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Industry 4.0 and Sustainable Development in the Automotive Sector

Indústria 4.0 e o Desenvolvimento Sustentável no Setor Automotivo

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RESUMO

O objetivo central do presente estudo foi verificar qual é o papel da sustentabilidade no desenvolvimento do conceito de Indústria 4.0 no setor automotivo. Para tanto, foi promovida uma pesquisa do tipo descritiva de natureza qualitativa com a participação de executivos que atuam no setor automotivo. Durante este estudo, se buscou compreender e relacionar o conceito e práticas contemporâneas ligadas à Indústria 4.0 e as dimensões do construto desenvolvimento sustentável. Os resultados apontam análises mais amplas a respeito do futuro da indústria automotiva. Apesar dos grandes investimentos a serem feitos e do processo operacional lento e gradual, já é reconhecido que os países desenvolvidos terão melhores chances de se adaptarem às novas realidades. Por outro lado, a real implementação da Indústria 4.0 nos países em desenvolvimento tardará um período maior de tempo, justificando a melhoria da capacidade produtiva e de adaptação e da qualidade da mão de obra. Este estudou comprovou a realidade de que os conceitos de desenvolvimento sustentável se fazem muito presentes na indústria 4.0, cujo setor automotivo demanda investimentos, tanto para melhor qualificação de seus colaboradores, quanto para garantir a sustentabilidade que seus produtos exercem para com o meio ambiente.

Palavras-chave: Indústria 4.0. Desenvolvimento Sustentável. Indústria Automotiva.

ABSTRACT

The central objective of the present study was to verify the role of sustainability in the development of the concept of Industry 4.0 in the automotive sector. For this purpose, a research of the descriptive type of qualitative nature was promoted, with the participation of executives who work in the automotive sector. During this study, it was sought to understand and relate the concept and contemporary practices related to Industry 4.0 and the dimensions of the sustainable development construct. The results point broader analyzes of the future of the automotive industry. Despite the large investments to be made and the slow and gradual operational process, it is already recognized that developed countries will have a better chance of adapting to the new realities. On the other hand, the real implementation of Industry 4.0 in the developing countries will take a longer period of time, justifying the improvement of productive capacity and of adaptation and the quality of the workforce. This study proved the

reality that the concepts of sustainable development are very present in the industry 4.0, whose automotive sector demands investments, both for the better qualification of its employees, as well as to ensure the sustainability their products exert towards the environment.

Keywords: Industry 4.0. Sustainable Development. Automotive industry.

1 INTRODUCTION

The world industry has been undergoing frequent and rapid changes. According to Banzato (2017), the advances in productive capacities, made by means of the steam engine, the best use of electric energy, the assembly line, the advent of informatics, among other factors, after three industrial revolutions) wondered when the next one would begin. Industry 4.0 today represents this new step towards the future.

According to Santos and Tadeu (2016), the term Industry 4.0 was used by Professor Klaus Schwab for the first time in Germany in 2011, which proposed an entirely digital revolution motivated by cyber-physical systems, internet of things, big data, augmented reality and other softwares and hardware that, despite being created in the Third Industrial Revolution, has undergone significant changes. ″The improvement of these technologies, combined with recent innovations, has provided possibilities never before seen that characterize the fourth industrial revolution″ (SANTOS; TADEU, 2016, p. 2).

Leading to the 21st century international corporate world, Industry 4.0 marks a ″new era in production that aims to interconnect data flows between partners, suppliers and customers and the vertical integration of production cycles within organizations, from development, to finished product″ (RIBEIRO, 2015, p. 5). However, Industry 4.0 has also caused some social concern, as there will be the imminent risk of labor market change, which would alternate human labor by autonomous machines and robots (ROZÁRIO, 2017). By encompassing factors, such as the decentralization of enterprise systems, the offer of computing would only be realized by computers. The human factor would be at risk of disappearing from various industry sectors. The difficulty, according to Rozário (2017), regarding the reallocation of professionals from the agricultural and industrial sectors will be the most complicated, with new jobs related to new technologies being considered the most quoted for the future. It is important that the portion of the population that can be affected allocate knowledge to other areas.

The National Association of Automotive Vehicle Manufacturers (ANFAVEA) argues that, in order to ensure that there are no factories and production lags, there should be new legislation and industrial policy for the automotive sector, as well as programs to support the auto parts chain, incentives to research and development, energy security and engineering. That is, ways to guarantee industry accessibility to Industry 4.0 over the next few years (MARTINS, 2017). The energy issue is crucial to sustainable development within the industry. Hybrid and electric cars, although already part of the consumer options catalog, are still expensive technologies when compared to the use of ethanol and gasoline, for example. For Martins (2017), in addition to the price being high, the consumer has not yet sensitized so much to the environmental issue or the autonomy of the car, since the price is high. In Brazil, only about 2,500 green cars were registered. A number well below the national fleet total, estimated at 50 million. Ensuring sustainable development - in every way - in Industry 4.0 is essential.

Although, according to Smit et al. (2016), the interconnections promoted by Industry 4.0 lead to higher levels of sustainability, there is still no substantial evidence to support such a claim, which shows the importance of studying this transition and its future results. Industry 4.0 is already revolutionizing the world, with news increasingly present in the popular everyday, like internet of things, Big Data among other tools. Companies will also be part of this evolution and will have to adapt to this technological evolution. In this evolution, it is necessary to observe the prism of sustainable development. At the same time that economic growth and corporate governance are fundamental elements, it will not be possible to disregard the social sphere. The Fourth Industrial Revolution must fit into social issues, without taking the economic side exclusively into consideration. In the European automotive industry, for example, according to Geissbauer et al. (2014), investment rates will grow by about 39 billion euros per year by 2020, based on Industry 4.0 solutions.

Considering the new industrial practices that will seek to adapt to the Fourth Industrial Revolution; the question of skilled labor and also the mass application of green technology in cars, the central question that this paper tried to answer was: *what is the role of sustainable development in the construction of the concept of Industry 4.0 in the automotive sector?* The main objective of the present study was to verify if there is influence of the sustainable development in the construction of the concept of Industry 4.0 in the automotive sector. The specific objectives of this work were*: (i) to characterize the concept of Industry 4.0; (ii) identify*

the behavior of Industry 4.0 in the automotive sector; (iii) to verify how sustainability in the automotive industry behaves.

The present study was structured in five sections. In addition to this introduction, a review of the theory on Industry 4.0 and sustainable development was developed. In sequence, the methodological procedures were presented, followed by the analysis and discussion of the results obtained. Finally the section on the conclusions about this research was elaborated, as well as a suggestion for future studies.

2 THEORETICAL FRAMEWORK

In this section a theoretical study was carried out on the concepts of Industry 4.0 and sustainable development.

2.1 INDUSTRY 4.0

The first Industrial Revolution, in the 18th century, witnessed the advent of steam engines and the use of coal as fuel; In the second, in the next century, electricity was the great innovation both in technology and in the means of production, being widely used not only by the industrial sector, but also by having its benefits spread worldwide. On the other hand, the third, in the 70's, brought with it the automation of machines, the emergence of computers and the Internet. What surprised, however, was the presage that even greater transformations were to come. Perhaps, what was present in cinematographic works of science fiction, like flying cars and robots that have behaviors similar to the humans, may not represent such distant ideas (ALVES et al., 2017).

A new era has been present since the last few years. The world, which has undergone periods of deindustrialization not only in developing but also in developed countries, now deals with the return of industrial processes, which compose factors that began in the 1970s with the spread of the information age, but which in 2010 are integrated into many more complex and integrated systems. According to Alves et al. (2017), the Fourth Industrial Revolution emerged in Germany and despite being treated as a new reality in some territories, it is already present in countries such as Germany and the United States (through its industrial renaissance), ensuring automation and digitization of countless sectors. If, on a daily basis, the internet of

things is about to leave society even more connected, in the business world Industry 4.0 has promoted a true revolution in processes, relationships and consumption habits.

Industry 4.0, according to Sátyro, Sacomano and Contador (2017), is considered the Fourth Industrial Revolution. It will allow human beings, machines and resources to communicate and collaborate in real-time, bringing interconnectivity that can reduce waste, and be more sustainable, supporting mass customization, increasing production, while also providing high levels of competitiveness. The Industrial Revolution has transformed people's lives, and now the latest of them has already begun and will unite "[...] intelligent machines, advanced computer analysis and collaborative work among connected people to generate profound changes and bring operational efficiency to various industrial sectors : manufacturing, transport, energy and health" (RIZZO, 2017, p.7).

According to Heidrich, Facó and Reis (2017) Industry 4.0 is a new productive concept that was conceived in a collaborative effort between government, industry, research and academic institutions. The environment in which we live will be increasingly transformed by robots and autonomous and integrated systems. That is, an increasingly efficient production process. The impact of Industry 4.0 will be very comprehensive, affecting the entire value chain, including producers, manufacturers, suppliers and workers. The training of professionals qualified to work in this environment should contain a set of skills and competencies required by Industry 4.0.

Industry 4.0 is considered a breakthrough as it uses a combination of technologies such as information, communication and location, which allows the production of specific goods for each consumer, but that there is no human intervention in the process of their manufacture. In addition to the integrated design systems, it is possible to offer the market a wide range of products perfectly adapted to the consumer. Amaral (2016, p.2) complements: *"Industry 4.0 also represents the definitive and unavoidable entry of Information Technology into the factory floor, with implications at all levels of the production system".* The Fourth Industrial Revolution is an industrial model in which all the means of its production, from supply chains to distribution chains, are digitally connected.

Technologies related to the Industry 4.0 concept fall into two broad groups. The first is related to the growth of organizational business and revenue growth (by manufacturing smarter products and services that ensure a more effective connection with customers and

accelerate innovation cycles). The second group related to technologies that increase productivity by reducing risk and costs (with strategic planning and studies of changes in the economy and the market), reacting in real time and connecting information technologies and operational technologies, automating and expanding after-sales service (SNIDERMAN et al., 2016).

To respond to these challenges, such as business growth and the reduction of risks and operating costs, organizations need to adopt solutions and a set of strategic tools to maintain competitiveness. The transition to a digital world is not simple, but with the right tools, it is possible to achieve such goals (SIEMENS, 2017). Some solutions and technologies related to the Industry 4.0 concept will be presented:

(a) Internet of Things (IoT) - When it first emerged, the Internet allowed the connection of people and organizations around the planet. There is now talk on the Internet of Things (IoT), devices that communicate with each other and make every human being's day-to-day life easier (whether in the personal or professional field). No wonder a family owns a refrigerator that coordinates the amount of yogurt and sends a message, via any communication technology or smartphones, when the product is at the end (SIEMENS, 2017).

(b) Big Data - Big Data is the term that describes the huge amount of data (structured and unstructured) that influence the business world every day. It is important to emphasize that the important thing is not the amount of data but what the organizations do with such data. Increasingly, Big Data is an important analytical basis for insights that lead to better decisions and strategic business directions (DUJIN; GEISSLER, 2016).

(c) Cloud Computing - Through cloud computing, it is possible to have access to any application needed for business development whenever it is needed over the internet, using the servers installed in a service provider and data. This technology enables more flexible, agile and secure data and information management (SIEMENS, 2017).

(d) Virtual reality - The use of this technology can allow consumers to react at very early stages of development, which allows them to adjust and correct the projects in order to guarantee a better satisfaction of the customers' needs (SNIDERMAN et al., 2016). The automotive industry is one of the sectors that most benefits from virtual reality technology. It is used not only in production, but also in vehicle sales. Optional applications such as the choice of accessories or

the color of the car can be tested through virtual reality. This technology allows the consumer to have an almost real experience through a simulator before buying your car (HELMRICH, 2016).

(e) 3D Printing - The production of prototypes through 3D printing technology can increase the speed of the design process and the final production of the product, allowing the reduction of dependencies in the value chain. In the automotive industry, prototypes can be produced within a few hours as opposed to the four weeks that were necessary with traditional techniques (SNIDERMAN et al., 2016). This reduction in projection and production times will be particularly relevant in an increasingly competitive business environment and determined by greater customization and customization requirements (COTTELEER et al., 2017).

(f) Cybersecurity - Information and data security are critical success factors for the contemporary industry. Ensuring secure communications at every point in the production process and secure interactions between different facilities are basic elements in the development of the industry. The technological tools offered by Industry 4.0 allow the creation of secure cyber environments (SIEMENS, 2017).

(g) Nanotechnology - This is the technology of manipulating atoms and molecules. With the use of nanotechnology, it is possible to develop machines, implements and equipment following the scale of nanometers (a unit of measurement that is equivalent to one billionth of a meter). This technology will allow the industrialization of safer, durable, intelligent and much smaller products than a human cell (DISNER; CESTARI, 2016).

2.2 SUSTAINABLE DEVELOPMENT

The term sustainability, according to Lange, Busch and Delgado-Ceballos (2012), comes from the Latin "sustentare", which refers to everything that can be sustained, kept in good condition, maintained and resisted. In a corporate environment, according to them, it is a business approach that takes into account both social, environmental and economic aspects, thinking of using them so that future generations can benefit from the results achieved earlier.

This is a subject that has gained more relevance in the last years, with a growing number of companies applying the necessary importance to these subjects. In addition, the sustainable issue also demands changes within these organizations, with the pursuit of

sustainability, which should unquestionably generate organizational innovations, also through the need to reformulate products, technologies, processes and often business models that transform the competitive landscape (PAZ; KIPPER, 2016).

Corporate sustainability, therefore, can be understood as a set of activities that involve (in a balanced and holistic way) the company's relationship with economy, society and the environment, being focused on raising financial resources and improving image / reputation of organizations, resulting in benefits to stakeholders and future generations (LANGE et al., 2012). With regard to image / reputation improvement, it is the actions that organizations carry out, within organizational sustainability, that can lead to other public perspectives to it, such as promoting social programs and reducing environmental impacts, improving thus, their economic position in the market - towards their consumers - and "acting in a socially responsible manner, taking into account the interests of the stakeholders that affect or are affected by their activities" (PAZ; KIPPER, 2016. p. 87).

Sustainability, in order to have positive effects, must first involve everyone in the internal field, that is, take initiative from within organizations, with the proper guidelines, concepts and importance taught to all actors in any business sector. It is essential that there be the necessary education, so that everyone is able to understand the same premise and walk the same path (WALS; SCHWARZIN, 2012).

According to Boechat and Lauriano (2012), the concept of sustainability is based on the relationships between economic, social and environmental dimensions. These dimensions are known internationally as triple bottom line (TBL) of sustainability (ELKINGTON, 1994). The main idea was for TBL to assist corporations in their quest for sustainable development; which, in turn, encompasses: *(a) economic development, together with the economic sustainability of the business; (b) social justice, that is, social sustainability, stimulating activities related to education, culture and social justice of the local population; (c) protection of the environment - through recycling programs,* preservation, among other aspects. In other words, TBL adopts the concept of triple bottom line, which is to improve financial growth by reducing negative environmental impacts while meeting societal expectations. (BOECHAT; LAURIANO, 2012; ELKINGTON, 1999; PAZ; KIPPER, 2016).

These three pillars of sustainability are related to four intersections: (i) fair - result of the intersection of economic and social resources; (ii) livable - a result of the intersection of

social and environmental resources; (iii) viable - result of the intersection of economic and environmental resources; (iv) sustainable - a result of the intersection of the three pillars, economic, social and environmental (Figure 1). Recently, the cultural pillar has been incorporated into the bottom lines. This pillar has not yet been fully incorporated by organizations as a form of analysis for sustainability. (ALLEDI FILHO et al., 2002; PAZ; KIPPER, 2016).

FIGURE 1 – SUSTAINABILITY AND ITS DIMENSIONS.

Source: Drawn from Alledi Filho et al. (2002) and Boechat and Lauriano (2012).

It is possible, through models like these, to see positive results, such as revenue generation and profits. A sustainable organizational institution will have lower costs because it would use smaller quantities of inputs in production, generating additional revenue by designing better products and new business with partners supporting the sustainable cause. The TBL addresses the important questioning of the need for companies - which are profitable and value-creating agents - to bring sustainable issues into their decision-making processes.

In their work, Drummond (1999) and Rodriguez, Ricart and Sanchez (2002) present critiques of the TBL tripod model. According to these authors, although the great majority of the organizations present a vision of sustainability, this one would still be biased, that is, directed, almost exclusively, to the economic question. For the correction (or adaptation) of this model some indexes were developed. The first of these was the Dow Jones Sustainability Index (DJSI), developed by socially and environmentally responsible organizations that make up the

Dow Jones index. This global indicator of sustainable financial performance aims to guide the allocation of resources by executives, stimulating corporate ethical responsibility and sustainable development (DJI, 2017).

In the same direction of the DJSI, the Corporate Sustainability Index (ISE) was born in 2005. A pioneering initiative in Latin America, the index seeks to create an investment environment compatible with the demands of sustainable development of contemporary society and to stimulate corporate ethical responsibility. It was funded by the International Finance Corporation (IFC), the World Bank's financial arm. Its methodology was developed by the Center for Sustainability Studies (GVCes) of the Getúlio Vargas Foundation School of Business Administration of São Paulo (FGV-EAESP) and its technical management of the responsibility of the Stock Exchange (GUIMARÃES et al., 2017. BM and FBOVESPA, 2017).

The ISE is a tool for comparative analysis of the performance of the organizations listed on BM & FBOVESPA under the corporate sustainability aspect, based on: *(a) economic efficiency; (b) environmental balance; (c) social responsibility; (d) corporate governance practices* (BM & FBOVESPA, 2017). This index is used as a benchmark so that stakeholders can follow the returns of these organizations concerned with the principles of sustainable development. It can be said that the use of this index encourages corporations to aggregate environmental and social issues in their decision and investment processes (PAZ; KIPPER, 2016. GUIMARÃES et al., 2017).

Corporate sustainability can be understood as a set of activities that involve (in a balanced and holistic way) the company's relationship with economy with society and with the environment, aimed at attracting financial resources and improving the image / reputation of the companies. organizations, resulting in benefits for stakeholders and for future generations (LANGE et al., 2012). In this sense, Guimarães, Peixoto and Carvalho (2017) understand that it is fundamental that companies know how to define their objectives and their internal functions to achieve this sustainable development based on economic growth, with social responsibility and environmental balance.

3 METHODOLOGICAL PROCEDURES

For this article a descriptive research of qualitative nature was adopted. This approach, according to Rampazzo (2006), aims to search for the specific and detailed conception of the object of study, through understanding through the meanings and characteristics of the scenarios that were presented to the interviewees, and of elaborated questions. For Gil (2008), social research can be grouped into three levels: exploratory, descriptive and explanatory research. The descriptive research is based on the detailed exposition of the characteristics of a phenomenon through the use of standard techniques of data collection, which may present a holistic view given by the interviewee, seeking to specialize more in the understanding, than, in fact, in the variables of the process as a whole.

According to Merriam (2002), qualitative research hopes to understand a given situation through the interpretation and experience of individuals about such context. That is, the researcher seeks to understand a situation through the logic and perspective of the interviewees (GODOI; BALSINI, 2006).

The data collection was done through structured interviews, with the objective of extracting from the interviewees the dimensions of Industry 4.0 and sustainable development within the automotive industry. The script was adapted from the works presented and discussed during the construction of the theoretical reference.

The interviews were conducted individually with executives working in the automotive sector. They occurred in the months of January and February of 2018 and were recorded with the consent of each participant. Then the contents of the recordings were transcribed in order to facilitate analysis of the data. It is important to point out that the interviewees were previously informed that this was an academic research, in order to understand the perception of each one about the subject, and that no data regarding the company and/or the participant would be disclosed.

The analysis of the data regarding this research was based on the principles of content analysis based on categorization concepts (FLORES, 1994). According to this strategy of categorization, the organization and interpretation of data were made by topics relevant to the researcher. For Flores (1994), the data have limited meaning, so it is necessary to find meaning in them. In the categorization phase of the analyzed components, the principles of data analysis are based on the operation of classification of the constituent elements, reduction of data, provision of data, passage from the particular to the general and verification of conclusions.

4 PRESENTATION AND ANALYSIS OF RESULTS

The interviews were carried out during the months of January and February of 2018, having as interviewed a logistics coordinator, a business management consultant and a Supply Chain director of a tire industry.

It is important to emphasize that all the interviews were recorded with the consent of the interviewees so that they could be transcribed later for a better understanding and consultation. Because it is an exclusively academic research, the names of the interviewees and the companies in which they work will not be disclosed.

The data collection and analysis of the results took into account the four dimensions of the sustainable development model proposed by the Corporate Sustainability Index (ISE) and its relation with the concept of Industry 4.0. It is possible, therefore, to delimit some subcategories within the scope of the theme proposed by the study, being: the technological, social and environmental relations. The professionals interviewed, therefore, were identified as E1, E2 and E3, and were approached with an interview with twelve open questions. Chart 1 presents information about the professionals.

CHART 1 - PROFESSIONALS INVOLVED IN INDUSTRY 4.0 ISSUES AND SUSTAINABLE DEVELOPMENT.

Interviewed	Education	Position	Industry experience
E1	Mechanical Engineering	Business Management Consultant	25 years
E2	Production Engineering	Logistic coordenator	20 years
E3	Production Engineering	Supply Chain Director	20 years

Source: authors.

4.1 ECONOMIC EFFICIENCY WITHIN THE CONTEXT OF INDUSTRY 4.0

During the analysis phase of the interviews, the category economic efficiency within the context of Industry 4.0 brought together two subcategories: (i) insufficient infrastructure in technological and structural aspects; *(ii) economic and technological benefits to the automotive sector*.

Since the First Industrial Revolution, during the passage of the eighteenth and nineteenth centuries, human civilization has witnessed innumerable transformations that science could bring. From the fields that study the smallest objects to the greatness of the universe. What disrupts a country's ability to keep pace with such changes is technology. So important, it has not been present for everyone since the dawn of heavy industrialization. Few managed to organize their productive capacity in a balanced and forthcoming way. Whether due to economic, social problems or even environmental conditions of each, the technological issue is fundamental.

What the data collection could do was attest to these conditions, that without technological advances, it is not possible to achieve a satisfactory degree of modernization, which has a natural and detrimental impact on the competitiveness of a country that is within the international system. Manufactured products have higher added value, adding price and benefits to export issues. The economic results improve and it becomes possible to invest to improve the national industrial pole more and more. This is the natural reasoning of events.

However, it is clear by making simple and brief observations in the contemporary world that most of the world has failed to achieve this success, becoming dependent on a small but very significant amount on technological issues. The results show that there are indeed opportunities to achieve a successful position. But rather, one must go a long way, along with unrelenting seriousness. In this way, the data will be presented, next, exposing and relating the opinion of professionals who work in the area of technology in one of the countries that failed to fully achieve the status of technologically developed: Brazil.

Industry 4.0 is characterized, among other forms, by process automation. That is, connected systems that include a long range of data at great distances, a factor that is already present in large companies, where it is possible to access data anywhere in the world, using remote access, via the Internet. In addition to the internet, other technological infrastructure, such as data transmission, is needed so that the real changes can emerge and thrive over time.

These things are only achieved with a high degree of technology applied to the process because everything is controlled by computerized systems. [...] Technology is not an empty word. Technology is so that we can have a better positioning, access to more sophisticated markets, greater participation of Brazil in the manufacturing industry and manufactured in the world. (Excerpt from interview with E1).

In addition, countries such as Brazil have not reached an acceptable level of transformation, behind many developed countries, such as Germany and the United States. In addition to undermining the research and development sector, the crucial factor for such delay is the procedures that would lead to possible evolutions of the current situation. The deployment of new technologies is slow, due to the issue having specific difficulties.

However, what further impacts the information sharing process is the high taxes, poor infrastructure, decaying internet services and high logistics costs, together with the growing lack of funding from public institutions so that updates could be made. within the scope of necessary transformations. E1 explains that: "These are things that have to be made available. They do not depend on an entrepreneur, but on the government, on larger operations [...]. All of these things end up impacting the speed at which you make projects viable".

It is possible to conclude that, at least in Brazil, there are several elements that end up making the process difficult, and that the lack of skilled labor, financing and excessive legal policies end up eroding a path that in itself is already very difficult. Although there are initiatives to add more people to quality education, which is expressed as one of the main obstacles, equating Brazil with the industrialized economies and with a large presence in the international market is at a still costly and bureaucratic level to be achieved.

By focusing attention on the automotive sector, it becomes easier to visualize how such changes will be implemented. Companies like Renault and Fiat Chrysler use augmented reality systems. In this way, the technician responsible for the tests, as soon as the vehicle is produced, can identify, through the elements available in his high technology glasses, which model of the car and which parts of it should be supervised, according to the one that was used in the test. Its basic rationale is that by connecting machines, systems and assets, companies can create intelligent networks along the entire value chain that can control production modules autonomously. Intelligent plants will have the ability and autonomy to schedule maintenance,

predict process failures, and adapt to unplanned production requirements and changes (DIAS, 2018).

Tools like this and 3D printers also help improve employees' quality of life - on ergonomic issues - and on production costs. According to Dias (2018), the aforementioned 3D printers generated savings of 150,000 euros for Renault between 2016 and 2017, allowing companies to manufacture approximately 800 items, rather than buying them from third parties. The quantity saved can be put in terms of logistics, freight and transportation, for example. Although they have high prices, tools like this and augmented reality devices represent not only the saving of the company, but also the preparation for the future and the permanence in a privileged position before the competition. Chart 2 shows the classification of the category sustainable development in its economic dimension and its subcategories found during the process of interpretation of the interviews carried out in this work.

CHART 2 - CATEGORIZATION OF ECONOMIC EFFICIENCY WITHIN THE CONTEXT OF INDUSTRY 4.0.

Categories	Subcategories
Economic Efficiency within the Context of Industry 4.0	Insufficient infrastructure in technological and structural aspects
	Economic and technological benefits to the automotive sector

Source: authors.

4.2 SOCIAL RESPONSIBILITY WITHIN THE INDUSTRY CONCEPT 4.0

During the analysis phase of the interviews, the category of social responsibility within the concept of Industry 4.0 brought together two subcategories: *(i) creation of education programs for employees; (ii) reduction of social risks.*

It is evident, although with little observation that, in Brazil, social issues always seem to have something missing, such things being a delay both educational and economic. Brazilian inequality is among the most disparate in the contemporary world, in which few have many and many have little. The result can be seen in the indices created by surveys conducted throughout the country, in which a very large portion of the population does not have or had access to quality education systems. It is not a recent situation and, according to the interviewees' perspective, it is still a difficult situation to correct. But not impossible.

The problem of not providing adequate education conditions to the population impacts not only on the future of the country and the types of professionals it will have, but also on the quality of life of these citizens. Opportunities that are lost because there are not enough professionals to take on such tasks. In addition, at times when employees are being replaced by machines in much of the production process, a climate of insecurity about the future is established. Technologies are threatening the workplace - and, at the same time, the livelihood - of many.

It was possible to see, through data collection, however, that not everything is lost. Contemporary companies have different visions and values, which value the quality of life of their employees and possibly do everything in their power to improve it, through the mechanisms that will be presented below. Current social issues are very present in the corporate environment, which is required to offer the greatest possible number of possible ascensions, in order to integrate in a deeper way the worker - who previously had a chance to be fired - to the process with the machines. Below, data analysis considerations are not surprising, not even unpublished, but show that there is still hope for a better future in a country with potential, in all areas.

One of the most debated questions about the transformations that Industry 4.0 has been proposing in recent years, on the other hand, is the question of the worker and his replacement by machines; something that has caused concern among several sectors in many areas. This is because most evidence indicates that, at least in technologically backward countries, there is the possibility that there will be no room for everyone in the future in the productive process of consumer goods, capital and services.

One of the attempts to achieve a correlation between the social and technological side is the creation of programs focused on the environment, education, sport and culture. Projects for the education of employees of a given company are based on technical schools and agreements with other private and / or governmental institutions so that more people can have access to knowledge and allow the development of a more qualified workforce, which guarantees better chances of jobs, wages and living conditions. E2 understands that: "At least 30 to 40 managers have been selected and close colleges have been established [...] employees pay a small fee and the school collaborates with the scholarships". Therefore, an autonomous system is created, in which it is possible to stimulate and develop job creation capacities in addition to a specific environment, with professionals who manage not only to understand, but

also to coordinate and supervise complex procedures, incentives through better pay and participation of results.

In this technological issue, between making more sophisticated products, the great consequence not only of the enrichment of the country [...], but mainly through the channel that you generate much more qualified jobs. You have much higher wages, with social benefits for the very best workers. So the fact that we do not adopt these advanced technologies is the space that you leave for the country that already adopts, in growing its participation in these more sophisticated industries worldwide. (Excerpt from interview with E1).

According to E3: "Sustainability is increasingly on the rise and is one of the most discussed issues today. Given this scenario, companies from the most diverse segments are keen to present themselves as sustainable for society". It is possible that, through the work carried out along the supply chain, the awareness and concern with the impacts, be they organizational or environmental, become present within the mentality of the company as a whole, this being the result of corporate and personal investments of each employee of the company and actor of the chain. Therefore, we create engaged and specialized teams, through teaching programs, in the process. Such advances help to improve the work performed, lower accident risks and errors in general, and better strategic and operational issues. The environmental, social and financial results are positive. Chart 3 presents the classification of the social responsibility category within the concept of industry 4.0 and its subcategories found during the process of interpretation of the interviews carried out in this work.

CHART 3 - CATEGORIZATION OF SOCIAL RESPONSIBILITY WITHIN THE CONCEPT OF INDUSTRY 4.0.

Categories	Subcategories
Social responsibility within the industry concept 4.0	Creation of employee education programs
	Reduction of social risks

Source: authors.

4.3 ENVIRONMENTAL BALANCE WITHIN THE CONCEPT OF INDUSTRY 4.0

During the analysis phase of the interviews, the category environmental balance within the concept of Industry 4.0 met two subcategories: *(i) responsible disposal of waste after the production process; (ii) elements of green chain management.*

E2 understands that: "a new generation of professionals who are entering the market ... comes from a more conscious formation". The question of sustainability and care for the natural stability of planet Earth is not something current. For decades, researchers have advocated a more conscious use of natural resources, as well as caring about how society generally treats the traces - often toxic - left behind by the end of productive processes.

In the automotive industry, it's no different and that makes all the difference in the corporate world. According to the website Pensamento Verde (2017), the company that is considered sustainable is basically the one that can develop without causing environmental and social damages and also act ethically and transparently with suppliers and partners. its Supply Chain, in addition to contributing to the society in which it is inserted. E3 demonstrates that: "[...] much in the development of the person, and increasingly think differently towards the future, and all this study aims at sustainability, in order to [...] find products that do not harm the environment". Companies with more sustainable thinking end up developing projects to create new ideas for sustainable development, which helps.

Segments like these, aligned with partnerships with other institutions (public and private) can play a key role in the way unused elements are disposed of in a conscious way towards the environment. In companies for the foundry industry, for example, according to E2, after the awareness process, the foundry sands were donated to the Army, which used them so that they were not disposed of in the environment. Such use was for reforms on sidewalks. Public investments in which society in general makes daily benefit.

In the pneumatic sector, Reciclanip represents the concern that this sector has for the environment and the establishment of conditions that allow the country to develop, while at the same time prioritizing the welfare conditions of the population and the environment. Created in 2007, it is a joint action of the largest tire companies in Brazil, such as Bridgestone, Goodyear, Pirelli and Michelin, so that the collection of used tires was not a separate activity. Several collection points were scattered throughout the country, so that waste tires could be collected and disposed of consciously by companies, to be crushed and destined for recycling. In addition to being an intermediary in the collection of tires, Reciclanip also develops studies that can enable the reuse of tires for the generation of energy for the industry itself.

Partnerships with other elements of the Supply Chain are also considered fundamental. Long-standing agreements and trust-building partnerships usually come from more socially and

financially credible actors. In this way, it is evident that there was a significant evolution in the corporate vision not only towards the environment, but also with practices within the organization and partnership with customers and suppliers.

If all of them are conscientized, formed, with vision of these things, perhaps the change is faster than you imagine. But the question of sustainability is indisputable, it has to be addressed. Technological development in an industry is fundamental, the issue of sustainability is very important. (Excerpt from interview with E1). Chart 4 presents the classification of the environmental balance category within the concept of Industry 4.0 and its subcategories found during the process of interpretation of the interviews carried out in this work.

CHART 4 - CATEGORIZATION OF ENVIRONMENTAL BALANCE WITHIN THE CONCEPT OF INDUSTRY 4.0.

Categories	**Subcategories**
Environmental balance within the concept of Industry 4.0	Responsible waste disposal after the production process
	Elements of green chain management

Source: prepared by the authors.

4.4 CORPORATE GOVERNANCE PRACTICES WITHIN THE CONCEPT OF INDUSTRY 4.0

During the analysis phase of the interviews, the category of corporate governance practices within the concept of Industry 4.0 brought together two subcategories: *(i) excellence in the management of the supply chain; (ii) transfer of gains and knowledge.*

The concept of the supply chain involves a large number of definitions, but all of them are based on the same basis: several elements operating in the best possible way, so that the product reaches the final consumer in a fast, competent and with quality. In this way, we have always sought to improve this intricate network of actors, being bigger and / or better than others. All aim at the improvement of such a factor, since it is, in a way, all the necessary structure for a certain process to work correctly. According to E1, the supply chain must be "extremely good at all stages of the process" and this includes both internal and external actors.

The improvement allows the entire production process to rise to a new level of quality, which in turn is increasingly demanded in the private sector. The supply chain manager enters into this question of improving such processes and maintaining what is already being done correctly. In industry 4.0 it is no different; on the contrary, it is even more requested because

there is the involvement of the care to the environment. Green Supply Chain Management emerges as an outlet that most companies are adopting.

Increasing attention is focused on the development of environmental management strategies for supply chains, which end up influencing business practices and strategies, organizational performance criteria, product lifecycle stages, logistics processes, etc. (Excerpt from the interview with E3).

Industry 4.0 anticipates - and already tries to put into practice - the maximum of its concepts possible. Among them is a new form of corporate governance. More inclusive, equal and fair to employees and also to the environment. Thinking in this way, what comes to mind is the sharing of earnings, especially those based on financial characteristics.

However, more than this, one of the most important transfers is not related to money, but to knowledge, thus increasing the competitiveness of a company in a given sector, through the improvement of its processes. According to E1: “in the sharing of earnings a much more far-reaching and short-term concept is inserted into the actors of the chain, which ceases to move only the quantitative perspective, that is, there will be, at some point, the perspective that to have the total gain for the whole chain to win in the operation, some will win and others will lose. However, the sum total in the chain is a gain”.

Although it is an existing aspect, reaching this level of knowledge sharing is possible, but also difficult to implement due to other factors that do not depend only on the chain to exist, such as roads and poor ports, according to E1.

E2 complements the arguments related to the presence of internal and external actors, emphasizing that every time the company invites a supplier to partner with and develops with it, a win-win is developed for both. But despite this, there are the internal and external partners. Suppliers benefit because the company breaks down this technology and helps suppliers develop something. E2 explains that: "In terms of employees, the company has all the incentive with the participation of results, which is also nice, because it helps to improve the vision of technology and not only self-develop, so all profits are divided with employees". Chart 5 presents the classification of the category of corporate governance practices within the concept of Industry 4.0, and its subcategories found during the process of interpretation of the interviews conducted in this work.

CHART 5 - CATEGORIZATION OF CORPORATE GOVERNANCE PRACTICES WITHIN THE CONCEPT OF INDUSTRY 4.0.

Categories	Subcategories
Corporate governance practices within the concept of Industry 4.0	Excellence in Supply Chain Management
	Transfer of earnings and knowledge

Source: authors.

5 DISCUSSION OF RESULTS

This article has contributed in a way to making the Industry 4.0 concept more accessible to the public that previously was unaware of a type of reality that is already present and gaining strength in the developed and developing world, as well as exposing the importance of sustainable development in these new technological ideals within the automotive sector and the consequences of such changes for society.

New technologies, new concepts, new ways of doing what we know and what we do not know. It can be said from the data obtained and analyzed that Industry 4.0 is only in its initial stage of development, which will in the future bring about a reality in which it is possible to imagine very little at present. Information integration and storage, cybersecurity, nanotechnology, 3D printing and virtual reality are just a few of the many elements that are already in everyday social life and that will get even bigger and more complex in a not too long period of time.

It is a matter of fact that some countries are already ahead of others with regard to the necessary industrial, structural, social and economic preparation for Industry 4.0. However, according to the data acquired, it will not be all those who will be able to insert themselves in the new practices, needing a greater professional qualification. According to Rozário (2017 p.1) "this revolution has caused unemployment in different areas of activity and much of the conservation of the work part of the demands of the new generation [...]. It can not be predicted, although the functions are the same, but with different applications".

The importance of public and private support in the form of investments to these workers is also highlighted. Some companies already develop educational programs to value their employees and this should serve as an example for many others, so that the greatest number of citizens can have quality of life both outside and inside the work environment - even when they already face substitutions from their work for use of machines. The automotive sector is

considered one of the best examples of adaptation, taking into account its importance to society, the demand for its products and the high technological level that it must possess to supply all these elements in a concise, correct and innovative way.

Moreover, the advance of the use of technology in industrial terms is already a reality adopted for years by the automotive sector, which should be, for reasons of competition, always in the best possible position, either to deliver quality products to society or to innovate in other ways, such as the car. 3D printers and virtual reality - as mentioned in the reviews - are mere examples of the novelties applied to a sector that began years ago to replace its human workforce with electronics, which is one of the fundamental topics of discussion about the role of the worker and the responsibility to equalize such a relationship. The importance of skilled work and investment in good employees is perceived and justified, either through transfer of knowledge or financial, because elements like this favor and develop both sides. For Banzato (2017, p. 1) "Those who can more efficiently implement Industry 4.0 will have great competitive advantages, as can be seen today in leading companies such as Google, Microsoft, Apple, etc."

At the same time, awareness for a cleaner, more sustainable world has come. Not only governments, but companies also carry the responsibility of involving such principles in their agendas to the population, which not only favors the planet, but also the view that citizens have about a particular company. Large corporations and financial institutions in Brazil and in the world have already become sustainable companies. Much more than a fad, this is a position that has come to stay and which, in the coming decades, should be crucial to the path of preservation and social development in all regions (PENSAMENTO VERDE, 2018). Green policies, partnerships with internal and external actors in the supply chain, product waste care and sustainable awareness are some of the steps chosen by companies to attract public attention that they do care about the world.

6 CONCLUSIONS

Following the proposed specific objectives, the concept of Industry 4.0 was characterized, presenting different visions of several authors about it, in an attempt to expose the reader to a new technological model, but not so recent (at least in developed countries). The concept of industry 4.0 has been expanded in several of its specificities, characterizing its

several innovations in several areas in which they are already reality. In addition, it identified the behavior of Industry 4.0 in the automotive sector, where it already represents a totally tangible reality in several countries, whose automotive factories already have, in their production process, high technology and performance equipment, connected to several systems and acting to produce massively and with less chance of errors and accidents involving human labor.

It was possible to verify how sustainability behaves in the automotive industry. Themes of countless discussions in any part of the world, the sustainable question, nowadays, is indispensable, attached, therefore, to a new mentality present both in the population and in the business sector. In fact, today's world is evolving faster and faster from the technological and ideological point of view, in the environmental sense and the attention that most of the society directs its efforts to the care of the planet.

The central objective has been achieved. Through the interviews with professionals, not only highly qualified but also profoundly knowledgeable about their respective themes, it was possible to conclude that industry 4.0 already represents a tangible reality for a large number of countries. If, on the one hand, in developed countries, their progress can already be seen in developing countries, it is also possible to categorize a tendency to approach this theme, even if it is much slower.

Despite this, the social issue fits for everyone regardless of their level of economic and industrial development. The risk that many workers are running is real and has already become a reality in numerous places around the world. The unanimous point, highlighted by all the interviewees, is the creation of efficient development policies that take into consideration all individuals. Policies aimed at the improvement and development of the national industry, as well as a state of social well-being for those who do not have it, with education services, mainly to re-educate, train and qualify such workers, so that they can work together with machines, in activities that involve less security risks and can thus create jobs, stimulate income and consumption for their families, move the economy and generate growth for the country. Quality vocational training is the most important tool for the development of society and the territory inhabited by it.

The technological issue is undoubtedly allied to the environmental issue, is increasingly defended by civil society and applied in corporate policies within the

organizational sector around the world. We see the creation of programs (in partnerships with public and private initiatives) so that the proper care is applied to the environment. Properly discarded waste and the use of this material for other purposes are just a few examples of successful practices present in the corporate environment, stimulated by both the automotive and technology sectors. The adoption of measures such as these do well not only the company's image before society, but also in reality represented by the damage caused by man to nature.

As for the limitation of the method, it can be said that qualitative research consists of highlighting the qualities of entities and processes, as well as meanings, which are not examined or measured experimentally with respect to quantity, volume, intensity or frequency. Therefore, it does not analyze the causal relations between variables and neither counts on mathematical models or statistical tables for the research (DENZIN; LINCOLN, 2006).

Due to the fact that this work has presented several tools available (thanks to the recent technological advances) by the industry 4.0, one of the objectives is the possibility of assisting the research practices in subjects related to the already mentioned new technologies, besides the current situation in that the application is based. In addition, by means of the research content, an analysis is suggested as an object of future studies, in order to verify the issue of sustainable development within the automotive industry (in the pneumatic sector, as mentioned in this paper), and point to the relevance of the practice of these activities not only in the automotive industry but also in several other areas, in order to support environmental issues as well as in the growth of the industry, when such improvements are possible.

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