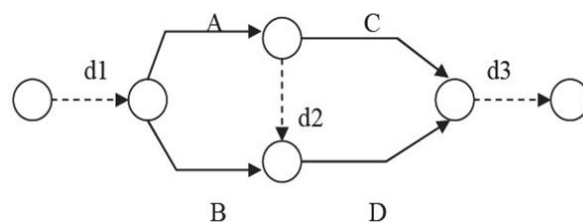


Fig.2: Methods AOA Network Diagram

3) PDM method (Precedence Diagram Method)

Methods Precedence Diagram Method (PDM) is a refinement of the CPM, because in principle CPM uses only one kind of relationship that ties the end of the initial activity and an activity can be started when the events that preceded it finished. Activities and events in the diagram precedent methods node written in the form of a rectangular box. The boxes marked an activity, which must be specified identity and activities over time. While the event is an activity ends. Each node has two events are the beginning and the end.

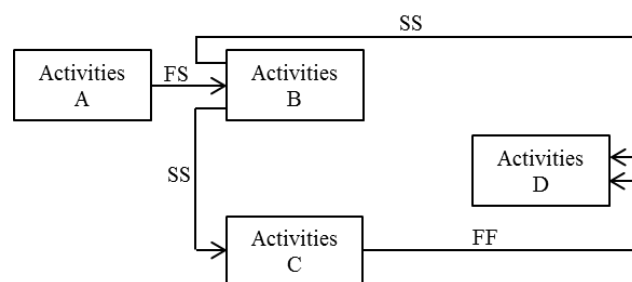


Fig.3: Network Diagram PDM

b. Critical Path

This path requires maximum attention of project managers, especially in the period of planning and implementation of work / activity concerned, for example, be given top priority in the allocation of resources can be a labor, equipment or working hours. In addition the project life can be known of how long the duration of the critical path are obtained.

2.3 Acceleration Project Duration

According to Syah (2004) crash program or accelerated implementation of the work means shortening (implementation) project. The amount / number is equal to the life of the project / the amount of time available to a critical path. Acceleration of implementation of the work means that efforts to shorten the critical path on the network work plan is concerned.

Meanwhile, according to Husen (2010) project crashing done so that the work completed by the exchange of cross-time and cost and to increase the number of shift work, hours of work, number of employees, the availability of

materials, and using equipment that is more productive and installation methods faster as direct cost component cost. Project crashing or crash the program is done by using the network planning schedule improvements that are on the critical path. The consequence is the rising cost crashing project (direct costs).

To further analyze the relationship between time and cost of an activity, then used the following definition:

a. Period of normal

Is the period of time required to conduct to completion, in an efficient manner but beyond consideration of their overtime and other special efforts, such as hiring more sophisticated equipment.

b. The normal cost

Are the direct costs necessary to complete a period of normal activities. There are fees and charges Normal Normal Material wages.

Normal fee formula:

$$\text{coefficient} = \frac{\text{Material costs} / \text{Wage}}{\text{Material and Wage Costs}}$$

Total Normal Cost = coefficient x Normal Cost x Volume of Work

c. This period of time is shortened (crash time)

Is the shortest time to complete an activity which is technically still possible. Here are considered resource rather than an obstacle.

The formula to calculate the duration of crashing:

Duration crashing = (Volume of Work) / (working capacity 12 hours x number of workers)

d. The cost for the shortened time (crashes cost)

Is the sum of direct costs to finish the job with the shortest period of time.

Total Wages Labor formula:

= ((Normal wage + wage hour to hour wage 1+ to 2+ wage + wage hour to 3 hours to 4) x Duration crash x number of labor)

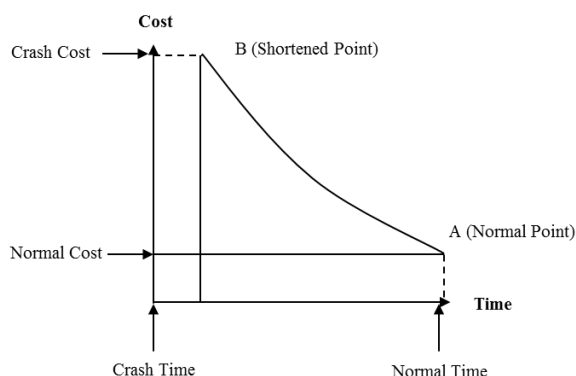


Fig.4: Relationships normal time-cost and shortened

The relationship between time and cost depicted as a graph in Figure 3. Point A shows the normal points, while point B is shortened. The line connecting point A to B is called the time-cost curves. In general, this line can be regarded as a straight line, when it is not (eg, concave) then held a calculation per segment consisting of several straight lines. If known shape of the curve-time cost of an activity, which means that by knowing how slope or angle of slope, it can be calculated how much it costs to shorten the time of day with the formula:

$$\text{cost slope} = \frac{\text{crash cost} - \text{Normal cost}}{\text{Normal time} - \text{Crash time}}$$

The total project costs are the sum of direct costs and indirect costs used during project implementation. The amount of this fee is dependent by the length of time (duration) of the project's completion, both of them changes with time and the progress of the project. While it can not be calculated with certain formulas, but in general, the longer the project goes higher cumulative indirect costs are required.

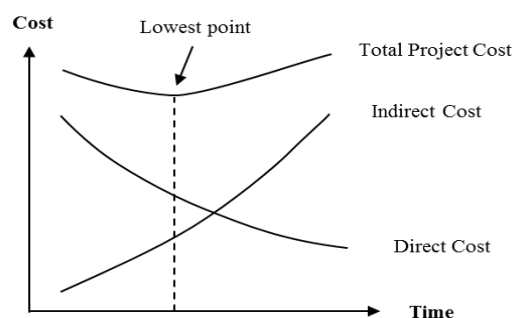


Fig.5: Grafik time relationship with the total costs, direct costs and indirect costs

III. RESEARCH METHODOLOGY

3.1 Research sites

This case study was carried out in the Maluku 3 Flats Construction Project located in Ety Village, West Seram Regency, Maluku Province

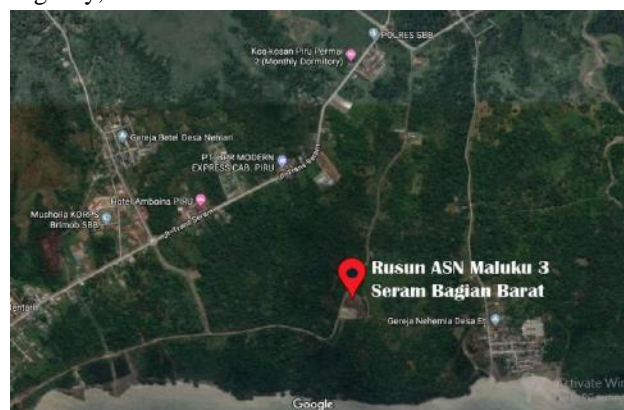


Fig.6: Research Location Map

3.2 Data Collection Technique

Data collection techniques used by the author in this study are:

a. Field Study

Field studies conducted to obtain primary data by conducting surveys directly on the construction project Rusun Maluku 3 which is the object of research, which conducted interviews with the supervising consultants, contractors, and workers at the project site and the parties related to the scope of the project.

b. Library Studies

Literature study was conducted to obtain secondary data in order to support the primary data. The data collection is done by reading and studying books, browse the internet and journals related to the acceleration of the implementation of the project.

3.3 Data Types

The type of data used in this paper are:

a. Primary Data

Is the data that can only be obtained from the original source or first. The primary data such as interviews with the parties involved in the implementation of such projects on the causes of delay in the execution

b. Secondary Data

Secondary data is data that has been provided so that only needs to be sought, collected and processed are obtained from the relevant agencies, including:

- Budget plan
- Unit Price Analysis Works
- Price Wages and Materials
- Project Plan
- Thime Schedule
- Project Report
- Methods Of Implementation
- Contract Change Order

3.4 Data Analysis

In the acceleration of the duration of the project is done by increasing the hours worked four hours, which is expected in a day the volume of work produced greater. Application of this method requires the calculation of crashes and crash duration, the instrument in this study using the Precedence Diagram Method (PDM) with the help of Microsoft Project to determine the critical path of the project, which will further speed up the calculation in activities which are on the critical path.

3.5 Flowchart of Research

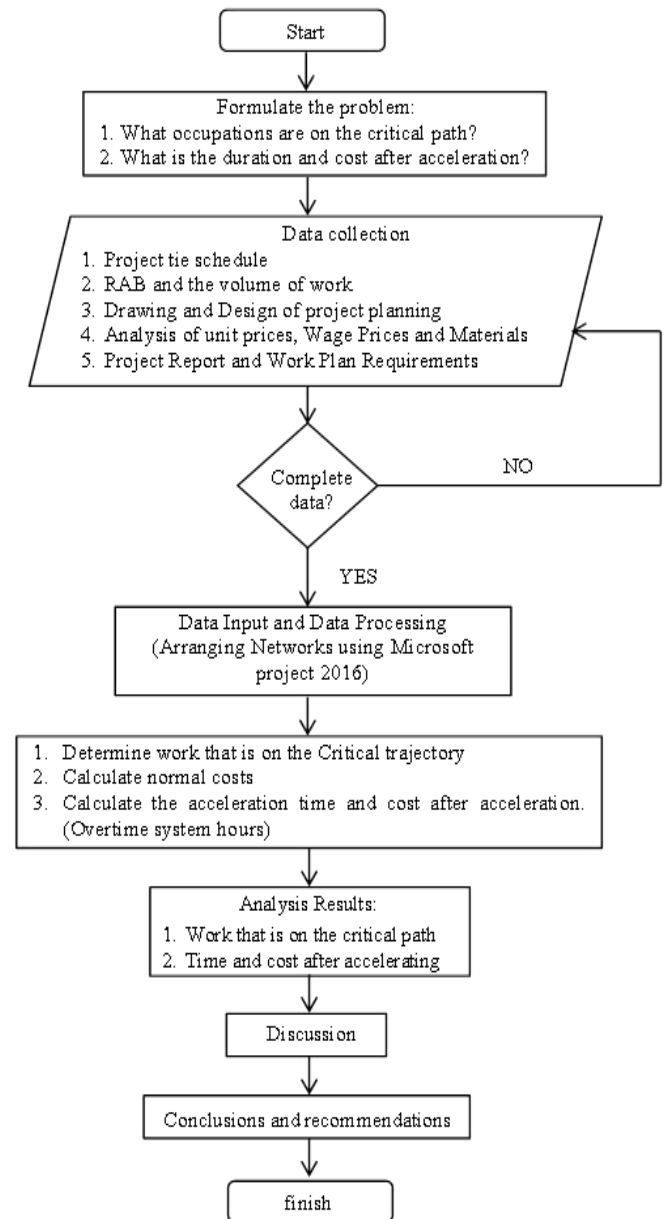


Fig.7: Flowchart

IV. RESULTS AND DISCUSSION

4.1 Data Project

The project name : Development of Flats in Maluku 3 West Seram

Project owner : Office PUPR

Project Implementation: PT. Prima Konstruksi

Project Planner: CV. Data Teknik

Project superintendent: PT. Matra Hasta Konsultan

Project Location: District of West Seram

Project duration: 120 calendar days

Implementation Period: August 23, 2018 to December 20, 2018

Source of funds : APBN 2018

Tabel.1: Price Wage Workers

WAGE PRICE	UNIT	UNIT PRICE
Foreman	OH	Rp 120,000.00
Foreman	OH	Rp 100,000.00
Bricklayer	OH	Rp 95,000.00
Carpenter	OH	Rp 95,000.00
Blacksmith	OH	Rp 95,000.00
worker	OH	Rp 70,000.00

Before conducting research, project data analysis is carried out in the form of Time Schedule and Budget Plan. Data obtained from the project will be analyzed again to get a faster project completion time by adding additional working hours. The analysis is only focused on the addition of working hours, while the material under normal conditions and the acceleration conditions are the same.

The analysis was performed to determine the difference in cost between a normal condition and the condition of the acceleration. Accelerate the process of project completion time by compressing the duration of the work that is in the critical path and possible to undertake additional work hours to four hours.

4.2 Determination of Critical Path

Once the duration of every job known to further define the relationship of each job, after the job is completed every relationship is modeled into a Microsoft project, it will get some work items that are on the critical path

Table.2: Jobs That Are Being on the Critical Path

ID	Job description	Duration Normal
5	Iron Concrete Column 1st Floor	4
9	Iron Concrete Wall Scroll 1st Floor	3
10	Formwork Wall Scroll 1st Floor	4
21	Iron Concrete Column 2nd Floor	4
26	Formwork Beam 2nd Floor	6
29	Reinforcement Plate 2nd floor	6
30	Formwork of the 2nd floor plate	5
33	Iron Concrete Wall Scroll 2nd Floor	3
42	Iron Concrete Column 3rd Floor	5
46	Iron Concrete 3rd Floor Beams	5
47	Formwork Beam 3rd Floor	5
50	Reinforcement Plate 3rd floor	5
51	Formwork Plat 3rd floors	5
59	Iron Concrete Column Floor Roof	3
64	Formwork Beam Floor Roof	3
68	Floor plate roof formwork	3
71	Concrete Steel Ring Beam Stand Easel	3
87	Light Steel Frame Roof coverings	9

4.3 Calculating Duration and Cost Jobs

Critical activities in Table 1 above are then analyzed to determine the activities that will be accelerated. Analysis

of the acceleration of these activities is based on critical activities that have the lowest cost slope value. Critical activities that will be accelerated are calculated based on data on the direct cost of the work to obtain additional work costs, as for one example of the calculation is as follows:

❖ Iron Works Concrete Column 1st Floor

1) Determining Work Productivity

Work Productivity = $1 / (\text{Coefficient of Labor})$

worker = 0007

Blacksmith = 0007

Foreman = 0.0007

Foreman = 0.0004

(Coefficient obtained from the AHS project)

worker = $1 / 0007 = 142.86 \text{ m}^3 / \text{day}$

Blacksmith = $1 / 0007 = 142.86 \text{ m}^3 / \text{day}$

Foreman = $1 / 0.0007 = 1428.57 \text{ m}^3 / \text{day}$

Foreman = $1 / 0.0004 = 2500 \text{ m}^3 / \text{day}$

2) Determining Total Workforce Index

Total Employment Index = $(\text{Volume of Work}) / (\text{Productivity Jobs} \times \text{Length Work})$

Volume = 6,988.3 m³

duration = 4 days

worker = $6,988.3 / (142.86 \times 4) = 8.15 \text{ OH}$

The smith = $6,988.3 / (142.86 \times 4) = 8.15 \text{ OH}$

Head Plumbers = $6,988.3 / (1428.57 \times 4) = 0.82 \text{ OH}$

Foreman = $6,988.3 / (2500.00 \times 4) = 0.47 \text{ The OH}$

Table 3: Coefficients Productivity In Overtime Hours

Overtime Hours (hours)	Decreased Productivity Index	Job Performance (hourly)	Percentage of Job Performance (%)	Productivity Reduction coefficient
a	b	c=b*a	d	e=100%-D
a				
1	0.1	0.1	10	0.9
2	0.1	0.2	20	0.8
3	0.1	0.3	30	0.7
4	0.1	0.4	40	0.6

3) Calculating Normal Labor Wages

Price wage = Total Labor x Price Unit Labor

Workers = $8.15 \times \text{Rp. } 70,000 = \text{Rp. } 570,713.62$

The smith = $8.15 \times \text{Rp. } 95,000 = \text{Rp. } 774,539.91$

Head Plumbers = $0.82 \times \text{Rp. } 100,000 = \text{Rp. } 81,530.52$

Foreman = $0.47 \times \text{Rp. } 120,000 = \text{Rp. } 55,906.64$

4) Acceleration Analysis duration By Adding Four Hours

Productivity of labor each day is already known from previous analyzes by duration of normal working hours is 8 hours / day. So that the duration will be calculated crashing

more hours four hours / day taking into account the decline in labor productivity during overtime hours.

a. Labor Productivity

Hourly productivity = (Work Productivity a day) / (Length of normal business hours)

Labor Productivity Overtime = (Productivity a day + (overtime x Productivity an hour x coefficient))

worker

=>Productivity an hour = $142.86 / 8 = 17.86$ OH

=>12 hour productivity = $(142.86 + (4 \times 17.86 \times 0.6)) = 185.71$ kg / day

Blacksmith

=>Productivity an hour = $142.86 / 8 = 17.86$ OH

=>12 hour productivity = $(142.86 + (4 \times 17.86 \times 0.6)) = 185.71$ kg / day

Foreman

=>Productivity an hour = $1428.57 / 8 = 178.57$ OH

=>12 hour productivity = $(1428.57 + (4 \times 178.57 \times 0.6)) = 1857.14$ kg / day

Foreman

=>Productivity an hour = $2500.00 / 8 = 312.50$ OH

=>12 hour productivity = $(2500 + (4 \times 312.5 \times 0.6)) = 3250$ kg / day

b. Specify the duration after four hours plus overtime hours

The duration of the work crashing = (Volume of Work) / (Productivity working 12 hours x number of workers)

Workers = $(6,988.3) / (185.71 \times 12:23) \approx 3$ days

The smith = $(6,988.3) / (185.71 \times 12:23) \approx 3$ days

Head Plumbers = $(6,988.3) / (178.57 \times 1:22) \approx 3$ days

Foreman = $(6,988.3) / (312.50 \times 0.70) \approx 3$ days

c. Determining the total additional cost and wage labor

Added 1st hour overtime wage = $1.5 \times (1/173) \times$ (normal wage) x (working days a month)

Addition of second overtime wage = $2 \times (1/173) \times$ (normal wage) x (working days a month)

Normal wage

Workers = Rp. 70.000.00

Blacksmith = Rp. 95000.00

Head Plumbers = Rp. 100.000.00

Foreman = Rp. 120.000.00

Wage Overtime Hours 1st

Workers = $1.5 \times (1/173) \times$ Rp 95000.00 x 24 = Rp14,566.47

The smith = $1.5 \times (1/173) \times$ Rp. 70.000.00 x 24 = Rp19,768.79

Head Plumbers = $1.5 \times (1/173) \times$ Rp. 100.000.00 x 24 = Rp20,809.25

Foreman = $1.5 \times (1/173) \times$ Rp 120,000.00 x 24 = Rp24,971.10

Wages Overtime Hours 2nd

Workers = $2 \times (1) / 173 \times$ Rp 95000.00 x 24 = Rp19,421.97

The smith = $2 \times (1/173) \times$ Rp. 70.000.00 x 24 = Rp26,358.38

Head Plumbers = $2 \times (1/173) \times$ Rp. 100.000.00 x 24 = Rp27,745.66

Foreman = $1.5 \times (1/173) \times$ Rp 120,000.00 x 24 = Rp33,294.80

Wages Overtime Hours 3rd

Workers = $2 \times (1/173) \times$ Rp 95000.00 x 24 = Rp19,421.97

The smith = $2 \times (1/173) \times$ Rp. 70.000.00 x 24 = Rp26,358.38

Head Plumbers = $2 \times (1/173) \times$ Rp. 100.000.00 x 24 = Rp27,745.66

Foreman = $1.5 \times (1/173) \times$ Rp 120,000.00 x 24 = Rp33,294.80

Wages Overtime Hours 4th

Workers = $2 \times (1/173) \times$ Rp 95000.00 x 24 = Rp19,421.97

The smith = $2 \times (1/173) \times$ Rp. 70.000.00 x 24 = Rp26,358.38

Head Plumbers = $2 \times (1/173) \times$ Rp. 100.000.00 x 24 = Rp27,745.66

Foreman = $1.5 \times (1/173) \times$ Rp 120,000.00 x 24 = Rp33,294.80

Total cost / day

(Normal wage + 1st hour wage + 2nd hour wage + 3rd hour wage + 4th hour wage)

Workers = $70,000 + 14.566 + 19.421 + 19.421 + 19.421 =$ Rp. 142,832

The smith = $95,000 + 26.358 + 26.358 + 26.358 + 26.358 =$ Rp. 193,844

Foreman = $100,000 + 27.745 + 27.745 + 27.745 + 27.745 =$ Rp. 204,046

Foreman = $120,000 + 33,294 + 33.294 + 33.294 + 33.294 =$ Rp. 244,855

Total laborwages

(Total cost a day x the duration of the work item x number of labor)

Workers = $Rp. 142.832 \times 3 \times 12:23 =$ Rp. 5,240,339

Blacksmith = $Rp. 142.832 \times 3 \times 12:23 =$ Rp. 7,111,888

Head Plumbers = $Rp. 204.046 \times 3 \times 1:22 =$ Rp. 748,620

Foreman = $Rp. 244.855 \times 3 \times 0.70 =$ Rp. 513,339

Cost Slope

(crash cost - normal cost) / (normal duration - crash duration)

Cost slope a day = (Rp13,614,186 - Rp8,896,144.09) / (4-3) = Rp. 4,718,041.74

Cost Slope total = Cost slope a day x (normal duration - the duration of the crash)

= Rp. 4,718,041.74 x (4-3) = Rp. 4,718,041.74

Table.4: Cost Slope Calculation Results

ID	Job Description	Normal		Crash		Cost Slope (Rp)
		Duration	Cost (Rp)	Duration	Cost (Rp)	
5	Iron Concrete Column 1st Floor	4	8,896,144.09	3	13,614,185.83	4,718,041.74
9	Iron Concrete Wall Scroll 1st Floor	3	7,184,812.00	2	9,773,559.29	2,588,747.29
10	Formwork Wall Scroll 1st Floor	4	14,879,066.40	3	22,770,131.96	7,891,065.56
21	Iron Concrete Column 2nd Floor	4	6,164,566.15	3	9,433,924.21	3,269,358.06
26	Formwork Beam 2nd Floor	6	44,260,642.80	5	75,260,148.88	30,999,506.08
29	Reinforcement Plate 2nd floor	6	13,938,929.91	5	23,701,552.30	9,762,622.39
30	Formwork of the 2nd floor plate	5	62,537,197.80	4	102,083,841.96	39,546,644.16
33	Iron Concrete Wall Scroll 2nd Floor	3	4,781,948.12	2	6,504,923.65	1,722,975.53
42	Iron Concrete Column 3rd Floor	5	6,164,566.15	4	10,062,852.49	3,898,286.34
46	Iron Concrete 3rd Floor Beams	5	2,044,785.60	4	3,337,846.55	5,869,265.32
47	Formwork Beam 3rd Floor	5	43,792,491.60	4	71,485,546.98	27,693,055.38
50	Reinforcement Plate 3rd floor	5	13,938,929.91	4	22,753,490.21	8,814,560.30
51	Formwork Plat 3rd floors	5	62,537,197.80	4	102,083,841.96	39,546,644.16
59	Iron Concrete Column Floor Roof	3	2,705,990.64	2	3,680,981.49	974,990.85
64	Formwork Beam Floor Roof	3	43,792,491.60	2	59,571,289.15	15,778,797.55
68	Floor plate roof formwork	3	15,583,837.50	2	21,198,823.27	5,614,985.77
71	Concrete Steel Ring Beam Stand Easel	3	1,084,901.52	2	1,475,800.53	390,899.01
87	Light Steel Frame Roof coverings	9	48,958,856.10	7	77,698,993.85	28,740,137.75

4.4 Analysis of Direct Costs and Indirect Costs

Once the analysis process is complete acceleration and already get the duration of acceleration, then will calculate the total cost of the project in normal condition and the condition after acceleration. The project costs consist of direct costs and indirect costs. Following the calculation of the total project cost.

1) In Normal Condition

Normal duration = 120 days

Budget Plan = Rp. 15,229,000,000

In the normal cost calculation obtained weighting of 91% direct costs and indirect costs weight by 9% (6% profit and a 3% overhead). Because the profit and overhead costs are part of indirect costs, so in this study was taken the value of profit of 6% of the total project costs and overhead costs 3% of the total cost of the project. From the description above, it can look for the value of profit and overhead costs in the following manner.

Profit = Total project costs x 6%
= Rp. 15,229,000,000 x 6%
= Rp. 913,740,000

Overhead costs = Total cost of project x 3%
= Rp. 15,229,000,000 x 3%
= Rp. 456,870,000

Overhead / day = (Overhead) / Length
= (Rp.456,870,000) / 120
= Rp. 3,807,250

After getting the value of profit and overhead, then the next can be calculated direct cost and indirect cost

Direct cost = 91% x Total cost of the project
= 91% x Rp. 15,229,000,000
= Rp. 13,858,390,000

Indirect cost = Profit + Overhead
= Rp. 913,740,036 + USD. 456,870,018
= Rp. 1,370,610,000

Total project cost
= Direct costs + Indirect costs
= Rp. 13,858,390,000 + Rp. 1,370,610,000
= Rp. 15,229,000,000

2) In the Accelerated Conditions (Crashing)

In this study the acceleration performed on activities that are on the critical path at an additional cost for each job in the previous calculation. To obtain optimum charge time and then crashing in phases starting from the work that has cost the smallest slope to slope the greatest cost, in order to get the time and the lowest cost.

Compression 1st Phase:

❖ Concrete Steel Ring Beam Stand Easel

Duration crashing = 1 day

Total Length = 120-1 = 119 days

Cost slope = Rp. 390,899/ day

The direct costs include:

A. The direct costs of normal = Rp. 13,858,390,000

B. Additional charges = Rp. 390.899

C. The total direct cost acceleration = A + B

= Rp. 13,858,390,000 + Rp. 390.899

= Rp. 13,858,780,899

Indirect costs include:

D. Overhead (119 x Rp. 3,807,250) = Rp. 453,062,750

E. Profit = Rp. 913,740,000

F. Total indirect costs = D + E = Rp. 1,366,802,750

Total cost of the project:

= Direct Costs + Indirect Costs

= Rp. 13,858,780,899 + Rp. 1,366,802,750

= Rp. 15,225,583,649

And so forth until the compression stage 18. The optimum total cost obtained if the sum of the direct and indirect costs reached the lowest value. The optimum time and costs can be seen in Table 5.

Table.5: Cost and Time Optimum

ID	Job description	Duration	Direct costs (Rp)	Indirect costs (Rp)	Total costs (Rp)
	Normal	120	13,858,390,000.00	1,370,610,000.00	15,229,000,000.00
71	Concrete Steel Ring Beam Stand Easel	119	13,858,780,899.01	1,366,802,750.00	15,225,583,649.01
59	Iron Concrete Column Floor Roof	118	13,859,755,889.85	1,362,995,500.00	15,222,751,389.85
33	Iron Concrete Wall Scroll 2nd Floor	117	13,861,478,865.38	1,359,188,250.00	15,220,667,115.38
9	Iron Concrete Wall Scroll 2nd Floor	116	13,864,067,612.67	1,355,381,000.00	15,219,448,612.67
21	Iron Concrete Column 2nd Floor	115	13,867,336,970.73	1,351,573,750.00	15,218,910,720.73
42	Iron Concrete Column 3rd Floor	114	13,871,235,257.07	1,347,766,500.00	15,219,001,757.07
5	Iron Concrete Column 1st Floor	113	13,875,953,298.81	1,343,959,250.00	15,219,912,548.81
68	Formwork Plate Floor Roof	112	13,881,568,284.57	1,340,152,000.00	15,221,720,284.57
46	Iron Concrete 3rd Floor Beams	111	13,887,437,549.90	1,336,344,750.00	15,223,782,299.90
10	Formwork Wall Scroll 1st Floor	110	13,895,328,615.46	1,332,537,500.00	15,227,866,115.46
50	Iron Concrete 3rd Floor Plat	109	13,904,143,175.76	1,328,730,250.00	15,232,873,425.76
29	Reinforcement Plate 2nd Floor	108	13,913,905,798.15	1,324,923,000.00	15,238,828,798.15
64	Formwork Beam Floor Roof	107	13,929,684,595.70	1,321,115,750.00	15,250,800,345.70
47	Formwork Beam 3rd Floor	106	13,957,377,651.09	1,317,308,500.00	15,274,686,151.09
87	Lightweight steel roof truss cover	104	13,986,117,788.83	1,309,694,000.00	15,295,811,788.83
26	Formwork Beam 2nd Floor	103	14,017,117,294.92	1,305,886,750.00	15,323,004,044.92
30	Formwork 2nd Floor Plat	102	14,056,663,939.08	1,302,079,500.00	15,358,743,439.08
51	Formwork 3rd Floor Plat	101	14,096,210,583.23	1,298,272,250.00	15,394,482,833.23

Table 5 shows, the shorter the duration of the project there will be an increase in direct costs while indirect cost decreased. The total project costs derived from the sum of direct costs and indirect costs, the most optimum cost obtained at the 4th stage of compression to the work of reinforced concrete column 2nd floor with a reduction in cost of Rp. 10,089,279.27 from normal total cost of Rp. 15,229,000,000.00 to Rp. 15,218,910,720.73 with the reduction of as many as five days from the time of the normal duration of 120 days to 115 days.

The percentage of the project cost and time efficiency are as follows:

Time Efficiency Project

(120 days - 115 days) / 120 days x 100% = 4,17%

Cost Efficiency Project

(Rp. 15,229,000,000.00 - Rp. 15,218,910,720.73) / Rp. 15,229,000,000.00 x 100% = 0,07%

Graph project cost and time relationship after accelerated in the alternative Extra working hours in Fig.8 display the optimum fee which may be lower than the total cost of the project, this is due to increase in direct costs less than the decrease in indirect costs so that the total project cost is also reduced.

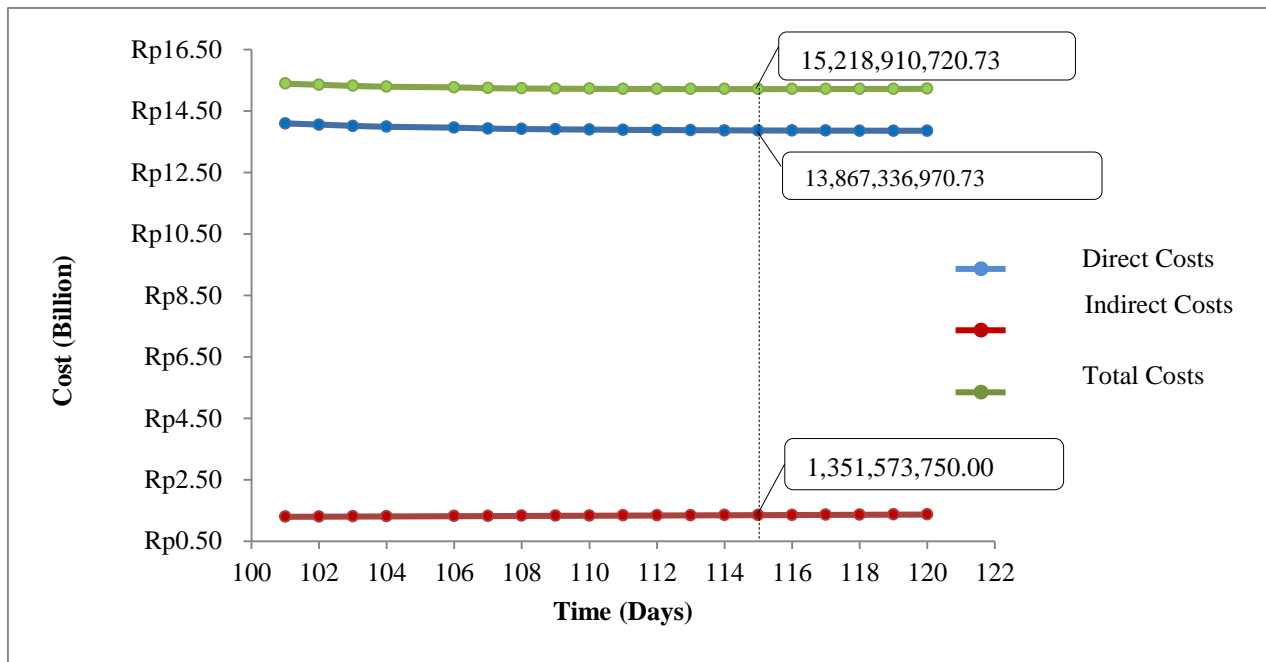


Fig.8: Relationships Graph Costs and Time

V. CONCLUSION

- 1) Critical path on the job structure are at work iron concrete column 1st floor, iron concrete wall scroll 1st floor, formwork wall scroll 1st floor, iron concrete column 2nd floor, formwork beam 2nd floor, reinforcement plate 2nd floor, formwork of the 2nd floor plate, iron concrete wall scroll 2nd floor, iron concrete column 3rd floor, iron concrete 3rd floor beams, formwork beam 3rd floor, reinforcement plate 3rd floor, formwork plat 3rd floors, iron concrete column floor roof, formwork beam floor roof, floor plate roof formwork, concrete steel ring beam stand easel, light steel frame roof coverings.
- 2) The total project cost under normal conditions is at Rp15,229,000,000.00 with a duration of 120 days of work of the project. From the analysis in this study obtained optimum total cost of the project in a condition after crashing with the addition of alternative work hours over four hours obtained for Rp15,218,910,720.73 or less 0.07% of the project costs in normal conditions and duration of project implementation 115 working days or sooner 4.17 % of normal duration.

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Learning Word and Sub-word Vectors for Amharic (Less Resourced Language)

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Abstract— The availability of pre-trained word embedding models (also known as word vectors) empowered many tasks in natural language processing, leading to state-of-the-art performance. A key ingredient to the successful application of these distributed word representations is the existence of large curated corpora to train them and use the pre-trained models in downstream tasks. In this paper, we describe how we trained such quality word representations for one of less-resourced Ethiopian languages, Amharic. We used several offline and online data sources and created 100, 200, and 300-dimension word2vec and FastText word vectors. We also introduced new word analogy dataset to evaluate word vectors for Amharic language. In addition, we created Amharic sentence piece model, which can be used to decode and encode words for subsequent NLP tasks. Using this SentencePiece model, we created Amharic sub-word word2vec embedding with 25, 50, 100, 200, and 300 dimensions trained over our large curated dataset. Finally, we evaluate our pre-trained word vectors on both intrinsic word analogy and extrinsic downstream natural language processing task. The result shows promising performance for both intrinsic and extrinsic evaluations as compared to previously released model.

Keywords— Amharic, word vectors, fasttext, word2vec.

I. INTRODUCTION

The introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper.

Learning distributed word representations using neural models such as word2vec (Mikolov et al., 2013b) and FastText (Bojanowski et al., 2017) have been widely used in natural language processing and shown promising progress over conventional approaches. The existence of freely available Wikipedia data for most languages supported the ability of learning from large amounts of texts. Publicly available models for resourced languages, which are pre-trained on large amounts of data through unsupervised learning, have become a key component of many neural language understanding models. However, Amharic is not benefited from such an advancement due to lack of large curated data collection over web. While most interesting neural architectures are massively introduced for English, but lack of data and pure word vector barely represented Amharic language for this domain.

The large text collection from Wikipedia and common crawl are commonly used data source to train and learn word vectors (Al-Rfou et al., 2013; Bojanowski et al.,

2017) for many languages. Unfortunately, the size of Wikipedia is relatively small and often not enough to learn high quality word vectors with wide coverage for many less-resourced languages including Amharic. While common crawl can be used as an alternative solution to get large text with a broader coverage, its data content is noisier than Wikipedia articles (Bojanowski et al., 2017).

As part of building 157 language word vectors project, Facebook released a pre-trained embedding for Amharic language. The Polyglot project (Al-Rfou et al., 2013) also provides pre-trained embedding trained on Wikipedia. While word vectors with about 3K vocabularies of Amharic language is included with Al-Rfou et al. (2013) and Grave et al. (2018) work, most of the words in the vocabulary are non-Amharic words. This is happened because of the dataset is not well prepared. Moreover, as mentioned above, Wikipedia is not rich to train word vectors for most less-resourced countries. In addition, none of the above authors evaluated Amharic word vectors. Thus, preparation of large and curated text collection from different available online and offline data sources and learning quality word vectors is required for empowering semantic word understanding of Amharic NLP tasks.

We contributed a high-quality word vectors for Amharic language using different word embedding models trained over varieties of online and offline data sources. We used Wikipedia, government websites, news articles, Facebook page posts, blogs, explicitly published Amharic text corpora for different NLP tasks, legal documents, fictions, academic books, and spiritual offline documents as data source to train and learn word vectors of both FastText and word2vec models in 100, 200 and 300 dimensions. We evaluated our word vectors with intrinsic word analogy task and extrinsic neural part of speech tagger task. We have also introduced new word analogy dataset that contain both semantic and syntactic word formations for Amharic language.

While pre-trained word embeddings are publicly available, vectors for sub-word are commonly trained on a per-task basis or used with dummy vector values using one-hot-vectors. Heinzerling B. and Strube M. (2018), released pre-trained sub-word embeddings in 275 languages which is trained by Wikipedia dumps using BPE tokenizer and GloVe (Pennington J. et al., 2014) model. Amharic sub-word GloVe vector is also released as part of their work. However, less quality of Wikipedia dataset and standard evaluation made it difficult to use. We trained sub-word tokenizer over our raw dataset for using open source SentencePiece library (Kudo T. and Richardson J., 2018) that can be also used as sub-word segmenting model for other Amharic NLP downstream tasks. Using our SentencePiece model, we have also released Amharic sub-word word2vec embedding with 25, 50, 100, 200, and 300 dimension trained in our curated quality and large coverage dataset and evaluated in neural Amharic-English downstream task. All Amharic learned word vectors we trained can be accessed from <https://github.com/Abe2G/AM-Vectors> and the code used to normalize Amharic text, train and evaluate word vector embedding is publicly available at <https://abe2g.github.io/>.

II. RELATED WORK

Several monolingual pre-trained word vectors have been released for different languages together with open source implementation of word embedding models. English word vectors trained on a part of the Google News dataset (100B tokens) were published with word2vec (Mikolov et al., 2013b). Pennington et al. (2014) released GloVe models trained on Wikipedia, Gigaword and Common Crawl (840B tokens). Al-Rfou et al. (2013), in which word vectors have been trained for 100 languages using Wikipedia data. Grave et al. (2018) released FastText

word vectors for 157 languages trained over Wikipedia and Common Crawl.

III. AMERHARIC LANGUAGE

Amharic (አማርኛ, 'āmarəñña) is an official working language of Ethiopian government spoken by over 100M people all over the country. The Amharic script is known as Ge'ez or Ethiopic. The writing system is called Fīdāl (ፊደል) in Ethiopian Semitic languages. Fīdāl means "script", "alphabet", "letter", or "character" or abugida (አቡጊዳ), from the first four symbols. Fīdāl is a syllabary writing system where the consonants and vowels co-exist within each graphic symbol (Hudson, G., 2009). Unlike majority of its Semitic scripts, such as Arabic and Hebrew, fīdāl is written from left to right. The writing system consists of 33 consonants, each having seven "orders" or shapes depending on the vowel with which a given consonant is combined. These are arranged into seven houses (orders) according to the kind of each vowel that the consonants associate themselves with, i.e., the consonant-vowel (CV) combinations (Mekonnen A. et al., 2018). Consider for instance the following individual symbols:

በ(bā) ቡ(bu) ቢ(bi) ባ(ba) ቤ(be) ብ(bō) ቦ(bo)

In Amharic, if string begins with a vowel then the vowel is written independently; which means, there are no symbols added to the individual vowels. In such cases as affixation, a vowel may come in contact with a consonant on its left side. The following are used as vowel (aka አናባቢ, 'ānababi) characters.

ኧ(ä) ኡ(u) ኢ(i) ኣ(a) ኤ(e) ኦ(o) ኦ(o)

At the time of formation, vowel will no longer be considered independently but together with the immediately preceding consonant forming a new unique symbol. We can better clarify this by taking a case for the declension of a noun for number by adding -አች('očə) at the end of the noun (Yimam B., 1997). As can be seen in the example below the combination of ት and ኦ results in ት.

ቤት(betə) + -አች('očə) = ቤትአች(betə'očə)

Written as: ቤት (betočə)

ሰው(säwə) + -አች('očə) = ሰውአች(säwə'očə)

Written as: ሰዎች (säwočə)

Unlike majority of the languages in the GF library that construct words by linearly concatenating morphemes,

Semitic languages have unique non-concatenative properties in addition to the 27 conventional concatenative modifications (Mekonnen A. et al., 2018).

In Amharic language, the end of a sentence is marked by pair of colon (:: አራት ነጥብ, 'aratə nāt'əbə). Whereas exclamatory and interrogative sentence are ended by '!' and '?' punctuation marks respectively. The individual words in a sentence are separated by colon (: ሁለት ነጥብ, hulätə nāt'əbə) or sometimes with whitespace character (Yimam, B., 1997). In Amharic there are 9 homophonic characters such as (ሀ, ኀ, ሐ, and ኸ), (ሰ and ሠ), (ጸ and ፀ), (ፌ and ቤ) and (አ and ዓ), which has the same pronunciation and meaning. Sometimes such characters are used interchangeably in a language and this also makes it challenging.

IV. DATASET PREPARATION

To ensure a high-quality product, diagrams and lettering MUST be either computer-drafted or drawn using India ink.

The quality of the word embeddings depends on frequency of a word, which is related to the corpora size. As the morphological richness of the language increases, the vocabulary size increases and the average frequency of every token decreases. Hence, it is important to collect and prepare a large collection of monolingual corpora for Amharic language to get high quality word embedding.

Table 1: Amharic Monolingual Dataset used to train word vectors.

Domain	#Tokens	#Status
Wikipedia	102,307,356	Clean
Fictions and Academic books (Offline)	55,879,654	Clean
Bible and other spiritual data (Offline)	34,102,452	Clean
Different Amharic Blogs	68,204,904	Noisy
Facebook Posts Scraped	88,254,789	Noisy
Amharic News Article (Walta, FanaBC, EBC, BBC-Amharic, VOA Amharic, Reporter)	122,768,827	Noisy
Other Legal and Official Documents (Offline)	115,948,336	Clean
Walta Information Center (WIC)	210,000	Noisy

JW300	68,204,904	Noisy
Habit-project (amWaC17)	30,692,207	Noisy
Total	686,573,429 tokens	

One of the big challenges for Amharic language is unavailability of curated corpora off-the-shelf. Even if Wikipedia is available for Amharic, the dumps are relatively small in size (compared to the English). However, for Amharic language, the proper data collection technique can get a large text collection from Wikipedia, social medias, newspapers, news portals, government websites, etc. which can be a source of high-quality, diverse monolingual corpora. Thus, crawling these sources was our primary task to create large monolingual corpora for Amharic. To get large coverage of word with domain inclusiveness, we trained our Amharic word vectors using the dataset composed over different offline and online sources. Government websites, news, Facebook page posts, blogs, Wikipedia, and publicly available Amharic text data from HabitProject¹, and OPSUS² Amharic machine translation dataset are used as online data source. Whereas legal documents (constitution and other guiding rules), fictions, academic books (grade 1st – 12th Amharic language text book and modules of higher education), spiritual offline documents, government office rules and guiding principles are used as offline data source. We have collected a dataset with more than 686.5 million token collections. The detailed dataset and token coverage is depicted at Table 1 above.

4.1 PREPROCESSING

As the data is collected from different source, we have noticed a number of irregularities between tokens. Thus, we performed series of preprocessing steps at token level to canonize all tokens to a standard format. Using simple regular expression, we tokenized each document into sentences and then each sentence is preprocessed at word level and stored to a file using one line per sentence format to enable memory efficient batch iterator based training.

After tokenization, in order to minimize irregularities in the dataset, we applied different forms of character level normalization to standardize the dataset.

In Amharic, there are several characters that have the same pronunciation and meaning with different structure. For example, the word “Habtamu” (ሀብታሙ) can also be written as ሐብታሙ, ኀብታሙ, ሐብታሙ ኀብታሙ and

¹ <https://habit-project.eu/wiki/HabitSystemFinal>

² <http://opus.nlpl.eu/JW300.php>

ታብታቡ። In addition, Amharic words ends with a suffix such as ቲል can also be written as ቱዋል or ቱክል. For example, በልቲል can also be written as በልቱዋል or በልቱክል. Thus, all homophonic characters are replaced into their common forms: ሐ and ኀ are replaced with ሀ, ሠ with ሰ, ዐ with አ, and ፀ with ጸ. We normalize any character under such category to common canonical representation to avoid unnecessary representation of single word in different forms.

The other issue that needs attention is normalization of punctuation marks. Different styles of punctuation marks have been used in the data as most of the data sources are noisy. For instance, for double quotation mark two single quotation marks, “,”, “<,” “>,” “,” “< or >” are used. Thus, normalization of punctuation marks is a nontrivial matter. We normalized all types of double quotes by “”, all single quotes by ‘’, question marks (e.g., ? and :) by ?, word separators (e.g., : and :) by plain space, full stops (e.g., :: and ::) by ::, exclamation marks (e.g., ! and !) by !, hyphens (e.g., :-, and :—) by :-, and commas (e.g., ÷ and ÷) by ÷. All other punctuation marks and non-Amharic characters are also removed.

In addition to character and punctuation marks irregularities, we have also identified number notation inconsistencies in Amharic document that are created because of nature of the language. In Amharic numbers can be written using Arabic or Amharic (Geez) numeral notation. For example, 100 in Arabic can also be written as ፲፱ in Geez. To handle such inconsistency, we have transformed all Arabic notations into Geez notation. In addition, in writing shortened notation of long number is also used in different scripts. For example, One Million Five Hundred Thousand can be written as 1.5 ሚሊዮን (1.5 million). We expand numbers expressed in shortened form to their equivalent long form of representation before transforming the representation into Geez notation.

4.2 Models

We used both word2vec (Mikolov et al., 2013b) and FastText (Bojanowski et al., 2017) models to train our word vectors. In this section, we briefly describe the models that we compare to train our word vectors.

4.3 Word2Vec

Word2Vec is the name given to a class of neural network models with two layer that, given an unlabeled training corpus, produce a vector for each word in the corpus that encodes its semantic information. The architecture of word2vec has two model variants:

continuous bag-of-words (CBOW) and SkipGram. (Mikolov et al., 2013). In the CBOW architecture, the model predicts the current word from a window of surrounding context words whereas the skip-gram architecture weighs nearby context words more heavily than more distant context words. In word2vec model, every word W in the dictionary V is mapped to a vector $w(x)$, which is a column (vector) in the matrix W . The CBOW model predicts a word w_t using its context $w_{t-n}, \dots, w_{t-1}, w_{t+1}, \dots, w_{t+n}$. A vector representation h of this context is obtained by averaging the corresponding word vectors:

$$\sum_{x=-n}^n u_{w(x)} \quad (1)$$

, where $u_{w(x)}$ are the word vectors.

Mikolov et al. (2013) also introduced the Skip-gram architecture built on a single hidden layer neural network to learn efficiently a vector representation for each word w of a vocabulary V from a large corpora of size C . Skip-gram iterates over all (target, context) pairs (w_t, w_c) from every window of the corpus and tries to predict w_c knowing w_t . The objective function is therefore to maximize the log likelihood:

$$\sum_{t=1}^C \sum_{k=-n}^n \log p(w_{t+k} | w_t) \quad (2)$$

, where n represents the size of the window (composed of n words around the central word w_t).

4.4 FastText

Bojanowski et al. (2017), introduced another unsupervised word representation as an extension to word2vec model in order to take into account internal word structure with character n -grams and improve the representation of rare words. Similar to Mikolov et al. (2013), fasttext also has both cbow and skipgram architecture. But the author recommended using skipgram model than cbow. To this end, they train a Skipgram architecture to predict a word w from C given the central word w_t and all the n -grams G_{w_t} (subwords of 3 up to 6 characters) of w_t . The objective function becomes:

$$\sum_{t=1}^C \sum_{k=-n}^n \sum_{w \in G_{w_t}} \log p(w_{t+k} | w_t) \quad (3)$$

where n is the size of window on which the model includes as context for the central word w_t . Here, along learning one vector per word as of word2vec, FastText also learns one vector per n -gram. FastText is able to extract more semantic relations between words that share common n -gram(s) or morphological variants of a word which can also help to provide good embedding for rare words since we can obtain a vector by summing vectors of its n -grams. Particularly, this subword consideration helps morphologically rich languages such as Amharic, Arabic, Hebrew, etc. to capture vector for word with similar semantic relation in to vocabulary word but differs with its formation.

4.6 Word Embedding Experimental Setups

Genism³ python is used to train and evaluate analogy for both word2vec and FastText models. First, we used default hyper parameters based on recommendation of the original paper (Mikolov et al., 2013). Then, we also tested our model with different parameter settings to check whether increasing window size, epochs and sampling techniques has effect on learning or not following. We used 5 as minimum count to discard words that appear less than minimum count times with $1e-5$ threshold to randomly down-sample highly frequent words. The hyper parameter settings we used in our work are described below:

Increasing window size: this parameter depicts the maximum distance between the current and predicted word within a sentence. We started with 5 window size and checked up to 10 window size. Our experiment has shown that increasing window size has no significant effect and we recommend using the size between 6 to 10 is enough for Amharic to include sentences with large word sequence length.

Increasing n -gram (for FastText) size: other than default 3 to 6 characters, we used 3 to 10 characters to make it more appropriate for morphologically rich Amharic language. The experiment shows that increasing subword size helps to improve the performance on syntactically rich languages. In our experiment, FastText model trained in 3 to 10 character range better performed on syntactic level word analogy.

Word embedding dimension: we used 100, 200, and 300 word embedding size. In our experiment, both word2vec and FastText model with 200 dimensions has comparatively improved performance for both intrinsic and extrinsic task evaluation as compared to 100 and 300

dimensions. The vector with 300 dimensions is the one with less performed model in our extrinsic task evaluation.

Increasing training epochs: We started with default parameter by FastText library trains models, which is 5 epochs and then used more epochs (iterations of training) to train the models. Here, we propose to use in range of 10 to 15 epochs.

Increasing negatives: By default, the FastText library samples 5 negative examples. We tested to different value in range of 5 and 15 and as proposed by (Bojanowski et al., 2017), we also propose to use 10.

One of contribution in this work is usage of Sub-word tokenization to train word2vec models. Word2vec models are criticized for ignoring the internal structures of words as compared to other character n -gram augmenting models such as FastText. Especially for languages with rich morphology such as Amharic, considering word as basic unit maximizes probability of OOV words. Thus, incorporating morphological variants of a word through systematic learning is required. Today, using sub-word units such as character, character n -grams or Byte Pair Encodings (BPE) to address the problem of out-of-vocabulary words in NLP is popular in word representation tasks (Sennrich et al., 2016; Bojanowski et al., 2017). However, global vector of such sub-word units is not further investigated other than using in specific downstream tasks. Following Kudo T. and Richardson J., 2018, we trained word2vec model in SentencePiece tokenized sub-words. To consider character level tasks, we released our embedding with 25, 50, 100, 200 and 300 dimensions.

4.7 Evaluation

We used both intrinsic (word analogy) and extrinsic (Amharic downstream task: Neural POS Tagger) evaluation. For all the evaluation we have used, Amharic embedding's from Al-Rfou et al. (2013) and Grave et al. (2018) as baseline.

4.8 Intrinsic Evaluation

4.8.1 Word Analogy Evaluation

One of commonly used word embedding evaluation approach for intrinsic evaluation is word analogy. This evaluation directly test for syntactic or semantic relationships between words. This approach was popularized by Mikolov et al. (2013a). Analogy datasets is used to evaluate semantic and syntactic ability of the word embedding. One of the contributions of this work is the introduction of word analogy datasets for Amharic language. Following Mikolov et al. (2013a), we prepared a dataset that contain a collection of semantic and syntactic

³ <https://radimrehurek.com/gensim/index.html>

relationship of words. The dataset is composed of four words separated with whitespace, of the form of በርሊን(berlin) : ጀርመን(Germany) :: ካይሮ(Cairo) : ግብጽ(Egypt). Total of 311 analogies are prepared by considering different morphological variants of a language and semantic analogies. The dataset contains opposite words, plural-nouns, future tense formations, past tense formations, past-participle formations, present-participle formations, actions-verbs, continent analogy, language analogy, nationality analogy, adjective-to-adverb mapping analogy, family analogy, currency and capital-common-countries classes. In general, given a triplet of words A : B :: C, the goal of word analogy is to find the word D for a given word C such that A : B and C : D share the same relation.

Table 2: Performance of the various word vectors on the word analogy task.

Models	Embedding Dimension	Word Analogy (Average Accuracy)
FastText Grave et al. (2018)	300D	11.02
Word2Vec-CBOW	100D	11.02
	200D	16.04
	300D	20.6
Word2Vec -SkipGram	100D	18.7
	200D	18.9
	300D	19.56
FastText-CBOW	100D	18.5
	200D	22.05
	300D	24.08
FastText-SkipGram	100D	16.9
	200D	17.45
	300D	16.07

The values of word analogy column are average accuracies in percentage. We only reported model trained with our proposed hyper-parameter settings.

According to the results, all models outperformed the baseline Grave et al. (2018). The one with best accuracy is FastText model trained with 300D, which improved +13.06 from the baseline FastText model. In all

experiments for both word2vec and FastText models, our CBOW model outperformed skipgram.

4.9 Extrinsic Evaluation

Apart from the analogy task, we have also conducted extrinsic evaluation using neural Amharic part-of-speech tagger. The task is selected based on availability of public dataset. The following sections briefs the model architectures of Amharic neural POS tagger.

4.9.1 Amharic Neural Part of Speech Tagger

We adopted a dataset from (Girma A. et al., 2006) as a training corpus. We grouped the dataset into 20, 10, and 70 splits for testing, validation and training sets respectively. Since our aim is to evaluate the performance of our word vectors in Amharic part of speech tagger task, we have create simple two layer bidirectional LSTM based neural network architecture to encode sentence and predict tags. We trained the same architecture for all word vectors (excluding sentence piece trained model) and compared our word vectors with Amharic word vectors released by Grave et al. (2018).

Table 3: Performance of Sub-word tokenized word2vec model in POS tagger task.

Model	Dimension	POS Tagger (Test Accuracy)
BPEEmbed (Kudo T. and Richardson J., 2018)	50D	0.902
	100D	0.925
SentencePiece-Word2Vec	50D	0.947
	100D	0.951

To evaluate sub-word embedding's in POS tagging task, due to **SentencePiece** tokenizer we must take special care for the correct alignment of token to tag. We keep tags of original word to each tokenized sub-word units which can then be used to project labels to the tokenized representation. Table 3 above depicts our model performance on neural POS tagging task using sub-word tokenized word2vec model. From over all, extrinsic evaluation, our sub-word embedding outperformed the baseline BPEEmbed with +3 in 100D and +4 in 50D. This is because our tokenizer plus word embedding models are trained in wide data coverage.

Table 4: Performance of the various word vectors on extrinsic POS tagger task

Models	Dimension	POS Tagger
FastText Grave et al. (2018)	300D	0.91
W2V-CBOW	100D	0.92
	200D	0.944
	300D	0.93
W2V-SkipGram	100D	0.925
	200D	0.931
	300D	0.90
FastText-CBOW	100D	0.944
	200D	0.952
	300D	0.935
FastText-SkipGram	100D	0.89
	200D	0.90
	300D	0.93

The values of word analogy and word detection column are average accuracies in percentage. We only reported model trained with our proposed hyper-parameter settings.

The experiment on word level word2vec and FastText models also performed promising accuracy for morphologically rich Amharic language part of speech tagging. Similar to word analogy, our model also performed interesting improvement in test set when compared to base line FastText model (Grave et al., 2018).

4.10 Visualizing Word Embedding

To evaluate how our word vectors cluster syntactically and semantically related words, we visualized few neighbor word using Tensorboard TSNE⁴. We created python function called plot_vector that read our embedding vector binary file and extract vocabulary words from embedding file. Then we created non-trainable TensorFlow model and defined TensorFlow 2D tensor variable that holds our embedding. Finally, we associated metadata with our word embedding. Then we run Tensorboard by referring the log directory of metadata. Because of limited computational resource, we visualized only few word space.

The visualization depicted interesting feature of our word to cluster words to their semantic space. As depicted in Figure 1, Amharic words such as ወር(wärä), ቀን(qänä), ሰዓት(sä'atä) to one category using as time measurement as semantic class. We can also see that ሜትር(metärä) and ኪሎ(kilo) are clustered together. Number categories such as ሚሊዮን(miliyänä), ቢሊዮን(biliyonä),

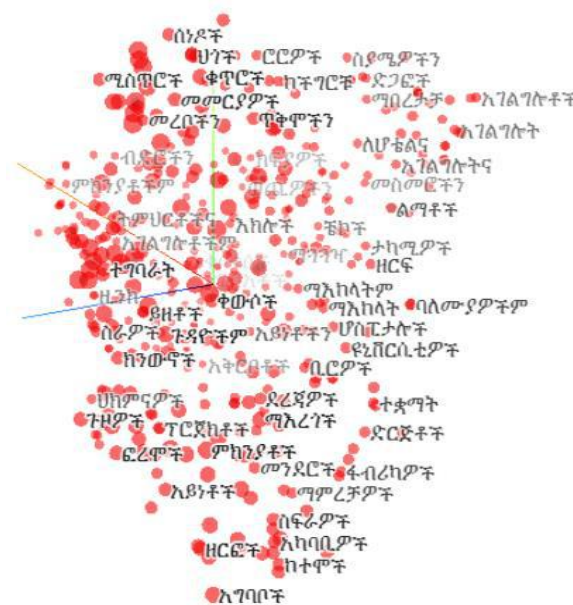


Fig.1: Visualizing word2vec 200D vectors to see how the model cluster semantically related words

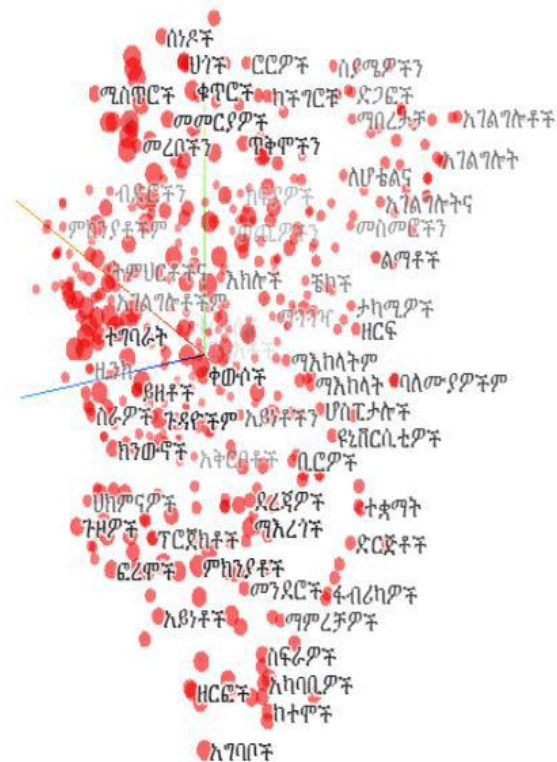


Fig.2: Visualizing FastText 200D vectors

⁴ www.tensorflow.org/tensorboard

ትረሊዮን(təṛiliyonə), and ሺህ(šihə) to one cluster; percentage indicators such as በአማካይ(bä'āmakayə) and በመቶ(bāmāto); financial terms such as ክፍያ(kəfəya) ወጪ(wäč'i) and ገቢ(gäbi) at one category.

This show the performance of our word vectors in capturing semantic relationship between words. As depicted in Figure 2 below, our FastText model clustered words with different morphological variations and having the same meaning in to similar vector space.

The model also clustered synonym words to one category. For example, words like ድርጅት(dəṛəḡətə) and ተቋም(täqwamə), ከተማ(kätäma), ስፍራ(səfəra), መንደር(mänədära), and አካባቢ(ākababi), መመሪያ(mämäriya), ህግ(həgə), and ሰነድ(sänädə) are grouped in similar space with the same derivational forms in a way that shows the quality of our word vectors to predict word analogy. In addition, visualization in Figure 3 also depicts our word2vec model can also capture word morphology.

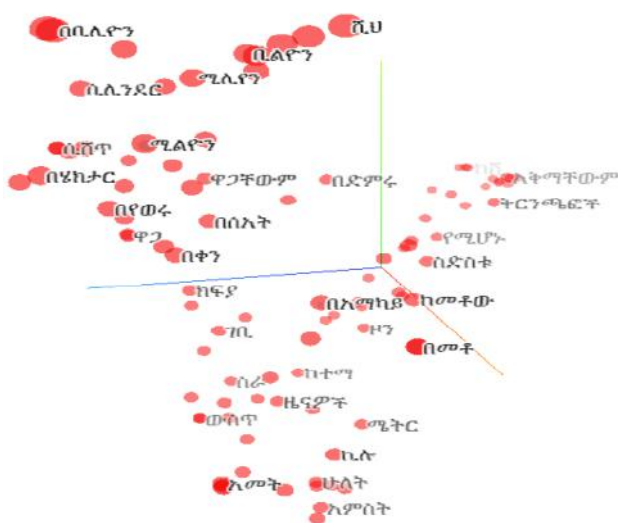


Fig.3: Visualizing word2vec 200D vectors for morphology

V. CONCLUSION

In this work, we contribute word vectors trained on varieties of online and offline sources, as well new analogy datasets to evaluate these models. We study the effect of various hyper parameters on the performance of the trained models, showing how to obtain high quality word vectors. In addition, we also created sub-word embedding using word2vec model. Here we get advantage of word2vec semantic similarity detection ability and capture syntactic features with sub-word embedding.

We also released Amharic SentencePiece tokenizer model that can be used for subsequent NLP tasks. Our evaluation shows that our models can generate quality vectors for Amharic words and proved the vectors are trained over large and curated data with wide coverage from online and offline sources. As future work, we would like to explore more techniques to improve the quality of models for Amharic and other Ethiopic languages including creation of contextualized transformer models.

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Digital System for Dynamic and Vibration Analysis of a Centrifugal Pump Using the Teknikao Sdav Software: A Case Study

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Abstract — The purpose of the paper is to explain how the measurement and vibration analysis software works. A virtual example and a real example were used, defining their initial configurations and analyzing the graphics resulting from the analysis from the vibration analysis software and thus presenting the results of both tests. Understanding how to operate the vibration measurement equipment and analyzing the data obtained from a previously established configuration, this learning about the operational knowledge of dynamic systems is extremely important because the problems become simple to be solved. The analysis was carried in a virtual and real situation, of the centrifugal pump motor vibrations in the SDAV software made available by the Technical website. The problem analyzed was the rolling of seven rotating spheres, this defect fits as a mechanical system with gap defect and with an intensity of one hundred percent. These settings are the parameters adopted to determine the frequency limits of the defect, the resolution of the graph and the number of readings to be taken. When starting, the software will perform all the analysis and measurement of the defect, returning the results in graphs. For the calculation of useful power, it is known that the electrical frequency was thirty-three hertz (33 Hz), which multiplied by sixty, the approximate value of two thousand revolutions per minute (2000 RPM) was obtained. According to the results shown in the graphs, the functioning of machine is excellent, is in perfect condition for use, not presenting light or serious failure.

Keywords— SDAV Software. Vibration. Centrifugal Pump. Vibration Sensor. Failure Identification.

I. INTRODUCTION

In engineering, to correctly understand the elements presented in vibratory systems and the physics involved in them is paramount for designing of structures and machines, for example. Although in many cases, in the study of vibratory systems it is not possible to analyze the system only with one degree of freedom, systems with two degrees or more are very little approached in General Physics books. [1]

The analysis of vibrational systems is very important in Physics and Engineering. In the latter, vibrations are present in the design of machines, structures and vehicles, for example. The applications of the study of vibrations are diverse, among which we can highlight the analysis of resonance curves to avoid collapse in structures and the search for adequate damping, stiffness and mass ratios to provide safety and comfort in vehicles. [1]

The theory fundamental of machine dynamics and vibrations is the study of free and forced vibrations in

mechanical systems. These studies are useful because they establish basic definitions understanding of theory fundamental concept. Can also correspond a solution to many real problems situations in manufacturing plant.

Mechanics is a branch of the physical sciences that deals with the resting state or the movement of bodies subjected to the action of forces. Rigid body mechanics is divided into three areas, static, kinematic and dynamic. Static studies the conditions of bodies at rest, kinematics deals with the geometric aspects of movement and dynamics analyzes the relationships between forces (cause) and movement (effect). [2]

A mechanical vibration normally occurs when a system is moved from its equilibrium position. Generally, when the system accomplish a return under a reset action, it exceeds position. The repetition of this process is known as oscillatory movement. The time interval required for the system to complete a movement cycle is called the vibration period. The number of cycles for unit of time defines a frequency, and the maximum displacement of the system measured from it is equilibrium position is called the amplitude of vibration.

II. THEORETICAL FOUNDATION

Industrial Revolutions, as they are called, do not happen frequently. Since the beginning of mankind, there were four industrial revolutions, the most recent being the fourth identified as such. The other three were identified only when they had already occurred, while the fourth is in full development. It is fundamental to all who work both in industry, as in any branch of activity, knowing this process and to prepare for the future that has already started. [3]

The implementation of systems that can be used to locate people and objects in closed environments is one of the issues that are being discussed as one of the topics of the industry 4.0. [4]

To assist in saving energy, several technologies are being used in from of designing automated systems. These

systems corroborate the benefit of people's lives and contribute to the community in general. [5]

The increase of world requirements for improved products joined to growing competition between companies in the global market makes the same seek processes that ensure lower costs allied to high productivity and high quality product. [6]

The training of an engineering professional must be broad, in his training curriculum it must cover diverse knowledge that goes beyond the field of exact sciences. [7]

The study of mathematical modeling and the developed prototype of damped free vibrations is extremely important for the engineering student to put into practice his knowledge acquired in the classroom, and also to become familiar with situations that may come true within the market job.

In the midst of the emergence of so many technologies and an unbridled growth of industrial and commercial needs, solutions are constantly being developed and implemented in the most diverse branches of business in order to provide an increase in sales and production. [5]

Industry 4.0 and the Internet of Things (IoT) are terms frequently encountered which are so concomitant to future production, labor and business. Both are closely interlinked with the increase of interconnectivity provided from IoT present in factories intelligent. [4]

The data generated in the term "4.0" is fully virtualized, that is, all information is collected dynamically to facilitate decision-making based on the big data tool, is stored in cloud computing and, as previously seen, the information is obtained through the IoT interface and corresponding software and protocols. [8]

There are software and hardware integrations that need to be made from the point of the communication interface with the sensor, to carry the data through structures of data communication networks, short and long distance, in addition to being necessary perform integration with servers and database. [9]

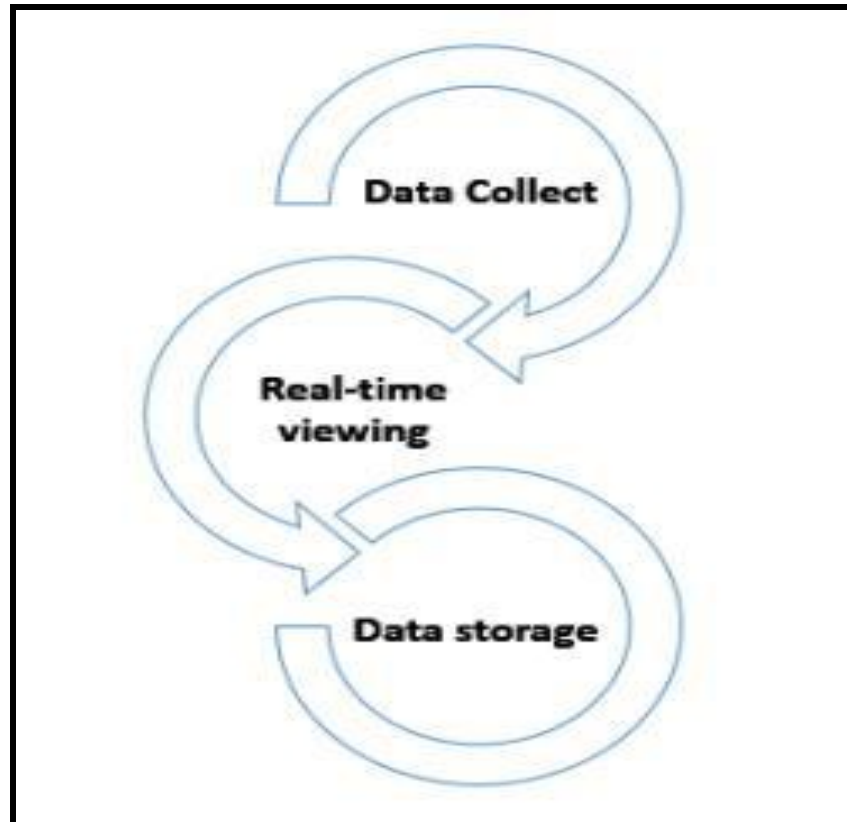


Fig. 1: Control and Instrumentation. Source: [9]

The future is intended to meet the demand for lead information directly to the local decision making, providing the metrological data for users of the equipment, for direct application in the production environment or field work, in real time. With all the technology and data available, intelligent and adaptive strategies of quality will be implemented, so the company earns a profit, productivity time, avoids wastage of raw material, uniformity in the batch produced and avoiding non-compliances. Assisting the manager of production and quality to create strategies to make decisions relevant to a good driving the production line. [3]

Due to the success achieved over time, there is a huge community of researchers and scientists who use this technology in their projects, because they are affordable, with easy acquisition of materials and sensors, applied in several projects. In some situations, controller boards can be developed independently without the need to purchase one in the national and international market. [10]

The fundamental paper objective is analyzing the functioning of software and to accomplish measurements with the equipment of vibration.

The analyzing of the data obtained from an previously established configuration is important, because with this

learning the professional will have operational knowledge in real situations of failures and problems inside manufacturing plant.

This work contains analysis of a virtual and real situation of the vibrations of an engine in the SDAV software made available for free by the Teknikao company website.

III. METHODOLOGY

3.1 Virtual Machine Configuration

The simulation developed in the SDAV software, needs to make an adjustment in the virtual machine simulation shows in figure 2. The following parameters were adopted.

- Utilized RPM: 2000 RPM.
- Frequency in Hz: 33.33

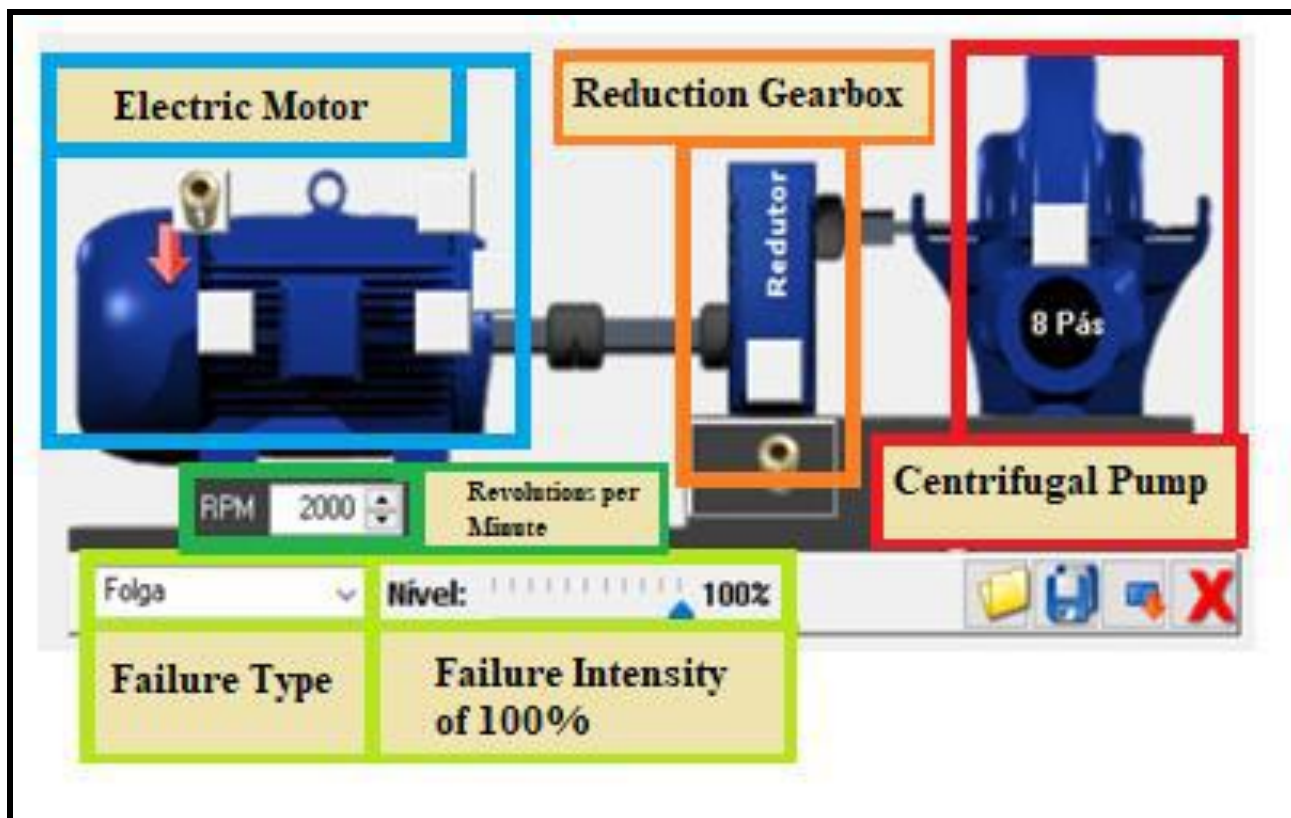


Fig. 2: Virtual Machine Simulation. Source: Authors (2020)

It is worth mentioning that frequency obtained through the RPM, divided by sixty. The Table 1 shows the settings used at software.

Table. 1: Settings Used at Sdav Software.

Source: Authors (2020)

Data Used in the Software			
Supplements	Speed	Envelope	Acceleration
Lines	16 K	16 K	16 K
Maximum Frequency	500 Hz	1 KHz	500 Hz
Averages	3	3	3
High Pass	5	5	5

The settings shown in table 1 are the parameters adopted to determine the frequency limits of failure, the resolution of the graph and amount of readings carried out.

The select defect was defect in bearing, with an intensity of 100%. When starting the simulation, software will do all the analysis and measurement of the failure, supply at graphs results, but results in a according to the configuration selecting of failure.

3.2 Speed and Acceleration

The Figure 3 and 4 respective, shows the speed and acceleration of the electric motor, with the obtained frequencies, it is possible to identify the specific failure in the item 3.4 bellow, can to observe best.

3.3 Envelope

The Figure 5 shows the graph of the envelope where, once again, it is possible to visualize the due failures, is possible visualize of peak frequency failures, frequency failures is of 5 Hz.

3.4 Failure Identification

In Figure 6 it is possible to notice the harmonic corresponding to the graph, it can be observed by the red dots in the frequency peaks.

How the virtual failure was stipulated at 100% and the failure frequency calculation is in 33.33 Hz, the gap failure is shown in the three graphs in 33.33 Hz frequency peaks, how stipulated.

At the highest peak is the failure determined in the bearing, if we multiply by sixty hertz (60 Hz), the same failure will be repeated cyclically.

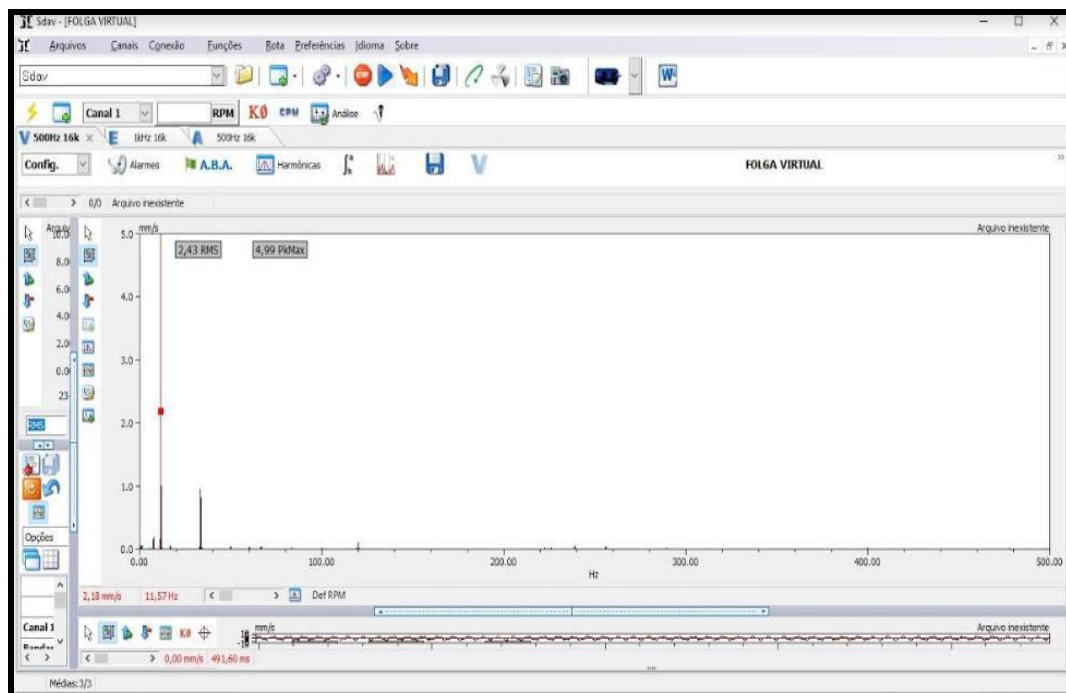


Fig. 3: Speed window at Sdav software. Source: Authors (2020)

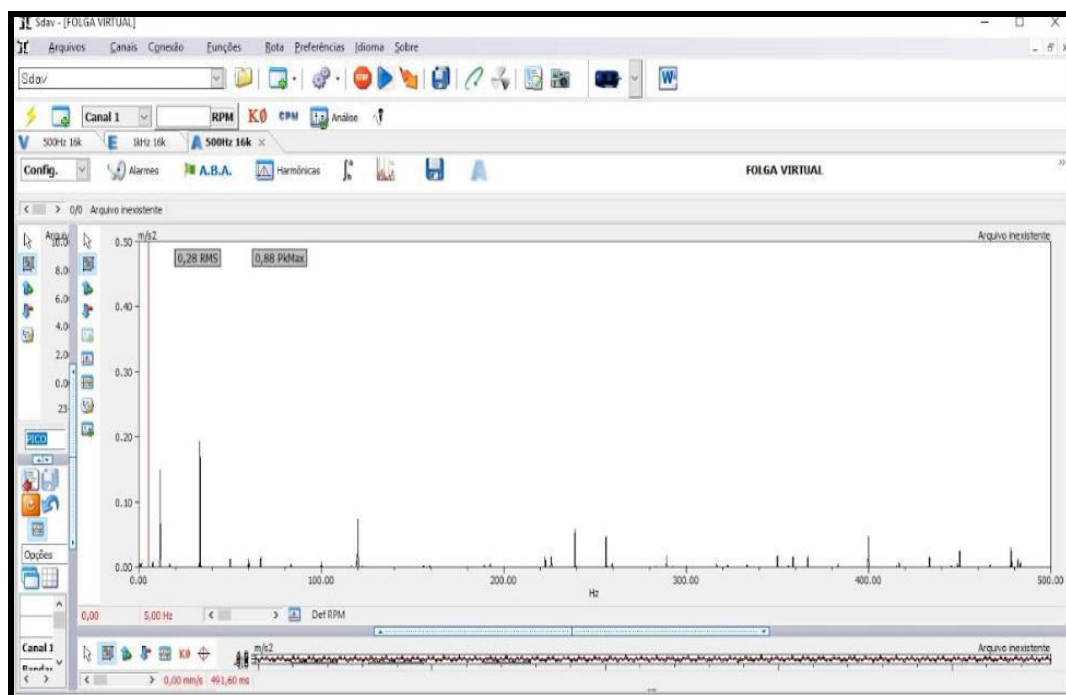


Fig. 4: Acceleration window at Sdav software. Source: Authors (2020)

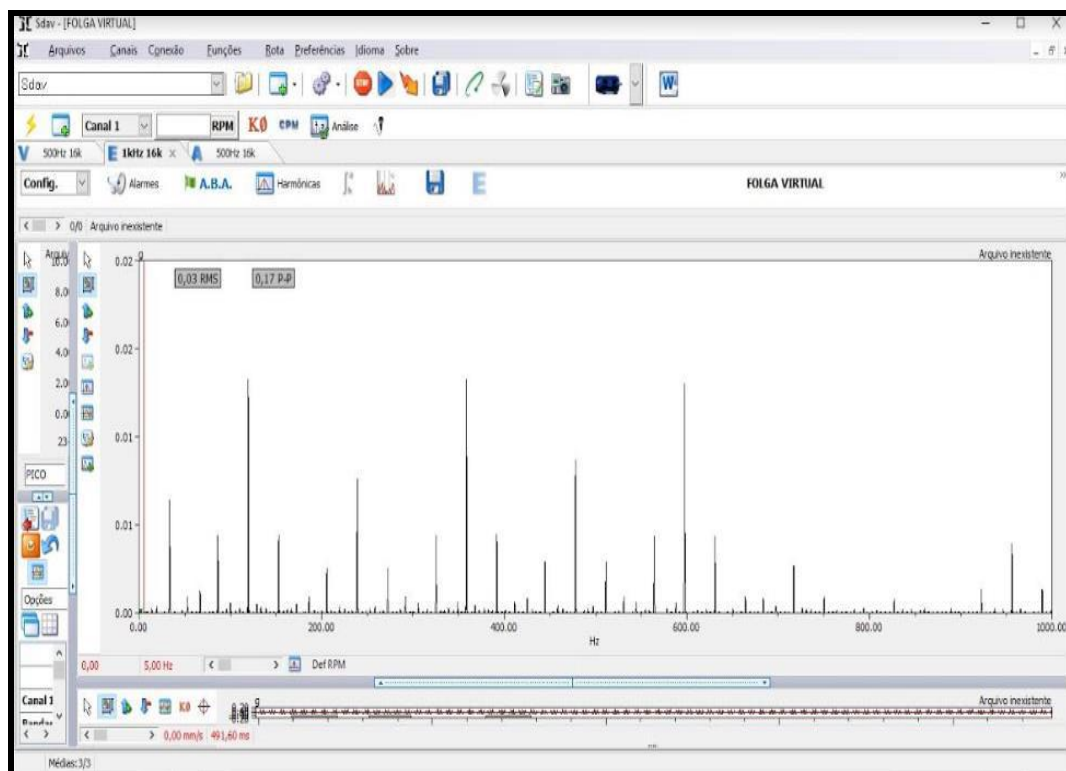


Fig. 5: Envelope window at Sdav software. Source: Authors (2020)

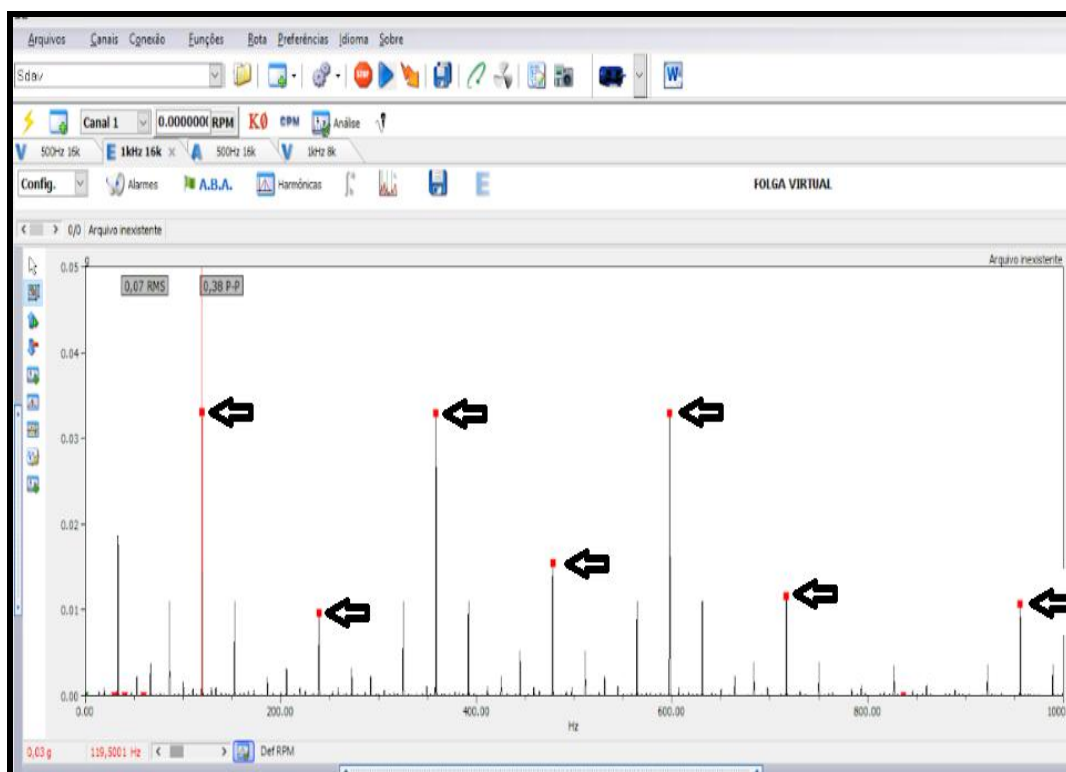


Fig. 6: Failure Identification Window at Sdav software. Source: Authors (2020)

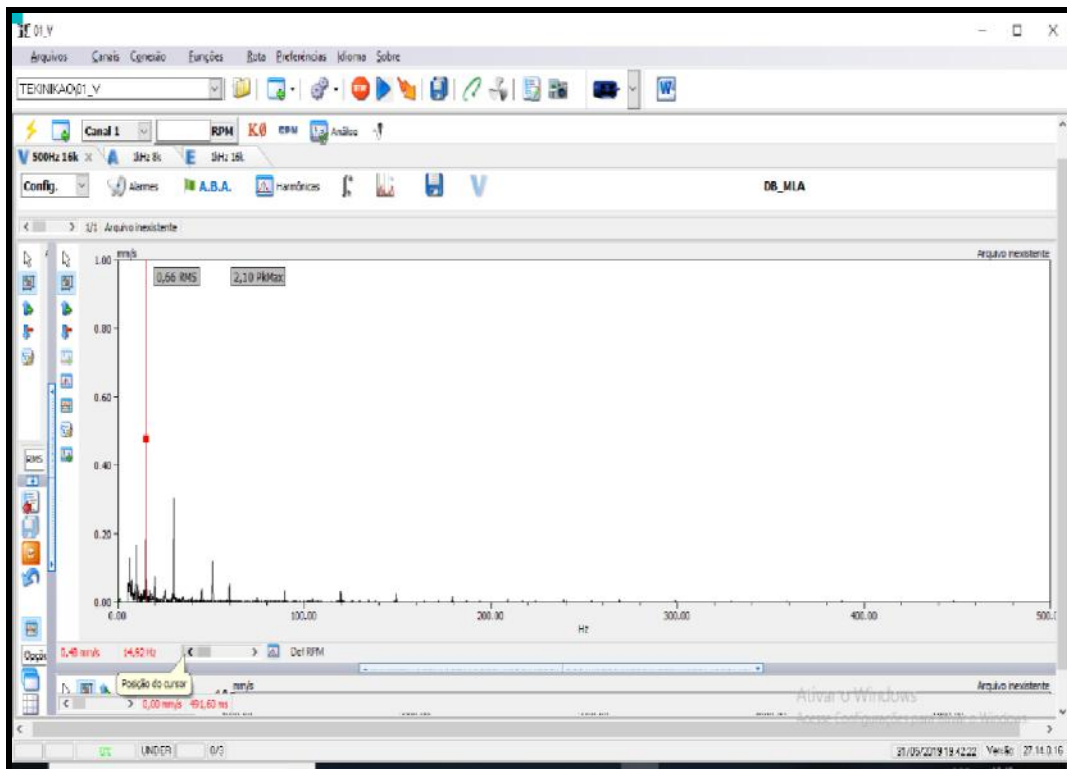


Fig. 7: Speed Window Measurements at Sdav Software. Source: Authors (2020)

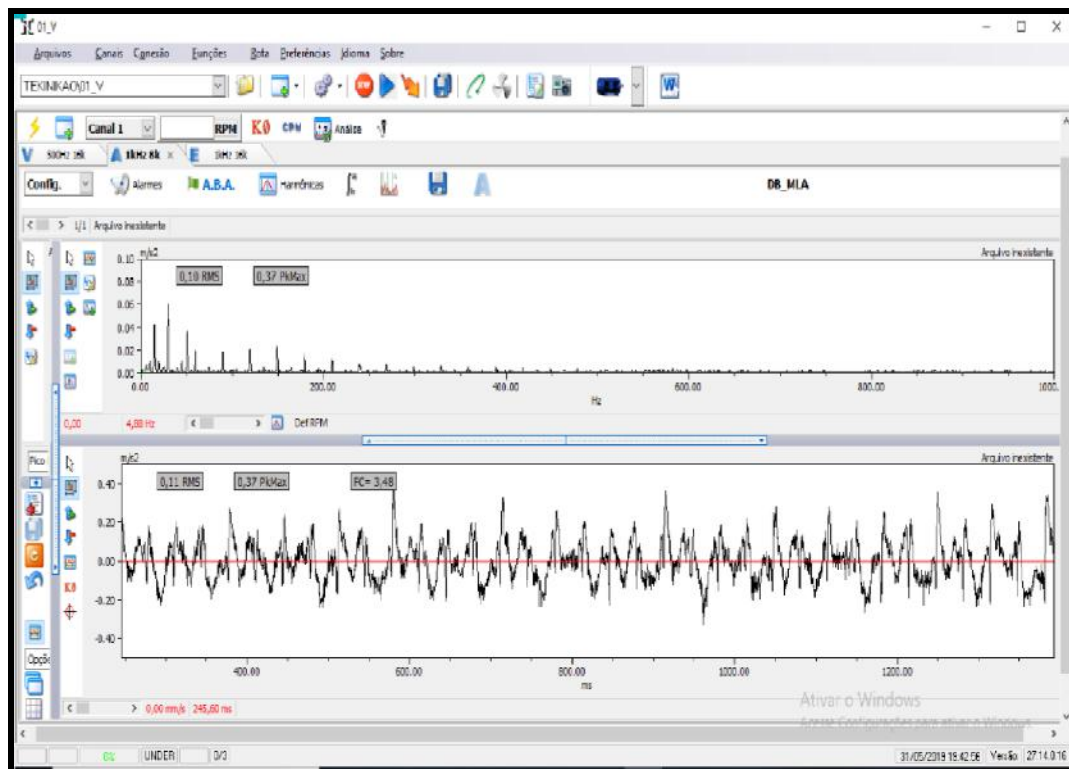


Fig. 8: Acceleration Window Measurements at Sdav Software. Source: Authors (2020)

3.5 Analysis of collected data

The calculation of useful power of motor, it is known that the electrical frequency was thirty-three hertz (33.3 Hz), was multiplied by sixty, and we obtained the value of approximately two thousand rotate per minute (2000 RPM). The difference between the rotations real and virtual means the total energy lost or dissipated during the operation of the motor. According to the value compared to the graph in the image above, the engine is working fine. The machine is in perfect condition for use, without presents failure.

The importance of works of this nature demonstrate the results of interdisciplinary knowledge in engineering solutions under current demands in the presentation of viable alternatives that can be improved in future research and in the creation of products. [11]

IV. RESULTS

4.1 Conclusion on virtual measurement

The work enabled us to learn to operate and to analyze data obtained through vibration analysis in a coherent way in to software and real test in laboratory. The program makes it possible to analyze and simulate damages such as bearings, reducers, faults, which can be analyzed separately or together.

It also favored the concepts maintenance predictive, being extremely important to using the equipment and sensors measuring, to monitoring the machines. These in order to obtain real data of the operation of the machine to facilitate failures visualization.

4.2 Configuring a Measuring the Rotating Assembly of a Real Machine

The centrifugal pump it is located in fluid laboratory of mechanical engineering department of UNISAL -Salesian University Center of São Paulo, the pump centrifugal was used to demonstrate analysis of vibrations in a real experiments, so using the software Sdav to applications of measurement vibration in machines reals. Important to mention the settings for the actual measurement are the

same as used for virtual machine in software. The electric motor rotation speed is indicated by red points on envelope graph disposed in Figure 5. How machine chosen for actual measurement was a laboratory machine, which was recently purchased, that is, a new machine, expected result in equipment failures find is null. The datasets has were obtained through sensors fixed in the machine, together with the software configuration. The several parameters and data obtained to be analyzed and come to a conclusion to check on there is any failure.

4.3 Images of the equipment used

4.3.1 Horizontal Measurements

- *Speed*

Speed measurements, shown page 8 with figure 7.

- *Acceleration*

Acceleration measurements, shown page 8 with figure 8.

4.4 Comparison of Results Obtained

In Table 2 shows the values obtained being compared.

Table. 2: Comparisons of Values Obtained at Sdav Software. Source: Authors (2020)

Comparisons of Values Obtained			
Real		Simulated	
<i>Speed</i>	<i>Acceleration</i>	<i>Speed</i>	<i>Acceleration</i>
<i>14,92 Hz</i>	<i>4,88 Hz</i>	<i>11,57 Hz</i>	<i>5 Hz</i>

4.5 Tests and Field Measurements

To use the equipment, according to the specificities calculated and simulated in the virtual environment, these specificities can be designated as for example: RPM and frequency. It was necessary to use a variable frequency drive (VFD), because through this device it is possible to work electric motor of the pump run in a correct version of frequency, this case was 33.33 Hz, this frequency was designated in variable frequency drive (VFD), can to observed in Figure 9 the utilizing of the VFD.

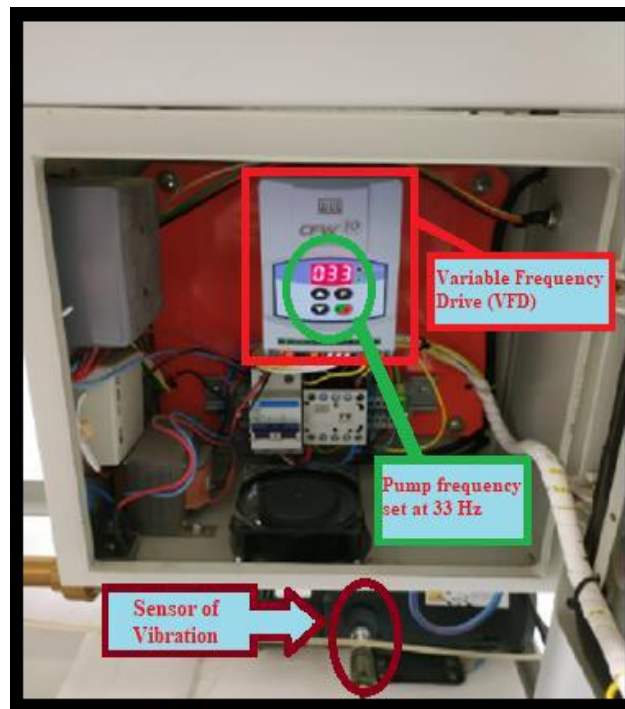


Fig. 9: Frequency Specification at Measurements of Pumping System. Source: Authors (2020)

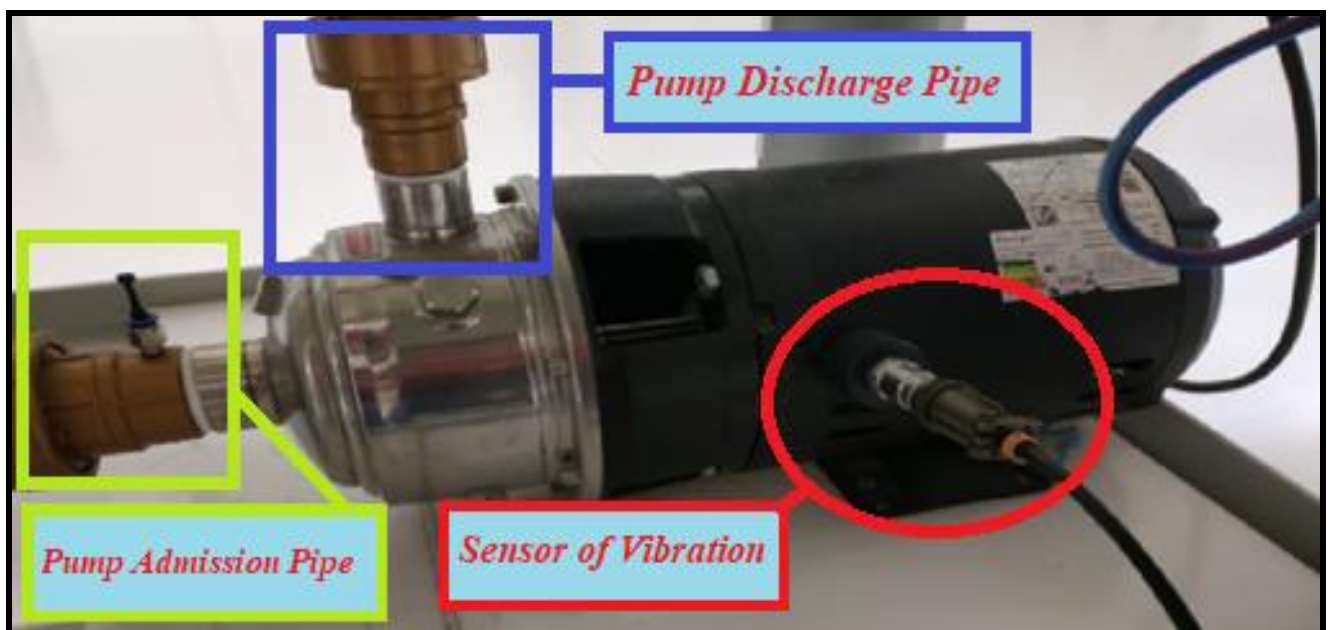


Fig. 10: Vibration Measurements at Centrifugal Pump of UNISAL. Source: Authors (2020)

Centrifugal pumps are far more ubiquitous than turbines in the turbomachinery market, therefore being more readily available to the consumer. [12]

It is worth mentioning that for the vibration measurement was using sensor horizontally position, the sensor of vibration was placed in perpendicular position of discharge pipe.

Other relevant factor that contributes to continuity of research and improvement of the prototype is that the municipality is located in the Paraíba Valley region, located in the state of São Paulo, consisting of a fertile and relevant scenario regional, national, international and multinational industry, thus concluding the effectiveness for the industries. [13]

Thus, it is necessary that those responsible for the industrial process must fully understand the manufacturing process to which they are inserted. [14]

When companies seek to observe their production system, in order to see possibilities, realize the potential of lucrative opportunities exist through the insertion of technological innovations [15].

To search for new technologies and to map new scientific and technological developments capable of significantly influencing a scientific and technological institution, is the main role of technological prospecting [16].

Research and innovation through an articulated view of knowledge requires an inter, trans and multidisciplinary approach [17].

Most of innovation studies and researches are not related to innovation measurement and, in general, it only addresses some innovative actions in terms of products, services or processes. [18]

V. CONCLUSION

The concluded that the analyzes made in the SDAV software were effective so that the student could have an experience with vibration analysis in a simulation software, learning to identify failures located in motors for that it is corrected, addition, the analysis performed on a real motor was extremely important, since the data obtained through a computer simulation and measurements carried out in fields, presented plausible and coherent results, validating the data analyzed virtually in the software and showing its effectiveness simulating complex mechanical systems and also being an auxiliary tool for the training of future engineering students.

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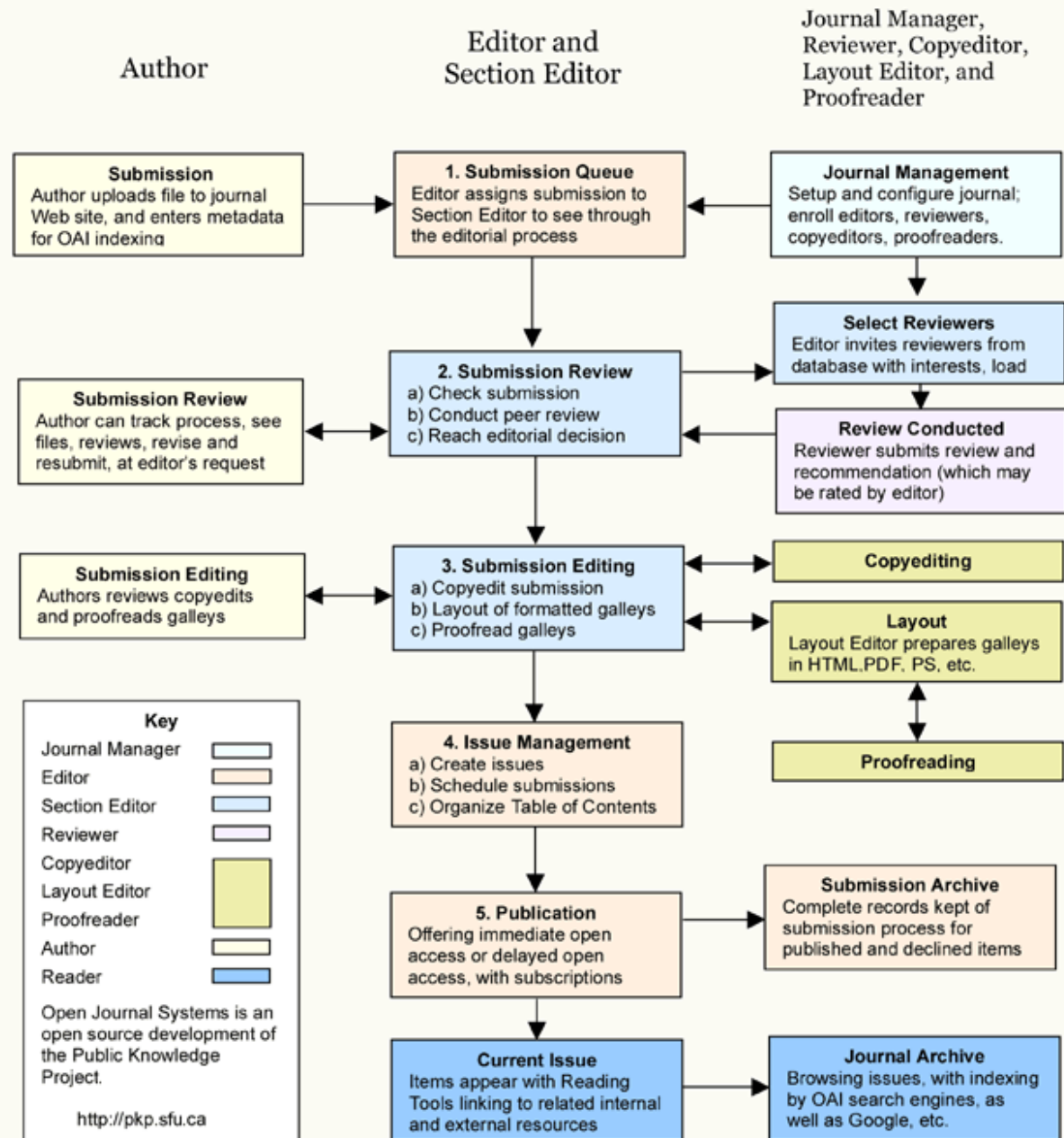
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