Analysis of sustainability in supply chain management in the South of the State of Rio de Janeiro

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The South of the State of Rio de Janeiro is an important industrial hub focused mainly on the automobile industry. As is known, the automobile industry is known for the strong connection between the automaker and its supply chains. Since the 2000s, the idea of sustainability applied to the management of supply chains has grown more and more in the world. This research interviewed professionals from the Industrial Pole of the South of the State of Rio de Janeiro who also graduated from local universities about what their perceptions were on sustainability in managing supply chains in the region. It can be observed that the perceptions of those directly involved with the supply chain were positive and those who are not involved were unaware of much of the subject. In the academic part, the research showed that sustainability is still a term little used by Universities in the region, which is therefore an extensive field for improvement and research.

KEYWORDS: Sustainability; supply chain management, automobile industry
1. Introduction

Some studies have emphasized the sustainable applications in the emerging countries (SCA varDa et al., 2019). This studies also include the sustainable application in the supply chain management in the automotive industries. In a search for sustainable supply chain management in the global automotive industry on the scopus platform, the most cited concepts were the triple bottom line, sustainable development, life cycle assessment, social sustainability and circular economy. However, there is a gap in the scopus platform regarding sustainability in supply chain management in the south pole of the state of Rio de Janeiro.

The industrial pole in south of Rio de Janeiro state is an important industrial hub in Brazil, in 2020 in the region there are four major automobile factories, the Volks Wagen bus trucks, Nissan, PSA - Peugeot Citroen and Jaguar-Land Rover, also there are still many supplier companies linked to these assemblers located in South of Rio de Janeiro state. According IBGE (2021) The city of Resende is the largest city in the industrial hub with 119.769 inhabitants, with the neighboring cities of Itatiaia (28.783 inhabitants) and Porto Real (16.592 inhabitants), which complement the industrial hub of the south of the state of Rio de Janeiro.

The economy of three cities is based mostly in automotive industries and in 2018, Resende had 30.7% of its economically active population and had the 9th highest GDP per capita in Rio de Janeiro, Itatiaia had 33.6% of its economically active population and had the 3rd highest GDP per capita in Rio de Janeiro and Porto Real had 45.0% of its economically active population and had the 4th highest GDP per capita in Rio de Janeiro. Industries, especially automobiles, are the main factor that keeps these indicators high for the three municipalities, which means that these municipalities have a huge dependence on industries (LIMA, 2012).

Perhaps Brazil has since 2014 an economic crisis with moments of recession in 2015 and 2016 (SOUEN; DE SOUZA CAMPOS, 2019), also in 2020, all the world faced the COVID-19 pandemic, causing recession, unemployment and instability in the world (NICOLA et al., 2020), in Brazil, informal workers have lost their livelihoods, and many companies have already begun to lay off employees with a signed license. It is expected to increase in the informality rate of the Brazilian economy, which in 2020 was around 40.8% (COSTA, 2020). The automobile companies was impacted also, Ford motors closed its truck plant in the state of São Paulo and the car plant in the state of Bahia, consequently partner companies also ended their activities (FERNANDES; HADDAD; DIAS 2021).

This research aims to compare how much the sustainable management of the supply
chains of the industries of the South of Rio de Janeiro can be compared with the global researches on the sustainable management of the supply chains. It will also compare how much the economic crisis in Brazil and the global economic crisis has impacted on the sustainable management of supply chains, and what is the view of workers in these industries has on sustainability in the management of supply chains.

2. Literature review

There is extensive research on applied sustainability in supply chain management in the automotive industries belong the years. In developing countries (ZHUL; SARKIS; LAI, 2007), (HASHEMI; KARIMI; TAVANA, 2015); (LUTHRA et al., 2017)(LUTHRA; GARG; HALEEM, 2016) and (DIABAT; KHODAVERDI; OLFAT, 2013) researched the relationships of sustainability applied in supply chain management in the auto industry in China, India and Turkey. In the automotive industry in Italy and Germany, sustainability in the supply chain was studied by (KOPLIN; SEURING; MESTERHARM, 2007); (BESKE; KOPLIN; SEURING, 2008) (BARTOLOZZI; RIZZI; FREY, 2013). In Brazil (VANALLE, 2014) studied applied sustainability in supply chain management in automobile companies in the metropolitan region of São Paulo. However, there is no specific study on automobiles in the south of Rio de Janeiro, a region where the automotive hub started to develop from the 1990s.

2.1 Supply Chain Management

According to (SEURING; MÜLLER, 2008) supply chain management (SCM) is the integration of these activities through improved supply chain relationships to achieve a sustainable competitive advantage. For (SCAVARDA; SCAVARDA, 2004) the supply chain encompasses all companies that participate in the manufacturing and marketing stages of a specific product or service that will be delivered to the end customer, and these companies may be from different sectors and playing different roles in the product or service cycle chain.

A key factor to manage the supply chain according is the structure of the chain, according Lambert and Cooper (2000) there are three structural aspects linked to this configuration: Supply chain members: include all companies or organizations with which the focal company interacts, directly or indirectly, from the point of origin to the point of consumption of the product. Since its number is high, it includes several members of the supplier layer and the customers of the focal company, working with all companies becomes extremely complex. In order to maximize the allocation of its resources, the focal company must identify the relevant
members for the integration and management of its chain's business processes. The members of the chain involved in the operational and managerial activities of the processes for the production of a product destined for a specific market, are called primaries. Members who provide technical, financial and knowledge resources to support primary school activities are called support.

The dimensional structure of the supply chain: There are three types of essential dimensions to describe, analyze and manage the chain. The first refers to the horizontal dimension of the chain, the second refers to the horizontal position of the focal company in the chain, that is, if it is close to the point of origin of production, where normally the added value of the product and the influence of the company at the end customer are reduced, or if it is close to the end customer, where the added value of the product is normally quite high and this proximity can produce a leadership position for the company in relation to the others in the supply chain. The third type refers to the vertical structure of the chain, that is, the number of companies in each layer.

The levels of links existing between members: the level of integration and management of business processes between the focal company and the other companies in its chain varies according to the importance of these companies for the success of the focal company and the supply chain itself. Not all links in the chain should be coordinated and integrated closely or directly by the focal company and only the most critical ones should involve partnerships.

Major vehicle manufacturers (automakers) have powerful molds for creating their supply chains and influences under many other businesses, most of which are obviously arises in relation to its suppliers of materials and components, which can constitute up to 80% of the value of a finished vehicle. Therefore, the purchasing department of the vehicle manufacturers is among the most professional and largest systems in the world, being particularly adept at obtaining cost reductions from their suppliers (VANALLE, 2014). Also automotive industry makes up the majority share in the manufacturing sector in a country’s economy. It contributes positively to employment generation and is considered as a flagship bearer, and a useful barometer that measures the current wealth of the international economy (BELHADI et al., 2020), it means the all supply chain in automotive industry has important for manufacturing economy for Brazil.

2.1 Sustainable Supply Chain
Sustainability is defined as the use of resources to meet the needs of the needs of the present without compromising the ability of future generations to meet the needs of their needs (LINTON; KLASSEN; JAYARAMAN, 2007).

According (LOPES et al., 2017) in the economic perspective, the circular economic term has emerged as an alternative to replace the linear business model of innovation. It is a movement that strives for sustainably restructuring economic systems, based on the replacement of disposals and on the removal of the system “take, make, and dispose” (LIEDER; RASHID, 2016).

(SRIVASTAVA, 2007) defines the term sustainable supply chain management (Sustainable Supply Chain Management or Green Supply Chain Management (GSCM)) as the integration of environmental thinking in the supply chain, including product design, selection of raw materials and their sources, the manufacturing processes, the delivery of the product to consumers, as well as the end of the useful life of this product, including the management of the product after its useful life.

According (VANALLE, 2014) a company can choose to get directly involved and invest your own resources to improve the environmental practices of chain members, or you can use your power or market mechanisms to influence them.

For the practice of green supply chain management (GSCM), manufacturers need to work together with suppliers and customers to increase environmental sustainability. It is expected that the implementation of GSCM practices will result in better environmental performance, measured by reductions in atmospheric events, effluent residues, solid residues and consumption of toxic materials. There is concern, however, whether these environmental sustainability efforts will ultimately translate into greater market share and profitability (GREEN et al., 2012)

3. Methodology

As for the research approach, it is a qualitative approach, as it occupies a recognized place among several possibilities to study the phenomena that involve human beings and their intricate social relationships, in different environments (MINAYO, 2017).

The research objective is exploratory and descriptive, with a non-random and intentional sample. Being non-probabilistic, it is therefore not possible to argue that all the companies that are part of the automobile pole in the south of the State of Rio de Janeiro were represented, but it should be noted that employees of the three assemblers that make up the pole and employees
of suppliers of these companies were interviewed. The choice for the Southern automobile pole of the State of Rio de Janeiro was due to the lack of studies in this region, the automobile industry being important for the region's economy and the pole being relatively newer, starting in the 1990s, in comparison with the automobile pole of São Paulo.

3.1. Instrument for data collection

The instrument used for data collection was a questionnaire generated by the Googleforms system, by the Google® platform. In the questionnaire, part of the questions were opened, such as the company data, the data of who filled out the questionnaire and the citation of known concepts of sustainable supply chain management. The rest of the questions were closed, so that they could be staggered and tabulated in levels, for this the Likert scale was used (LIKERT; 1932).

The questionnaire was organized with questions in Portuguese, for a better understanding of those involved. The first part of the questions were directed to the identification of the participant and the company of which the participant is involved. The first question was for the participant to identify himself, for the sake of preserving identity and opinions, this field was optional, giving the possibility for the participant not to identify himself. The second semi-closed question asked which sector the participant's company was part of, whether it was automotive or some non-automotive sector but involved, in the third field the participant was asked to answer which and the company he worked for.

The second part of the questionnaire dealt with the impressions that the participant had in relation to the treatment that his company gave in terms of sustainability applied to supply chains. And in the final part, questions were asked about the academic background of the participants and how sustainability applied in supply chains was addressed during their academic background.

The questionnaire consisted of the following questions (Q) and answer options (A):

1. Q – Name (Optional)
   A –

2. Q - What is the activity of the company you work for?
   A – ( ) Automaker
      ( ) Other (describe)

3. Q - What is the activity of the company you work for?
   A – ( ) Automaker
4. Q – Name of the company that works
   A – (Describe)

5. Q – Works in supply chain management?
   A – ( ) Yes
   ( ) No, but I have direct involvement
   ( ) No

6. Q - How important is your company to the supply chain?
   A – ( ) A lot of importance
   ( ) Some importance
   ( ) Little importance
   ( ) No importance
   ( ) I don’t know

7. Q - How important is your company to the sustainable supply chain management?
   A – ( ) A lot of importance
   ( ) Some importance
   ( ) Little importance
   ( ) No importance
   ( ) I don’t know

8. Q - Which terms on sustainable supply chain management are you familiar with in your work? (List everyone you know or hear about)
   A –

9. Q - What is your college degree?
   A –

10. Q - In which university and city do you study / attended your higher education course?
    A –

11. Q - During your academic training, how much did you hear about supply chain management?
    A – ( ) A lot of
       ( ) Enough
       ( ) A littler
       ( ) Nothing

12. Q - During your academic how much did you hear about sustainability?
13. Q - During your academic how much did you hear about sustainable supply chain management?
A – ( ) A lot of
( ) Enough
( ) A littler
( ) Nothing

3.2. Methodology of analysis
Some statistical and graphical analyzes were generated by the GoogleForms® program, other analyzes were performed by the Minitab software.

4. Results obtained
4.1. Company and professional profile
In total, forty-three workers in the automotive industry in the south of Rio de Janeiro answered the questionnaire. Of these thirty-six, they work for the three automakers in the region and seven work for suppliers and local partners of these automakers.

After asking the name of the participants and which company they worked for, it was asked if they worked directly with the supply chain, if they were involved or if they did not work and were not involved, and this is a closed question. Is possible can see the number of people who responded and the percentage in
Figure 1:
Is possible to see in Figure 1 that the workers who answered the questionnaire, twenty three do not work with supply chain, eight work with supply chain and twelve do not work directly but have functions that involve the supply chain.

The second closed question was about the importance that the company attaches to the supply chain, the options were very important, some importance, little importance, no importance or I don't know, the graph is in Figure 2:

In this question twenty six replied that it is very important, seven some importance, one little importance and one no importance and eight said that didn’t know.
If considering only the twenty participants who are involved in or work with supply chain management, about the importance the company attaches to the supply chain, fourteen of them said it was very important and six said some importance, in Figure 3:

Figure 3 - Importance of supply chain management in company (people involved with supply chain)

![Importance of supply chain management in company](image)

Source: The author

It is possible to see by comparing Figure 2 and Figure 3, for those that are involved with supply chain, auto companies give importance to supply chain management. This differs greatly when considering those who are not involved in the supply chain because many are unaware of the importance of the supply chain in the company and two participants consider that the company attaches little or no importance to supply chain management.

The next question asked about the importance that the company places on sustainability in supply chain management, once again the options was very importante, some importance, little importance, none importance and I don’t know. The number of options answered by the participants is shown in
Figure 4:
The Figure 4 shows that eight people said it is very important, six said some importance, four said little importance, 1 said no importance and two people don’t know.

When considering only those working in the supply chain, five people said that sustainability is very important in supply chain management, six people said it has some importance, seven said it has little importance and one said it had none importance and one said he did not know, the number of answers is in Figure 5:
Comparing Figure 4 with Figure 5, realize that there is a small tendency for those involved in supply chain to have the opinion that companies pay more attention to sustainability, but still 45% of those working with supply chain do not know or think that their companies place little or no importance on sustainability in supply chain management.

4.2. Technical graduation and knowledge about supply chain management

An open question was asked about which concepts they knew about sustainable supply chain management. The question was asked openly so that each participant could include any concept they wanted and also so that they were not influenced by lists of concepts. The concepts mentioned by the participants and the number of times they were mentioned are in the figure.

In the Figure 6 is possible to see that the most cited concept was Industry 4.0 with thirty-two citations, Reuse with twenty five citations Circular Economy with fourteen citations, Green Design with eleven citations, one person cited 3R and sei participants said they did not know any concept.

Participants were asked about their technical background, thirty-eight were engineers, three administrators, one in logistics and one industrial designer. The university of origin of the participants was asked, and this is also an open question. It can be seen from Figure 7 that the majority came from colleges in the south of Rio de Janeiro.
As for the university of origin, sixteen were from the State University of Rio de Janeiro (UERJ - Resende), eight from the Faculty of Engineering of Resende (FER - Resende), five from the Faculty of Engineering of Estácio de Sá in Resende and five from the Federal University Fluminense (UFF - Volta Redonda) and nine from other universities.

It was asked in a closed way as to the academic formation if during the course it was talked about supply chain management, either in a specific discipline within another discipline. It was a closed question, with the options being a lot, enough, little and nothing, the answers are in the Figure 8:
In the Figure 8, Six participants said they heard a lot, twenty-four said they heard enough, eleven said they heard little and two said they heard nothing. Most of the participants were satisfied with what their courses said about supply chain.

Participants were asked how much they heard about sustainability throughout their degrees, with the same options of answer, a lot, enough, little and nothing, the answers are in Figure 9:
In Figure 9 is possible to see that ten participants said a lot, seventeen said enough and sixteen said they heard little. Also most of the participants were satisfied with what their courses.

Finally, the participants were asked if they heard about sustainable supply chain management throughout the course. Three said a lot, twelve said enough, seventeen said little and eleven said they had not heard about it during their graduation Figure 10.

![Figure 10 - Sustainable supply chain during graduation](image)

Of the three who said a lot, all were students at UERJ Resende, of those who said enough, three were from UERJ Resende, three from FER Resende, one from UFF Volta Redonda and five from other universities.

5. Final Considerations

It was observed that among the participants, those who work with the supply chain have a view that companies value the sector and supply chains more, confirming the premise that the supply chains of the automobile industries are complex and well managed. Those who do not work with the supply chain have a somewhat nebulous vision, but a good part still understands the importance.

It is concluded that in the south of the state of Rio de Janeiro the employees of the industrial sector have divergent opinions on sustainability in supply chain management. Those who are directly involved with the supply chain tend to believe that companies value sustainability in their supply chains, those who are not involved believe that companies attach
little importance. As for the knowledge of the concepts, the most widespread is Industry 4.0 and also reuse, but few mentioned more complex concepts. A reasonably cited concept more directly related to sustainability in supply chains was the circular economy.

Regarding universities in the south of the state of Rio de Janeiro, most universities have a good curriculum to deal with supply chain management, but they are still behind in terms of the sustainability approach.

The research was superficial and did not go into details, giving scope for the future to deepen the supply chain management in the automotive industry and how the concepts are treated internally, in addition to being able to deepen the academic approach and seek to understand why a good part of the participants considered the universities' approach to sustainability in supply chain management to be unsatisfactory.

References


