

Industry 4.0 and collaboration along the Brazilian automotive chain: visions of automakers and auto parts

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Abstract

Industry 4.0, an integral part of the Fourth Industrial Revolution, portrays techno-logical advances and affects the way of management along with the automotive chain, with its pillars offering greater opportunities for all members along the chain. This article aims at identifying and analyzing the difficulties of automakers and auto parts for the use of relevant technologies for Industry 4.0 in order to promote supply chain integration. The data were collected through a survey, carried out with managers from the industrial area of companies in the automotive segment (automakers and auto parts) in Brazil. The results showed that data connectivity and collaboration along the chain are the main bottlenecks for the use of new technologies, which the level of investment, especially in auto parts is insufficient. Despite the interdependence among companies surveyed, the automakers are in a more advanced stage while the technological gap is more evident by the auto parts. These divergences make the integration of these companies even more difficult.

Keywords

Automotive chain, connectivity, investments, digital technologies.

1. Introduction

Industry 4.0, an integral part of the Fourth Industrial Revolution, portrays technological advances and disruptive development in the industrial sector (Dallasega, Rauch, Linder, 2018) and affects the way supply chains are managed (Hofmann, Rüsçh, 2017). Among these new technologies, connectivity creates connections among devices, sensors, machines, and software, by optimizing communication among members of the value chain (Büyüközkan; Göçer, 2018) being described as one of the necessary prerequisites for the transition to Industry 4.0 (SCHUH et al., 2017).

Likewise, familiarity with new technologies increases, and the benefits of digital transformation are increasingly understood. In order to adapt to the global expansion of the markets, the operating systems gradually become more complex (Ras et al., 2017) and Industry 4.0 permeates the entire value chain of organizations, requiring, thus, new business models. The combination of these new technologies may provide significant gains in productivity and improve the competitiveness of companies, configuring themselves as a new perspective of production (CNI, 2018).

An important aspect for this new production possibility refers to the connectivity. However, in Brazil, 91% of the companies are not connected (ABIMAQ, 2018). This situation can hinder the integration and collaboration among the members of the supply chain of the automotive segment, since it is an underdeveloped dimension that requires investments for the adequacy of technological infrastructure.

Although, in Brazil, the costs of the technologies required for transition to Industry 4.0 have been decreasing, it certainly cannot be applied for throughout industrial segments at the same and at same pace (Santos, Ruggero, Sacomano, 2019). We might also consider that changes in the culture of companies, collaborative knowledge and data transparency as a necessary characteristic Industry 4.0 transition.

Despite the need of adequacy, the automotive sector in the country, requires its participation in the GDP (Gross Domestic Product), for employment generation, investments in innovation, and for significant linkages in its production processes (Daudt; Willcox, 2018). And, even with an extensive supply chain, auto parts companies and automakers represent its main links.

Bearing in mind the importance of the supply chain for the competitiveness of companies in the global scenario, the relevance of the automotive segment, this article aims to identify and analyze the difficulties of automakers and auto parts, in Brazil, for their use of technologies covered by Industry 4.0 and its capacity to promote the integration and collaboration of the supply chain.

2. Literature Review

The concept of Industry 4.0, which proposes the end-to-end digitization of the production chain, thus providing the integration of physical assets in systems and networks linked to a series of technologies to create value (Görçün, 2018). Characterized by the increasing use of information and automation technologies in the manufacturing environment (Davies; Sharp, 2014), it promotes the improvement of productivity in a collaborative way.

However, access to resources for investment in new technologies is variable and can work as a barrier for some links in the chain. Thus, the implementation of new technologies occurs gradually, according to the economic and operational needs of each company and the availability of resources (Schuh, 2014), resulting in different levels of digitalization along the value chain and the difficulty of horizontal integration (PWC, 2017).

The integration of systems along the chain, considered crucial to the success of Industry 4.0 (Lu, 2017) can also be affected by the lack of internal and external interoperability, which translates into the ability of two different computer systems to work together and to provide access to their resources reciprocally (DUMITRESCU ET AL., 2015).

Thus, the use of the different pillars of Industry 4.0 offers greater opportunities for members of the value chain (Vogel-Heuser; Hess, 2016) but imposes collaboration between suppliers and customers (Davies, 2015). In this way, three elements: connectivity, resources and availability of information are increasing and demanding collaboration between chain and digitalization. It can provide efficiency in integration, access to global manufacturers, suppliers of various raw materials and potential customers (WANG; ONORI, 2015; GEISSBAUER; EDSØ; SCHRAUF, 2016).

In order to promote changes in functional structures, it is necessary to manage collaborative knowledge and integrate the supply chain with data transparency (Liao et al., 2017), however there are many barriers to the use of new

technologies, highlighting the scarcity of research, lack of infrastructure, data, lack of digital culture and trust in business partners (WANG; WAN; ZHANG, 2016).

In this context, emerging markets such as Brazil it presents several challenges for companies and its capacity of being able to use technologies related to Industry 4.0. Highlighting investments in digital technologies, adapting layouts, processes, relationships between companies and forms of management along the production chain (CNI, 2016), also considering that investment is the variable capable of bringing the pillars of Industry 4.0 closer to the need to adapt infrastructure and labor (LORENZ et al., 2016).

3. Methods

The methodology of this article is exploratory, qualitative and quantitative. The collection of primary data occurred through the application of a survey, from December 2019 to January 2020, using a self-filled in form, which were sent by e-mail to the industrial area managers in the segment of automotive companies, (automakers and small and medium-sized auto parts), located in São Paulo, Minas Gerais and Rio de Janeiro. The responses were received by Google Forms platform without any identification for both: respondent and company as a way to preserve the anonymity of the participants through the stages of the survey.

The research used 08 closed multiple-choice questions which were based on theoretical reference, especially in the studies of Schuh et al. (2017), with two questions for sample qualification, by identifying the type of company (automakers or auto parts) and the role of participants. Table 1 below illustrates the other 6 questions which were discussed in this article.

Table 1 –Survey

DESCRIPTION
What is the level of data connectivity between your company, suppliers and customers?
How collaborative is your company with suppliers and customers for business development using digital technologies?
What is the level of use, in your company, of digital technologies in the production process?
What are your company's bottlenecks for using new technologies?
In the last 2 years, what level of investment has been made to implement technologies related to industry 4.0?
For the next 5 years, what level of investment is being planned for the implementation of technologies related to industry 4.0?

The auto parts companies and automakers were selected in terms of belonging to the automotive segment supply chain, which represents 18% of the Industrial GDP (ANFAVEA, 2020). The participants to whom the forms were addressed hold leadership positions in the industrial area (directors, managers, leaders, and supervisors).

The questions were asked in order to understand issues related to integration and collaboration along the automotive chain; the configuration of companies in relation to the use of Industry 4.0 technologies; the bottlenecks faced by the respondents' companies and the level of investments. Of the 55 questionnaires sent, 46 returned answered and 9 did not justify the absence of sending. The sample is represented by 72% of auto parts companies and 28% of automakers companies.

5. Results and Discussion

The results obtained are presented in the figures and table below. Figure 1 e 2 respectively illustrate the levels of connectivity and collaboration among companies which took part in the survey, their suppliers and customers for business development by using digital technologies.

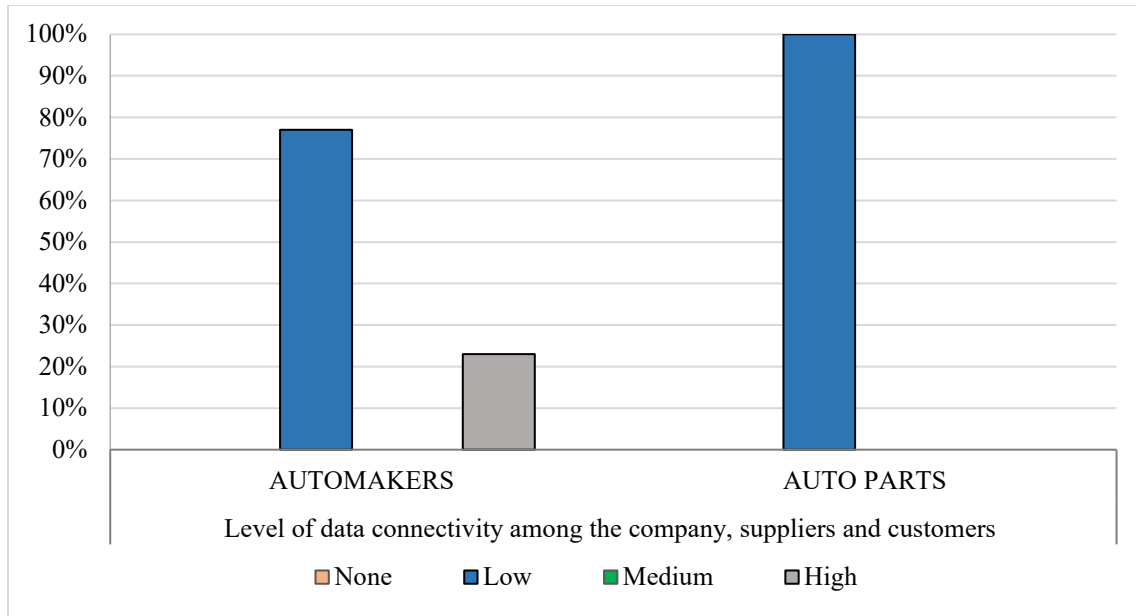


Figure 1 - Level of connectivity among those interviewed companies, their suppliers, and customers.

In the analysis it was found that the level of data connectivity among companies, suppliers and customers is low for 100% of auto parts, while in 23% of automakers the level of connectivity is high. Considering the fact that connectivity is one of the prerequisites for the transition to Industry 4.0 (Schuh et al., 2017), the inequality of connection, revealed by the research, it makes the process more difficult for both: automakers and auto parts.

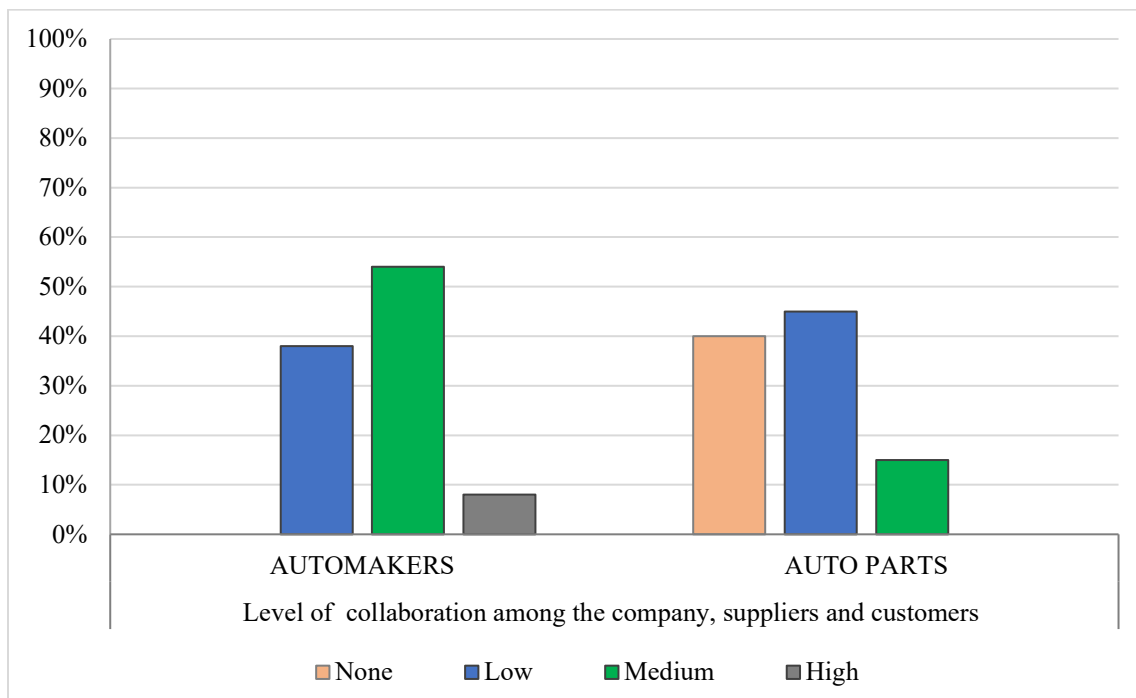


Figure 2 - Level of collaboration among those interviewed companies, their suppliers and customers

Regarding collaboration, the relationship between automakers and auto parts reveals a customer-supplier kind, respectively, and it also implies that auto parts face greater difficulties. If we consider that collaboration between companies is internally and externally affected by the lack of interoperability (Davies, 2015) and the opportunities offered by the pillars of Industry 4.0 require greater collaboration between companies (Geissbauer; Edsø; Schrauf, 2016), the revealed divergences implies a deepen impossibility of integration.

However, the differences shown in figure 1, can be explained by re-search (CNI, 2016) which indicates automakers as cutting-edge industries and with greater technological advancement, and that no the entire industrial segments are able to advance at the same pace (CNI, 2018).

Figure 3 shows the bottlenecks seen as limiting point for the use of new technologies.

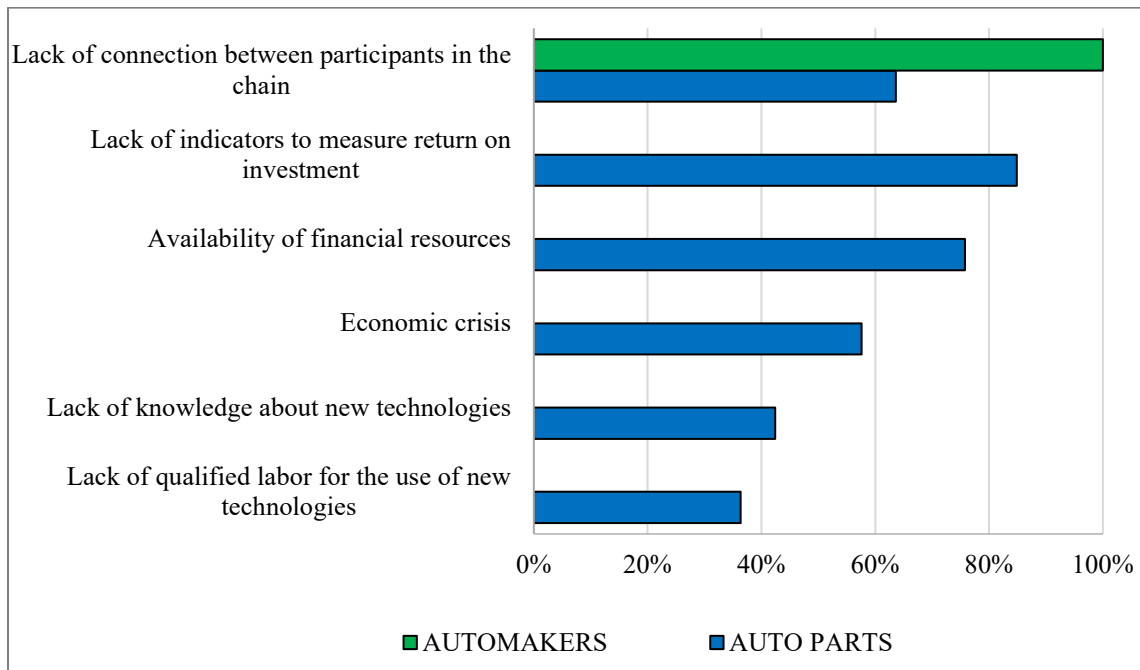


Figure 3 – Bottlenecks for using new technologies

While the auto parts indicated several impediments, the automakers of pointed only to the lack of connection between the participants in the chain. Considering the need for companies to adapt their business models (Almada-Lobo,2016), and that collaborative knowledge management and supply chain integration are also necessary to promote these adaptations (Liao et al., 2017), indicating the lack of connection can make the transition process in the entire automotive chain even more difficult.

Taking into account this field of study in Brazil, which considers the automotive sector as a segment in the most advanced stage to impulse the transition to Industry 4.0 (FIRJAN, 2016), is possible to consider that the automakers represent the link for this chain. At same time, this link has better conditions facing those mentioned difficulties. As emphasized it might justify the fact of considering the lack of connection between the participants as the only impediment for it. In addition, is worthy to mention that those highlighted bottlenecks by auto parts may find resonance in other studies, which indicates that not whole industrial segments are able to advance at the same pace (CNI, 2019).

The differences between automakers and auto parts are consolidated during the analysis of the results and are reflected in the availability and use of new technologies. Table 2 below summarizes the data related to the use of technologies relevant to Industry 4.0 by the companies surveyed.

Table 2 – Use of technologies by auto parts and automakers

TECHNOLOGIES /LEVEL	AUTO PARTS					AUTOMAKERS				
	Not applicable	Null	Low	Medium	High	Not applicable	Null	Low	Medium	High
Communication with machines via RFID	6%	88%	6%	0%	0%	0%	0%	15%	77%	8%
Use of RFID to label products and	6%	79%	15%	0%	0%	8%	0%	8%	84%	0%
Communication with machines via cell phone	6%	79%	15%	0%	0%	0%	0%	0%	38%	62%
Real-time location system	6%	82%	12%	0%	0%	0%	0%	0%	38%	62%
Big Data Analytics	9%	76%	15%	0%	0%	0%	0%	0%	23%	77%
Cloud computing	9%	82%	9%	0%	0%	0%	0%	0%	23%	77%
Communication between machines	0%	61%	36%	3%	0%	0%	0%	0%	23%	77%
Robots	15%	82%	3%	0%	0%	0%	0%	0%	38%	62%
3D printing	0%	49%	48%	3%	0%	0%	0%	0%	54%	46%
Artificial intelligence	9%	88%	3%	0%	0%	0%	0%	23%	39%	38%
Process simulation	9%	88%	3%	0%	0%	8%	0%	0%	31%	61%

In the analysis of the data it was possible to perceive that technological gap related to this use is higher for auto parts, which the levels of use of technologies are low and zero, while the levels for automakers are high and medium. Is important to highlight that the use of technologies which are covered by Industry 4.0 may offer opportunities for all companies (Vogel-Heuser; Hess, 2016). The collaboration among the the various members of the chain is imperative (Davies, 2015), the differences presented between automakers and auto parts can create greater difficulties both to establish integration and to promote advances to-wards Industry 4.0.

Regarding still on difficulties in the use of new technologies, the survey participants emphasized that in the last two years 100% of automakers have invested heavily while 97% of car parts made smaller investments. For the next 05 years, the situation seems to be maintained since 100% of auto parts intend to make only small investments and 62% of automakers highlighted the realization of larger investments. The idea that the low level of investment represents an obstacle is supported by literature since it is the capable of bringing the pillars of Industry 4.0 closer than the need for companies to adapt it (LORENZ et al., 2016).

Thus, when comparing automakers and auto parts, it appears that the difficulties for the use of new technologies are greater for auto parts, which have fewer resources than the automakers. However, the industrial system has connections that cross several chains and when a vector promotes technological progress, it provides structured strategies towards Industry 4.0, thus conceiving paths for stability and development in the country, anchored by the growth of production (IEDI, 2019)

6. Conclusion

The purpose of this article was to identify and to analyze the difficulties of automakers and auto parts, in Brazil, to use technologies from Industry 4.0 by promoting the integration of the supply chain. The present study showed that

the difficulties are different for automakers and auto parts. While the automakers have as main obstacles the lack of connection and collaboration along the chain, the auto parts point to several bottlenecks, highlighting the low investment capacity and, consequently, restrictions on the use of new technologies.

In this scenario and despite the interdependence between automakers and auto parts, the results indicated that the automakers are at a more advanced stage, as they have greater investment capacity, easier access to new technologies and other resources. Auto parts, in turn, are in favor to survive in the market to the detriment of strategies for making more investments for the use of new technologies.

The main contribution of this study was to identify that the divergence of conditions in the use of technologies and the lack of connectivity accentuate the difficulties of integration and collaboration in the automotive chain. As researches have its limitations, these results cannot be generalized to the universe of companies, considering the sample size and other researches, other times, or even different sort of segments which may present divergent outcomes. Due to the relevance of the topic, for future studies is recommended to analyze how the other links tend to behave in relation to integration and collaboration along the supply chain.

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