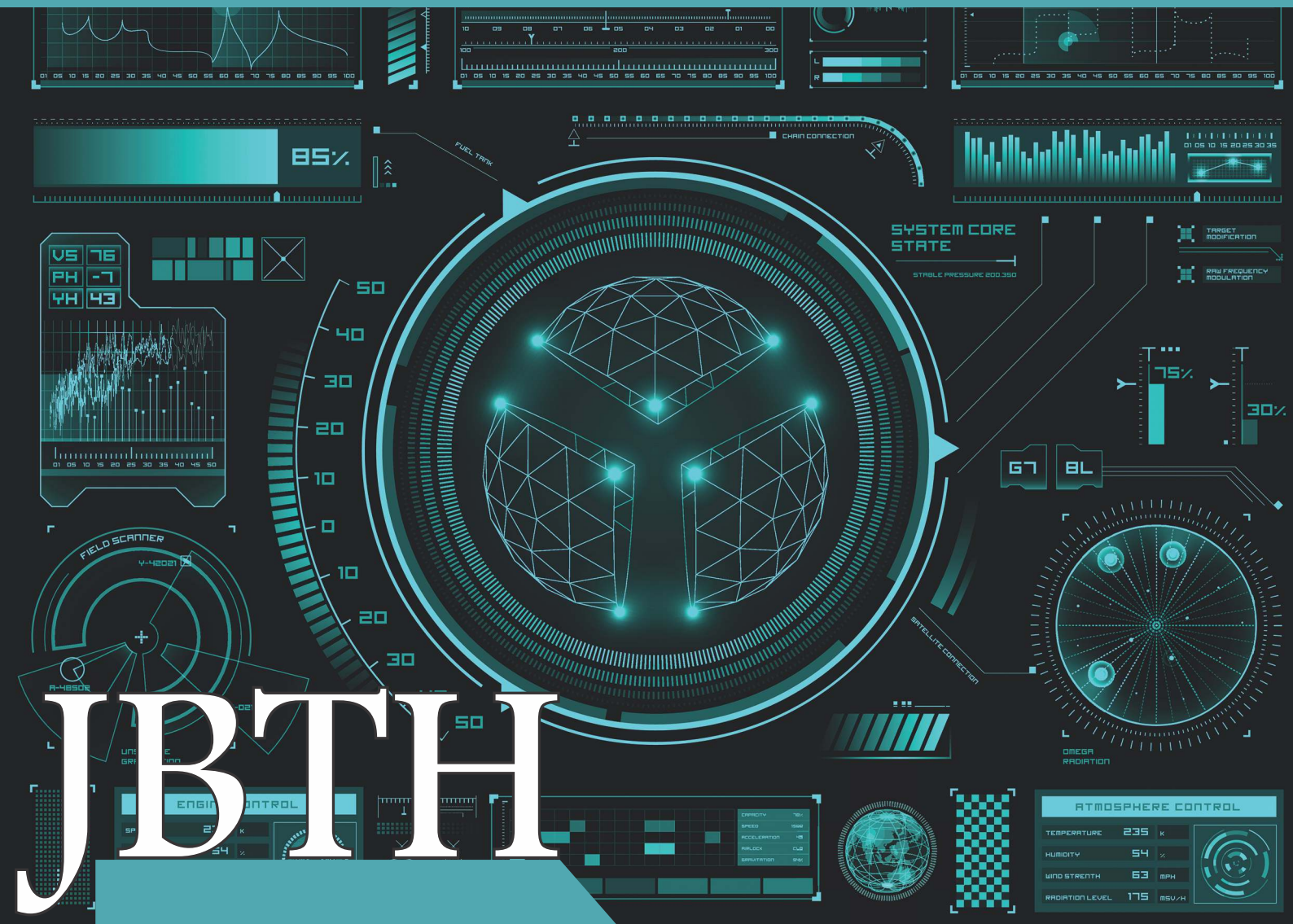
ISSN: 2595-2137
e-ISSN: 2674-8568

Volume 4· Nº 4 · December 2021

Journal of Bioengineering and Technology Applied to Health

An Official Publication of
SENAI Institute of Innovation in
Advanced Health Systems - ISI/SENAI CIMATEC



JBTH

ISSN 2595-2137 / e-ISSN 2674-8568

Volume 4 • Number 4 • December 2021

JOURNAL OF BIOENGINEERING AND TECHNOLOGY APPLIED TO HEALTH

SENAI Institute of Innovation in Advanced Health Systems - ISI/SENAI CIMATEC

PUBLISHED BY SENAI CIMATEC

Sistema FIEB | SENAI CIMATEC
PELO FUTURO DA INOVAÇÃO

December 2021
Printed in Brazil

JOURNAL OF BIOENGINEERING AND TECHNOLOGY APPLIED TO HEALTH

SENAI Institute of Innovation in Advanced Health Systems - ISI/SENAI CIMATEC

JOURNAL OF BIOENGINEERING AND TECHNOLOGY APPLIED TO HEALTH

Volume 4 • Number 4 *December 2021*

SUMMARY

The Journal of Bioengineering and Technology Applied to Health (JBTH) is an official publication of the ISI (SENAI Institute for Innovation in Advanced Health Systems) /SENAI CIMATEC. It is published quarterly (March - June - September - December) in English by SENAI CIMATEC – Avenida Orlando Gomes, 1845, Piatã, Zip Code: 41650-010, Salvador-Bahia-Brazil; phone: (55 71) 3879-5501. The editorial offices are at ISI (SENAI Institute for Innovation in Advanced Health Systems) /SENAI CIMATEC.

Editorial Office

Correspondence concerning subscriptions, advertisements, claims for missing issues, changes of address, and communications to the editors should be addressed to the Deputy Editor, Dr. Roberto Badaró, Journal of Bioengineering and Technology Applied to Health – JBTH – Avenida Orlando Gomes, 1845, Piatã, Zip code: 41650-010, Salvador-Bahia-Brazil; phone: (55 71) 3879-5501; or sent by e-mail: jbth@jbth.com.br

Permissions

Postmaster

Send address changes to JBTH, Avenida Orlando Gomes, 1845, Piatã, Zip Code: 41650-010, Salvador-Bahia-Brazil.

Information by JBTH-ISI (SENAI Institute for Innovation in Advanced Health Systems) / SENAI CIMATEC

Home-page: www.jbth.com.br
E-mail: jbth@jbth.com.br
Phone: (55 71) 3879-5501 / 3462-9599
ISSN: 2595-2137
e-ISSN 2674-8568

https://doi.org/10.34178

COVER: Set of futuristic user interface elements for dashboard or car control panel. Photo: istock gallery.

Resistance to PPE Using by Gas Station Attendants

Ananda Vieira de Lima Almeida[1]*, Vitor Erick Cardoso Freitas[1]
[1]Senai Cimatec University Center; Salvador,Bahia, Brazil

The discussion about the use, or not, of Personal Protective Equipment (PPE) by gas station attendants has been growing, in the contemporary context, due to the expansive increase in the consequences generated by the absence of this essential equipment at gas stations. The present study highlighted the importance of raising awareness among the attendants regarding their working conditions, mainly due to the high exposure to toxic compounds. At this core, resistance to use PPE by these workers comesfrom sociocultural issues that notoriously influence the conditionsimposed by this service. In this logic, the case study, determined by the book of Research Methodology by Marconi and Lakatos (2003), thistheme is based on data collection at gasstationsin the city of Salvador- BA, in 2021, to highlight the situations faced by these professionals and, consequently, the impacts on their quality of life and health. The resistance to the use of this equipment harms the present and future well-being of the attendants.
Keywords: Gas Station Attendants. PPEs. Risks.

Introduction

The growing demand for fuel in Brazil boosted the discussions about the attendants. The exposure suffered by these workers when performing their function leads the present study to highlight the resistance of using PPE by the attendants. In this context, it is worth noting that gasoline contamination - the principal fuel at stations - emphasizes an unhealthy work environment, according to article 189 of the Consolidation of Labor Laws (CLT), which drives serious problems related to worker health and, consequently, the maximization of questions about the role of PPE as a prophylactic measure [1].

Therefore, the resistance of gas station attendants regarding PPE comes from the lack of knowledge about the consequences of exposure to gasoline since toxicity is the main factor to be considered [2].

In this scenario, the Ministry of Labor, through Regulatory Standard 9 and 12 (NR-9 and NR-12) and Ordinance No. 25/1994, classifies occupational risks into five types: physical, chemical, biological, ergonomic, and accidental, which are essential to assimilate the unfavorable situation found in the work environment of gas station attendants.

The issue of the need to use PPEs to guarantee the physical integrity of these professionals is under discussion due to the obstacles related to the effects of not using essential equipment, which demonstrated that fuel inhalations (toxic to human beings) and fuel explosions in establishments (flammable) have gradually become more common in the daily lives of gas station attendants [2].

From this perspective, it is essential to evaluate the social, economic, technological, and organizational factors interconnected by the work environment of the gas station attendants [3]. So, this study plans to present the obstacles observed by the attendants and to amplify the discussions about the nature of the chemical composition of gasoline.

This work highlights, exemplifies, and solidifies the resistance to the PPE by gas station attendants. Therefore, evidencing the consequences of not using such equipment. In this scenario, the choice of theme assumes that we can mitigate the risks faced by gasstation attendants with PPE. However, the lack of information regarding the need for such equipment has an impact on their well-being. We justify, therefore, this study by the use, or not, of PPE by gas

Received on 12 August 2021; revised 28 November 2021.
Address for correspondence: Ananda Vieira de Lima Almeida. Av. Orlando Gomes, 1845 - Piatã, Salvador - BA- Brazil. Zipcode: 41650-010. Phone: (71) 3462-8449. E-mail: anandavlalmeida@hotmail.com. DOI 10.34178/jbth.v4i4.174

J Bioeng. Tech. Appl. Health 2021;4(4):117-127.

station attendants in Salvador-BA, Brazil, based on descriptive statistics in the year 2021.

Therefore, aiming to mitigate the long-term effects of not using PPE on the health of these workers, this research proposes to express that the resistance to the PPE by gas station attendants is harmful to the physical and psychosocial variables.

Theoretical Referential

In this section, we divided into three parts, the chemistry present at gas stations, such as gasoline and itsmain characteristics, wasinitially studied.In addition, the relationship of gas station attendants with PPE and the main consequences of inhaling toxic compounds inherent in gasoline. Because of this study, to certify and support this research, we used the followed references:

a) Neto (2012) [4] exemplifies the need to use PPE due to the risks of gasstations combined with Regulatory Standard 20 that explains the management of health and safety in environments with flammable materials.
b) Moraes (2003) [5], Machado (2015) [6], Moreira and Gomes (2011) [7], Costa and Goldbaum (2016) [8] discuss the physicalchemical characteristics of gasoline together with the MSDS study provided by BR Distributing Company.
c) Marinho (2011) [9] brings in his book about the process of Atmospheric Distillation in the Oil Industry.
d) Rocha, Cezar-Vaz, Almeida and colleagues (2014) [1] addresses the risks that gas station attendants are exposed to chemical components.
e) Soares (2019) [2] highlights the negligence in PPE's use by these workers, addressing the factors that influence this issue.
f) Regulatory Norm Brazil (NR) 6 lists the application of PPE in places that present risks to their workers [10].
g) Regulatory Norm Brazil (NR) 15 applies to the issue of unhealthy conditions, a feature present at gas stations [11].
h) Campos (2017) [12] discusses the essentiality of gas station attendants knowing the consequences of exposure to gasoline.
i) D'alascio, Menegali, Bornelli, and Magajewki (2013) [13] explain the effects of benzene in the human body.

Chemistry at Gas Stations

Fuels, in general, are used by society as a means of obtaining energy for transportation. In this sphere, NR 20 [10] classifies gas stations as class I, so that they are classified as a service that has flammable materials. Thus, it is first necessary to understand how gasoline, of fossil origin, present in gas stations, is obtained through atmospheric distillation in the Petroleum Industry.

In a simplified way, the work “New Chain of Oil and Natural Gas” conceptualizes atmospheric distillation as the “fractionation of crude oil to be processed in all “refineries” and, therefore, the gasoline goes through this process, to be sent to the fuel distribution networks and, finally, to the final consumer, through the handling of gas station attendants [9].

Figure 1 shows the oil refining process, in which crude oil undergoes a heating process to raise the temperature of this oil and, subsequently, goes to the atmospheric distillation tower, which obtains the fractions of petroleum, such as gasoline, the main chemical component to be studied in this article.

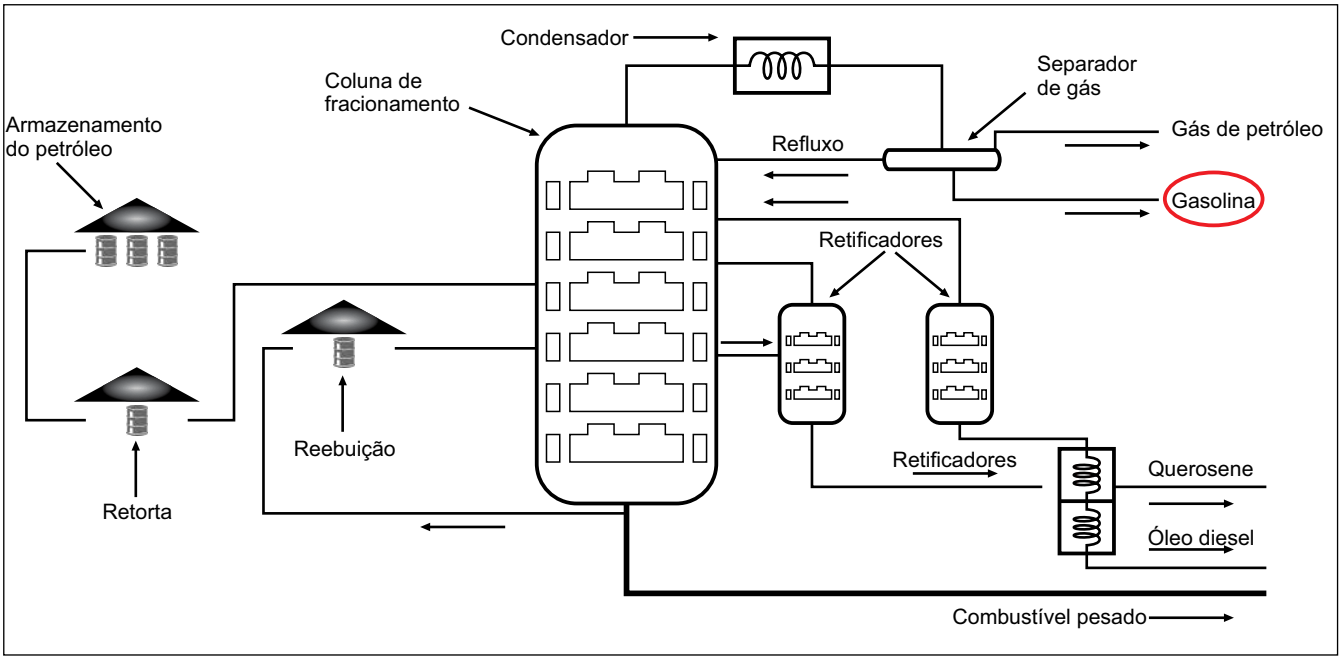
So, exposure to the chemical components of gasoline generates the need for PPE use due to the risks presented [4].

Gasoline

Gasoline is the principal fuel used to fuel vehicles. Similarly, it isthe product that gasstation attendants are exposed to in their workplace.

In Brazil, there are several types of gasoline. However, our analysis used the general chemical nature of this substance, which is used for internal combustion engines with ignition [9].

Figure 1. Oil refining.



Source: Luciana Mendonça (2011) [19].

In this context, it is crucial to evaluate the gasoline physical-chemical characteristics to understand why it is necessary to use such equipment.

The principal characteristic is the organic composition. It is a naphtha complex, substances with hydrocarbons, carbon chains from C5 to C12, including paraffinic, olefinic, and aromatic hydrocarbons, and boiling range from -20 to 230ºC [15].

Therefore, the volatility of this chemical component is a crucial characteristic. It poses high risks for gas station attendants when they fill the vehicles' tank because of the inhalation – evaporation facilitates – of the chemical compounds present in gasoline.

Within the analysis aspects of gasoline, the octane of this compound is an indicator of the performance of this chemical under varying engine operating conditions [5].

The conditions are high pressure and high temperature, thus creating a spontaneous detonation resistance inside the combustion chamber, in which the mixture between fuel vapor and the air is pushed to the maximum limit. The octane follows the chemical composition of gasoline, called the octane number or octane number.

Thus, gasoline is a component with several mixtures of multicomponent. We use two references to delimit the octane number, the regular- heptane defined as ZERO, as it has low compressive strength and iso-octane (2,2,4 Trimethylpentane) as a parameter for presenting high compressive strength [6].

After evaluating the volatility and octane of gasoline, it is essential to understand hydrocarbons, which can be paranific, olefinic, and aromatic, the latter being the most aggressive to the human body.

Benzene

Benzene (C6H6) – aromatic compound – has exposed the employees to toxicity in medical literature since the 19th century [7]. In this

analysis, this toxicity is related to the worsening of hematotoxicity, problems related to blood circulation, and genotoxicity, related to the mutagenic and carcinogenic capacity, resulting from its metabolism [8].

Figure 2 shows the risks generated by the inhalation of gasoline, arising from the completion of refueling. So, the PPE use could avoid nervous system disease, genetic changes in human cells, and other systematic disorders due to gas inhalation.

According to the Chemical Product Safety Data Sheet (MSDS) for gasoline, the toxicological characteristics to which gas station attendants are exposed are: acute toxicity - orally -, which can generate nausea and vomiting, corrosion and skin irritation, eye damage, respiratory sensitization, germ cell mutagenicity, carcinogenicity, and reproductive toxicity.

Thus, the exposure of attendants must be minimized to ensure their health.

Relationship Between Gas Station Attendants x PPEs

Gas stations present risks related to workers, who need to carry out their activities, namely: contact with chemical products, noise, heat, and inhalation of chemical compounds such as aromatics, which are offensive to the attendants' health and life-quality at their workday [1].

The NR-20, a classification established in the SIT (Labour Inspection Secretariat) Ordinance No. 787, informs the minimum requirements for the management of safety and health at work against risk factors for accidents in extraction, production, storage activities, transfer, and handling of flammable products and combustible liquids [10].

Hence, the commercialization of fuels and flammables requires inspection and monitoring. It is of great importance for gas station workers who are exposed to these chemical products' commercialization activities.

In addition, Regulatory Norm Brazil (NR) 15, which was originated by SIT Ordinance No. 787, in which it is related to activities that must be classified as unhealthy, thus generating unhealthy bonusesfor workers who deal with noise exposure, ambient heat, ionizing radiation, and chemical agents containing benzene, in which the attendants are subject to these situations [11].

Thus, as a solution or improvement in the quality of life and health for this category of employees, Regulatory Standard 6, which is in STI Ordinance No. 787, which regulates the execution of work with the Personal Protective Equipment (PPE), regardless of sector or economic or commercial activity. Furthermore, the obligation to provide the supply and PPE for employees and workers, including gas station attendants, who have specific protective equipment to combat the risks present in the workplace [6].

Therefore, the realities present in these places are inconsistent with the regulatory standards, which aim to ensure individuals who work with flammable products, in which the attendants refuse to apply these NR, taking high risks to their well-being and health.

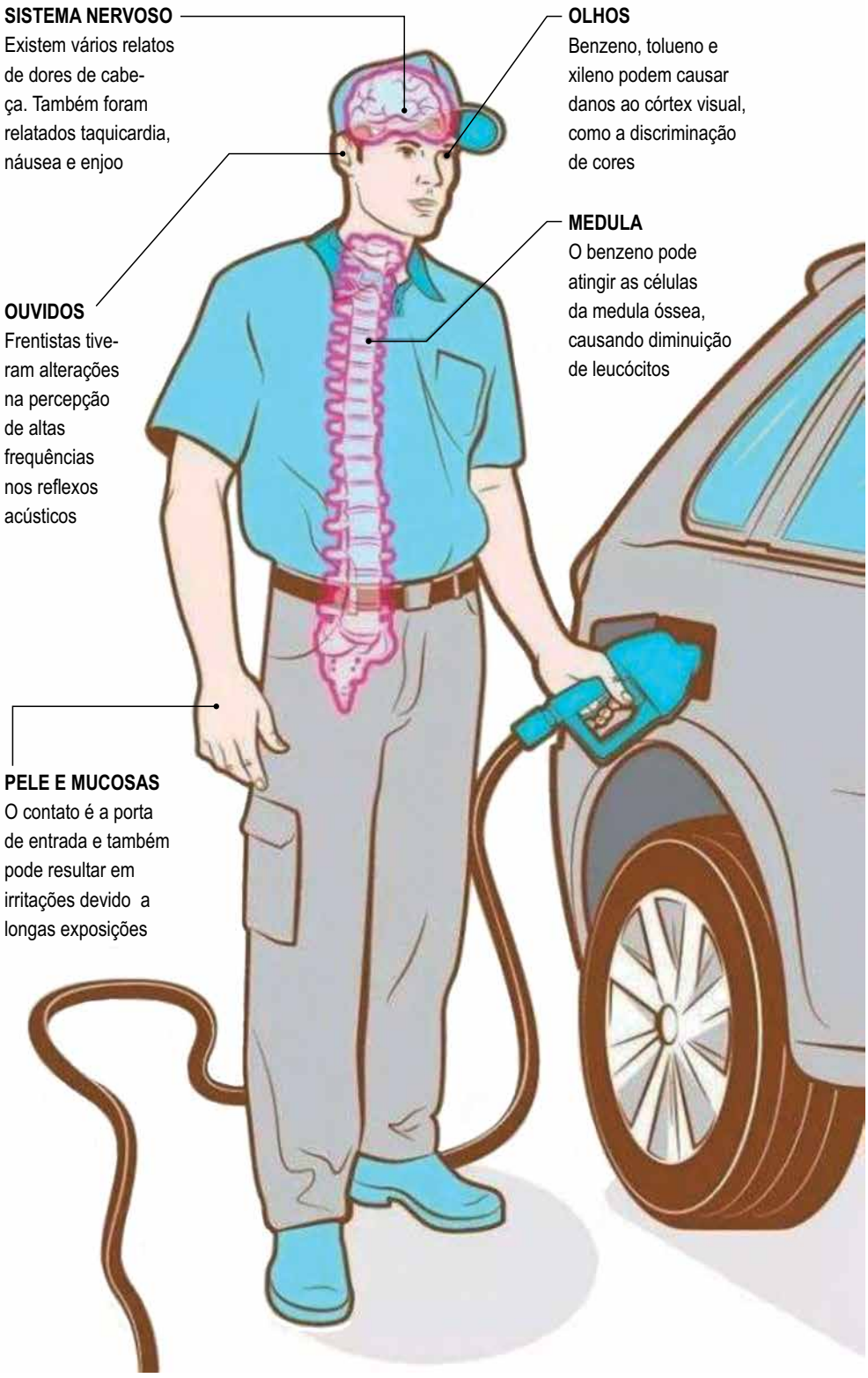
Resistance to the PPEs

The reason that causes resistance in the application of PPE by gas station attendants is that they "claim" discomfort when using it, forgetfulness, non-supply equipment, and, finally, underestimating the risks present at gas stations. In addition, inadequate physical structures conditions at the workplace contribute to low adherence to PPE use. For example, exposure to heat is a risk for workers [2].

So, the resistance to using protective equipment makes the work environment highly dangerous and unhealthy for all employees. Furthermore, the non-performance of inspection by public bodies related to Work Safety (ST) facilitates workers not complying with the obligations established by the Regulatory Norms (NRs) [10,11].

In addition, the non-provision of PPE by companies and station owners, who should distribute according to NR-6 to gas station attendants, to make a safer work environment

Figure 2. Gasoline as the main villain for the health of gas station attendants.



Source: Brazil Postos (2014) [20].

and thus prevent occupational diseases, such as the inhalation of chemical products, specifically benzene, which is present in the composition of gasoline [18].

Lack of PPE by Gas Station Attendants

The effects caused by the absence of Personal Protective Equipment are, mostly, harmful to the health of attendants.

When evaluating the effects generated by the absence of PPE, first, occupational diseases that may eventually affect gas station attendants are highlighted. In this context, exposure to benzene, an aromatic compound present in gasoline, is the main precursor of the adversities found in the human body. Thus, it is up to the National Occupational Health Policy in Brazil to establish means to expose a situational and preventive diagnosis for these workers [12].

First, it is necessary to understand the concept of 'Benzenism': “Benzenism is a set of signs, symptoms, and complications resulting from acute or chronic exposure to benzene. Complications can be acute, when there is exposure to high concentrations with the presence of neurological signs and symptoms, or chronic, with different clinical signs and symptoms, and complications may occur in the medium or long term, located mainly in the hematopoietic system (bloodforming). [14]” In this analysis, it is known that benzene can enter the human body, mainly through the airways, but the skin and ingestion may also be considered modes of absorption. Similarly, immediate contact with benzene irritates the mucous membranes which, over time, can cause pulmonary edema and hemorrhage in contact areas, causing death [17].

Thus, the intense contact with this compound may, initially, characterize mild symptoms that, later, with advancing exposure, may result in a slow but aggressive degeneration for human health.

So, Figure 3 showsthe form of contamination due to the chemical compound benzene, such as, through inhalation, contact with the skin, and ingestion, leading to problems in the systems of the human body.

Analyzing the effects of benzene on the human body, the nervous alterations are drowsiness, headache, vertigo, and tremors, and the hematological alterations, due to damage to the bone marrow, the blood-forming tissue, are given by anemia, leukopenia, lymphocytopenia, thrombocytopenia, coagulation disorders, and recurrent infections [13].

In short, this study highlights the consequences generated by the lack of PPE by gas station attendants,thusthe great possibilityof occupational diseases with exposure and inhalation of chemical components, specifically benzene, causing disease in the blood and respiratory streams, in which to solve or minimize the diseases and the supply of PPE by companies responsible for gas stations and the application of PPE by gas station attendants.

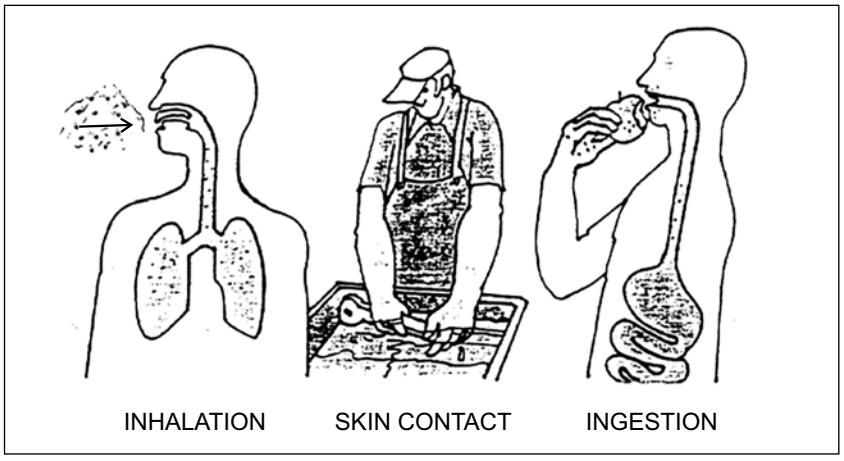
Materials and Methods

This research, based on a case study, used articles with several theorists, present in several scientific websites, such as Academic Google, Scielo, "Research Gate", UFERSA Library, and UFRJ Library, to use bibliographic research so that they can legitimize the issues highlighted in the objectives of this research. In addition, descriptive statistics were used, through a questionnaire, at gas stations in Salvador-BA, to prove that the situations portrayed in this article are part of the daily lives of gas station attendants. Finally, after analyzing the responses collected, which were 10 gas station attendants, the relevance of the present study was evidenced through the results.

Results and Discussion

According to Marconi and Lakatos (2003) [16], the results of a case study are the most important part of the research. Because of this, this topic will evidence the data we collected at the Salvador-BA gas stations between April and May 2021.

Figure 3. Benzene intoxicating pathways.



Source: BT CDC (2011) [21].

We divided the questionnaire into foursections: general information, consciousness about PPE, knowledge about the risks involved, and receiving PPE.

The first analysis was carried out in a general way regarding age, length of service, and level of education, which are crucial categories for assessing socioeconomic factors. In this analysis, more than half of the gas station attendants fall into the category between 40 and 60 years old. Then, 30% were between 25 and 40 years and, finally, only 1 of the interviewees was between 18 and 25 years.

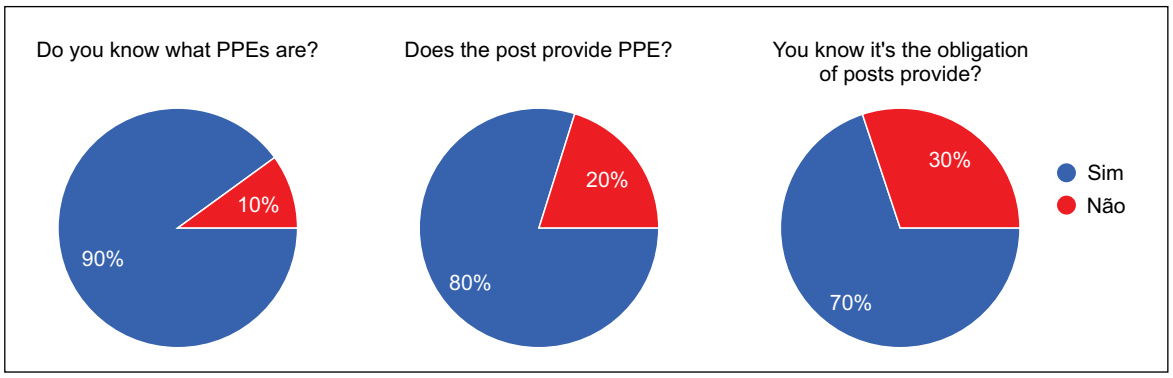
In addition, it appears that the length of service varied among most of the gas station attendants interviewed. In this sense, 40% have been working for 10 to 15 years. This information matches our interviews: 0 to 5 years, 5 to 10 years, and 15 to 20 years, each presenting a percentage of 20%. Finally, the level of education shows that 9 out of 10 respondents have High School. After analyzing these three socioeconomic variables, the second session of the questionnaire: factors related to PPE at gas stations (Graph 1).

Initially, given the importance of using PPE, 90% of the attendants answered that they know the concept of this equipment, which characterizes a positive characteristic for this project, as it proves that the references used showed that the attendants knew about the PPE, but, later, we showed that they, despite knowing, do not use properly. Then, the gas stations provide PPE to their workers, complying with NR 6. On the other hand, although 70% of the attendants are aware that the stations have to provide such equipment, 30% are still not aware of this information, which hinders the dissemination of protected information to the attendant. In the background, the charts below present essential safety factors for these workers (Graph 2).

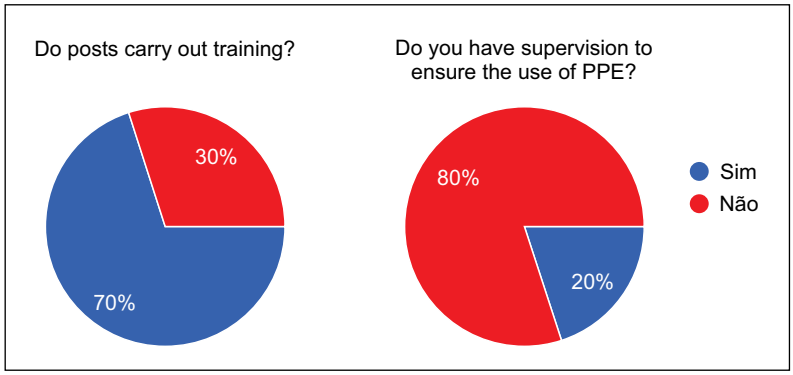
From these graphs, it is worth emphasizing, at first, that training on how PPE should be done is essential to ensure the consistent use of this equipment since misuse can cause damage in the same way as non-use. In this aspect, 70% of the attendants stated that they received training, ensuring that they use it correctly. However, inspection to guarantee the use of PPE does not occur at most gas stations, which, notoriously, is at odds with the study proposed by Soares (2019) [2]. In this bias, safety management (NR-20) should enhance to guarantee the use of PPE by gas station attendants [10]. Therefore, the variables questioned by the attendant were analyzed.

Although the attendants – in their entirety – consider the use of PPE important in their services, it was evident that 50% of the interviewees did not use this equipment for their safety. The lack

Graph 1. About PPEs' knowledge.



Graph 2. Trainning and supervision to PPE.



of inspection at gas stations, which would explain such resistance from these professionals, can explain this percentage (Graph 3). Such questions are necessary: Would inspection guarantee the use of PPE by gas station attendants? Do gas station attendants need to be scrutinized for their safety? If attendants used PPE, would inspection be essential to ensure safety or just by protocol? About the benzene, 70% of the gas station attendants said they had prior knowledge about gasoline and 30% said they did not. However, this is not justified since the training carried out by gas stations should include using PPE: avoid contacting the compounds present in gasoline. About benzene, 90% claimed to know about this aromatic compound. Nevertheless, the workers were not aware of the consequences that the possible contact could cause on their health.

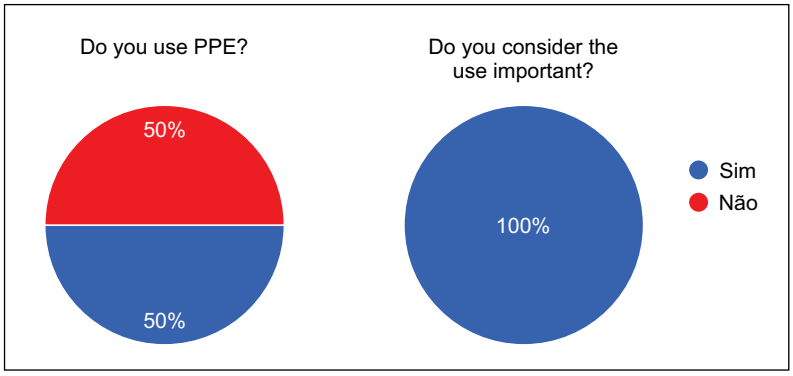
The third session of this study deals with the risks involved in this type of work. The question asked was: What risks do you believe you are being exposed to? (Graph 4).

According to Graph 4, exposure to benzene by handling fuels can lead to eye contact, inhalation of vapors, repeatability, fire and explosion, skin contact, intense activity, and contamination fuels themselves are the main complaints of gas station attendants, which proves the main objective of this study.

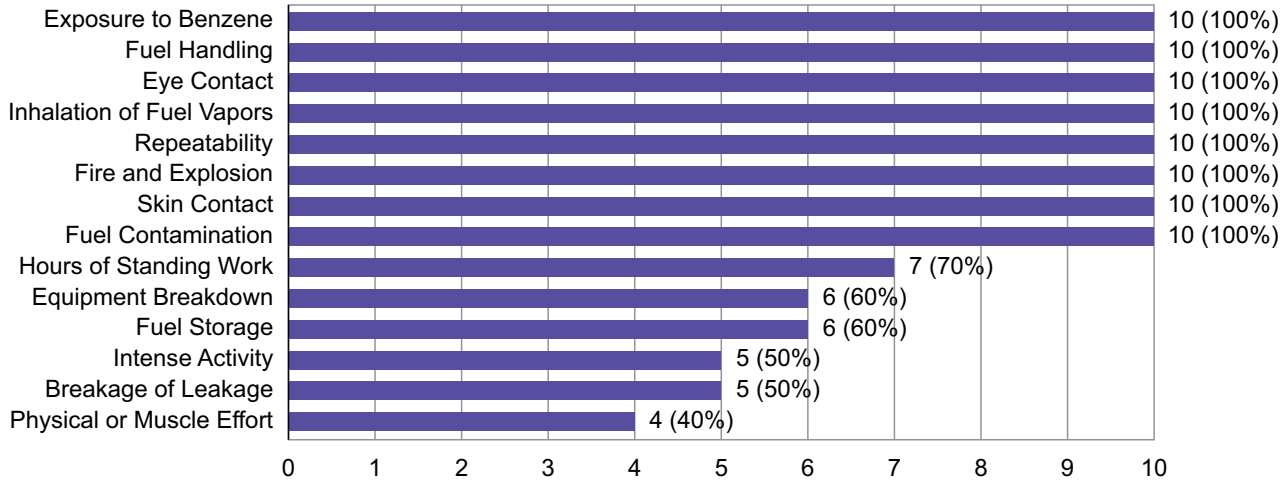
The data on risks of rupture and leakage, physical and muscular effort, fuel storage, equipment breakdown, repetitiveness, and intense activity were other complaints portrayed, but not in their entirety.

The last session of the questionnaire developed by the authors is about the receipt of PPE, which, as shown above, is the obligation of gas stations to provide gas station attendants. But, it is not

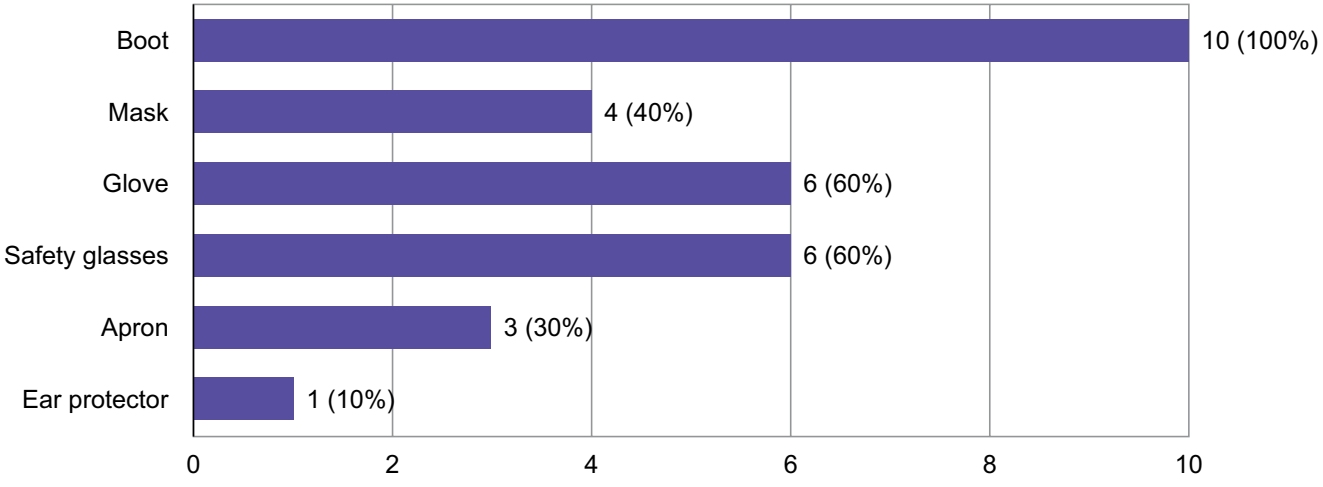
Graph 3. Dealing of PPEs.



Graph 4. Involved risks without PPEs.



Graph 5. PPEs' use by attendants.



always carried out, thus causing safety problems for attendants (Graph 5).

According to Graph 5, the boot is the PPE most provided by the posts since all respondents claimed to receive it. From a health perspective, the majority supply of the boot is at odds with the explanations of the International Agency for Research on Cancer (2012) [17], as it states that the main route of exposure to benzene is respiratory. Agreeing with the Agency, the provision of a mask should be the principal equipment available. Nevertheless, less than half of the respondents receive this equipment. Furthermore, 60% of the attendants said they received gloves to use in their respective work environments, minimizing the contact with products with toxic chemical compounds, thus exemplifying the need for such equipment to prevent contact with human skin. Therefore, the PPE is necessary to mitigate all factors collected at gas stations in Salvador-BA.

Conclusion

The PPE is necessary to avoid future consequences for gas station attendants. From the data collection, we observed attendants are being exposed to daily risks without any inspection to prevent them. We also noted the lack of information between them and the resistance to PPE use since there is no inspection at gas stations. Therefore, by entering the discussion of a very relevant but little-discussed topic, the doors for future research are opened, as by looking at safety and health, it is possible to understand the many facets of these workers.

Acknowledgments

We thank the professors who helped us during the article creation process, especially Mr. Wadson Barbosa. In addition, we would like to thank the coordination of our technical course, Mrs. Nayara Oliveira. We also thank our classmates throughout the course. We thank each other (Ananda and Vitor) for all the construction of this project, which, for sure, would not be possible without our partnership. And finally, we thank the SENAI CIMATEC Institution for our technical training in Petrochemicals. Without all this support network, it would not be possible for us to obtain this opportunity to publish our article at the SIINTEC symposium in 2021. Thank you all.

References

1. Rocha L, Cezar-Vaz MR, Ameida M, et al. Use of personal protective equipment by gas station attendants: Contribution of nursing. Federal University of Rio Grande do Sul. 2014. Available at: Accessed on: 28 Mar 2021.
2. SoaresTN.Analysis ofthe conditionsforthe use of PPEs and the importance of awareness of their usefulness for the activity of gas atations in gas stations in the municipality of Mossoró - RN. Federal Rural University of the Semiarid (UFERSA) – Course Conclusion Paper, 2019. Available at: Accessed on: 23 mar 2021.
3. Potres MN. Perception of gas station attendants on the repercussionsoftheirprofessional activityon theirhealth in the city of Uberaba. 2008. 65 f. Dissertation (Masters in Exact and Earth Sciences) - Federal University of Uberlândia, Uberlândia, 2008. Available at: Accessed on: 23 mar 2021.
4. Neto VG. Importance of the use of PPE by gas station attendants in Salvador-BA. for. 18. 2012. Salvador-BA. (Article for Bachelor requirement) Available at: Accessed on: 26 Mar 2021.
5. Moraes JEB. Experimental module for fuel octane determination. 2003. Available at: Accessed on: 29 Apr 2021.
6. Machado JV. Isomerization of n-octane over Pt/HBEA catalyst to improve the quality of gasoline. 2015. Dissertation (Masters in Chemical Engineering. Available at: Accessed on: 27 Apr 2021.
7. Moreira GG, Gomes S. Occupational poisoning from benzene: an environmental health issue. 2011. Available at: Accessed on: Apr 23, 2021.
8. Costa DF, Goldbaum M. Chemical contamination, precariousness, illness and death at work: benzene in Brazil. Ciência & Saúde Coletiva [online]. 2017, v. 22, no. 8 pp. 2681-2692. Available at: https:// www.scielo.br/j/csc/a/DGWMrgwdFGhZPzm6tr74qpL/?format=pdf&lang=pt> Accessed on: 24 Apr 2021.
9. Marinho R. New oil and natural gas productive chain. Volume I. 1st Edition. Santa Cruz do Rio Pardo – SP: Editora Viena, 2011.
10. Ministry of Labor. MTB Ordinance No. 3.214, of June 8, 1978. NR 20, Regulatory Standard-6 (1978).

Official Gazette of the Federative Republic of Brazil – Brasilia.
11. Ministry of Labour. MTB Ordinance No. 3.214, of June 8, 1978. NR 15, RegulatoryStandard-15 (1978). Official Gazette of the Federative Republic of Brazil – Brasília.
12. Campos AG. Analysis of the activity of the attendant in face of the danger of exposure to benzene. 2017. 94 f. Dissertation (Academic Master's in Public Health) – Instituto Aggeu Magalhães, Oswaldo Cruz Foundation, Recife, 2017. Available at: Accessed on: 23 Apr 2021.
13. D'alascio R, Menegali M, Bornelli A, Magajewki F. Symptoms related to occupational exposure to benzene and occupational habits in workers at retail fuel resale stations in the southern region of Santa Catarina. Rev Bras Med Trab. 2014;12(1):21-29. Available at: < https://cdn.publisher.gn1.link/ rbmt.org.br/pdf/ v12n1a04.pdf> Accessed on: 29 Apr 2021.
14. Arcuri A, Costa D, Possebon J, et al. Benzene: it is not a flower to smell. São Paulo: FUNDACENTRO, 2011. Available at: Accessed on: 23 Apr 2021.
15. Chemical Safety Sheet: Gasoline. 2020. Available at: Accessed on: 23 apr 2021
16. Lakatos EM, Marconi MA. Methodology of scientific work. São Paulo: Atlas, 2003.
17. International Cancer Research Agency; 2012.
18. Vasconcelos S, Santos J, Soares MA, Santos MB. Health and safety analysis at fuel reseller stations in the Municipality of Campina Grande - PB. ENEGEP,7. 2009. Available at: Accessed on: March 23, 2021.
19. Marinho R. New Oil and Natural Gas Chain - Volume I. 2011. Publisher: Viena. 1st Edition.
20. Attendant: Profession Danger. Galileo Magazine. 2014. Available at: Accessed on: 24 apr 2021. 21. Available at: Accessed on: 24 apr 2021.

Essential Oil Extraction: Being Green and Emerging Technologies

Carlos Alberto Tosta Machado[1*], Herman Augusto Lepikson[1], Matheus Antônio Nogueira de Andrade[2], Paulo Renato Câmera da Silva[2]

[1]Senai Cimatec University Center; [2]Federal University of Bahia Salvador,Bahia, Brazil

The essential oil extraction industry responds for a significant role as a raw material supplier to the cosmetics, pharmaceutical, and cleaning product segments. These oils are produced mainly via steam distillation in small businesses, applying systems with broad opportunities when technology is concerned. This paper aims to present the technological features to optimize extraction effectiveness (yield) and energy consumption. The answer to the question in the title involves improvement proposals to green extraction and the impact on business. This study is the continuation of the one previously published in the number 3/2021 of this Journal, entitled "Essential Oil Steam Distillation: Manufacturing 4.0".

Keywords: Essential Oil. Yield. Technology. Green Extraction.

Introduction

The essential oils (EO) extraction industry is, in general terms, supported by production systems with significant potential for technological upgrades [1]. These processes are characterized by yield uncertainties: the variability coming from the raw materials (herbs), in addition to undetected and uncorrected operational occurrences, due to the lack of basic instrumentation and control. In general, the essential oil extraction process operates in multipurpose plants, in batches, with a broad range of feedstock (leaves, branches, roots, flowers, and bark). In addition, they present variation in process cycles [2], energy, and time waste, thus with direct effects on productivity and quality, compromising the expected results. The steam distillation method is, unquestionably, the most frequently used within extraction industries [3,4].

This work presents a comparative frame between the current situation and a scenario of technologically improved processes. It is based on emerging technologies that may achieve a direct positive impact on sustainability indicators. As far as technology is concerned, the proper use of sensors and controllers [5,6], data acquisition, data treatment, followed by intelligent modeling [7] (for instance, with digital twins [8]), have the purpose of improving the steam distillation process. The detection of undesired occurrences and their correction, in the steam flow through the vegetable bed, is brought with promising proposals to optimize the extraction process toward green extraction.

Yield and extraction duration are indicators of the process performance. When optimized, these factors deliver both energy and water minimum consumption for effective production. Besides, digging down into the production chain, maximum yield requires a reduced planted area for the same produced quantity of essential oil. Therefore, it reduces all the agricultural needs and environmental impacts.

Essential Oils

Essential oils are a complex chemical mixture. Produced by secondary plant metabolic systems, they are responsible for communication with other plants, animals, attracting or repelling them, as they can be beneficial or malefic for the organism, respectively, and protection against fungi and other microorganisms. With broad use in several industries, their importance is highlighted by their customer industries: cosmetics, pharmaceutical, home care, and food preservatives [9-11].

Received on 13 August 2021; revised 23 October 2021.
Address for correspondence: Carlos Alberto Tosta Machado. SENAI CIMATEC. Avenida Orlando Gomes, Número 1845 - Piatã, Zip Code: 41650-010, Salvador, Bahia, Brazil. E-mail: carlos.tosta@uol.com.br. DOI 10.34178/jbth.v4i4.175.

J Bioeng. Tech. Appl. Health 2021;4(4):128-133.

The Technological Scenario of the EO Industry

The vast majority of the worldwide EO volume is produced via steam distillation. Many other methods such as organic solvents, cold pressing, micro-wave assisted, ultrasound-assisted, carbon dioxide in a critical state, and others, with small-expression, are also found in industry, academic research, and product development areas. Nevertheless, when steam distillation is concerned, the lack of technology leads to high energy consumption, risk of poor quality, and yield loss, all due to process control and monitoring weaknesses.

According to Chemat [12], process intensification is a clear path toward green extraction with direct benefits on other business' areas as customer service, product quality, and operational costs.

Figure 1 presents the process that applies the conventional concept. Hydrosol is the odorized water obtained from the separation after condensation.

Simply explaining the process, steam is generated and flows through the plant material carrying the essential oil. Afterward, it is condensed and separated from the hydrosol. The sketch shown in Figure 1 shows the cases when the EO is lighter than the hydrosol. Just for context, some few EO's are heavier than the hydrosol.

Materials and Methods

The path to reach the purpose of the present work consists of an ordered comparison between the current state, the basic process shown in Figure 1, and the proposed concept, with technological upgrades, as the spinal column of this paper. Among the countless possibilities, we considered a few in this comparison due to their overall process effectiveness.

The sensors, controllers, data acquisition and analysis, and intelligent modeling are tools to improve the steam distillation process. Table 1 exposes the core of the propositions to process improvements and, in consequence, sustainable performance (green extraction). PLC (Programmable Logic Controller) is the first element of process control. SCADA (Supervisory Control and Data Acquisition) is the human-

Figure 1. Essential oil conventional steam distillation process.

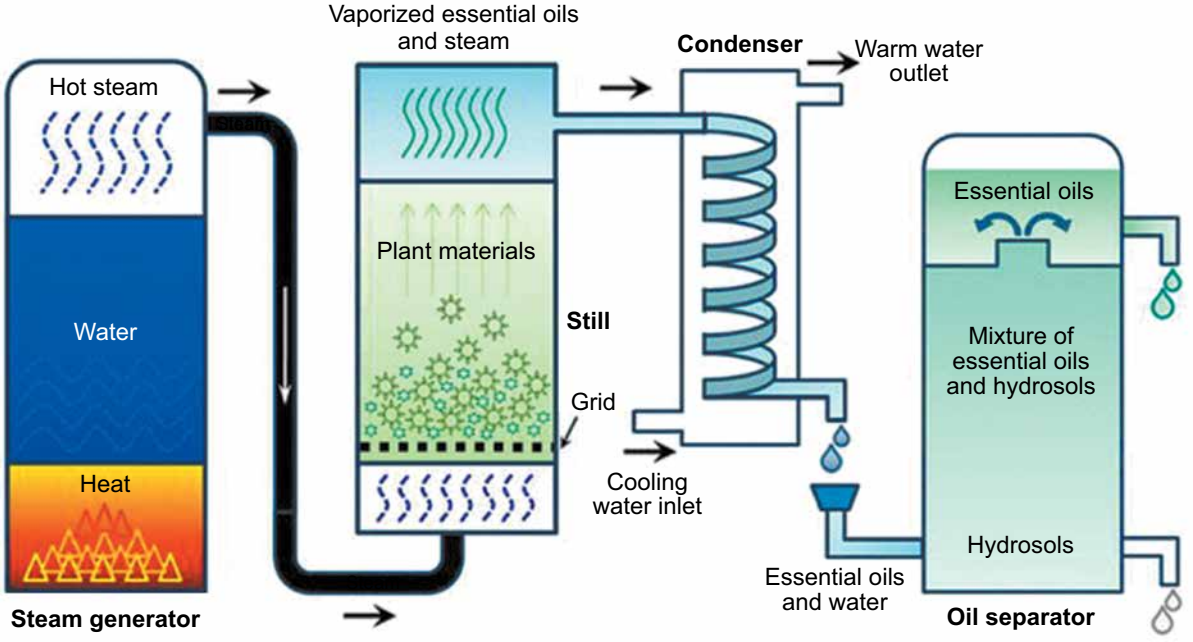


Table 1. Comparison between current and proposed situations.

	Current Status	Proposed Status
Sensors	Few sensors, local indication	Sensors transmitting data to PLC, SCADA and A.I.
Data Acquisition	No automatic data acquisition. Only handwritten logbook with final yield and process duration information.	All data are from sensors, operator inputs, duration between main events, and outputs are logged to allow correlations.
Data Treatment	None	Statistical analysis and search for promise correlations.
Modeling (A.I.)	None	Correlations allow the systematic improvement of process parameters coming from A.I.

machine interface and the center of the data acquisition system. The AI (Artificial Intelligence) is embodied in a model, searching correlations and proposing optimized process parameters [13].

The process diagrams display the differences between a conventional extraction plant, without sensors/controls, and the one instrumented to detect deviations, allowing proper control, correlations, and, consequently, process parameters optimization (Figure 2).

In this optimized proposition, conventional temperature sensors (transmitters) should be installed (Figure 3). In this conception, the thermocouples were inserted internally into the raw material bed to detect fluctuations in temperature at the points where they should be the same (or just slightly different). These differences indicate that the steam is flowing through preferential paths, named channeling by the authors. When these undesired process phenomena occur, they affect yield and quality: two indicators with primary and secondary consequences over the environmental performance.

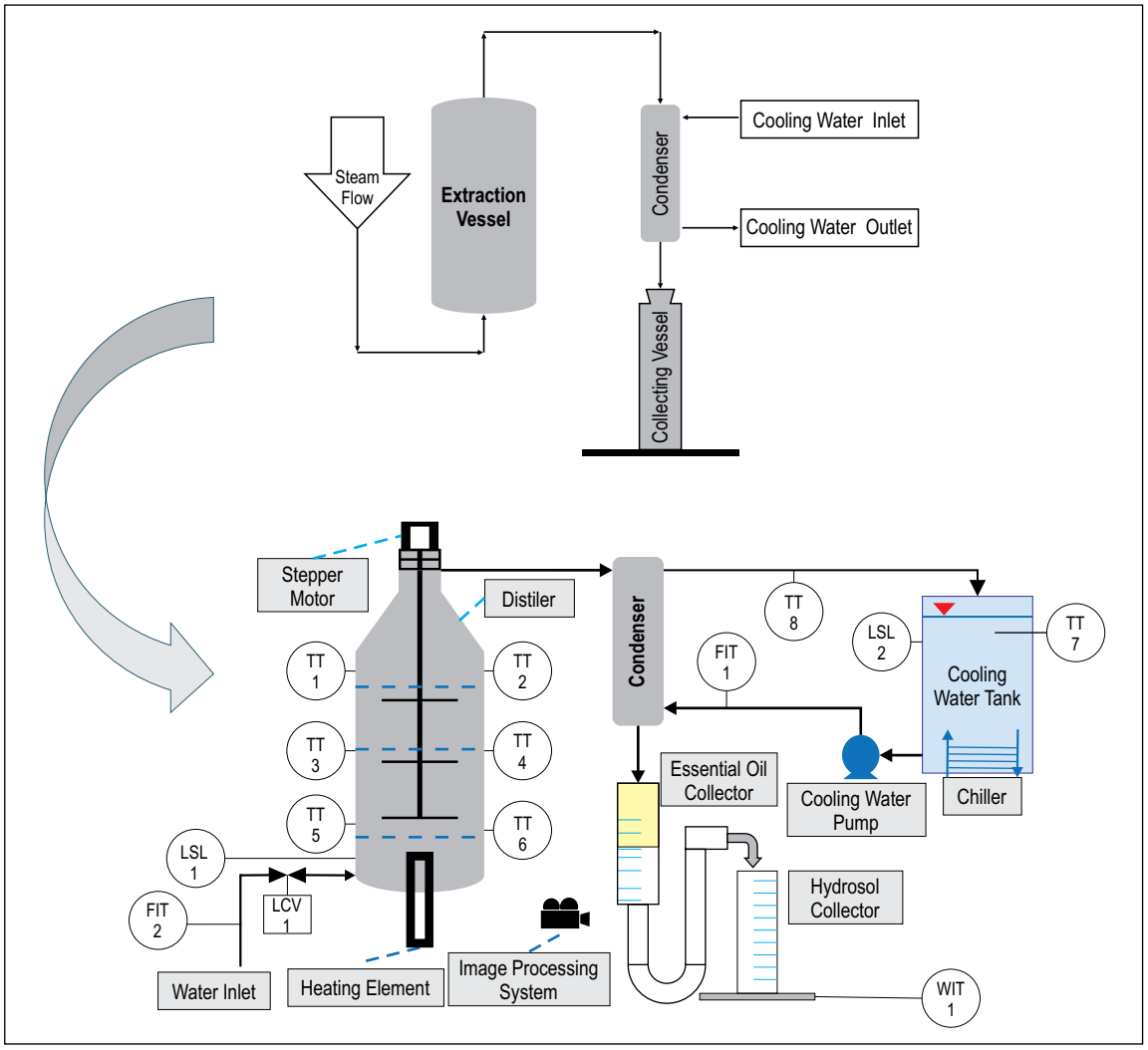
The image processing system intends to detect the progress of the extraction curve (Figure 4) and determine the economic end-of-extraction, being t1 within the ramp of maximum slope, t2 the economic end-of-extraction time, and t3 the time usually used in the industry. The period between t2 and t3 shows where is the waste of energy, water, and capacity: a clear impact on the operation's overall effectiveness, including environmental care. Also, it shows the risk of product degradation, due to overexposure to high temperatures, can occur.

All correlation possibilities among yield, hydrosol weight, cooling water temperatures, and other factors like channeling correction via stepper driver action (frequency of action, duration, and magnitude of the movement) are possible due to the applied technology. The data acquisition and the data treatment indicate, batch after batch, better parameters, toward the optimized ones with modeling [7], for instance with a digital twin [8]. It means that monitoring, controlling, and providing optimized process parameters can effectively contribute to an eco-friendly operation.

Results and Discussion

The main results can be placed as a promising proposition for the essential oil industry as a technological path toward a continuous improvement production process. The prospects coming from the affirmation: “being green with technology” are clear: manufacturing facilities market development, without the properly applied technology, is impacted, reduced if none

Figure 2. Comparison between conventional and technologically developed processes.



FIT: Flow Indicator and Transmitter; LCV: Level Control Valve; LSL: Level Switch Low; TT: Temperature Transmiter; WIT: Weight indicator/transmitter

when competitiveness is at the stake. The structure production (extraction, lacks control, monitoring, and continuous optimization parameters) can compromise the strategic business dimensions. Then, technology embeds opportunities for the essential oil business, with an impact on sustainability performance.

Conclusion

It is almost impossible to establish a standard solution to fit all needs in the essential oil industry. It is, indeed, not a case of "one size fits all". However, this paper is an invitation to researchers for further studies on the subject with evident beneficial consequences to a greener world.

Acknowledgments

Authors are grateful for:

- The financial support from the Bahia State Research Foundation - FAPESB through the research grant awarded (5633/2019).

Figure 3. Channeling.

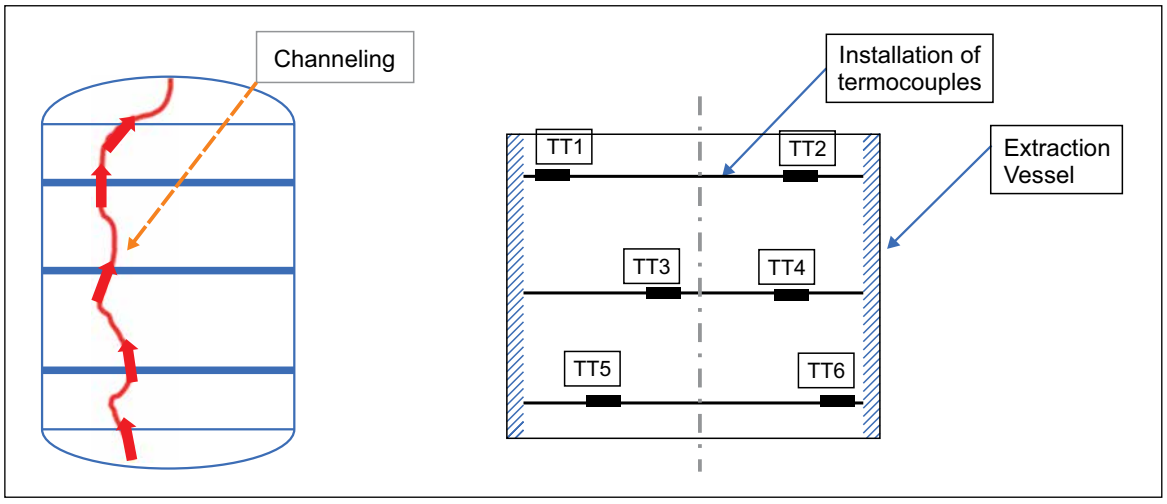
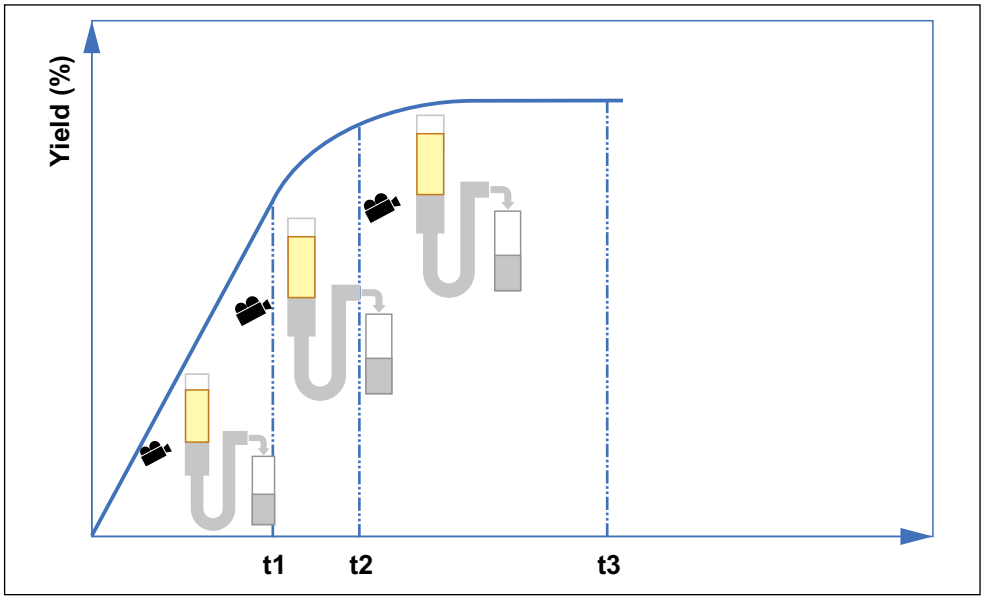


Figure 4. Optimum yield, optimum extraction time.



- Process equipment, control system and unvaluable recommendations for the research from Linax indústria e comércio de óleos essenciais Ltda.
- Location for the experimental phase, raw materials from the farm, energy, and water from Akã óleos essenciais Ltda.
- Cooling water unit, priced just to cover direct costs, from LimaTec equipamentos para laboratório Ltda.

References

1. Chávez MGC. Hidrodestilación de aceites esenciales: modelado y caracterización. Tese de Doutorado. Universidad de Valladolid, 2007.
2. Cannon JB, et al. Modification of yield and composition of essential oils by distillation time. Industrial Crops and Products 2013;41:214-220.
3. Baser KHC, Buchbauer G (Ed.). Handbook of essential oils: science, technology, and applications. CRC Press, 2015.
4. Chemat F, Boutekedjitey C. Extraction//steam distillation. Reference Module in Chemistry, Molecular

Sciences, and Chemical Engineering; Elsevier: Amsterdam, The Netherlands 2015;:1-12.
5. Valderrama F, Ruiz F. An optimal control approach to the steam distillation of essential oils from aromatic plants. Computers & Chemical Engineering 2018;117:25-31.
6. Castillo Castellanos JS, Rodrígues MCG. Diseño de la ingeniería en detalle para la repotenciación de la unidad de extracción multipropósito para prácticas no presenciales. 2021.
7. Cassel E, et al. Steam distillation modeling for essential oil extraction process. Industrial Crops and Products 2009;(29)1:171-176.
8. Andrade MAN, Lepikson HA, Machado CAT. A model proposal for digital twin development: Essential oil extraction perspective. 2021.
9. Guenther E, Althausen D. The essential oils. New York: Van Nostrand, 1948.
10. Rojas CM, et al. Regulation of primary plant metabolism during plant-pathogen interactions and its contribution to plant defense. Frontiers in Plant Science 2014;5:17.
11. Akhtar MS, Swamy MK, Sinniah UR. (Ed.). Natural bioactive compounds. Volume 1: Production and applications. Springer Nature 2019.
12. Chemat F, et al. Green extraction of natural products. Origins, current status, and future challenges. TrAC Trends in Analytical Chemistry 2019.
13. Topaloglu F. Industrial Automation and Edge Computing SCADA PLC PAC IO-LINK-2. Turkish Journal of Science and Technology 2021;(16):1:179-185.

Proposing a Method for Assessing Fuel Consumption and Pollutants Emissions with the Use of Continuously Variable Transmission in Town Cars

Leonardo Serfert Junior[1,2*], Thiago B. Muraria[2], Lilian Lefol Nani Guarieiro[1]
[1]Senai Cimatec University Center; Salvador, Bahia; [2]Ford Motor Company Brasil; Camaçari, Bahia, Brazil

The 21st century brings countless social, economic, environmental, and technological challenges to humanity and, to face them, the United Nations (UN) created the Sustainable Development Goals (SDGs). The auto industry, which is part of the private sector, aims to reach them. In this context, this study aims to evaluate the consumption and emissions of pollutants by using an automatic transmission of the CVT (Continuously Variable Transmission) type concerning the automatic transmission of the "Planetary" type. This study will be based on the Consumption/Energy Efficiency tables, published annually by INMETRO (National Institute of Metrology, Quality, and Technology) and whose data will be processed and evaluated using the Quik Sense Software. Thus, the work aims to appraise the advantages of vehicles with automatic transmission of the CVT type about fuel consumption, energy efficiency and emissions, in markets such as Brazil, where these vehicles use ethanol or a mixture of gasoline with up to 27 as fuel % Ethanol. This research can contribute to studies of emission control and approval, benefiting the automotive industry in general, government agencies, the environment, the economy, and society, contributing to the UN's SDGs achievement.

Keywords: Emissions. Consumption. CVT. Transmission by Planetary. Energy Efficiency. Sustainable Development.

Introduction

Nowadays, research and development of quality products that meet the demands of consumers are essential, in addition to the broad competition in the market and the relevant legislation (Route 2030: Law No. 13,755). In addition, these products must be within the Goals for Achieving Sustainable Development (SDG), included in the 2030 Agenda of the United Nations (UN), which Brazil ratified.

The Sustainable Development Goals (SDGs) belong to a global agenda, adopted during the United Nations Summit on Sustainable Development, in September 2015, comprising 17 objectives and 169 goals to be achieved by 2030 (UN, 2015). This agenda includes global actions in the areas of poverty eradication, food security, agriculture, health, education, gender equality, reduction of inequalities, energy, water and sanitation, sustainable patterns of production and consumption, climate change, sustainable cities, protection, and sustainable use of oceans and terrestrial ecosystems, inclusive economic growth, infrastructure, industrialization, among others (UN, 2015). Among the 17 SDGs, three are directly impacted by urban mobility and the use of motor vehicles.

The SDG 03 "Good Health and Well-being" aims "To ensure a healthy life and promote well-being for all, at all ages" Within its objectives is the target 3.9: "By 2030, substantially reduce the number of deaths and diseases from dangerous chemicals, contamination and pollution of air, water and the soil", which this work will seek to contribute when offering proof of which transmission will pollute less.

The SDG 01, " Sustainable Cities and Communities", seeks to "Make cities and human settlements inclusive, safe, resilient and sustainable. " Its goal 11.6: "By 2030, reduce the negative environmental impact per capita of cities, including paying special attention to air quality, municipal waste management, and others; " and, in particular, submit 11.6.2 "Average annual level of inhalable particles (e.g. with particulate

Received on 23 August 2021; revised 15 September 2021.
Address for correspondence: Leonardo Serfert Junior. SENAI CIMATEC. Avenida Orlando Gomes, Número 1845 - Piatã, Zip Code: 41650-010, Salvador, Bahia, Brazil. E-mail: lserfert@ford.com. DOI 10.34178/jbth.v4i4.176.

J Bioeng. Tech. Appl. Health 2021;4(4):134-140.

diameter less than 2.5 μm and 10 μm) in cities (weighted population)", which are also targets of the contribution of this study.

And SDG 13, "Action Against Global Climate Change", seeks to "take urgent action to combat climate change and its impacts". Within this objective, goal 13.2: "Integrate climate change measures into national policies, strategies, and planning"; and its goal 13.2.2: "Total greenhouse gas emissions per year"; which are united nations determinations that this research aims to privilege, through the use of a more efficient product by the consumer.

A solution to reduce fuel consumption and pollutant gas emissions in automatic transmission vehicles is the Continuously Variable Transmission (CVT), imagined by Leonardo da Vinci more than 500 years ago, which can simulate an infinite amount of gait relationships. It contains a system of two pulleys of different sizes, which are interconnected by a high-strength metal belt, rather than gears with certain sizes (Beltrão, 2015).

There is a consensus that a CVT transmission presents an advantage with fuel consumption when compared to automatic planetary transmissions. This is since CVT has a “continuous” gear shift, making it possible to keep the engine working in “optimal” regions of torque and power [14].

In a CVT transmission, torque transfer is done by friction between a belt and two pulleys. The torque transmission capacity of the CVT is directly related to the axial forces of the primary and secondary pulleys. These forces are the result of hydraulic pressure from the transmission pumping system. This hydraulic pressure plus the friction of the metal belt with the pulleys are the main points of efficiency losses: oil pump / hydraulic actuation system that works between 50 and 70 bar (a Planetary automatic transmission is less than half of this pressure) and the very high friction torque transmission (to prevent slipping). Thus, the efficiency of a CVT is 10% to -20% lower than an automatic transmission by planetary [6].

It is important to note that, in a continuously variable transmission (CVT), the ratio changes between its maximum and minimum values (Span), a characteristic that disassociates the engine's speed (rotation) from the vehicle's speed. This feature allows an additional degree of freedom to accompany the ideal engine operation line (OOL- Optimal Operation Line) and thus operate in a region of greater efficiency. However, for automatic transmission by planetary gears, which have defined gears (“gear sets”), gear changes can only contribute to the operation of the engine in areas “close” to its ideal region. This difference between them allows an improvement of 5% to 15% in fuel economy for a vehicle with CVT transmission - when we compared a vehicle with automatic transmission for planetary (stepped gears). Especially when the maximum speed of the vehicle is relatively low; we observed that the improvement in fuel economy is more significant [14].

In addition, as the number of gears ("gear sets") of an automatic planetary transmission increases and the interval decreases, such as an 8/9 or 10-speed transmission, the influence of the types of "gear changes" (planetary staggered and continuously variable) in the efficiency of the engine operation is reduced. In addition, the improved fuel economy of CVT vehicles became not very clear, as the efficiency of the planetary transmission is higher due to its lower hydraulic loss. [14].

In this context, the objective of this project will be to compare CVT automatic transmissions with automatic planetary transmissions in vehicles sold in Brazil using E27 and E100 fuels and INMETRO approval data for consumption and emissions and to analyze the best correlation methodology. Thus, the development of this research can contribute to the goals of SDGs 03, 11, and 13 and the Brazilian “NDC” (“Contribuições Nacionalmente Determinadas”, like Rota 2030), which can bring more savings to the consumer and contribute to the sustainable development of the planet. To exemplify, we present the Graphic 1 of the “sawtooth diagram”, in which the scale of a manual transmission (planetary transmissions

presents a similar behave) can be compared with a "smoother curve" of a CVT transmission.

Materials and Methods

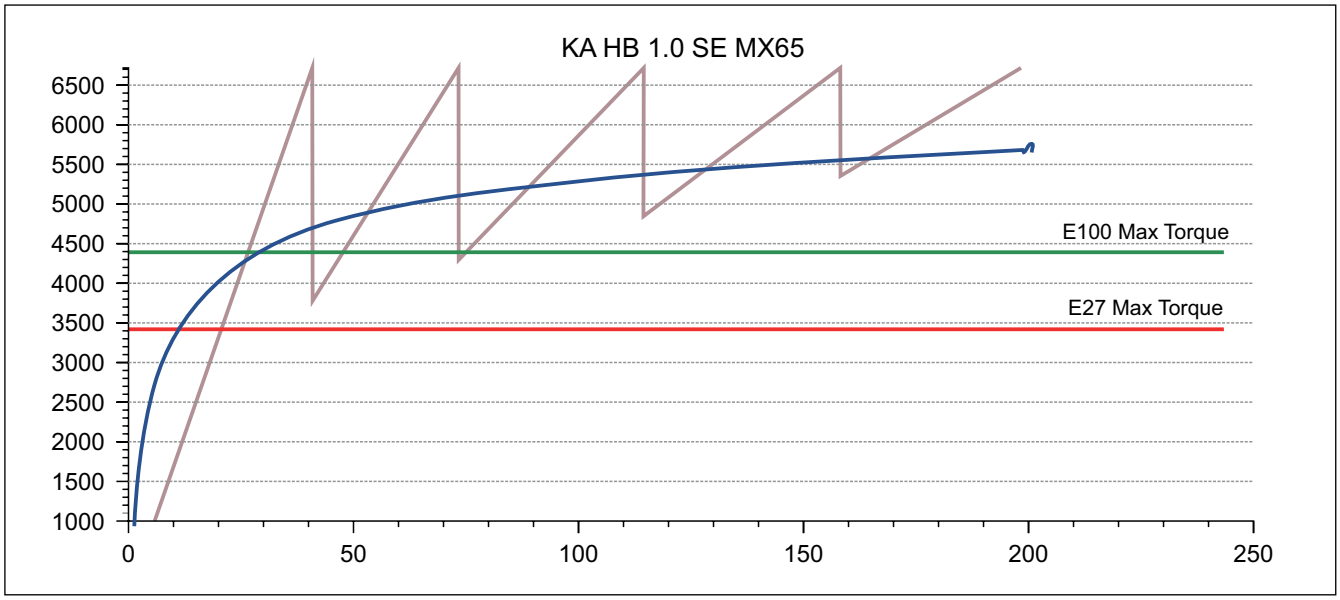
We did a bibliographic search to identify the results of studies that evaluate: fuel consumption as a reason for choosing CVT transmission to equip vehicles; comparisons of types of automatic transmissions regarding fuel consumption and atmospheric emissions, and efficiency studies of CVT transmissions.

We used the data about consumption and emissions from back 2011 through the annual publication of vehicle homologation issued by INMETRO (National Institute of Metrology, Quality and Technology – "Instituto Nacional de Metrologia, Qualidade e Tecnologia") [11]. The choice of the "Fuel consumption/energy efficiency table for automotive vehicles", applied by INMETRO for vehicles sold in Brazil, is due to the standardization of data from various sources (automakers), such as the same test procedures. Results are shown in km / l (kilometers per liter) taken under the same standard laboratory conditions (NBR7024) and adjusted for the most common simulated conditions of use (applications). We tabulated this data in an excel spreadsheet, selecting vehicles and engines of most commercialized versions; excluding manual, hybrid, and automated transmissions. We also excluded diesel engines and vehicles of specific applications (sports and off-road use), focusing on CVT and planetary transmissions and gasoline and flexible engines with a maximum displacement capacity of 2.0 liters and with torque and power numbers within a specific range (Table 1).

Results and Discussion

Using the "Qlick Sense" software for the consumption, efficiency, and emissions data, from the sample resulting from the tabulation, we can understand the collective behavior of each type of transmission studied (planetary and Continuously Variable). The analysis, also, has been validated by statistical reviews and comparisons. Finally, we create a dashboard per cluster system to understand the collective behavior of each type of transmission, associated with the type of fuels and engines applications (Graphics 2 and 3).

Graphic 1. Sawtooth diagram (Manual transmission and CVT "smoother curve).



Source: Adapted from Autoentusiastas" 2018;September 30.

Table 1. Fuel consumption/energy efficiency for automotive vehicles" (snapshot).

Marca	Modelo	Versão	Motor	Transmissão Velocidades (nº)	Ar Cond.	Direção Assistida	Combustível	Emissões no Escapamento						Quilometragem por Litro				Consumo Energético (MJ/km)
								Poluentes				Gás Efeito Estufa		Etanol		Gasolina ou Diesel		
				Manual (M) Automática (A) Automática Dupla Embreagem (DCT) Automatizada (MTA) Contínua (CVT)	Sim (S) Não (N)	Hidráulica (H) Mecânica (M) Elétrica (E) Eletro-hidráulica (E-H)	Etanol (E) Gasolina (G) Flex (F) Diesel (D)	NMHC (g/km)	CO (g/km)	NOx (g/km)	Redução Relativa ao Limite	Etanol CO2 fóssil (g/km)	Gasolina ou Diesel CO2 fóssil (g/km)	Cidade (km/l)	Estrada (km/l)	Cidade (km/l)	Estrada (km/l)	
CAOA CHERY	NEW QQ	1.0 LOOK / 1.0 LOOK PLUS / 1.0 SMILE / 1.0 SMILE PLUS / 1.0 ACT / 1.0 ACT PLUS	1.0 - 12V	M-5	S	H	F	0,014	0,244	0,032	B	0	98	8,9	9,9	12,9	14,4	1,59
KIA	PICANTO	EX5/ LX5 1.0 FF MT	1.0 - 12V	M-5	S	E	F	0,013	0,364	0,055	C	0	104	7,9	10,3	11,6	15,0	1,69
KIA	PICANTO	EX5/ LX5 1.0 FF AT	1.0 - 12V	A-4	S	E	F	0,012	0,353	0,041	B	0	105	8,1	9,9	11,4	14,7	1,70
VW	up!	move	1.0-12V	M-5	S	E	F	0,023	0,218	0,032	B	0	89	9,6	10,6	14,2	15,3	1,46
VW	up!	move (I-Motion)	1.0-12V	MTA-5	S	E	F	0,037	0,599	0,018	C	0	89	9,4	10,6	14,0	15,8	1,47
VW	up! TSI	move (Rodas aro 14")	1.0-12V	M-5	S	E	F	0,027	0,296	0,031	B	0	86	10,0	11,5	14,3	16,3	1,40
VW	up! TSI	move (Rodas aro 15") / pepper	1.0-12V	M-5	S	E	F	0,032	0,357	0,026	B	0	88	9,6	11,1	14,1	16,0	1,44
VW	up! TSI	cross	1.0-12V	M-5	S	E	F	0,022	0,189	0,032	B	0	93	9,5	10,4	13,7	14,7	1,50
FIAT	500	CULT	1.4-8V	M-5	S	E	F	0,007	0,316	0,024	A	0	111	8,0	9,0	11,4	13,0	1,79
FIAT	MOBI	DRIVE	1.0-6V	M-5	S	E	F	0,010	0,320	0,017	B	0	90	9,6	11,3	13,7	16,1	1,45

Source: INMETRO.

In both "scatter plot" graphs we can see that CVT transmission presents the lowest consumption result for the city cycle in both Ethanol and Gasoline when compared to planetary transmissions. In the road cycle, the CVT achieves consumption values similar to the best Planetary transmission (A7 - 7 gears) when using Ethanol and is among the lowest consumptions for the road cycle when using Gasoline.

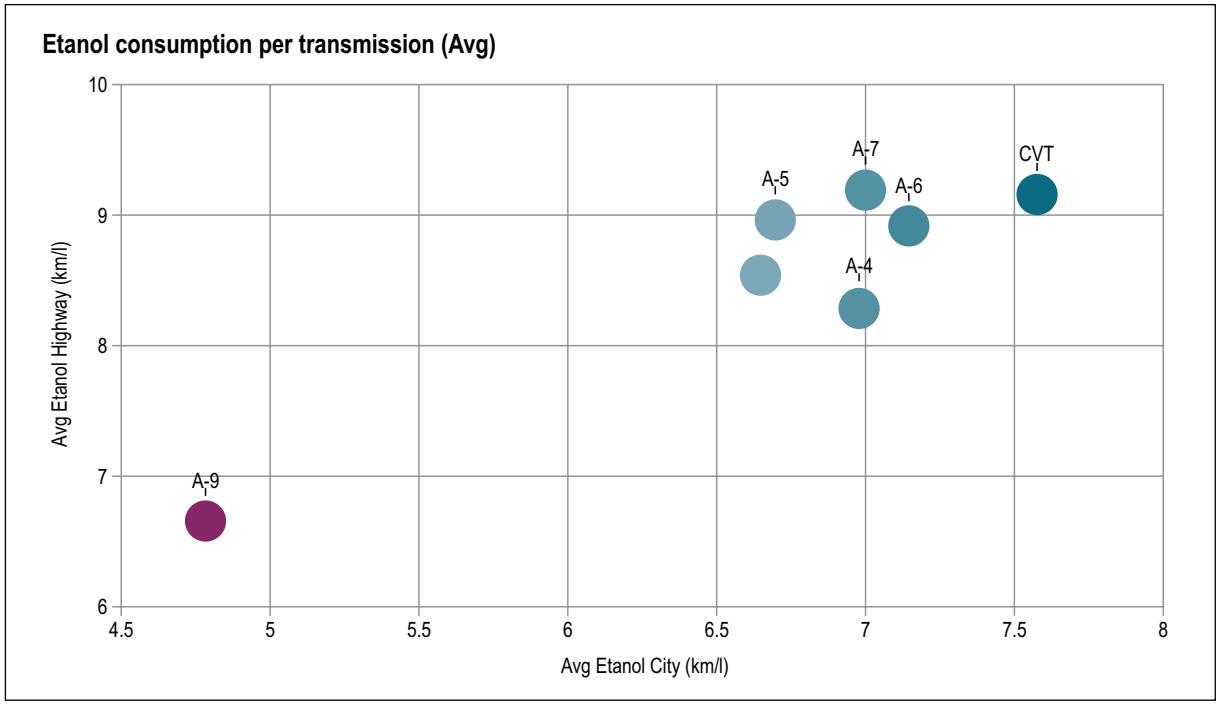
Conclusion

Through our study we were able to conclude: 1) Based on a summary of INMETRO Homologation data for fuel consumption, energy efficiency, and exhaust emissions for PL6 (Brazilian market in the last 10 years), CVT has been showing an advantage about the fuel consumption, but planetary transmissions launched in the last years it has been showing good consumption figures in "Highways", and like the "Dashboard", we will be able to expand it to other vehicles and markets that use homologation tables similar to those used in Brazil. 2) Further work may provide a view of the Brazilian market, its competitors, and what are the trends in the short and medium term.

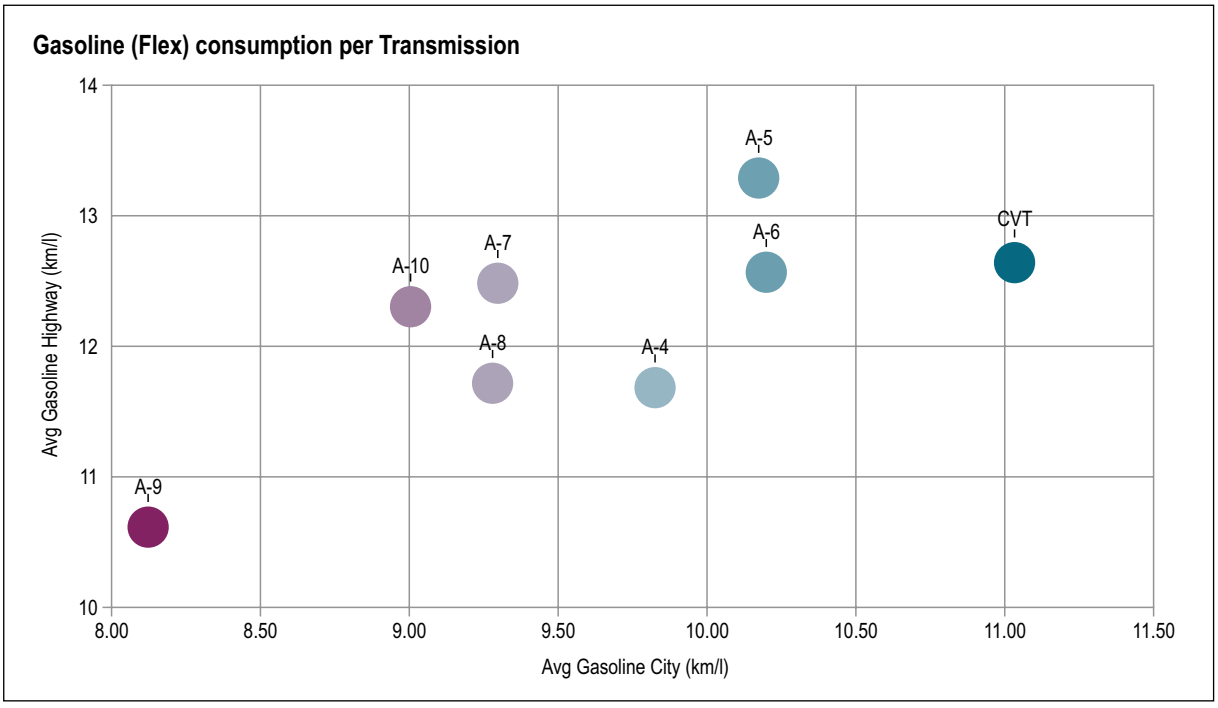
References

1. Arbex A. Sistema para simulação de um banco de testes para transmissão veicular automática. Universidade Estadual Paulista 2008.
2. Beltrão C. Da Vinci: Monalisa, Homem Vitruviano, Ornitóptero. CVT. Blog ArtenaRede, Rio de Janeiro, 21 Abril, 2015. Disponível em: < http://artenarede.com.br/blog/index.php/da-vinci-monalisa-homem-vitruviano-ornitoptero-cvt/ >. Acesso em: 14 Jan. 2021.
3. Bonsen B, Steinbuch M, Veenhuizen PA. CVT ratio control strategy optimization. In: 2005 IEEE Vehicle Power and Propulsion Conference. IEEE, 2005. p. 5 pp.
4. Brasil. Contribuição nacionalmente determinada para consecução do objetivo da Convenção-Quadro das Nações Unidas sobre Mudança do Clima. Brasília, DF: Centro Gráfico, 2016. Disponível em: < https://bit.ly/1Ru0Jm3 >. Acesso em: 27 de nov. de 2020.
5. Brasil. Lei Nº13.755, de 10 de dezembro de 2018. Estabelece requisitos obrigatórios para a comercialização de veículos no Brasil; institui o

Graphic 2. Ethanol fuel consumption average scatter plot.



Graphic 3. Gasoline fuel consumption average scatter plot.



Programa Rota 2030 - Mobilidade e Logística; dispõe sobre o regime tributário de autopeças não produzidas e dá outras providências. Disponível em: < http://www.planalto.gov.br/ccivil_03/_Ato2015-2018/2018/Lei/L13755.htm> . Acesso em: 30 out. 2020.

6. Dias J. Curso de especialização em Engenharia Automotiva. Universidade Tecnológica Federal do Paraná, Março, 2011.Disponível em: < http://damec.ct.utfpr.edu.br/automotiva/downloadsAutomot/c2CVT.pdf > Acesso em: 28 Jan 2020.
7. Fanton F, Lima D. Estudo da transmissão continuamente variável CVT de polias expansivas. Ilha Solteira, 2008.
8. Hearst Autos Research. What is an Automatic Car? Revista Car and Driver. 2020. Disponível em: < https://www.caranddriver.com/research/a31884931/what-is-an-automatic-car > . Accessed on: 22 Abril 2021.
9. Heywood JB. Internal combustion engine fundamentals. McGraw-Hill Education, 2018.
10. Yu-Guanga CHEN, et al. Simulation Research for the Dynamic Regulation of Car Running Condition Domains. Journal of Chongqing University of Technology (Natural Science), 2012:11.
11. IMETRO. Tabela PBE para veículos leves: 2019. Disponível em: <http://www. inmetro.gov.br/consumidor/pbe/veiculos leves2019.pdf> . Acesso em: 09 nov. 2020.
12. IPEA. Cadernos ODS: ODS 13. Disponível em: < http://www.ipea.gov.br/ portal/Images/stories/PDFs/livros/livros/191014_cadernos_ODS_objetivo_13.pdf > . Acesso em: 30 out. 2020.
13. Inukai K, et al. Development of high-efficiency new CVT for midsize vehicle. SAE Technical Paper, 2013.
14. Ji J, He B, Yuan L. A comparative study on fuel economy for CVT and 9-speed AT based vehicles. SAE Technical Paper 2017.
15. Jiang F, Wang M Li L. Software Design of Engine Characteristic Simulation. JSW 2012.(7)2:316-321.
16. Lechner G, Naunheimer H. Fahrzeuggetriebe Grundlagen, Auswahl, Auslegung und Konstruktion. Berlin: Springer – Verlag, 1994.
17. LearnEngineering, YouTube, 2017: < https://www.youtube.com/watch?v=ARd-Om2VyiE > acesso em 10 Maio 2021.
18. Krestschmer, J. e Kara, A.: The new 8-speed automatic transmission, ResearchGate, 2009. Disponível em: < https://www.researchgate.net/publication/293164231_The_new_BMW_8-speed_automatic_transmission > . Acesso em: 18 nov. 2020.
19. Kushwaha GS, Sharma NK. Green initiatives: a step towards sustainable development and firm's performance in the automobile industry. Journal of Cleaner Production 2016;121:116-129.
20. Kwak Y, Cleveland C. Continuously variable transmission (CVT) fuel economy. SAE Technical Paper 2017.

21. Lanzarotto D, et al. Overview of different hybrid vehicle architectures. IFAC-PapersOnLine 2018;(51)9:218-222.
22. Macor A, Rossetti A. Fuel consumption reduction in urban buses by using power split transmissions. Energy Conversion and Management 2013;71:159-171.
23. Mayet C, et al. Influence of a CVT on the fuel consumption of a parallel medium-duty electric hybrid truck. Mathematics and Computers in Simulation 2019;158:120-129.
24. Michkoshi Y, et al. Toyota new TNGA high-efficiency eight-speed automatic transmission direct shift-8AT for FWD vehicles. SAE Technical Paper 2017.
25. Micklem JD, Longmore DK, Burrows CR. Modelling of the steel pushing V-belt continuously variable transmission. Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science 1994;208(1):13-27.
26. McIntosh JIL. How it works: Automatic transmissions. Disponível em https://driving.ca/auto-news/news/how-it-works-automatic-transmissions. Acesso em: 04 Maio 2021.
27. Nakata Automotiva. Entenda tudo que acontece com o Sistema de transmissão do seu carro, 2020. Disponível em: < https://blog.nakata.com.br/entenda-tudo-que-acontece-com-o-sistema-de-transmissao-do-seu-carro/> , acessado em: 17 Maio, 2021.
28. Nice K. How torque converters work. How stuff works. 2021. Disponível em: < https://auto.howstuffworks.com/auto-parts/towing/towing-capacity/information/torque-converter.htm >. Acesso em 18 de Maio de 2021.
29. Noce T, et al. Energy factors for flexible fuel engines and vehicles operating with gasoline-ethanol blends. Transportation Research Part D: Transport and Environment, v. 65, p. 368-374, 2018.Disponivel em: < https://doi.org/10.1016/j.trd.2018.09.002 > , acessado em: 06 Set. 2020.
30. Pfiffner R, Guzzella L, Onder CH. Fuel-optimal control of CVT powertrains. IFAC Proceedings Volumes 2001;34(1):17-22.
31. Sharp B. Ford Ka 1.0 SE em teste no uso. Revista Autoentusiastas. 2018. Disponível em: < https://autoentusiastas.com.br/2018/09/ford-ka-10-em-teste-no-uso-com-video > . Acessado em: 27 jan 2020.
32. Sun S, et al. Vehicle emissions in a middle-sized city of China: Current status and future trends. Environment International 2020;137:105514.
33. Srivastava N, Haque I. A review on belt and chain continuously variable transmissions (CVT): Dynamics and control. Mechanism and Machine Theory 2009;(44)1:19-41.
34. Tang T-Q, et al. A fuel-optimal driving strategy for a single vehicle with CVT. Physica A: Statistical Mechanics and Its Applications 2018;505:114-123.
35. Thorne C. CVT Transmission: A Platform Technology for On and Off-Road Hauling Applications. SAE Technical Paper, 2017. Disponível em: < https://doi.org/10.4271/2017-01-1930 >. Acesso em: 30 out. 2020.
36. Tracy D. This is how an automatic transmission works. Disponível em < https://jalopnik.com/this-is-how-an-automatic-transmission-works-517581894>. Acesso em 14 Maio de 2021.
37. Tsuji T, Takeoka M. Study of fuel consumption improvement of the car with the dry hybrid belt CVT. JSAE Review 1996;17(4):381-385.
38. Greene DL, Schafer A. Reducing greenhouse gas emissions from US transportation. Pew Center on Global Climate Change. Estados Unidos, 2003.

The Paradox and Dynamic Betweem Sustainable Development and Corporate Performance

Óliver Silva Costa Barreto[1*], Marcelo Santana Pinheiro[1], Luiz Marcelo Fonseca Soares[1], Robson Rosario Junior[1], Marcio Hideki Maruta[1], Renelson Sampaio[1], Thiago Barros Murari[1], Bruna Aparecida Souza Machado[1]
[1]Senai Cimatec University Center; Salvador, Bahia, Brazil

This article discusses the false antagonism between sustainable development and corporate performance amalgamated with the search for innovation, intensive use of technologies, and global awareness, during the COVID-19 pandemic scenario and the transformations imposed on society, together with the effects of the necessary insertion of new technologies such as Artificial Intelligence. The study highlights the interaction between elements of a technological revolution that imposes profound changes in society, organizations, and, at the same time, unprecedented health and environmental crisis that put at risk the capacity of human resilience to build the future, and opportunities to reconcile socio-economic advances and sustainability practices.
Keywords: Economic Development. Sustainability. Innovation. Artificial Intelligence. COVID-19.

Introduction

Faced with the enormous challenges related to the protection of the planet and the issues of development, knowledge, and sustainability, some may question whether it is possible to speak of management skills for sustainable development because this seems to be a theme that contradicts the current economic logic and calls into question the commitment to the future. In addition to raising questions about environmental challenges, "sustainable growth" also brings new perspectives on people's relationship with the environment, suggesting other practices based on new concepts of learning and skills training for work.

This article addresses the paradox and the dynamics between sustainable development, corporate performance, and the current capitalist system. It is a great challenge to incorporate sustainability at the heart of organizations, which still maintain the angry economic models based on polluting and non-renewable energy sources. This challenge is aligned with the idea of possible configurations of organizational practices aimed at "bearable growth". It can improve through new technologies, new skills, and updates in learning models focused on sustainability.

The emergence of the SARS-CoV-2 coronavirus and the rapid spread, mutation, and lethality of the virus has forced a context of abrupt changes in the way of life in today's society. With the global synergy to fight the pandemic, the emergence of new technologies, fostering innovation, reducing bureaucracy in various means of communication and connectivity, disseminating knowledge, and adapting to a new way of life, society is experiencing an unprecedented moment of inevitable transitions.

The current crisis has intensified the urgency for effective and more than ever immediate solutions. To this end, the intensive use of new technologies and the demand for technological innovations to solve current problems play a central role in today's society. In this panorama, we discussed the current role of Artificial Intelligence (AI).

The Relentless Competition Between Economic and Sustainable Development

Schumpeter [1] when studying Kondratieff's cycles in detail (Figure 1) and pointing out that periods of economic expansion were leveraged by major innovations in the world economy, which are disruptive forces that allow economic growth and affirming that entrepreneurship is the force propelling economic development, it opposes the

Received on 15 September 2021; revised 12 October 2021.
Address for correspondence: Óliver Silva Costa Barreto. SENAI CIMATEC. Avenida Orlando Gomes, Número 1845 - Piatã, Zip Code: 41650-010, Salvador, Bahia, Brazil. E-mail: oliversc.barreto@gmail.com. DOI 10.34178/jbth.v4i4.177.

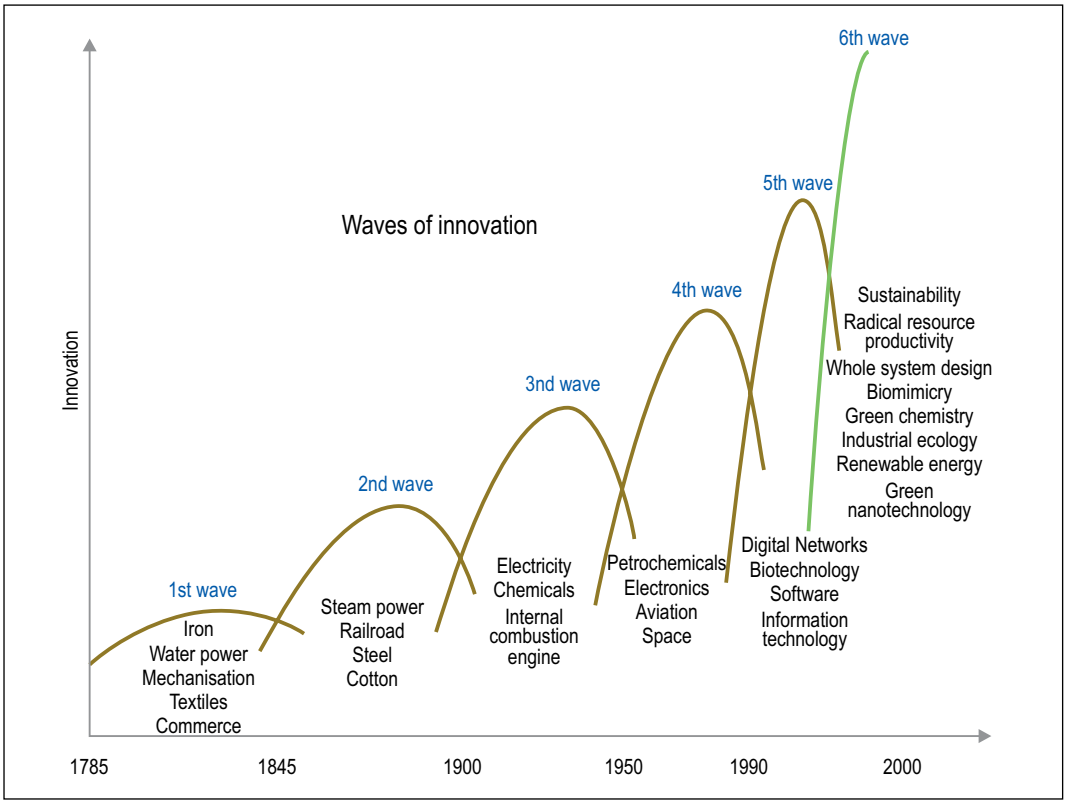
neoclassical view that defended the economy as something stationary.

Understanding as a determining characteristic of the entrepreneur the search for monopoly profit, arising from the means of production, the entrepreneurial function has played a fundamental role in stimulating economic dynamism using technical ideas and inventions, accessing finance, and transforming these ideas into technological, commercial, and organizational innovations, heating the capitalist economy as a whole [3,4]. That said, we emphasize that for corporate development to continue to reach new consumer markets, it is necessary to update, innovate, explore commercial and material resources. And, amid the unregulated balance between the increase in the world population, high consumption of goods, and the insufficiency of policies and practical actions for sustainable products, reverse logistics, and renewable energies, it becomes imperative to remodel how projects have been related to the environment.

Treating sustainability more comprehensively presupposes breaking paradigms in our current society. The broadest treatment of the word refers to the way to conduct the construction of the global society. So, it may guarantee its present and future existence with decent conditions to safeguard the basic needs and further others. There is no way to consider the partial sustainability of one or several countries. It is necessary to consider the impacts of human nature as a whole, rather than individual countries.

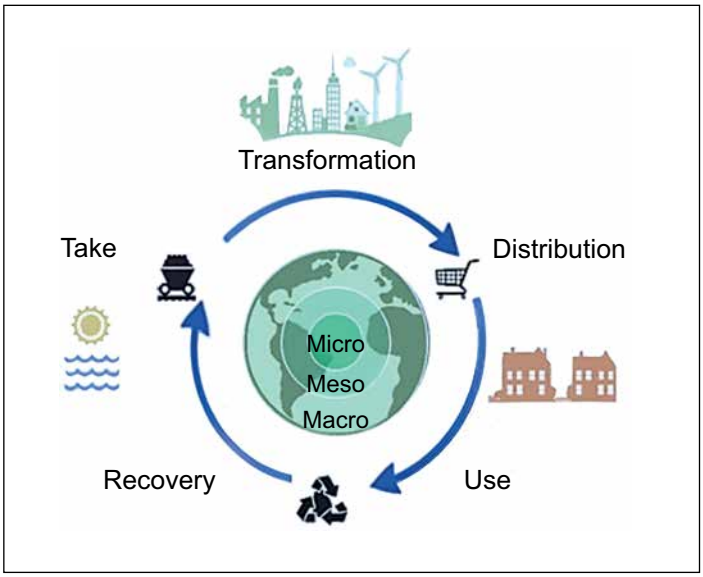
An approach much discussed in recent years is that of the Circular Economy, which can be expressed as an economic model aimed at the efficient use of resources supported by their prolonged use, reduction of waste and primary resources, the incentive to closed product cycles, benefits socio-economic, environmentally adapted production processes and systems (Figure 2). It is believed that the circular economy decouples economic

Figure 1. Long waves of innovation.



Source: Adapted from Hargroves and Smith [2].

Figure 2. Circular economy.



Source: Adapted from Pietro-Sandoval (2018) [7].

growth from the negative consequences of the exploratory use of resources and environmental degradation [5,6].

It is possible to notice that the direction, training, public policies, and sensitivity regarding the allocation of management capacities change due to environmental and social changes. By defining organizational goals and strategies aimed at economic development in parallel with sustainable performance, it is possible to make the organization highly competitive and, even so, engage the entire corporate environment towards a sustainable agenda [8].

Post-Covid Social Behavior

With the arrival of the COVID-19 Pandemic, several companies adhered, almost obligatorily, to the telework or home-office model, aiming at the normal functioning of the operation, accelerating the flexibility of the labor model, which was in a slow growth process [9].

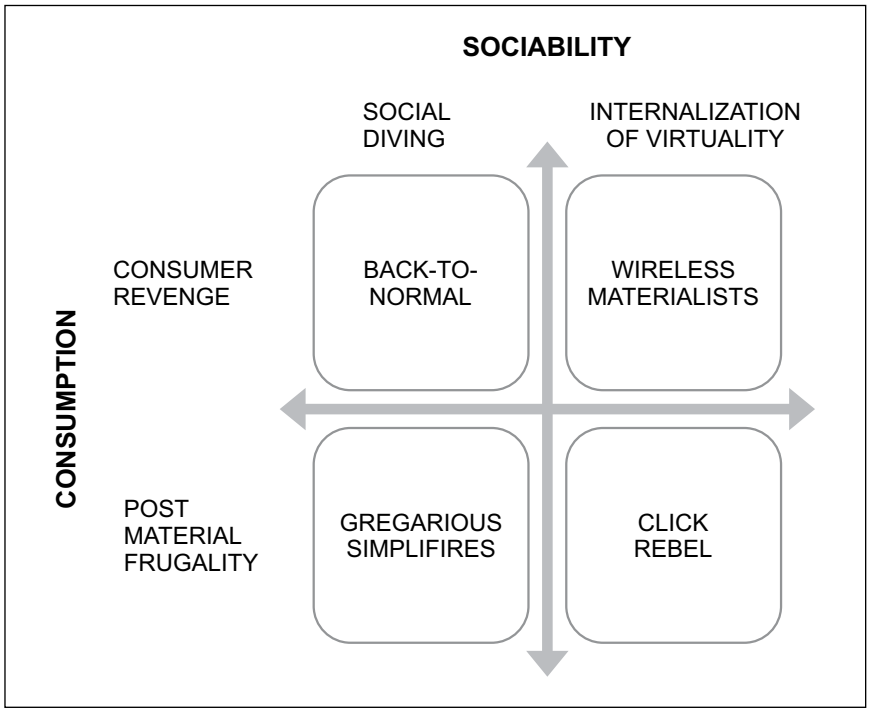
The confinement experience can follow different social paths. Positivist scenarios can touch on the valorization of less materialistic activities and obtaining new technologies developed during COVID-19, there are also possibilities of opposing scenarios that can follow the old normality, virtual materialists, gregarious simplifiers, and online rebels. Figure 3 shows the relationship between sociability and consumption, in a post COVID scenario [10].

The future scenario, related to a long-term sustainable lifestyle, will depend on interactions between governments, corporate commitments, organized civil society activism, barriers, and opportunities, social and environmental imbalances that gave rise to the pandemic itself [10].

Artificial Intelligence and the Paradox of Development and Employability

According to the World Economic Forum, held in September 2020, in 2025, the participation of workers and machines in the labor market was statistically tied, with 53% of human beings in labor activities, and 47% of machines. The adoption of digital technologies has been widely applied, such as, for example, Artificial Intelligence (AI), adding competitive differentials to multiple sectors of

Figure 3. Post COVID scenarios and the relationship between sociability and consumption.



Source: Adapted from Echegaray (2021)[10].

the economy, relevant for the preservation and evolution of business [11].

A new approach to data-based governance is expected for large Brazilian cities. From the race to create new platforms, such as health surveillance and emergency forecasting, artificial intelligence (AI) systems formulate substantiated political evidence inferred through the handling of big data and other sources of information available to governments. Thus, we expected that learning with AI would expand the universalization of government actions. [12].

The COVID-19 scenario reveals inequality in access to digital capital, a mirror of structural inequalities in Brazil. During this period, there will have strong creation and generation of information using technologies, but there is no expectation that this knowledge and potential can reach the entire population. Such issues bring up the risk of reproducing and perpetuating inequalities in the highly technological environments of the future, real and not to be underestimated. Marginalized groups survive in a complex matrix of vulnerabilities, ranging from economic, social, and legal dimensions to cultural, digital, and political dimensions [12].

Materials and Methods

The research methodology applied in this article has an observational purpose, aiming to explore modern content based on social and economic sciences. Three aspects related to changes in human relations and the scenario of sustainable development after COVID-19 are analyzed. Furthermore, regarding the nature of the research, it is classified as applied and its approach is qualitative, allowing analysis of specific characteristics in each circumstantial context [13].

This research has an exploratory character, analyzing and updating concepts in a specific context and exploring a current panorama through bibliographic review.

Concerning technical procedures, the methodology of this article uses bibliographic and documentary research. In this context, scientific publications, articles, and documents from private organizations were used as the basis for the analysis presented in this article.

Results and Discussion

All the effects perceived by the deceleration of human exploratory activities in the biosphere also called "blessing in disguise" must be analyzed and considered so that it can serve as a guide for a new model of human development that remodels issues of corporate development in communion with sustainable development, in the broader sense of the expression. The constant reflection on the events resulting from the pandemic is crucial for society to self-assess the impacts it has brought to the planet and rethink the possible measures that should be taken within this new capitalist dynamic. Some socio-environmental problems are exposed during the pandemic. The scientific-technological development in the health areas is the most easily perceptible. However, with a little more care, the identification of gaps in the energy, logistics, and material management sectors, which assume new management approaches and the inclusion of increasingly intelligent digital devices (Figure 4).In a "new normal", development must meet the needs of a lifestyle without compromising the capacity of future generations, and, for this, technological innovations and transformations are stimuli for the diffusion and absorption of green technologies, the basis for enabling the challenge in reconciling economic growth and social and environmental well-being. It is a feasible proposal to active influence against the depletion of natural resources and environmental degradation, at a level more adjusted to the opportunities presented during the COVID-19 pandemic.

The digital world reproduces the business models of the physical economy. Thus, in a new dynamic of cities, the use of new technologies developed in the areas of education, health, and infrastructure will contribute to participation and collaboration by citizens, in addition to the possibility of improving public transparency. Thus, there must be an impact on the sustainable development of cities and the potentializing innovation benefits for people. The dynamic after COVID-19, in a perspective of more frugal consumption, signals more and more adherence to the circular economy, with the expectation of developing technologies capable of improving the efficiency of manufactures and use of resources, renewable and recyclable products with

Figure 4. Digitalization of environmental impacts.

Source: Adapted from Tigre 2014 [4].

carbon capture solutions. There is an opportunity for the lessons learned from the collaboration and sharing of information in research, which provided the world with the development of new knowledge and means to support the period of isolation, to be the great technological lever for the union of various branches of the economy, establishing partnerships for the development of innovation and technology, deconstructing the paradox of individualities between nations and companies.

Conclusion

Through this study, it was possible to respond to existing relationships and highlight that we are experiencing a technological revolution that imposes profound changes that put at risk our capacity for the humanitarian organization to build a more balanced future with sustainable development. Human-machine collaboration and emerging technologies in this country are essential to ensure ethical, creative, and responsible use of AI. It is possible to develop it to support human potential in challenges such as the fight against the coronavirus from a data platform, diagnosis, discovery of new treatments, identification of serious diseases, or monitoring environmental legislation.

It is suggested that the outcome depends on how we will use this knowledge and our capacity for global cooperation towards community goals. Based on effective global cooperation, we will have the opportunity to reconcile social-economic advances and sustainability practices with the recovery of the environment.

References

1. Bögenhold D. Schumpeter, creative destruction and entrepreneurship. In: World encyclopedia of entrepreneurship. Edward Elgar Publishing, 2021.
2. Hargroves K, Smith M. The natural advantage of nations: business opportunities, innovation, and governance in the 21st century. The Natural Edge Project, Earthscan: London, 2005.
3. Malerba F, Mckelvey M. Knowledge-intensive innovative entrepreneurship integrating Schumpeter, evolutionary economics, and innovation systems. Small Business Economics 2020;(54)2:503-522.
4. Tigre PB. Gestão da Inovação: a economia da tecnologia no Brasil – 2ª Edição, Rio de Janeiro: Elsevier, 2014.
5. Morseletto P. Targets for a circular economy. Resources, Conservation and Recycling 2020;153:104553.
6. Hofmann F. Circular business models: Business approach as driver or obstructer of sustainability transitions? Journal of Cleaner Production 2019;224:361-374.
7. Prieto-Sandoval V, Jaca C, Ormazabal M. Towards a consensus on the circular economy. Journal of cleaner production 2018;179:605-615.
8. Borges LO, Yamamoto OH. O mundo do trabalho. Psicologia: organizações e trabalho no Brasil 2004;2.
9. Ferreira FFVM, et al. Internet access in the New Brazilian Normal: A basic need for access to income, health, and education. Journal of Bioengineering and Technology Applied to Health 2020;(3)3:298-304.
10. Echegaray F, et al. Sustainable lifestyles after COVID-19. Routledge, 2021.
11. Lamb LC. O futuro do trabalho pós-pandemia de COVID-19: Reflexões sobre os impactos da Inteligência Artificial, ciência educação. Available at: <https://metricas.usp.br/wp-content/uploads/2020/07/M%C3%A9tricasUSP-final09Jul2020-LAMB.LC_.pdf>. Access by 05 Aug, 2021.
12. Magalhães LG. A pandemia e a nova ordem sociodigital no sul global: O caso de São Paulo. COVID-19 from the Margins 2021:129.
13. Gil AC. Métodos e técnicas de pesquisa social. 6. ed. Editora Atlas SA, 2008.

Prospective Study of Communication and Information Technologies for the Deaf

Aline da Cruz Porto Silva[1*], Luiz Antonio da Silva Gonçalves[2]
[1]Federal Institute of Bahia/IFBA; [2]Federal University of Bahia/UFBA; Salvador, Bahia, Brazil

This article presents a prospective study of Information Technologies and Communication for Deaf people. Aims to carry out a technological investigation of patents filed in Questel Orbit, to identify the Accessible Information and Communication Technologies developed for Deaf people. The methodological path in this research is a systematic review, exploratory, and prospective study of technologies. So, we identified ninety-two documents filed in the Orbit patent database. This prospective study showed a progressive growth of papers in the last five years, but discreet regarding developed Deaf technologies' registration. It also highlights that China has the highest number of these technologies, while Brazil has only one technology developed.
Keywords: Prospecting. Technology. Communication. Deaf. Patent.

Introduction

The development of Information and Communication Technologies (ICT) enables an education space, providing opportunities to develop new spaces of teaching and learning. Digital innovations place informational resources and communication tools more accessible to users, helping people use the available tools.

The development of an 'interface' accessible to people with disabilities promotes digital inclusion and enables knowledge. In this study, we chose hearing loss /Deafness.

According to Marchesi (1996) [1], deafness is characterized by loss, larger or minor, of the current perception of sounds, with several categories of hearing impairment, in general, classified according to the degree of hearing loss.

Currently, the expression deaf is used, in the clinical/medical context, to the person who has a hearing deficit that impedes acquiring the oral/auditory language. However, the term Deaf is used especially by the deaf community to build a cultural identity anchored in the Brazilian Sign Language - Libras recognized and regulated by laws and federal decree.

According to Skliar (1999 p.142) [2], sign language cancels the deficiency and allows that the deaf constitutes, then, a different minority linguistic community and not a deviation from "normality". So, thinking of deafness should be as a linguistic difference, not a pathology nor a disability that attributes to the Deaf person a condition of inferiority for being users of a modality of language visual-gesture.

In this sense, the present study aimed to survey world technology of patents filed in Questel Orbit®, thus intending to identify the accessible Information and Communication Technologies developed for Deaf people.

Information and Communication Technology x Importance of ICTs

In modernity with the Internet Invention and current evolution, the information reaches people quickly and, the use of various tools provides, above all, interaction and consequently learning. According to Levy (1999) [3], new ways of thinking and living are being developed in the world of Computing. Thus, various technological resources have been created to contribute to human life beings, which we highlight as one of the most Eminent Information and Communication Technologies (ICT's).

ICTs are made up of technical resources integrated with some objectives and as a tool that

Received on 22 June 2021; revised 27 October 2021.
Address for correspondence: Aline da Cruz Porto Silva. Rua Doutor Gerino de Souza Filho. No. 2864, Edificio Paul Cézanne, 401 Lauro de Freitas / Bahia. E-mail: linelibras@gmail.com. DOI 10.34178/jbth.v4i4.178.

J Bioeng. Tech. Appl. Health 2021;4(4):147-151

allows communication between humans without barriers. Consequently, through the 'internet', information and communication systems are developed, forming a network that is constantly reinventing itself. For Vasconcelos (2015) [4], technologies should contribute to personal experiences, sensations and create emotions regardless of culture and location, enabling new experiences through networks that allow access to information.

In this manner, information and communication technologies, as tools, create different spaces for interaction, teaching, and learning, providing autonomy, making information and communication accessible to everyone in the democratic process of contemporary society.

The Importance of Information and Communication Technology for the Deaf

Information and Communication Technology play a pivotal role in the digital and social inclusion of the Deaf, as it helps with information and communication.

For Rosa and Cruz (2001) [5], the Internet and its various configurations are crucial for the insertion of the Deaf in society, because it provides a multiplicity and diversity of visual resources, enabling a better understanding of the messages since their communication takes place through the Brazilian Sign Language, which constitutes a visual-space language. ICTs contribute by capacitating the Deaf to have access to information, communication, and consequently to knowledge.

Materials and Methods

We did a literature review, followed by a prospective study of technological solutions with potential application in deaf education. A survey of patent application processes was carried out on the Questel Orbit Intelligence® software platform, filed nationally and internationally in the period 2001 to 2021.

Questel Orbit Intelligence® was chosen because it enables statistical analysis and the generation of graphs and maps on broad sets of patents, filing companies, inventors, geographic distribution, legal status, and year of registration.

Questel Orbit® is a paid platform for online access to the patent search and analysis system with information on more than 107 million patents filed in several countries [6]. The search strategy used was the advanced search — Title, Abstract, and Claims — for the following descriptors in English — Technology, Communication, Deaf. The logical Boolean operator “and” was also used to cover a more effective result, as shown in Figure 1. Data collection was carried out in July 2021.

The inclusion and exclusion criteria were the Information and Communication Technologies developed for the Deaf, deposited in the Questel Orbit database since 2002 - the year of Law 10.436 that regulates the Brazilian Sign Language. The exclusion criteria were patents that did not focus on the researched subject and those filed before Law 10.436 of April 24, 2002 [7,8].

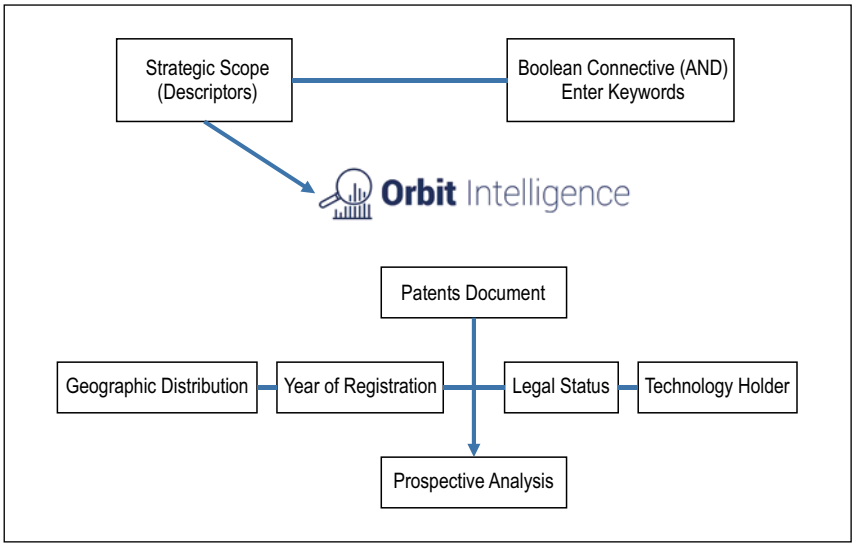
Results and Discussion

We selected and analyzed 92 patent documents focusing on the study of Information and Communication Technologies developed for the Deaf, deposited in the Questel Orbit database (2021) [6]. The results present the distribution of patents among countries; the annual evolution of patent filings over the years; the identification of the 15 biggest assignees of the 15 biggest inventors.

Figure 2 shows the world map of countries with Information and Communication Technologies developed for the Deaf. The gray color means countries without patents, and as the blue color gets darker, it means increasing the number of patents.

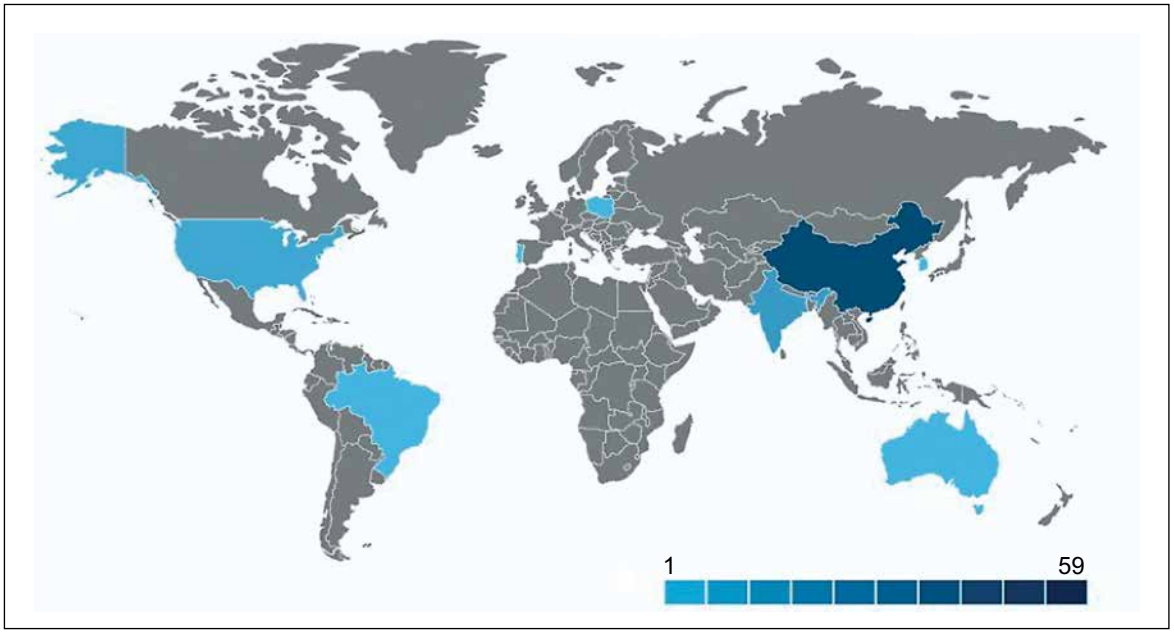
Assessing the documents obtained through technological prospecting, it was possible to observe that the largest developing country of information and communication technologies

Figure 1. Data collection (July 2021).



Source: Adapted from Gonçalves and Bezerra (2018) [9].

Figure 2. Distribution of patents between countries.



Source: Questel Orbit (2021) [6].

developed for the Deaf is China with 59 patents, followed by India with 16 and the United States with 11 technology.

Figure 3 shows the annual evolution of patent applications filed, correlated in the various technological areas, between the years 2002 to 2021. We observed that the number of registered patents remains constant from 2008 to 2015. However, there was a pattern of growth, with some atypical peaks in the years 2016 to 2020, after then there was a sharp drop in the number of publications. The year 2018 had a high occurrence in patent registrations with 22 filings.

The year 2021 should not be interpreted as a result of low investments in research and development, based on the number of patents filed in the area, noting that the reduced number must be explained by the period of secrecy, which normally lasts 18 months.

In Figure 4, it is possible to verify the relationship between the Institutions with the prominence in the protection of information and communication technologies developed for the Deaf and the number of patents related to each one of them. So, Chinese universities appear with a significant percentage of deposits, as it confirms the predominance of university institutions.

In Figure 5, the top 15 inventors are listed in a 20-year interval based on the priority year, highlighting inventors Ceng Yaokuan, Li Guanghuang, Li Wanjian, Luo Hui, Qin Guomi, Zhong Zhiwei, and Zhu Penghui, all of them with 03 families of patents.

The results presented in this prospective study show that after the enactment of Law 10.436 24/04/2002 [7], which recognizes Libras as the first language of Deaf people, in Brazil the advances in the development of new assistive technologies for Deaf people who communicate in the Language of signs are still incipient about other inventor countries.

Final Considerations

This prospective study made it possible to consider that there are patented technologies around the world on information and communication technology for the Deaf. With the search, it was possible to observe that Brazil has one (01) registered technology. Our study shows that Brazil has not given importance to the development of assistive technologies which would provide the Deaf with access to information and communication, ensuring digital and linguistic accessibility, according to Brazilian legislation. On the opposite way to Brazil, we observed that countries such as China, India, and the United States of America intensify studies in large University Institutions.

Therefore, we verified that the registration of patents is an indicator of the development of information and communication technology for the Deaf, in this manner, it presented a gradual growth in the last five years, although still discreet registration.

The use of technologies is essential for social inclusion and enables people's cognitive development. In the digital age, several technologies have been helped the Deaf, especially in communication, and provided social inclusion.

Figure 3. Annual evolution of patent filing over the years.

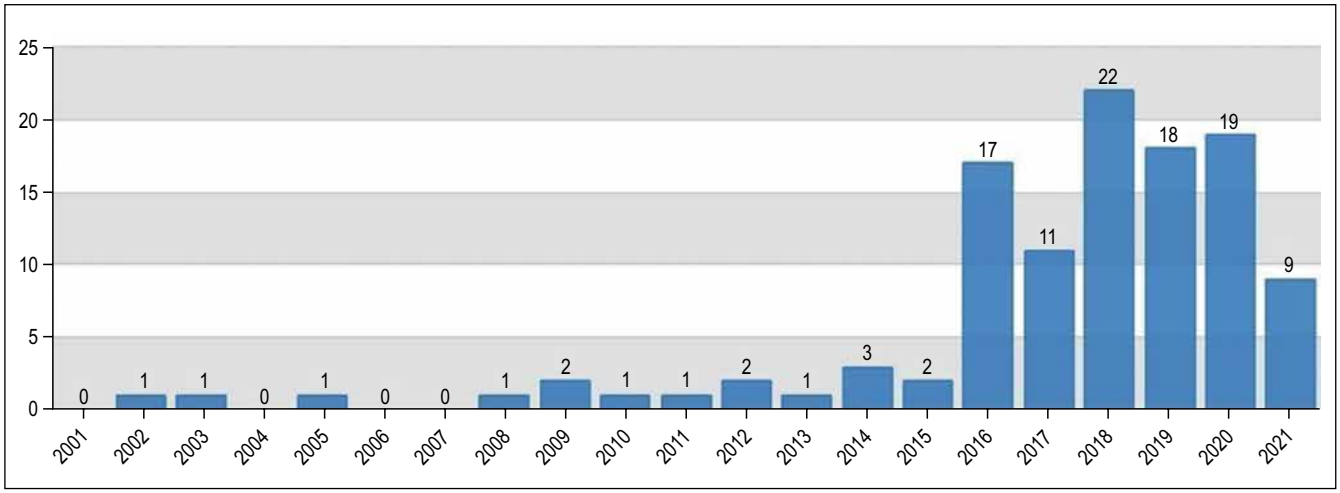


Figure 4. Identification of the 15 largest technology holders.

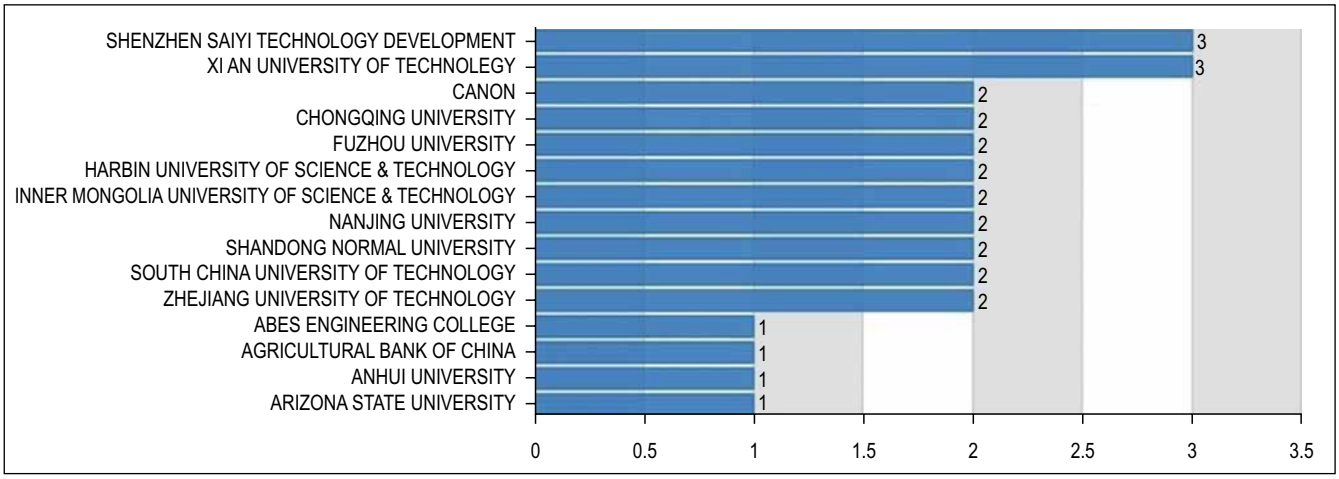
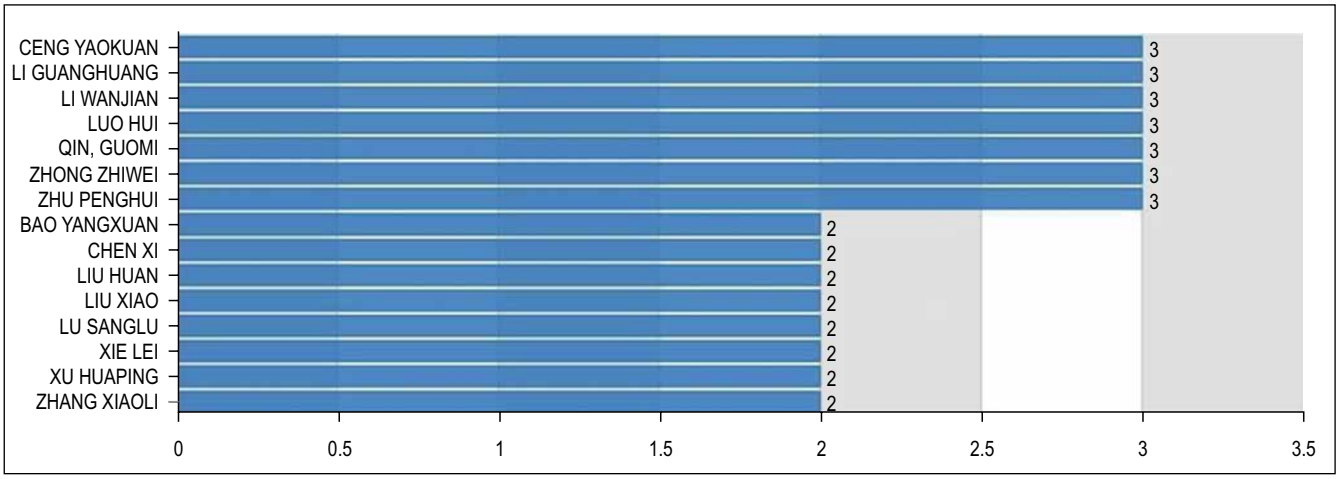


Figure 5. Identification of the 15 greatest inventors.



References

1. Marchesi, A. (1996). Communication, language, and thinking. In César Call; Jesus Palaces & Álvaro Marchesi. (Org.), Psychological Development and Education. Porto Alegre: Medical Arts, 1996: 200-216.
2. Skliar C. Deafness: a look at the differences. Porto Alegre: Mediation, 1998.
3. Lévy P. Cyberculture. São Paulo: Editor 34, 1999.
4. Vasconcelos CA. Interactive interfaces in the undergraduate course in geography at UAB at IFPE and UFS. 2015. 109f. Report (Post-Doctoral Internship) – Postgraduate Program in Contemporary Education. Federal University of Pernambuco, Caruaru, PE, 2015.
5. Rosa AS, Cruz CC. Internet inclusion factor of the deaf person. Campinas, Rev. Online of the Library. Prof. Joel Martins 2001;(2)3:38-54.
6. Questel Orbit IP Business Intelligence. [2021]. Available at: https://www.questel.com/software/ipbi/. Accessed on: Oct 4th. 2021.
7. Brazil. Law 10.436 of April 24, 2002. Available at: http://www.planalto.gov.br/ccivil_03/leis/2002/l10436.htm. Accessed on August 08, 2021.
8. Decree No. 5.626, of December 22, 2005. Regulates Law No. 10.436, of April 24, 2002, which provides for the Brazilian Sign Language – Libras, and art. 18 of Law No. 10,098, of December 19, 2000. Official Gazette of the Union.
9. Gonçalves LAS, Bezerra JS. Prospective study of the technological process of pyrolysis with emphasis on INPI's green patent program. Prospecting Notebook. Salvador, v. 11, no. 1, p.74-86, Jan./Mar.2018 Official Gazette: http://dx.doi.org/109771/cp.v11i1.23094.

Statistical Analysis of Factors Related to Suicide Records in the World Between 1985 and 2020

João Pedro Barbosa de Almeida[1*], Matheus Carvalho Nascimento de Souza[1], Yuri Papaterra Fonseca[1], Felipe Emmanouil Martires Stamoglou[1], Márcio Renê Brandão Soussa[1]

[1]Senai Cimatec University Center, Computing Department; Salvador, Bahia, Brazil

Suicide is considered by the World Health Organization (WHO) as a public health problem that afflicts the whole society and it counts more deaths than many diseases. Therefore, the current objective is to analyze the suicide deaths between 1985 and 2020 and classify them according to the act. Through KNN, this study presents suicide cases grouped by sex (male and female) and associate them to factors by country, pointing out information that allows us to understand what influences the act the most directly or indirectly. The results showed that, unlike other researches, the rate of suicide does not have differences based on sex. However, further studies are needed.
Keywords: Suicide. Victim. Data. Influences.

Introduction

Suicide is a voluntary act that aims to end one's life and is considered an act of violence [1], affecting families, communities, countries, leaving deep marks on those who stay [2]. Therefore, the World Health Organization (WHO) considers suiciding a public health problem [3].

The WHO [3] reports that suicide remains one of the leading causes of death in the world (one in a hundred) and that annually counts more deaths than diseases such as HIV, malaria, breast cancer, as well as homicides and wars. In 2019 alone, more than 700,000 people committed suicide worldwide (1 case every 40 seconds) [4], and many others tried but failed. According to the Secretaria de Saúde da Bahia [4], in Brazil, about 12,000 people take their own lives each year, corresponding to approximately 6% of the population. There is one case every 46 minutes, being more recurrent in the male black population aged between 10 and 29 years. It is estimated that more than 90% of suicide cases are related to mental illnesses, being depression first, followed by bipolar disorder and drug abuse.

Received on 10 September 2021; revised 27 October 2021.
Address for correspondence: João Pedro Barbosa de Almeida. Avenida Orlando Gomes, 1845, Piatã, Zip Code: 41650-010, Salvador, BA, Brazil. Phone: +55 71 3879-5677. E-mail: jpbarbosinha@gmail.com. DOI 10.34178/jbth.v4i4.179.

J Bioeng. Tech. Appl. Health 2021;4(4):152-156.

Given the pandemic scenario due to COVID-19, the need to stay at home increased the rate of suicide worldwide. According to OPAS [5], the anguish, anxiety, and depression of isolation, combined with cases of violence, alcohol consumption disorders, substance abuse, and feelings of loss, can become factors that may increase the chances of a person taking their own life. With the severity of the scenario, several measures have been used to prevent the consummation of the act, such as the creation and operation of social assistance centers, like Psychosocial Care Centers (CAPS) and the Centers for The Valorization of Life (CVV). The WHO [4] states that suicide is preventable in 90% of cases, and towards that goal, there is also an awareness campaign established for suicide prevention, the month of September, also viewed as the month of suicide prevention. Initiatives that make use of technologies have also played an important role in suicide prevention, in example "the algorithm of life", developed by SAP and Amazon Web Services, which monitors tweets seeking to identify profiles at high risk of depression, forwarding the messages to specialized centers [6].

Seunghyong Ryu and colleagues [7] propose a tool that makes use of the random-forest machine learning algorithm, a computational model for predicting suicidal ideation in individuals through Machine Learning. The study aimed to develop a tool capable of perceiving how likely individuals are to proceed with the act, based on samples of ideals. In its completion, it was concluded that,

although its accuracy is acceptable, working on some factors is necessary to increase it throughout the technique.

Taking into account the previous study, another was also carried out involving the n-gram linear regression method and later random-forest machine learning within the Facebook social network looking for texts or other types of publications possibly related to the act of suicide[8]. These types of studies show that, through social media and its resources, it could be possible to prevent the suicide act from simple messages and posts interchange.

Therefore, this research aims at predicting and correlating factors involved in suicides to understand which of them most affect and influence the execution of the action, when those factors are seen from a scope.

Materials and Methods

In this work, a knowledge discovery in databases (KDD) process was carried out, containing the following steps: Database Definition, Pre-processing, Data Mining, and Data Analysis. They are detailed below.

Database Definition

We used two public databases extracted from the World Health Organization (WHO) [9], one (deaths database) containing records of deaths worldwide during the period from 1985 to 2020, and another (population database) containing the total population of each country during the same period. The first consists of 5 files, totaling 4.209.751 records, and 5 attributes the number of deaths grouped by age group, country, year, sex, population, and cause of death. The second consists of a single file grouped by mid-year population and live births, with 9.719 records.

Pre-Processing

The first step was to change the identification of the country attribute from numbers to their actual names. The database is formatted with only an ID of each country, and that has to be referenced with the list of names given by the same organization. As the objective of this project was to analyze a correlation between possible factors that lead to suicide, it was necessary to filter the deaths database. To proceed, a filtering of the column "cause" that represents the causes of death, was done, selecting only those whose codes are indicative of suicides and self-inflicted injuries, thus ensuring to work only with records related to the focus of the study, suicide. Given value of total deaths and populations were absolute, it was necessary to normalize them, so we used the MinMaxScaler method of Python 3's SKLearn module. Following that, the population database was joined with the deaths database generating a single dataset that was used in the data mining and data analysis steps.

Data Mining

We did a comparison between the columns of the dataset to check if the numbers of suicides and total populations have any perceivable relation. Then, to apply the K Nearest Neighbours (KNN) method, a range of K-values were analyzed based on the accuracy with which they could better fit the classification method. This research followed a branch of studies, namely CVV and OPAS, which reported cases of suicides being more present in men than women, justifying the main factors used for the classification: sex, number of suicides, and population. Therefore, we analyzed the results by the K-Nearest Neighbors (KNN) method, in which sex was used as the target of the classification. Thus it could be demonstrated if the cases would present a uniformity based on the sex of the victim.

Data Analysis

We used the Python 3 language to perform the data analysis with the libraries: numpy, pandas, seaborn, and matplotlib. The results were plotted

in the form of a Heatmap to allow visualization of the relations between each data. Then, after the best value for the KNN classification was found in a graph showing the accuracy, the classification was executed by itself and its decision regions were plotted, so their homogeneity could be analyzed.

Results and Discussion

Heatmap

The heatmap produced presents the correlation between the values of total deaths and total populations in each country and the years they were noted (Figure 1). The lighter points represent high correlation, and the darker ones represent the low correlation. Each label is separated with two hidden attributes between them.

The correlation showed no relevant data to the study, having the values of the deaths correlate with themselves. It, however, demonstrates that closer age groups have a higher correlation with themselves, except for the age groups in the extremities, the younger and older ones. It also shows in the darker areas a lesser correlation of the younger age groups to suicide rates when compared to the older age groups, as children are usually less connected with deaths by suicide and its causes.

The K Nearest Neighbour Method (KNN)

Cross-Validation

For the realization of KNN, the best value of K Nearest Neighbors was verified through cross-validation, using a graph for a more accurate demonstration of the value range chosen. We use another module called SciKit Learn, also from Python 3, to do the process.

The accuracy was measured between the values 1 through 30. The value of 2 was the most accurate for the classification (Figure 2). No further testing was needed as accuracy only decreased as the value increased.

Classification

The data was then formatted using Python's PCA module to fit the format of the KNN method, implementing it with the values 0 for the missing data, 1 for men, and 2 for women. With all the requirements mentioned, the decision regions were plotted to analyze the homogeneity of the data as shown in Figure 3.

In the plotting regions, a low homogeneity was demonstrated for both sexes, with the female showing to be the most concrete. About the regions, none seems to be consistent enough to classify the data, and multiple outliers are present across the regions, which is in the jagged borders of the regions and the invading contrasting areas. It is also worth noting that the value used for K is relatively small, both decreasing the bias of the classification and increasing its variation, which could explain the outliers.

Conclusion

After observing the results of the KNN methodology in standardized data, we concluded that there are no significant clusters among the evaluated data, demonstrating a lack of similarity in the characteristics presented, hindering the discovery of factors related to the rate of incidents. However, we verified that female victim does not differ much from males, except for a few outliers, contradicting a few existing studies. Although it can be theorized that there is a correlation between the size of the population and the number of suicides, as seen at the beginning of the study, subsequent checks through the methods bring contrary information, especially at years when the rate of calculated suicides does not differ much from country to country. With the data restructured, the plot created did not have enough information to answer what factors lead to the person committing the act but opened the possibility for new studies that seek different factors from those used here, which can determine what leads someone to exceed the limit

Figure 1. Heatmap of the correlation between the data.

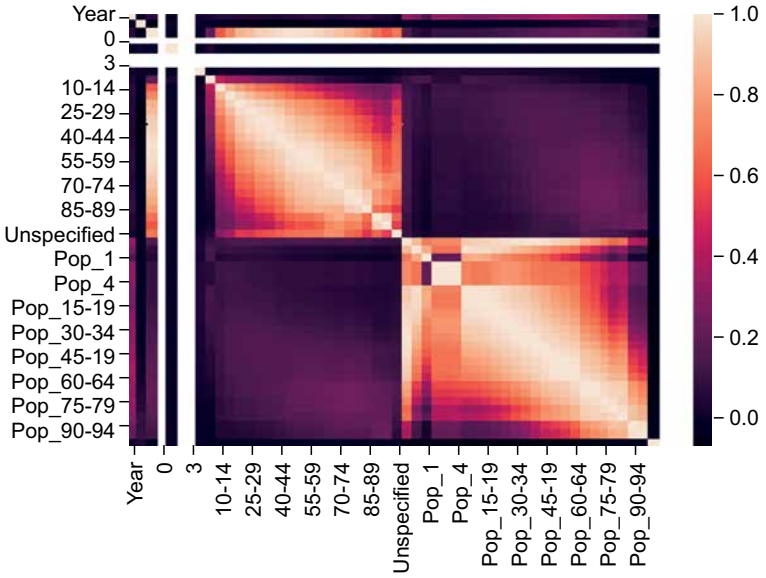


Figure 2. Graph of the values analyzed and their accuracy.

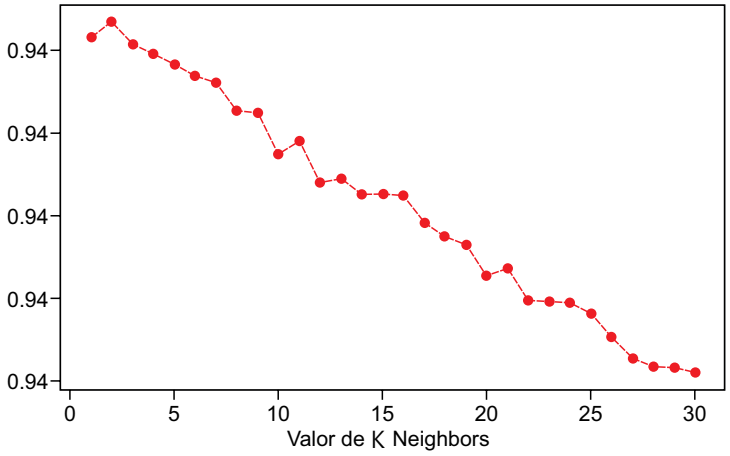
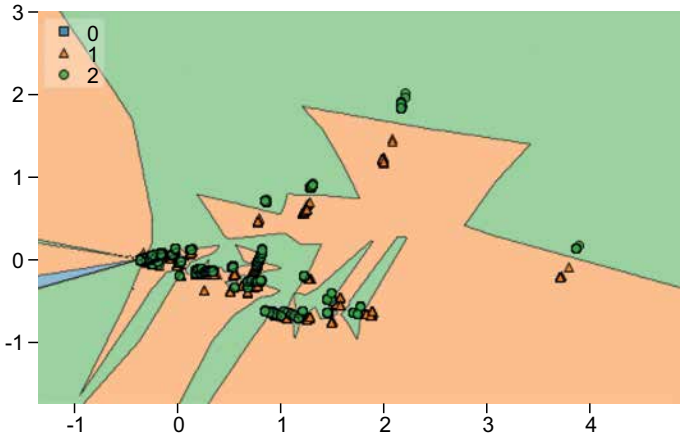


Figure 3. KNN decision-making regions carried out.



of "thinking" about suicide to "act", to point out new ways to reduce or prevent the in point of suicides in countries.

References

1 Ribeiro NM, et al. Análise da tendência temporal do suicídio e de sistemas de informações em saúde em relação às tentativas de suicídio. Texto & Contexto-Enfermagem 2018;27.

2. WHO - World Health Organization. Notícias. Available at: <https://www.who.int/news/item/17-06-2021-one-in-100-deaths-is-by-suicide>. Accessed Aug. 4, 2021.
3. WHO - World Health Organization. Departamento de Saúde Mental e de Abuso de Substâncias. 2006, 18p. Available at: <https://www.who.int/mental_health/media/counsellors_portuguese.pdf>. Accessed: Aug. 4, 2021.
4. Governo do Estado, Secretária de Saúde. Notícias. Available at: <http://www.saude.ba.gov.br/2020/09/10/oms-alerta-suicidio-e-a-3a-causa-de-mortede- jovens-brasileiros-entre-15-e-29-anos>. Accessed Aug 4, 2021.
5. OPAS - Organização Pan-Americana de Saúde. Notícias. Available at: <https://www.paho.org/pt/noticias/10-9-2020-pandemia-covid-19-aumenta-fatores-risco-para-suicidio>. Accessed Jul. 16, 2021.
6. SAP Brasil, Tecnologia como ferramenta de prevenção ao suicidio. 2019, Available at:<https://news.sap.com/brazil/2019/10/tecnologia-como-ferramenta-de-prevencao-aosuicidio-bl0g/>. Accessed Aug 4, 2021.
7. Ryu S, Lee H, Lee D, Park K. Use of a machine learning algorithm to predict individuals with suicide ideation in the general population. National Center for Biotechnology Information 2018. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6258996/>. Accessed Aug 4, 2021.
8. Andrade NNG, et al. Ética e inteligência artificial: prevenção do suicídio no Facebook. Filosofia e Tecnologia 2018;(31)4:669-684.<https://link.springer.com/content/pdf/10.1007/s13347-018-0336-0.pdf>. Accessed Aug 22, 2021.
9 WHO - World Health Organization. WHO Mortality Database. Available at: <https://www.who.int/data/data-collection-tools/who-mortality-database>. Accessed Jul. 9, 2021.

Technological Prospection with a Focus on Assistive Technology in Adapted Vehicles for People with Disabilities

Rosemeire do Carmo Furtado[1*], Camila Pereira Guizzo[1], Xisto Lucas Travassos[2]
[1]GETEC, Senai Cimatec University Center; Salvador, Bahia; [2]Technological Center, Federal University of Santa Catarina; Joinville, Santa Catarina, Brazil

This study aimed to review the production of patent documents related to assistive technology on adapted vehicles for people with disabilities. The technological prospection was carried out through a search on the Espacenet database, resulting in 277 patents whose data we organized into charts. The results show that the total number of patents filed in this area is small and with a limited increase over the years, maybe due to industrial secrecy. Twenty-eight countries registered patents. The Republic of China and the Korea Republic were the main depositors, while Brazil registered only one patent. They focused on people with a physical disability, so further projects to attend to other types of disability are also required. There is a necessity to increase government and private sectors investments for technological advances in this area.
Keywords: Assistive Technology. People with a Disability. Vehicles. Patents.

Introduction

According to the Brazilian Law on the Inclusion of Persons with Disabilities (LBI – Lei Brasileira de Inclusão, in Portuguese) [1], a person with a disability is that one that has a long-term impairment of a physical, mental, intellectual, or sensory nature. And their interaction with one or more barriers may hinder their full and effective participation in society on equal terms with other people. As stated by World Health Organization (WHO) [2], about 15% of the world population or an estimated 1 billion people live with disabilities. Brazil has almost 46 million people with disabilities (PwD), which corresponds to 24% of its total population.

Most of them present visual or physical impairment and is more than 60 years old [3]. Between 2000 and 2015, the life expectancy increased by 5 years globally and Brasil registered a life expectancy of 75 years, and the tendency was to increase it even more [4]. There was a decline of 1.94 years in 2020 due to the COVID-19 pandemic; this index in 2021 might drop even more [5]. Anyway, the world population tends to increase around 26%, achieving 9,7 billion people in 2050 [6]. Of course, PwD quantity will proportionally increase with this.

Many PwD needs are not supported due to lack of infrastructure or investments and Brazil has been slow in addressing these issues compared with more developed countries. An arsenal of equipment, services, and specific strategies called assistive technology (AT) have been developed to minimize or eliminate the functional problems encountered by PwD. Per Portaria interministerial nº 362 [7], there are 12 AT categories:

1. Aid for daily life and practical life.
2. Augmentative and/or Alternative Communication.
3. Computer accessibility features.
4. Environmental control systems.
5. Architectural projects for accessibility.
6. Orthoses and prostheses.
7. Postural adequacy.
8. Mobility aids.
9. Aid for the qualification of visual ability and resources that expand information to people with low vision or blindness.
10. Aid for hearing ability and autonomy in communication to people with hearing loss, deafness, and deaf-blindness.

Received on 15 September 2021; revised 29 October 2021.
Address for correspondence: Rosemeire do Carmo Furtado. Avenida Orlando Gomes, 1845, Piatã, Zip Code: 41650-010, Salvador, BA, Brazil. Phone: +55 71 3879-5677. E-mail: rofurtad@yahoo.com.br. DOI 10.34178/jbth.v4i4.180.

J Bioeng. Tech. Appl. Health 2021;4(4):157-163.

11. Adaptations in vehicles and vehicle access environments.
12. Sports and leisure.

Overall, this study aims to characterize the current technological maturity in the subject related to assistive technology in adapted vehicles for people with disabilities, analyzing the progress of patent documents through a search on the Espacenet database. Technological prospection is useful to present the state-of-the-art of some technology area, obtain information about its past trajectory, and to market trends and perception of items to be improved [8].

Materials and Methods

We used the free-of-charge patent searching tool called Espacenet, from the European Patent Office (EPO), with more than 90 million patent documents from around the world. According to INPI (Instituto Nacional da Propriedade Industrial, in Portuguese) [9], the patent classification offers an effective search tool for patent documents by intellectual property offices and other users, intending to establish novelty and to evaluate the inventive step of technical disclosures in patent applications.

To understand the state-of-the-art assistive technology in adapted vehicles for people with disabilities, we searched a patent with a strategy that combined a set of keywords and International Patent Classification (IPC) codes. The IPC, established by the Strasbourg Agreement 1971, provides for a hierarchical system of language-independent symbols for the classification of patents and utility models according to the different areas of technology [10]. The keywords and/or IPC codes presented in table 1 were inserted on the field "title or abstract", returning 383 patent documents (Table 1).

We found the IPC codes on the International Patent Classification WIPO (World Intellectual Property Organization), which provides the contents of 70 million patents worldwide [10]:

- A61G 3/00 - Ambulance aspects of vehicles; Vehicles with special provisions for transporting patients or disabled people, or their conveyances.
- A61G 3/02 - Loading or unloading personal transports; Facilitating access of patients or disabled persons to get into, or exit from, vehicles.
- A61G 3/04 - Transfer of seated patients or disabled persons by swinging about an upright axis.
- A61G 3/06 - Transfer using ramps, lifts, or similar equipment.
- A61G 3/08 - Accommodating or securing wheelchairs.

By reading the 383 patent abstracts, only those patents focusing on PwD and adaptations in vehicles/vehicle access environments (AT number

Table 1. Keywords and IPC codes used for patent search on the European Espacenet database.

Keywords and/or IPC	Number of Patent Documents
Disable and Vehicle and A61G3	280
Disabled and A61G3/00	60
Assistive Technolog and Vehicle	22
People with Disabilities and Vehicle	8
Disabled Person and Automotive	7
Disabled People and Automotive	6
Total	**383**

11) were selected, totaling 277 patents, which are the focus of this technological prospection study. The 277 patents were exported to CSVed 1.4.9 program and then to Microsoft Excel for distribution of patent documents by the country of origin; annual progress of patent development; patent filings by principal applicants and inventors; distribution of patent documents by the main IPC codes.

Results and Discussion

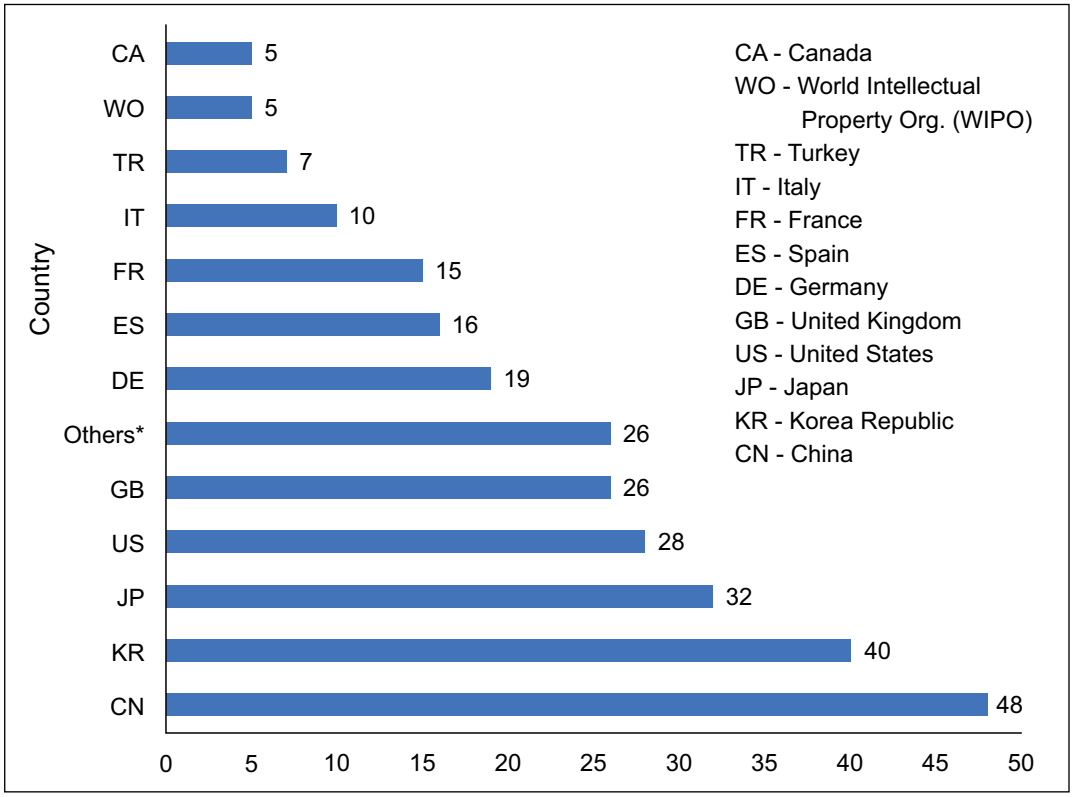
Origin of Patent Documents

Figure 1 shows the distribution of patent documents by country. In total, 28 countries registered patents, being most of them belonging to China (48), followed by the Korea Republic (40) and Japan (32). Even having a high number of PwD, Brazil has registered just one patent document. It reinforces the importance of fostering new AT projects for vehicles in this country.

Annual Progress of Patent Documents

Figure 2 shows the global annual progress of patent publications between 1970 and 2020, illustrating that the number of patents filed in this study area is small (277) for 50 years. The first patent was filed in 1973 in the United States. However, there was an increased number of patent deposits between 2007 and 2014 with a peak of 19 patents in 2014. Then there was a fall between 2015 and 2020, with a maximum number of 12 patents in 2018 and only 5 in 2020. We can also notice many years with no patents in the studied

Figure 1. Distribution of patent documents by the countries with the highest number of deposited patent documents.



Others*: NZ – New Zealand, PL – Poland, AU – Australia, NL – Netherlands, HU – Hungary, FI – Finland, RU – Russia, AT – Austria, BR – Brazil, TW – Taiwan, SE – Sweden, SI –Slovenia, PT – Portugal, CZ – Czech Republic, EP – European Patent Office (OPE/EPO), MX – Mexico. It appeared three times or less.

area, and the increase of patents publications over the years is low.

Principal Applicants (Depositors) of Patent Documents

Regarding the holders of technology, the total number of patent documents spreads by different depositors. Auto Tech Corp company from the Korea Republic held the most with 8 patents, followed by Daguang HU from China with 6 patents and Toyota Auto Body CO LTD from Japan / Egan Thomas F from the United States with 4 patents each. In Figure 3, we can see the applicants with 3 or more deposited patents. The other 267 depositors appeared just once or twice. As expected, based on the previous analysis from, Brazil is not on the list of principal applicants.

Main Inventors of Patent Documents

Figure 4 shows the number of patent documents distributed by the inventor, and it considers only the ones with 3 or more deposited patents. The predominance of the Korea Republic appears again (21 patents), followed by the United States (9 patents) and China (6 patents). The other 413 investors appeared only once or twice. Kang Seong Hee (Korea), Egan Thomas F (United States), and Daguang Hu (China) have the highest number of patent documents, being 6 for each of them.

International Patent Classification (IPC)

The number of patent documents by IPC code is shown in Figure 5, containing only the principal ones that appeared 10 times or more. A61G3/06 is predominant (160 times), followed by A61G3/00 (83 times), A61G3/02 (76 times), and AG61/08 (43 times). Other 176 codes not available in the chart were cited 8 times or less. The A61G3 code family (ambulance aspects of vehicles; vehicles with special provisions for transporting patients or disabled persons, or their conveyances) is predominant with 39% of total IPC codes that appeared on this search. From this, the highest portion (44%) is related to projects for transferring using ramps, lifts, or similar equipment (A61G3/06). Therefore, most of the projects are focused on AT related to vehicle access environments.

Conclusion

This study demonstrates that, despite the relevance of this subject, there is still not a representative number of patents related to AT in adapted vehicles for PwD. According to the presented data, there is a dominance from China, Korea Republic, Japan, and United States on the assistive technology in adapted vehicles for people with disabilities. It is probably driven by incentives led by their governments for Research and Development (R&D) in the fields related to technology. Even having a high quantity of PwD, Brazil has only one deposited patent. All the patent documents analyzed in this technological prospection refer to mobility and accessibility assistance, focused on people with a physical disability. So, further projects to attend to other types of disability are also required. There are opportunities and needs for increasing investments in AT projects inside the vehicles, mainly to support PwD to drive them. The increase of patents deposits over the years is low and it may be related to companies' confidentiality policies that limit their publications. In the automotive industry, many innovations are protected by patents but there is a lot of restriction on data disclosure due to industrial secrecy. Furthermore, the time and scope of research work are not reflected in innovations incorporated by business models. Another issue is that the TA projects are expensive and do not always provide the financial return desired by the companies, limiting their investments. The global demand from the PwD and the needs for new assistive technology will continue growing in proportion to the increase and aging of the population.So,there is a necessity to increase

Figure 2. Global growth of patent documents (annual progress between 1970 and 2020).

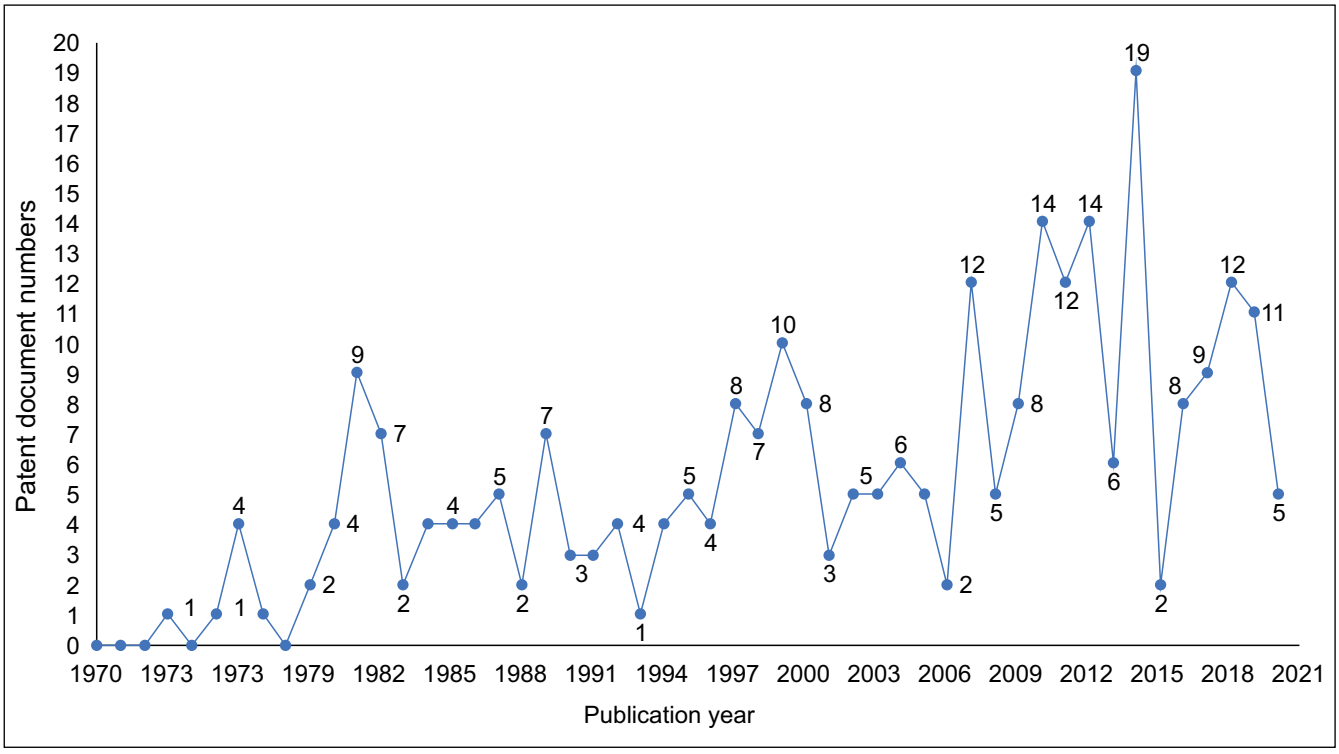


Figure 3. Principal applicants (depositors) of patent documents.

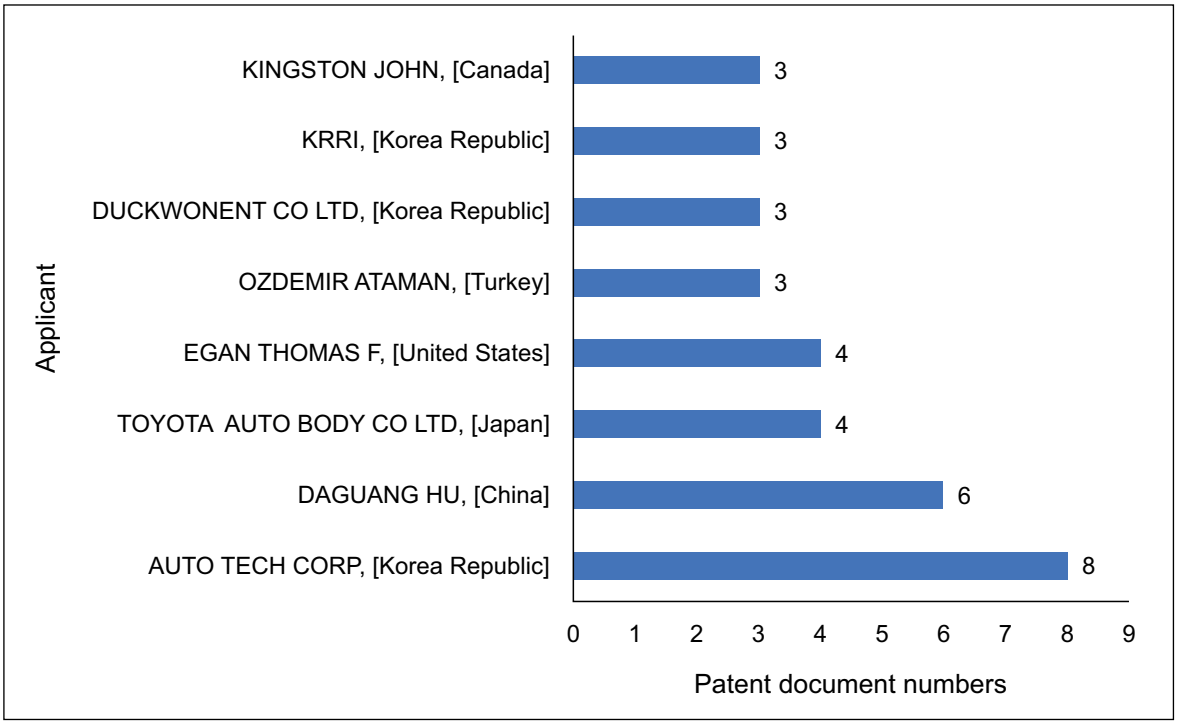


Figure 4. Principal inventors of patent documents.

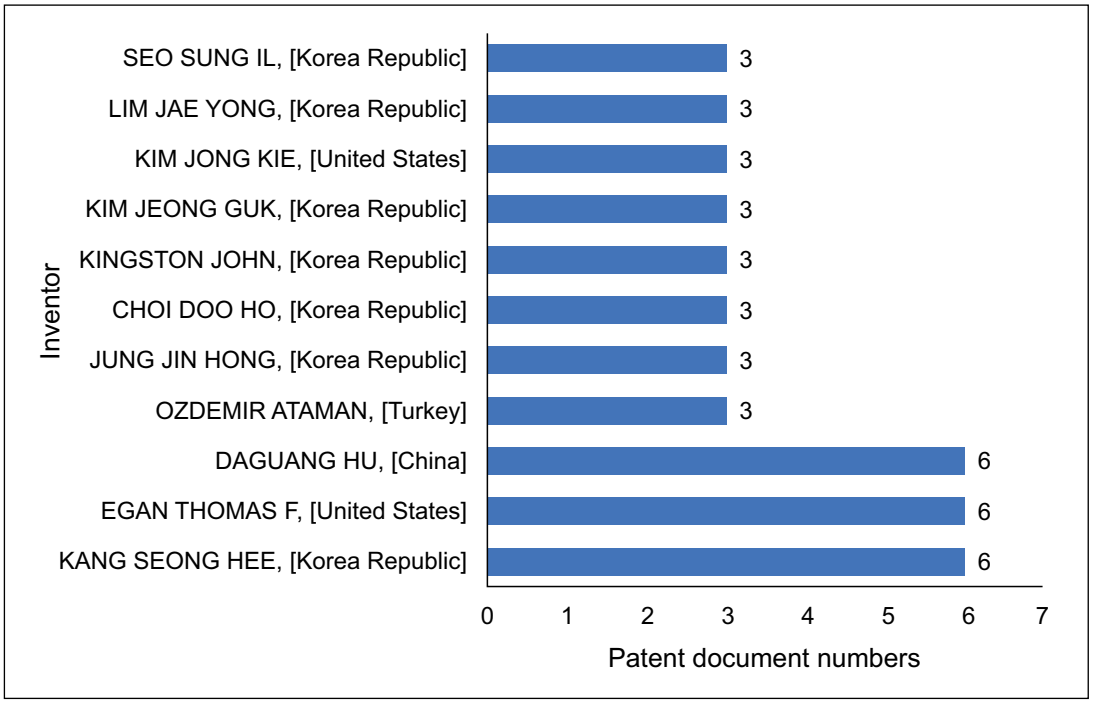
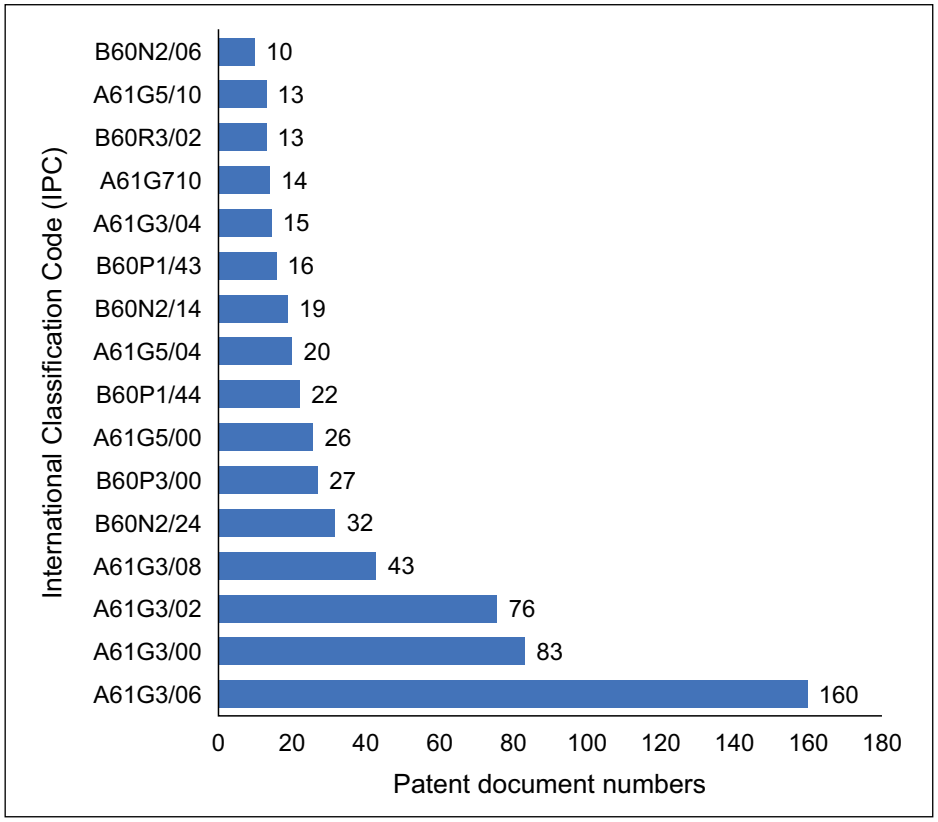


Figure 5. Distribution of patent documents by the principal International Patent Classification (IPC) code – with 10 deposited patents or more.



government and private sector incentives and investments for technological advances in this area; especially in Brazil with such an inexpressive patent actuation,

References

1. Brasil. Presidência da República Secretaria-Geral. Lei nº 13.146, de 6 de Julho de 2015. Lei Brasileira de Inclusão da Pessoa com Deficiência (Estatuto da Pessoa com Deficiência). Available at: <http://www.planalto.gov.br/ccivil_03/_ato2015-2018/2015/lei/l13146.htm>. Accessed on: 14 Mar. 2021.
2. WHO. World Health Organization. World Report on Disability, 2011. Available at: <https://www.who.int/publications/i/item/9789241564182>. Accessed on: 1 May 2021.
3. IBGE. Instituto Brasileiro de Geografia e Estatística, Censo 2010. Available at: <https://censo2010.ibge.gov.br/resultados.html>. Accessed on: 7 Jan. 2021.
4. OPAS. Organização Pan-Americana de Saúde, 2016. Available at: <https://www.paho.org/bra/index.p?option=com_content&view=article&id=5102:oms-expectativa-de-vida-subiu-5-anos-desde-2000-mas-desigualdades-na-saudepersistem&Itemid=839>. Accessed on: 10 Jan. 2021.
5. Castro MC, et al. Reduction in the 2020 life expectancy in Brazil after COVID-19. medRxiv, 2021.
6. UNDP. United Nations Development Programme. Human Development Report, 2019. Available at: <http://hdr.undp.org/sites/default/files/hdr2019.pdf>. Accessed on: 18 May 2021.
7. Brasil. Secretaria Especial de Fazenda. Portaria Interministerial nº 362, de 24 de Outubro de 2012. Available at: <https://www.gov.br/fazenda/pt-br/acesso-ainformacao/institucional/legislacao/portarias-interministeriais/2012/portaria-362>. Accessed on: 14 Mar. 2021.
8. Coelho GM, Coelho DMS.Prospecção tecnológica: metodologias e experiências nacionais e internacionais. Rio de Janeiro: INT, 2003.
9. INPI. Instituto Nacional da Propriedade Industrial. Classificação de patentes, 2020. Available at: <https://www.gov.br/inpi/pt-br/servicos/patentes/classificacao-depatentes>. Accessed on: 20 Feb. 2021.
10. WIPO. World Intellectual Property Organization. International Patent Classification (IPC), 2021. Available at: <https://www.wipo.int/classifications/ipc/en/>. Accessed on: 15 Jan. 2020.

Instructions for Authors

The Authors must indicate in a cover letter the address, telephone number and e-mail of the corresponding author. The corresponding author will be asked to make a statement confirming that the content of the manuscript represents the views of the co-authors, that neither the corresponding author nor the co-authors have submitted duplicate or overlapping manuscripts elsewhere, and that the items indicated as personal communications in the text are supported by the referenced person. Also, the protocol letter with the number should be included in the submission article, as well as the name of sponsors (if applicable).

Manuscripts may be submitted within designated categories of communication, including:

- Original basic or clinical investigation (original articles on topics of broad interest in the field of bioengineering and biotechnology applied to health). We particularly welcome papers that discuss epidemiological aspects of international health, clinical reports, clinical trials and reports of laboratory investigations.
- Case presentation and discussion (case reports must be carefully documented and must be of importance because they illustrate or describe unusual features or have important practice implications).
- Brief reports of new methods or observations (short communications brief reports of unusual or preliminary findings).
- State-of-the-art presentations (reviews on protocols of importance to readers in diverse geographic areas. These should be comprehensive and fully referenced).
- Review articles (reviews on topics of importance with a new approach in the discussion). However, review articles only will be accepted after an invitation of the Editors.
- Letters to the editor or editorials concerning previous publications (correspondence relating to papers recently published in the Journal, or containing brief reports of unusual or preliminary findings).
- Editor's corner, containing ideas, hypotheses and comments (papers that advance a hypothesis or represent an opinion relating to a topic of current interest).
- Innovative medical products (description of new biotechnology and innovative products applied to health).
- Health innovation initiatives articles (innovative articles of technological production in Brazil and worldwide, national policies and directives related to technology applied to health in our country and abroad).

The authors should checklist comparing the text with the template of the Journal.

Supplements to the JBTH include articles under a unifying theme, such as those summarizing presentations of symposia or focusing on a specific subject. These will be added to the regular publication of the Journal as appropriate, and will be peer reviewed in the same manner as submitted manuscripts.

Statement of Editorial Policy

The editors of the Journal reserve the right to edit manuscripts for clarity, grammar and style. Authors will have an opportunity to review these changes prior to creation of galley proofs. Changes in content after galley proofs will be sent for reviewing and could be required charges to the author. The JBTH does not accept articles which duplicate or overlap publications elsewhere.

Peer-Review Process

All manuscripts are assigned to an Associate Editor by the Editor-in-Chief and Deputy Editor, and sent to outside experts for peer review. The Associate Editor, aided by the reviewers' comments, makes a recommendation to the Editor-in-Chief regarding the merits of the manuscript. The Editor-in-Chief makes a final decision to accept, reject, or request revision of the manuscript. A request for revision does not guarantee ultimate acceptance of the revised manuscript.

Manuscripts may also be sent out for statistical review ou *ad hoc* reviewers. The average time from submission to first decision is three weeks.

Revisions

Manuscripts that are sent back to authors for revision must be returned to the editorial office by 15 days after the date of the revision request. Unless the decision letter specifically indicates otherwise, it is important not to increase the text length of the manuscript in responding to the comments. The cover letter must include a point-by-point response to the reviewers and Editors comments, and should indicate any additional changes made. Any alteration in authorship, including a change in order of authors, must be agreed upon by all authors, and a statement signed by all authors must be submitted to the editorial office.

Style

Manuscripts may be submitted only in electronic form by www.jbth.com.br. Each manuscript will be assigned a registration number, and the author notified that the manuscript is complete and appropriate to begin the review process. The submission file is in OpenOffice, Microsoft Word, or RTF document file format for texts and JPG (300dpi) for figures.

Authors must indicate in a cover letter the address, telephone number, fax number, and e-mail of the corresponding author. The corresponding author will be asked to make a statement confirming that the content of the manuscript represents the views of the co-authors, that neither the corresponding author nor the co-authors have submitted duplicate or overlapping manuscripts elsewhere, and that the items indicated as personal communications in the text are supported by the referenced person.

Manuscripts are to be typed as indicated in Guide for Authors, as well as text, tables, references, legends. All pages are to be numbered with the order of presentation as follows: title page, abstract, text, acknowledgements, references, tables, figure legends and figures. A running title of not more than 40 characters should be at the top of each page. References should be listed consecutively in the text and recorded as follows in the reference list, and must follow the format of the National Library of Medicine as in Index Medicus and “”Uniform Requirements for Manuscripts Submitted to Biomedical Journals” or in “Vancouver Citation Style”. Titles of journals not listed in Index Medicus should be spelled out in full.

Manuscript style will follow accepted standards. Please refer to the JBTH for guidance. The final style will be determined by the Editor-in-Chief as reviewed and accepted by the manuscript’s corresponding author.

Approval of the Ethics Committee

The JBTH will only accept articles that are approved by the ethics committees of the respective institutions (protocol number and/or approval certification should be sent after the references). The protocol number should be included in the end of the Introduction section of the article.

Publication Ethics

Authors should observe high standards with respect to publication ethics as set out by the International Committee of Medical Journal Editors (ICMJE). Falsification or fabrication of data, plagiarism, including duplicate publication of the authors’ own work without proper citation, and misappropriation of the work are all unacceptable practices. Any cases of ethical misconduct are treated very seriously and will be dealt with in accordance with the JBTH guidelines.

Conflicts of Interest

At the point of submission, each author should reveal any financial interests or connections, direct or indirect, or other situations that might raise the question of bias in the work reported or the conclusions, implications, or opinions stated - including pertinent commercial or other sources of funding for the individual author(s) or for the associated department(s) or organizations(s), and personal relationships. There is a potential conflict of interest when anyone involved in the publication process has a financial or other beneficial interest in

the products or concepts mentioned in a submitted manuscript or in competing products that might bias his or her judgment.

Material Disclaimer

The opinions expressed in JBTH are those of the authors and contributors, and do not necessarily reflect those of the ITS/SENAI CIMATEC, the editors, the editorial board, or the organization with which the authors are affiliated.

Privacy Statement

The names and email addresses entered in this Journal site will be used exclusively for the stated purposes of this journal and will not be made available for any other purpose or to any other party.

Brief Policies of Style

Manuscript	Original	Review	Birief Comunication	Case Report	Editorial ; Letter to the Editor; Editor' s Corner	Innovative Medical Products	State-of-the-Art	Health Innovation Initiatives
Font Type	Times or Arial	Times or Arial	Times or Arial	Times or Arial	Times or Arial	Times or Arial	Times or Arial	Times or Arial
Number of Words – Title	120	90	95	85	70	60	120	90
Font Size/Space-Title	12; double space	12; double space	12; double space	12; double space	12; double space	12; double space	12; double space	12; double space
Font Size/Space-Abstracts/Key Words and Abbreviations	10; single space	10; single space	10; single space	10; single space	-	-	10; single space	10; single space
Number of Words – Abstracts/Key Words	300/5	300/5	200/5	250/5	-	-	300/5	300/5
Font Size/Space-Text	12; Double space	12; Double space	12; Double space	12; Double space	12; Double space	12; Double space	12; Double space	12; Double space
Number of Words – Text	5,000 including spaces	5,500 including spaces	2,500 including spaces	1,000 including spaces	1,000 including spaces	550 including spaces	5,000 including spaces	5,500 including spaces
Number of Figures	8 (title font size 12, double space)	3 (title font size 12, double space)	2 (title font size 12, double space)	2 (title font size 12, double space)	-	2 (title font size 12, double space)	8 (title font size 12, double space)	8 (title font size 12, double space)
Number of Tables/Graphic	7 title font size 12, double space	2 title font size 12, double space	2(title font size 12, double space)	1(title font size 12, double space)	-	-	7 title font size 12, double space	4 title font size 12, double space
Number of Authors and Co-authors*	15	10	5	10	3	3	15	10
References	20 (font size 10,single space	30(font size 10,single space	15 (font size 10,single space)	10 (font size 10,single space)	10 (font size 10,single space	5(font size 10,single space	20 (font size 10,single space	20

*First and last name with a sequencing overwritten number. Corresponding author(s) should be identified with an asterisk; Type 10, Times or Arial, single space. Running title of not more than 40 characters should be at the top of each page. References should be listed consecutively in the text. References must be cited on (not above) the line of text and in brackets instead of parentheses, e.g., [7,8]. References must be numbered in the order in which they appear in the text. References not cited in the text cannot appear in the reference section. References only or first cited in a table or figures are numbered according to where the table or figure is cited in the text. For instance, if a table is placed after reference 8, a new reference cited in table 1 would be reference 9.1 would be reference 9.

Checklist for Submitted Manuscripts

❑1. Please provide a cover letter with your submission specifying the corresponding author as well as an address, telephone number and e-mail.

❑2. Submit your paper using our website www.jbth.com.br. Use Word Perfect/Word for Windows, each with a complete set of original illustrations.

❑3. The entire manuscript (including tables and references) must be typed according to the guidelines instructions.

❑4. The order of appearance of material in all manuscripts should be as follows: title page, abstract, text, acknowledgements, references, tables, figures/graphics/diagrams with the respective legends.

❑5. The title page must include a title of not more than three printed lines (please check the guidelines of each specific manuscript), authors (no titles or degrees), institutional affiliations, a running headline of not more than 40 letters with spaces.

❑6. Acknowledgements of persons who assisted the authors should be included on the page preceding the references.

❑7. References must begin on a separate page.

❑8. References must be cited on (not above) the line of text and in brackets instead of parentheses, e.g., [7,8].

❑9. References must be numbered in the order in which they appear in the text. References not cited in the text cannot appear in the reference section. References only or first cited in a table or figures are numbered according to where the table or figure is cited in the text. For instance, if a table is placed after reference 8, a new reference cited in table 1 would be reference 9.

❑10. Reference citations must follow the format established by the "Uniform Requirements for Manuscripts Submitted to Biomedical Journals" or in "Vancouver Citation Style".

❑11. If you reference your own unpublished work (i.e., an "in press" article) in the manuscript that you are submitting, you must attach a file of the "in press" article and an acceptance letter from the journal.

❑12. If you cite unpublished data that are not your own, you must provide a letter of permission from the author of that publication.

❑13. Please provide each figure in high quality (minimum 300 dpi: JPG or TIF). Figure must be on a separate file.

❑14. If the study received a financial support, the name of the sponsors must be included in the cover letter and in the text, after the author's affiliations.

❑15. Provide the number of the Ethics Committees (please check the guidelines for authors).