



HAL
open science

Industry 4.0: Maturity of Automotive Companies in Brazil for the Digitization of Processes

Sergio Miele Ruggero, Nilza Santos, José Benedito Sacomano, Antonio Carlos Estender, Marcia Silva

► **To cite this version:**

Sergio Miele Ruggero, Nilza Santos, José Benedito Sacomano, Antonio Carlos Estender, Marcia Silva. Industry 4.0: Maturity of Automotive Companies in Brazil for the Digitization of Processes. IFIP International Conference on Advances in Production Management Systems (APMS), Aug 2020, Novi Sad, Serbia. pp.131-138, 10.1007/978-3-030-57993-7_16 . hal-03630877

HAL Id: hal-03630877

<https://inria.hal.science/hal-03630877v1>

Submitted on 5 Apr 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

Industry 4.0: maturity of automotive companies in Brazil for the digitization of processes

Sergio Miele Ruggero¹[0000-0002-2370-2238], Nilza Aparecida dos Santos^{1,2} [0000-0001-9037-0686], José Benedito Sacomano¹ [0000-0002-4877-3139], Antonio Carlos Estender¹ [000-0002-0547-1077], Marcia Terra da Silva¹[0000-0002-5314-4978]

¹ Graduate Studies in Production Engineering – Universidade Paulista, São Paulo, SP 04026-002, Brazil

² FATEC, Cotia, SP 06702-155, Brazil
miele326@gmail.com
nilzaasantos7@gmail.com
jbsacomano@gmail.com
estender@uol.com.br
marcia.terra@uol.com.br

Abstract. This article deals with the level of maturity of companies in the automotive segment in Brazil, to carry out the transition to Industry 4.0, in order to identify the degree of maturity of companies in this segment for the digitalization of processes. The data collection took place through a survey sent to directors, managers, supervisors and leaders of companies in the automotive segment. The results obtained indicated that the transition to Industry 4.0, although considered relevant, does not translate into reality for the companies surveyed. The level of infrastructure of the equipment is insufficient, the level of automation is low and the adaptability of the equipment is not yet technically possible in all companies in the segment. There is also no evidence of the use of digital technologies in the production process in approximately 60% of companies, and the maturity in the digitalization of processes occurs at a slow pace.

Keywords: Industry 4.0, Digitalization, Technology, Automotive.

1 Introduction

The concept of Industry 4.0, considered an integral part of the fourth industrial revolution, encompasses the main technological innovations in the fields of automation, control and information technology applied to manufacturing processes [1]. Characterized by the increasing use of information and automation technologies in the manufacturing environment [2], it brings reflexes to worldwide production, based on cyber physical systems, internet of things, big data and cloud computing.

The new technologies have led companies in the industrial sector of various segments in Brazil and in the world to an intense digital transformation, which can lead to shorter delivery times, greater product reliability and cost reduction.

In developing economies, digitalization can open new markets, leverage innovation and productivity gains. However, for this progress to occur, it is necessary to adopt, on the part of governments, incentive programs, improvements in infrastructure, together

with policies that challenge the different effects related to the market structure, innovation and divisiveness the benefits of digitalization [3].

Companies will need to adapt their business models to take part in this transformation [4]. The conditions of the companies can be measured by maturity models [5], which describe the stage in which organizations and processes are attaining the transition to Industry 4.0 [6].

In this context, the problem question in this article is: What is the maturity level of companies in the automotive segment in Brazil, in order to make the transition to Industry 4.0? Aiming to identify the degree of maturity of companies in the automotive segment for the digitalization of processes.

2 Literature Review

The concept of Industry 4.0 proposes digitalization from end-to-end of the value chain, through the integration of physical assets in systems and networks linked to a series of technologies to create value [7]. Digitalization can provide efficiency in horizontal integration, access to global manufacturers, suppliers of different raw materials and potential customers [8].

In a smart factory, the production process can promote the communication of workers, machines and inputs, transmitting information in real time [9,10]. In the search for competitiveness, more and more, companies are looking for improvement and efficiency in their production processes and adaptation to these new technologies.

The transition to Industry 4.0, although the exact consequences for manufacturing operations are not yet known, seems inevitable. Companies need to define their manufacturing model, planning a program for transformation [4]. The digital infrastructure is made up of networks, software and data and precise digital resources to use them efficiently.

Digitalization makes it easier to face growing market challenges [11]. Vertical integration portrays the use of information technology (IT) systems in different hierarchical levels of companies, optimizing the production process, through monitoring and process control in operational and managerial terms [12].

Companies seek to adopt integrated production planning and scheduling solutions that can combine company data with information from partners in the horizontal value chain, controlling inventory and demand levels [13]. The integrated planning of the shop floor, predictive maintenance and horizontal collaboration provides better use of production equipment [14].

Another challenge to promote collaborative activity, within companies, internally and externally, is the interoperability of information systems, which, from the point of view of computer technology, is the ability of two different computer systems to work together and provide access to reciprocal resources [15].

The scenario of each company in relation to the use of new technologies is demonstrated through models of maturity, which can be defined as a conceptual structure, composed of requirements that demonstrate the stage of development to achieve a desired situation [16].

3 Methods

The method used to carry out this research was exploratory, of qualitative and quantitative nature. Interviews were conducted with professionals in the industrial area, belonging to the automotive segment.

The primary data were collected through a survey sent to directors, managers, supervisors and leaders of companies in the automotive segment. Sixty questionnaires with 7 questions were addressed, covering the company's segment; the company's level of knowledge in relation to Industry 4.0; the infrastructure of the equipment in relation to Industry 4.0; automation of equipment in the productive sector; adaptability of equipment; the use of indicators to evaluate productivity and the level of use of digital technologies in the production process.

The questions were prepared based on the professional experience of the authors, in order to portray the resources that the companies surveyed have in relation to the technologies of Industry 4.0, as well as the knowledge of the participants on the subject, mapping the stage of maturity that they are in.

51 responses were obtained from the sample. The questions were presented to respondents at random. Of the responses received, 25% are large assembly companies, 65% small and medium-sized auto parts companies and 10% metallurgical companies. Secondary data were obtained through document analysis and bibliographic references. In parallel with the verification and analysis of results, the professional experience and participation of authors in the segment through the observational method was also considered.

4 Result and Discussion

The results presented below were based on data collection, through research, documentary and observational analysis. In response to the question about the level of knowledge of companies in relation to Industry 4.0, 22% stated that they have little knowledge related to Industry 4.0, 78% answered that they are interested in the subject and consider the topic important, but of these only 9% of companies has a strategy for deploying technologies from Industry 4.0.

The results of the research are presented through in the following figures.

Figure 01 illustrates how the equipment infrastructure is evaluated in the companies of the respective interviewees. The levels of control of the equipment by the network and the communication of the machines with each other are measured on a scale ranging from nonexistent to very high. The non-existent level corresponds to 0%; the very low 1% to 5%; the low of 6% to 10%; the medium of 11% to 40%; the high of 41% to 70% and the very high of 71% to 100%.

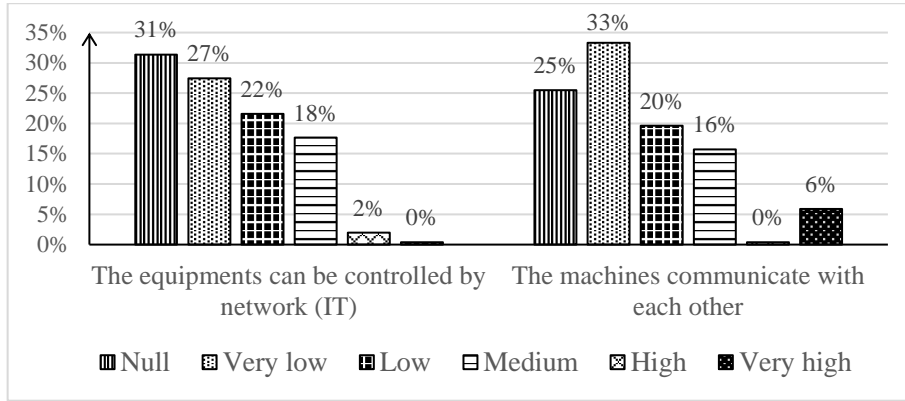


Fig. 1 - Infrastructure level of equipment in relation to Industry 4.0 (Source: prepared by the authors).

Regarding the control of the equipment through network (IT), it was found that 31% of companies the level of control is non-existent and 49% levels are low.

In terms of communication between the machines, in 25% of companies the communication is non-existent and in 53% the levels are low. It can be noticed that the equipment infrastructure and the communication between the machines are still embryonic with regard to Industry 4.0.

The level of automation of equipment in the companies' productive sector is shown in figure 02.

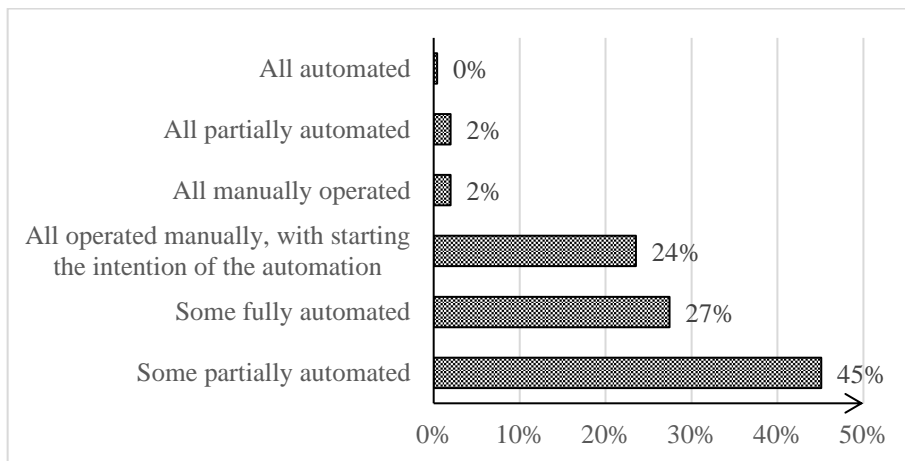


Fig. 2 - Automation level of equipment in the productive sector (Source: prepared by the authors).

The data show that 70% of the equipment still operate manually or are partially automated.

The companies' maturity in terms of equipment adaptability is shown in figure 03.

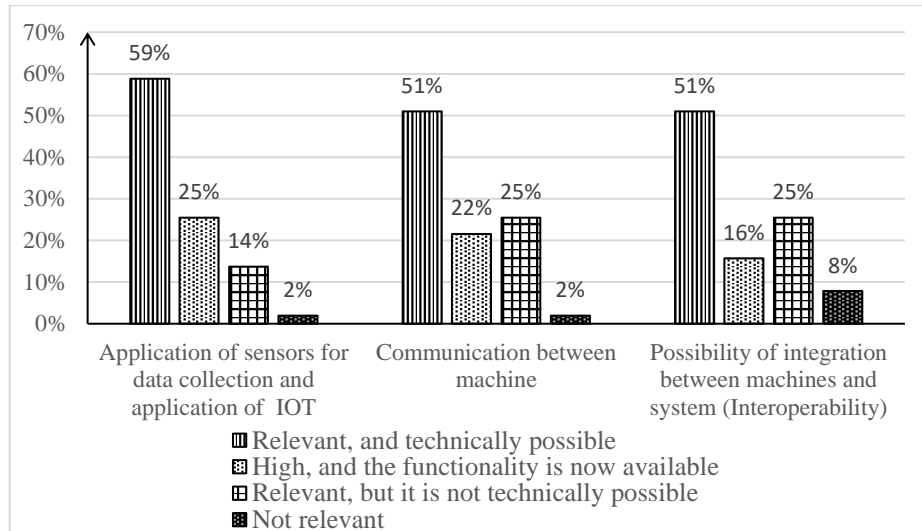


Fig. 3 - Adaptability of equipment (Source: prepared by the authors).

The data indicate that the application of sensors, the communication between machines and the integration between machines and systems are relevant and can be considered technically possible. However, based on the observational method, adaptability of equipment, although relevant, may not be technically possible in part of companies, especially small and medium-sized ones.

It was also asked whether companies use indicators to assess productivity. The results obtained demonstrate that the companies surveyed already use or are in the implementation phase, as shown in figure 04 below.

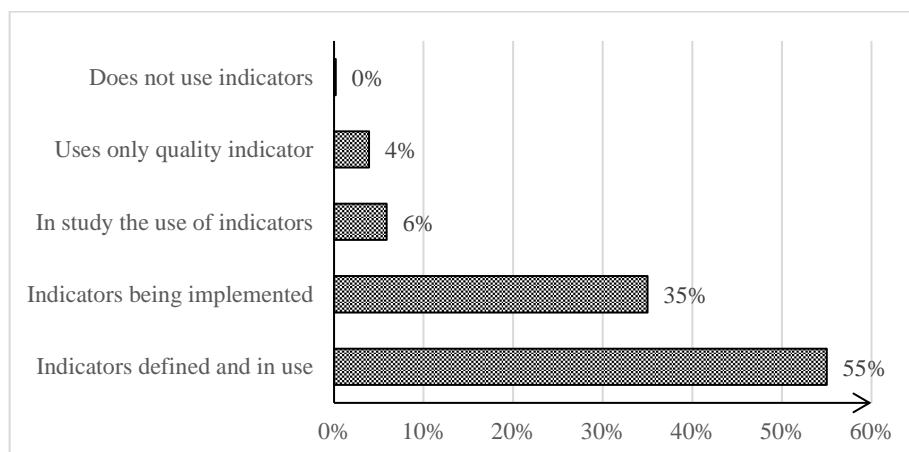


Fig. 4 - Use of indicators to evaluate productivity (Source: prepared by the authors).

Another issue to understand the maturity of companies in relation to Industry 4.0 is related to the types of digital technologies used in the production process of the respective ones, as shown in figures 05 and 06.

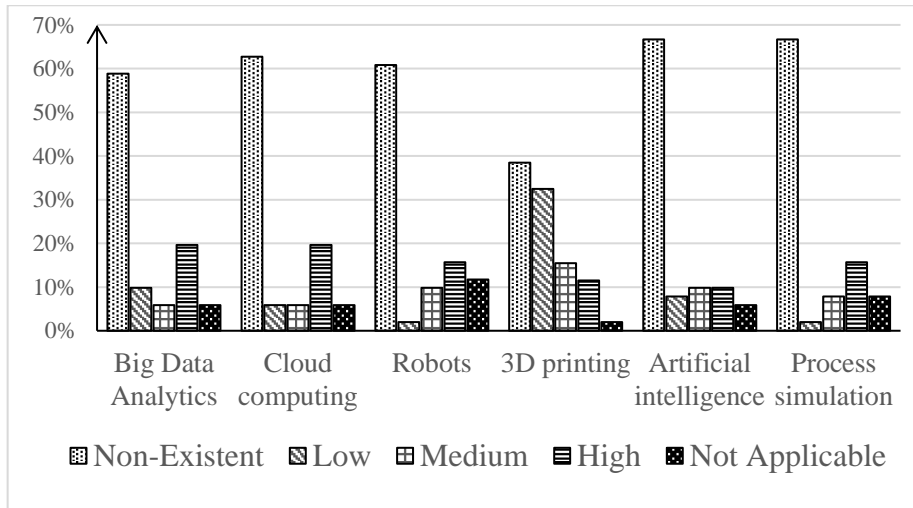


Fig. 5 - Level of use of digital technologies in the production process (Source: prepared by the authors).

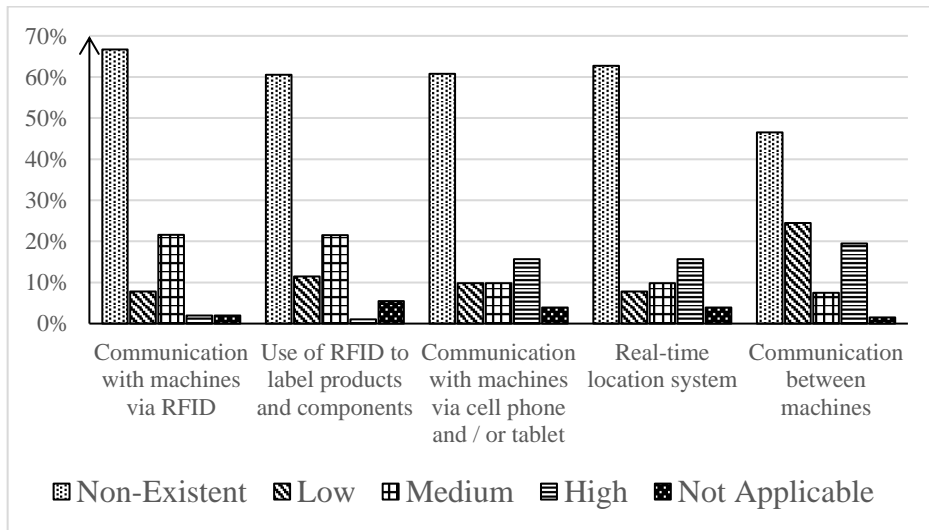


Fig. 6 - Level of use of digital technologies in the production process (Source: prepared by the authors).

In the analysis of figures 05 and 06, it can be seen that the use of digital technologies in the production process is still non-existent in approximately 60% of the companies surveyed.

5 Conclusion

In seeking to answer the level of maturity of companies in the automotive segment in Brazil, this article sought to identify the degree of maturity of companies for the digitalization of processes.

In the analysis of the data, it was found that 78% of the companies consider the topic relevant, however the significance given to the subject has not yet been translated, in this case, into reality when the focus is on the transition to Industry 4.0. For most of the companies interviewed, the level of equipment infrastructure is insufficient, the level of automation is still low, the adaptability of the machines is considered relevant, but it is not technically possible in all companies in the segment.

The companies pointed out that they already use or are in the implementation phase of some kind of indicator to evaluate productivity.

Regarding the use of digital technologies in the production process, in approximately 60% of the companies there is no evidence of use. The indications of high use of these technologies, when detailing the data, it can be verified that they refer only to the automakers, a situation also found in secondary research [17] that denotes that the auto parts do not follow the same pace of transition, that investments in modernization are restricted in relation to available technologies and that automakers have greater access to new technologies and de-more resources.

Research by PWC [14] points to Industry 4.0 no longer as a trend, but as an epicenter of strategies in global terms, as companies seek to combine advanced connectivity and automation services, cloud computing, sensors and 3D printing, connectivity, computerized processes, artificial intelligence and Internet of Things in transforming your business. On the other hand, they also corroborate the results obtained in this article when they state that Industry 4.0 in Brazil is still at an early stage.

Considering all care in the collection, presentation, analysis and interpretation of the data to ensure the accuracy of the results obtained, the present research does not contain conclusions, but in response to the proposed question it can be stated, based on the results obtained, that in terms process maturity has been taking place in companies in the automotive segment in Brazil, but at a slow pace.

Acknowledgment. This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

References

1. LEE, J., BAGHERI, B., & KAO, H. A. A cyber-physical systems architecture for industry 4.0-based manufacturing systems. *Manufacturing letters*, 3, 18-23 (2015).
2. A. DAVIES AND D. SHARP, RICS Strategic Facilities Management. Case studies, International Workplace, Cambridge, Report, 2014.
3. IEDI Homepage, https://iedi.org.br/media/site/artigos/20190311_industria_do_futuro_no_brasil_e_no_mundo.pdf. accessed em 15/02/2019.
4. ALMADA-LOBO, FRANCISCO. "The Industry 4.0 revolution and the future of manufacturing execution systems (MES)." *Journal of innovation management* 3.4 (2016).
5. WENDLER, Roy. The maturity of maturity model research: A systematic mapping study. *Information and Software Technology*, v. 54, n. 12, p. 1317–1339 (2012).
6. SANTOS, R.C.; MARTINHO, J.L. An Industry 4.0 maturity model proposal. *Journal of Manufacturing Technology Management* (2019).
7. O. F. GÖRÇÜN . "Industry 4.0". Beta Publisher, 1-199 (2018).
8. GEISSBAUER, R., EDSØ, J., SCHRAUF, S. <https://www.strategy-business.com/article/A-Strategists-Guide-to-Industry-4.0?gko=a2260>, last accessed 2020/01/10.
9. RODRIGUES, L. F.; JESUS, R. A.; SCHÜTZER, K. Industrie 4.0: A literature review. *Revista de Ciência & Tecnologia*, v. 19, n. 38, p. 33-45 (2016).
10. HERMANN, M., PENTEK, T., & OTTO, B. Design principles for industrie 4.0 scenarios. *System Sciences (HICSS)*, 2016 49th Hawaii International Conference (pp. 3928–3937) (2016).
11. ZHONG et al., 2017; R.Y. ZHONG, X. Xu, E. KLOTZ, S.T. Newman. Intelligent manufacturing in the context of industry 4.0: a review *Engineering*, (2017).
12. DUMITRESCU R, GAUSEMEIER J, KÜHN A, LUCKEY M, PLASS C, SCHNEIDER M, WESTERMANN T. Auf dem Weg zu Industrie 4.0: Erfolgsfaktor Referenzarchitektur . it's OWL Clustermanagement (2015).
13. WANG, S .; WAN, J .; ZHANG, D .; LI, D .; ZHANG, C. Towards Smart Factory for Industry 4.0: A Self-organized Multi-agent System with Big Data Based Feedback and Coordination. *Comput. Netw.* (2016).
14. PWC Homepage, https://www.pwc.com.br/pt/publicacoes/servicos/assets/consultoria_negocios/2016/pwc-industry-4-survey-16.pdf, last accessed 2020/01/15.
15. FOLMER, E., VAN SINDEREN, M. & OUDE LUTTIGHUIS, P. Enterprise interoperability: information, services and processes for the interoperable economy and society. *Inf Syst E-Bus Manage* 12, 491–494 (2014).
16. SCHUMACHER, Andreas; EROL, Selim; SIHN, Wilfried. A Maturity Model for Assessing Industry 4.0 Readiness and Maturity of Manufacturing Enterprises. *Procedia CIRP*, v. 52, p. 161–166 (2016).
17. SANTOS, N.A.; RUGGERO, S. M.; SACOMANO, J. B. A Transition to Industry 4.0: A study on the nature of investments in automakers and auto parts. *ENEGEP* (2019).