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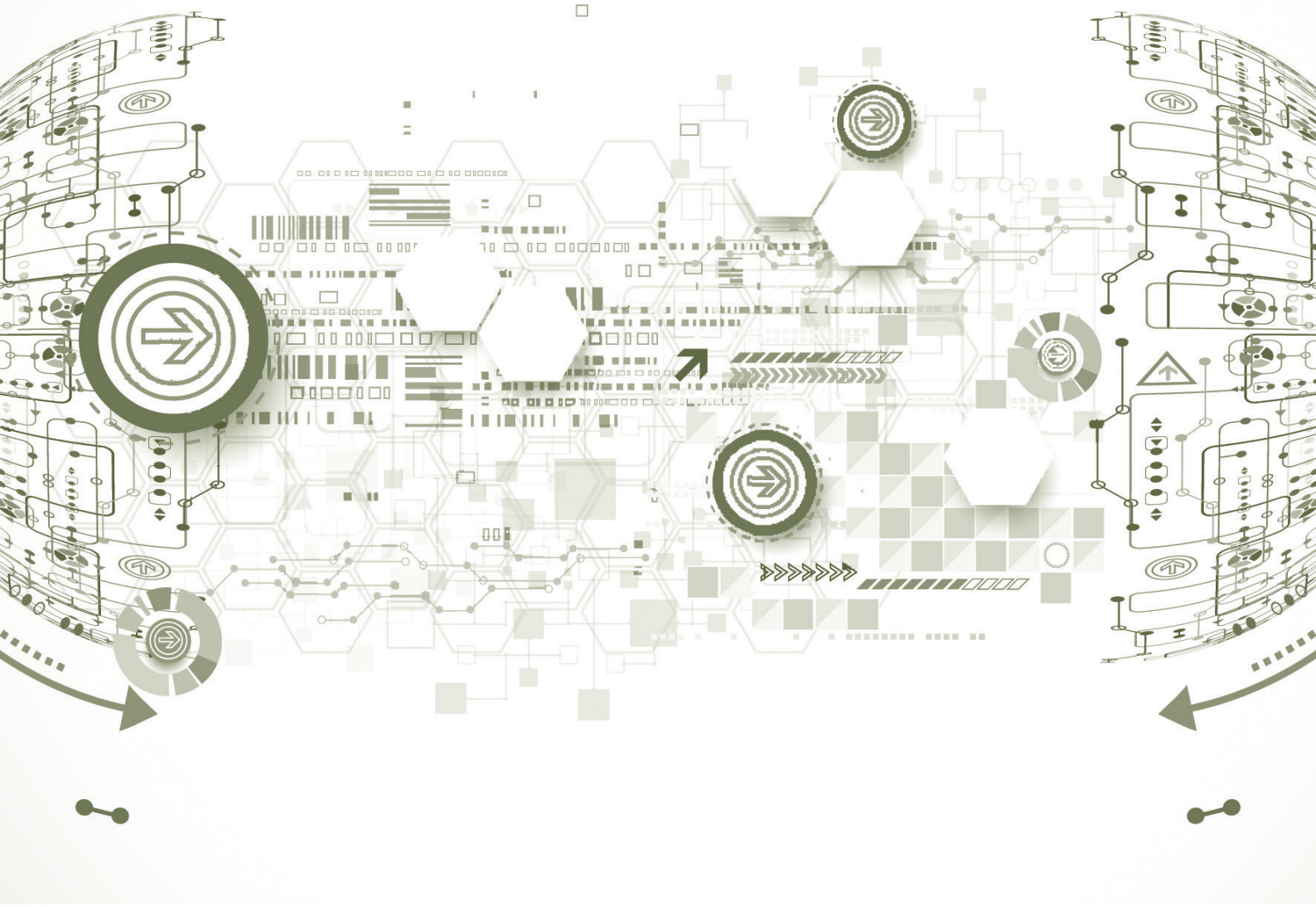

CHALLENGES FOR INDUSTRY 4.0 IN BRAZIL

Brasília
2016

CHALLENGES FOR INDUSTRY 4.0 IN BRAZIL

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Brasília
2016

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CATALOGING IN PUBLICATION DATA

C748d

National Confederation of Industry
Challenges for industry 4.0 in Brazil / National Confederation of Industry. – Brasília: CNI, 2016.
34 p. : il.

1. Digitalization of the economy. 2. Industry 4.0. I. Title

CDU: 329

Acknowledgements

CNI is grateful to Jefferson de Oliveira Gomes, João Fernando Gomes de Oliveira, José Borges Frias Júnior and Roberto Vermul for their comments, while exempting them of any responsibility.

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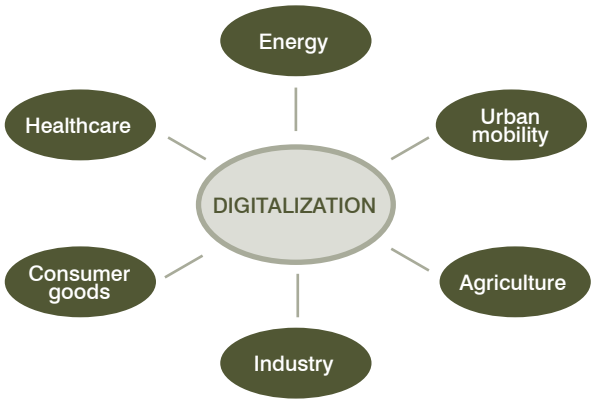
1 INTRODUCTION: DIGITALIZATION OF THE ECONOMY

Digitization has become an increasingly important process in the lives of companies and people. Combined with information and communications technology (ICT), digitization can be found in such applications as ebooks, digital format music services, and even taxi apps.

The progress of digitization has the potential to revolutionize our daily lives, providing solutions to major domestic challenges in areas such as urban mobility, through the development and adoption of technologies linked to the concept of smart cities; energy efficiency, through the introduction of smart grids; healthcare in a country of continental size such as Brazil, through the development of, for example, distance healthcare solutions; and industrial productivity, through the development of Industry 4.0, or Advanced Manufacturing.

FIGURE 1 – MAIN AREAS OF PROGRESS IN DIGITIZATION



Source: Prepared by the authors.

One feature that is common to all these technologies is using the Internet as a platform for sharing information to make communication possible between an unlimited number of devices, giving rise to what is now referred to as the Internet of Things (IoT).

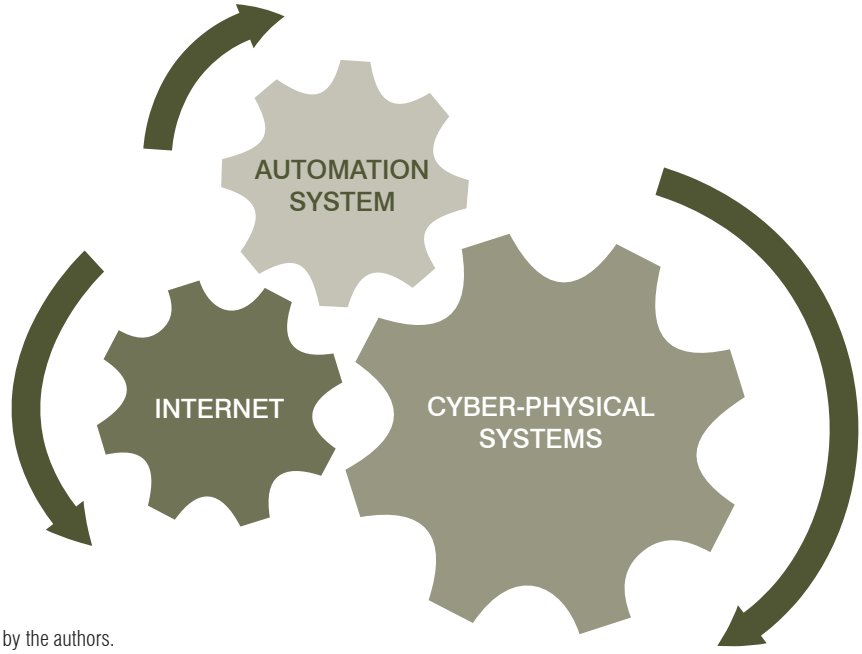
These technologies will permeate all areas of the economy, leading to many economic and social transformations over the next few years. A growing number of devices that can communicate with each other and gather data on their surroundings and on users (e.g. smartphones, vehicles, household appliances, lighting systems), together with big data technologies, cloud computing and new data handling technologies, will certainly pave the way for the development of new business models and change the way companies relate to customers and suppliers. The traditional divisions between industry and services and the boundaries between industrial sectors will be altered.

Among many other opportunities afforded by digitization, **this document will focus on Industry 4.0** because of its relevance to industrial productivity.

2 INDUSTRY 4.0

The incorporation of digitization into industrial activity has resulted in the concept of Industry 4.0, a term that refers to the 4th industrial revolution, characterized by the integration and control of production based on a network of interconnected sensors and devices and the fusion of the real and virtual worlds, creating the so-called cyber-physical systems and making the use of artificial intelligence.

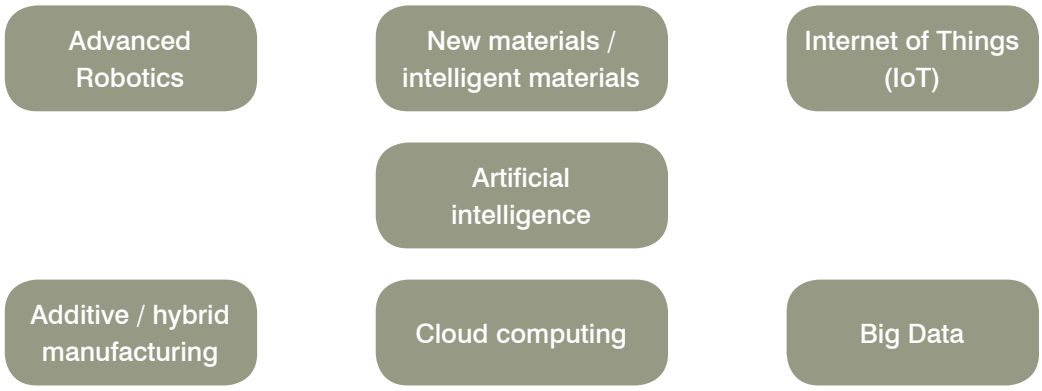
FIGURE 2 – INTEGRATION IN INDUSTRY 4.0



Source: Prepared by the authors.

The main enabling technological principles behind this revolution include the above-mentioned Internet of Things, big data, cloud computing, advanced robotics, artificial intelligence, new materials, new additive manufacturing technologies (3D printing), and hybrid manufacturing (additive and machining functions in the same machine).

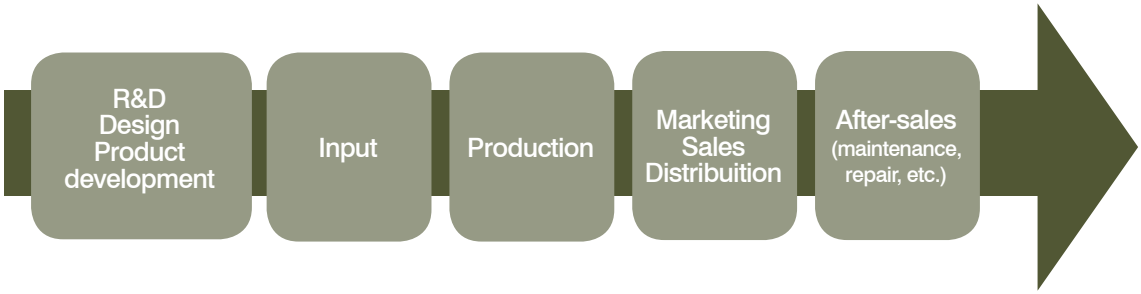
FIGURE 3 – ENABLING TECHNOLOGIES



Source: Prepared by the authors.

In these "intelligent industries," machines and consumables "talk" to each other during industrial operations to give scale and flexibility to the manufacturing process, which is thus carried out in a relatively automated and integrated manner. Devices located in different units of a company, or even in different companies, can also share information instantaneously about purchases and stocks, allowing for a previously unthinkable level of logistical optimization, as well as greater integration between the links in the production chain. However, the concept of Industry 4.0 goes beyond integrating production and distribution processes to also involve all the different stages in the value chain, from new product development processes such as design, development and testing to even simulating production conditions and after-sales services.

FIGURE 4 – INTEGRATION OF STAGES IN THE VALUE CHAIN

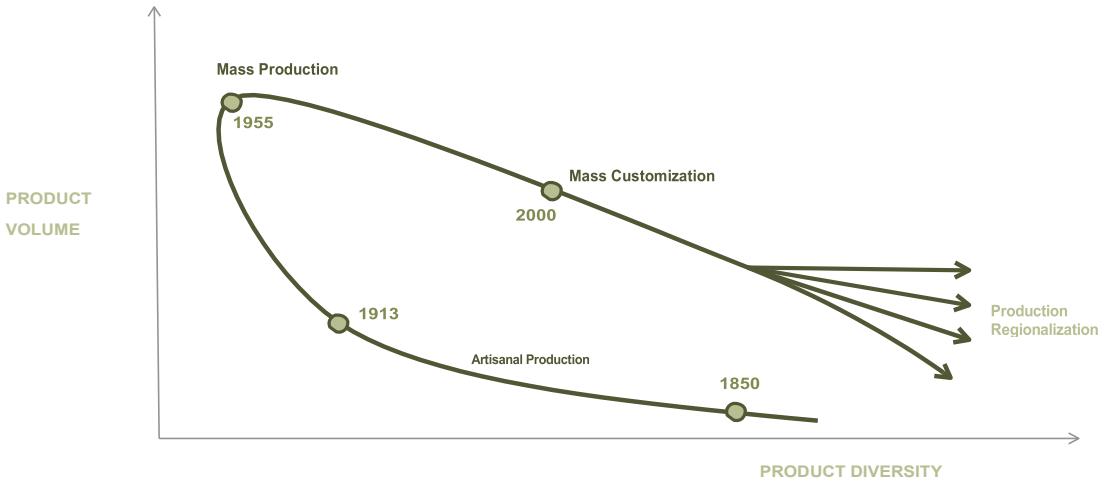


Source: Prepared by the authors.

The impacts will extend far beyond factory-floor productivity gains. This new industrial revolution will include shorter lead times for launching new products onto the market, more flexible product ranges, increased productivity, more efficient use of resources (e.g. energy) and even the capability of companies to integrate into global value chains.

Increased production-line flexibility will in turn enable *mass customization*: instantaneous communication between different links in the production chain. The development of highly flexible automation systems will enable customized goods to be produced in accordance with the preferences/needs of different customers and with a degree of efficiency that was until recently only possible when goods were produced in mass. Mass customization is clearly one of the new characteristics of modern industrial activity.

FIGURE 5 – THE REVOLUTION IN PRODUCTION MODELS OVER TIME



Source: Adapted from "The Global Manufacturing Revolution"[1]

[1] KOREN, Yoram. *The global manufacturing revolution:* product-process-business integration and reconfigurable systems. Hoboken: John Wiley & Sons, 2010. p. 34. v. 80.

APPLICATIONS OF INDUSTRY 4.0 – EXAMPLES

The machines at Siemens' electrical and electronic equipment unit in Amberg, Germany, operate around the clock. There are 1,000 different variants of Programmable Logic Controllers (PLC) that the system commissions automatically. This extreme level of automation has led to a very low fault rate: 12 faulty parts in every million produced.

Rolls-Royce, the British aero engine manufacturer, is preparing to use 3D printing technology to produce components for its engines. Today, it may take up to 18 months to produce certain parts because of the tooling process involved. 3D printing technology may shorten this process considerably, in addition to making it possible to produce lighter parts[2].

In Brazil, **Embraer** has begun to train shop floor operatives virtually, in 3D, a year before production start-up. This project went through 12,000 hours of tests before the aircraft took off. Faults that would normally only be detected with the aircraft in the air were sorted out during the preparation stage. Production line operatives use computers and tablets with augmented reality technology and if any doubts arise there is always a video to explain how to carry out an operation. All the benefits of digitization have already resulted in assembly time falling by 25%[3].

LABelectron, a laboratory-factory linked to the CERTI Foundation (Florianópolis – state of Santa Catarina), has developed the Factory Floor Information Management System, a structured software architecture system consisting of four modules (Factory Floor Service Module, Quality Service Module, Visual Factory Module and Messenger Module) implemented to enable full productive process traceability using manufacturing functionalities and controls[4].

[2] ROLAND BERGER STRATEGY CONSULTANTS GMBH. *Industry 4.0:* the new industrial revolution. 2014. Available at: <https://www.rolandberger.com/media/pdf/Roland_Berger_TAB_Industry_4_0_20140403.pdf>. Accessed on March 1, 2016.
[3] COSTA, Melina; STEFANO, Fabiane. A era das fábricas inteligentes está começando (The Age of Intelligent Factories is Beginning). *Exame Magazine*. Jul. 2014. Available at: <http://exame.abril. com.br/revista-exame/edicoes/1068/noticias/a-fabrica-do-futuro>. Accessed on March 1st 2016.
[4] CERTI - Sistema de Gerenciamento de Informações de Chão de Fábrica (Factory Floor Information Management System). Available at: http://labelectron.org.br/competencias-sistemas-fabris-inteligentes.html

Developing Industry 4.0 in Brazil involves challenges that range from investing in equipment that incorporates these technologies to adapting layouts, adapting processes and the types of relationships between companies along the productive chain, creating new specialties and developing competences, among other challenges. Cross-checking information that enables purchase orders, production and distribution to be connected autonomously, without the need for people to make decisions all the time, for example, will require new management and engineering approaches all along the production chain.

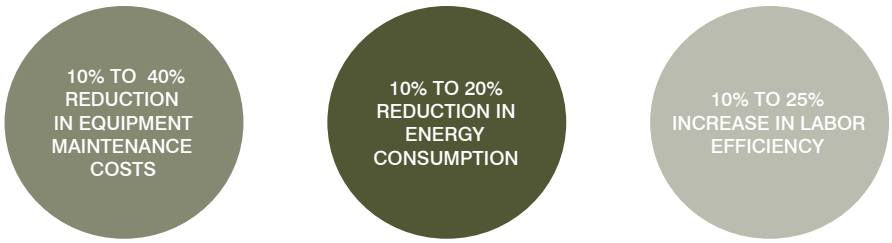
Few companies will be ready to face all the changes in one go. On the other hand, there are thousands of companies that will gradually be involved in the process of disseminating these new technologies according to their background, capabilities and strategies. In this context, an initiative designed to promote the development of Industry 4.0 in Brazil must focus on the early joiners of this new paradigm and on stimulating other companies to join this new wave, or else they will run the risk of being unable to survive in this new competitive environment.

3 EXPECTED IMPACTS

Several consultancy companies have estimated possible impacts of increased digitization on Brazil's competitiveness. Accenture, for example, estimates that the implementation of technologies related to the Internet of Things in different sectors of the economy is likely to have an impact on the Brazilian economy of about USD 39 billion by 2030[5]. This gain could rise to as much as USD 210 billion if the country creates favorable conditions to speed up the absorption of related technologies, which depends on improvements in the business environment, infrastructure, technology dissemination programs, regulation, etc.

McKinsey estimates that, by 2025, processes related to Industry 4.0 will also make it possible to reduce maintenance costs by between 10% and 40%, to reduce energy consumption by 10-20%, and to increase labor efficiency by between 10% and 25%[6].

FIGURE 6 – IMPACTS OF INDUSTRY 4.0



Source: McKinsey, 2015.

[5] ACCENTURE STRATEGY. The growth game-changer: how the industrial Internet of things can drive progress and prosperity. 2015. Available at: <https://www.accenture.com/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Dualpub_18/Accenture-Executive-Summary-Growth-Game-Changer-Industrial-Internet.pdf#zoom=50>. Accessed on May 30, 2016.

[6] MCKINSEY GLOBAL INSTITUTE. Unlocking the potential of the Internet of things. June 2015. Available at: <http://www.mckinsey.com/business-functions/business-technology/our-insights/the-Internet-of-things-the-value-of-digitizing-the-physical-world>. Accessed on Jan 1, 2016.

The gains described above, however, only represent some of the impacts that are likely to be observed. The dissemination and consolidation of Industry 4.0 will also have a series of consequences that will require a full-scale revamping of industrial policy in Brazil. The most important of these consequences are:

i) reduction in spurious competitive advantages, which will tend to be eliminated by productivity gains resulting from the adoption of new technologies, likely redefining factors that determine where productive investments are made;

ii) increased cooperation between economic agents, whose operations will become increasingly integrated;

iii) enhanced competitiveness between production systems, which include companies, suppliers, customers and environment;

iv) development of new business and market participation models, possibly redefining sectors of economic activity;

v) expanded scale of business; and

vi) emergence of new activities and new professions, which will require changes in human resource training standards.

4 THE STATE OF DIGITIZATION IN BRAZILIAN INDUSTRY

CNI survey[7] has shown that Brazilian industry's knowledge of digital technologies and their incorporation into production, which are preconditions for Industry 4.0 to move forward, is still not very widespread: 42% of the surveyed companies were not aware of the importance of digital technologies for industry's competitiveness and more than half (52%) reported that they do not use any of the digital technologies included in a list of 10 options.

Sample profile: 2,225 companies, 910 of which were small enterprises, 815 were medium enterprises, and 500 were large enterprises. From 29 sectors of the Manufacturing and Extractive industries. Data-collection period: January 4-13, 2016.

The table below identifies the 10 technologies listed in the survey, with the addition of "CAD/CAM computer-aided manufacturing processes[8].

[7] NATIONAL CONFEDERATION OF INDUSTRY. Industry 4.0. *Special survey* (Sondagem especial). Brasília, No. 66, May 2016.

[8] The option "CAD/CAM computer-aided manufacturing processes", that is, licensed software used in the development and manufacturing stages, is not considered digital technology, in spite of meaning more automated manufacturing. It was included in the responses was meant to make the difference from "Integrated engineering systems for product development and product manufacture" more clear.

TABLE 1 – LIST OF DIGITAL TECHNOLOGIES

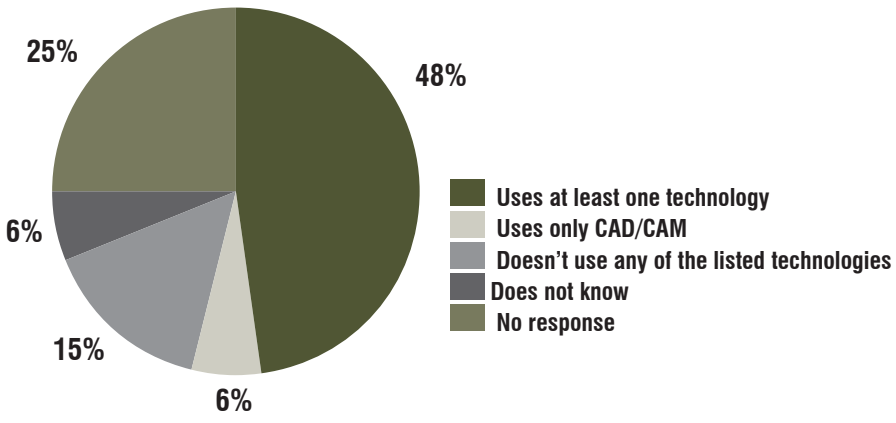
LIST OF DIGITAL TECHNOLOGIES	USE	IMPORTANCE
Digital automation without sensors	11	3
Digital automation with process control sensors	27	20
Remote monitoring and control of production through systems such as MES and SCADA (1)	7	14
Digital automation with sensors for product and operating conditions identification, flexible lines	8	21
Integrated engineering systems for product development and product manufacturing	19	25
Additive manufacturing, rapid prototyping or 3D printing	5	9
Simulations/analysis of virtual models (Finite Element, Computational Fluid Dynamic, etc.) for design and commissioning	5	5
Collection, processing and analysis of large quantities of data (big data)	9	15
Use of cloud services associated with the product	6	11
Incorporation of digital services into products ("Internet of Things" or Product Service Systems)	4	12
Computer-aided manufacturing projects CAD/CAM (2) (3)	30	9
None of the items listed	15	3
Does not know/no response	31	39

Note: The sum of the percentages exceeds 100% because of the possibility of multiple responses.
(1) MES - Manufacturing Execution Systems, SCADA - Supervisory Control and Data Acquisition.
(2) CAD - Computer-Aided Design, CAM - Computer-Aided Manufacturing.
(3) The choice "Computer-aided manufacturing projects CAD/CAM," i.e. software licenses used in development and manufacturing stages, does not fall under the category of digital tech¬nology, even though it does mean greater manufacturing automation. Its inclusion among the answer choices was intended to make clearer the difference from "Integrated engineering systems for product development and product manufacturing."
Source: Special Survey No. 66. Industry 4.0. CNI. May 2016.

Special mention should be made of the fact that 31% of the surveyed companies either did not answer or claimed not to know if they used any of the technologies on the list, revealing their high level of unawareness about this subject.

CHART 1 – USE OF AT LEAST ONE OF THE 10 LISTED DIGITAL TECHNOLOGIES IN THE TABLE ABOVE

Percentage of responses (%)



Source: Special Survey No. 66. Industry 4.0. CNI. May 2016.

The level of unawareness is significantly higher among small enterprises (57%). The percentage of large enterprises that did not mark any of the 10 digital technologies listed in the survey as important for competitiveness was lower, 32%.

A sectoral analysis, however, reveals a high degree of asymmetry in the level of use of these technologies. They are most used in the following sectors: Computers, electronics and optical products (61%); Electrical equipment (60%); Coke, refined petroleum products and biofuel, and Machinery and equipment (both with 53%). On the other hand, sectors such as Other transport equipment (23%); Repair and installation (25%); Pharmaceutical products (27%); Non-metallic mineral products (28%); Wearing apparel (29%) and Footwear and parts (29%) stand out for their low use of digital technologies.

TABLE 2 – USE OF DIGITAL TECHNOLOGIES

Percentage of companies that use at least one of the digital technologies listed in the survey (%)

	SECTOR	%
Most used in	Computers, electronics and optical products	61
	Electrical equipment	60
	Coke, refined petroleum products and biofuel	53
	Machinery and equipment	53
	Basic metals	51
Least used in	Other transport equipment	23
	Repair and installation	25
	Pharmaceutical chemicals and pharmaceuticals	27
	Non-metallic mineral products	28
	Wearing apparel	29
	Footwear and parts	29

Source: Special Survey No. 66. Industry 4.0. CNI. May 2016.

5 CHALLENGES FOR INCORPORATION AND DEVELOPMENT OF INDUSTRY 4.0 IN BRAZIL

In the medium and long term, incorporating new technologies into a strategy designed to develop of Brazilian industry will be essential to boost the country's competitiveness and increase its share in global value chains.

In some countries, Industry 4.0 has already started to become a reality, including with the support of the governments of the main economic powers, which have positioned it at the center of their industrial policy strategies. This has created a double challenge for Brazil, since apart from striving to incorporate and develop these technologies, it must also do so relatively quickly, so as to prevent the competitiveness gap between Brazil and some of its main competitors from increasing.

Furthermore, as has been the case in other countries, Industry 4.0 technologies will not be disseminated to all sectors in Brazil in the same way and at the same time. The level of heterogeneity of our industry will require adjustments in policies for different groups of sectors and companies, which will make progress in this area at different speeds and under different conditions.

In this context, CNI is drawing up an agenda of proposals on this topic through its Permanent Thematic Council for Industrial Policy and Technological Development (COPIN). This agenda features seven priority dimensions for the development of Industry 4.0 in Brazil, as listed below:

i) applications in productive chains and development of suppliers;

ii) mechanisms to drive the adoption of new technologies;

iii) technological development;

iv) expansion and improvements in broadband infrastructure;

v) regulatory aspects;

vi) human resource training; and

vii) institutional coordination.

Each of these dimensions is described below.

Applications in productive chains and development of suppliers

Digital integration of companies along production chains is paramount for the expected efficiency gains and will cause significant changes to the relationships between customers and suppliers. This will require not only adapting current processes, but also developing and incorporating new hardware and software technologies.

It is important to identify the production chains that will have to adapt to this new paradigm as quickly as possible, so that they can remain internationally competitive, regardless of their degree of autonomy in generating the technologies.

The idea is that there is, above all, a need to make progress toward Industry 4.0, not only due to the competitive pressure from competitors based on low-cost production factors, but also because the development of Industry 4.0 in other countries will certainly put more competitive pressure on some sectors of the Brazilian economy, which will need to take steps to adopt these technologies more quickly than others.

At the same time, the demand for goods and services generated by this need will create clear opportunities for digital technology suppliers in Brazil. The challenge lies in implementing policies designed to stimulate technological development in these companies and the adaptation of their products and services to the reality of Industry 4.0 in Brazil and in the global economy. The task of preparing the domestic industrial base to provide this type of solution, which involves boosting innovation, will vary in difficulty depending on the productive chain under analysis and

the set of tangible and intangible assets involved, evincing the importance of identifying paths of least resistance.

Proposals:

- Identifying sectors and types of companies with the highest potential for adopting technologies linked to Industry 4.0;
- Identifying sectors/types of companies that will be under greater competitive pressure to adopt these technologies in the short and medium term;
- Identifying sectors/types of companies in which the demonstration effects will be greatest and have the strongest impact on competitiveness all along the chain;
- Creating programs designed to develop suppliers of goods and service providers linked to digital technologies for the selected chains/sectors;
- Drawing up strategic plans for developing the selected chains/sectors.

Mechanisms to drive the adoption of new Industry 4.0 technologies

The low level of awareness of digital technologies and of their benefits, as revealed by CNI's Special Survey - Industry 4.0[11], showed the need for efforts to disseminate knowledge on the topic.

The wide range of technologies that fall within the scope of Industry 4.0 makes it difficult for users to identify the most efficient ways to meet their needs. Moreover, the complexity of these technologies requires high levels of knowledge for users to be able to employ them efficiently.

A second challenge concerns identifying industrial policy instruments that can ensure the feasibility of developing Industry 4.0 in Brazil and of stimulating it.

[11] NATIONAL CONFEDERATION OF INDUSTRY, Industry 4.0. Special Survey. Brasília, No. 66, May 2016.

Technological and commercial exchange with other countries will be fundamental for gaining access to knowledge. Therefore, the policy must stimulate such exchange for foreign technologies to be absorbed as efficiently as possible, while ensuring the feasibility of the competitive production of goods and services that are considered strategic.

Proposals:

- Creating demonstration systems for technologies associated with Industry 4.0, applying them to priority sectors;
- Improving the tax system for the selected sectors to prevent it from becoming a barrier to investment;
- Creating mechanisms to provide funding under differentiated terms with the aim of promoting the development and adoption of these technologies.

Technological development

Due to the diversification of Brazilian industry and to the attractiveness of the domestic market, the development of Industry 4.0 in Brazil will create opportunities for the development of domestic providers of solutions within this new technological environment.

For these opportunities to be fully taken advantage of, it will be necessary to develop and strengthen tools in support of the technological development of local companies. As part of this challenge, industry and government need to identify the niches where entry barriers are lowest and where, consequently, development possibilities will be greatest. The magnitude and urgency of this challenge will require focus.

The need for customizing existing solutions for different customers in a wide range of sectors will create clear opportunities for services linked, for example, to software and system integration sectors, where Brazil already has a competent base in place.

Proposals:

• Developing technological prospecting programs/services;

• Identifying segments/niches with the greatest scope for technological development domestically;

• Creating programs designed to develop specific technologies to meet Brazilian needs (mission-oriented), such as demonstrative technological platforms or testbeds;

• Focusing ICT efforts and companies on developing specific technologies, adopting the technological platform model, among other possibilities;

• Creating programs designed to facilitate technological and commercial exchange, especially with leading countries in these technologies.

Infrastructure

In the realm of Industry 4.0, information flows are essential for production to run smoothly. Therefore, a limited broadband infrastructure and cell phone network are barriers to its efficient operation.

Proposals:

• Reinforcing programs that stimulate investment in broadband and in the cell phone network;

• Reviewing the telecommunications model so that public funds can be used to ensure the feasibility of investments in the telecommunications infrastructure, regardless of the service provision regime.

Regulation

The technological transformations brought about by Industry 4.0 require an institutional coordination that is different from that applied to existing models. The architecture of the Internet can be divided into layers, each with its own characteristics. It is possible to break it down into physical infrastructure (cables, satellites, devices), logical infrastructure (technical standards) and applications (content)[12]. The players involved can be divided into connection providers, application providers, telecommunications infrastructure providers, IT goods industry, telecommunications and software goods industry, and also the user corporate sector.

Grouping layers and players according to their common characteristics makes it possible to identify specific regulatory requirements. Connection providers and providers of telecommunications infrastructure may see the need to reform the General Telecommunications Law as a priority, the software industry may require greater protection for its intellectual creations, providers of applications may see rules related to the handling of personal data as a priority, the user corporate sector may demand laws on cybersecurity, and so on. In every case, regulations should be designed to drive innovation and technological change.

As for the definition of technical standards, it should be pointed out that the regulatory process applied to the governance of the Internet is characterized by a bottom-up structure, that is, it is based on deliberations in specific global forums, such as in the W3C (World Wide Web Consortium), IETF (Internet Engineering Task Force), ICANN (Internet Corporation for Assigned Names and Numbers) and IGF (Internet Governance Forum).

Proposals:

- Reviewing the telecommunications model so that public funds can be used to ensure the feasibility of investments in the telecommunications infrastructure, regardless of the service provision regime.

- Providing appropriate protection to intellectual property;

[12] KURBALIJA, Jovan. *An introduction to Internet governance*. 6th ed. 2014. Available from: <https://issuu.com/diplo/docs/an_introduction_to_ig_6th_edition/1>. Accessed on May 30, 2016.

• Making sure that the law on the handling of personal data does not hinder the flow of international data or the collection and handling of data in machine-machine systems;

• Adopting cybersecurity standards with the aim of minimizing the number of cyberattacks, along with appriopriate laws designed to prevent and respond to incidents;

• Adopting an international approach to technical regulation with the aim of minimizing any negative effects related to the lack of interoperability.

Human resources

The new forms of production derived from Industry 4.0 require professionals with different skill sets to those of today. The integration of different forms of knowledge, which is a characteristic of this production approach, will require multidisciplinary teams with a high level of technical knowledge and the capacity to interact with different knowledge areas.

Proposals:

• Creating new technical courses to meet specific needs;

• Redesigning courses in engineering, management and other fields with the aim of adapting them to the needs of these new technologies;

• Creating multidisciplinary production management courses focused on Industry 4.0;

• Stimulating technical competency programs in companies.

Institutional Coordination

Ensuring coordinated actions among the different public players that deal directly or indirectly with matters related to the digitization of the economy, as well as appropriate links between them and private associations and companies, will play a key role in making it possible for Brazil to take advantage of all the opportunities afforded by the incorporation and development of solutions in the country.

As progress is made in digitizing the economy, different areas of application will each require specific solutions, but based on similar enabling technologies (ICT) and on the same infrastructure, such as the ones already mentioned above, i.e. smart grids, smart cities, and distance healthcare solutions, etc. Each of these is, in principle, the responsibility of different public administration bodies and can be developed separately. Coordinated actions could, however, generate scale and efficiency gains and could, in combination with industrial policy tools, ensure the feasibility of developing new digitization-related activities.

Proposals:

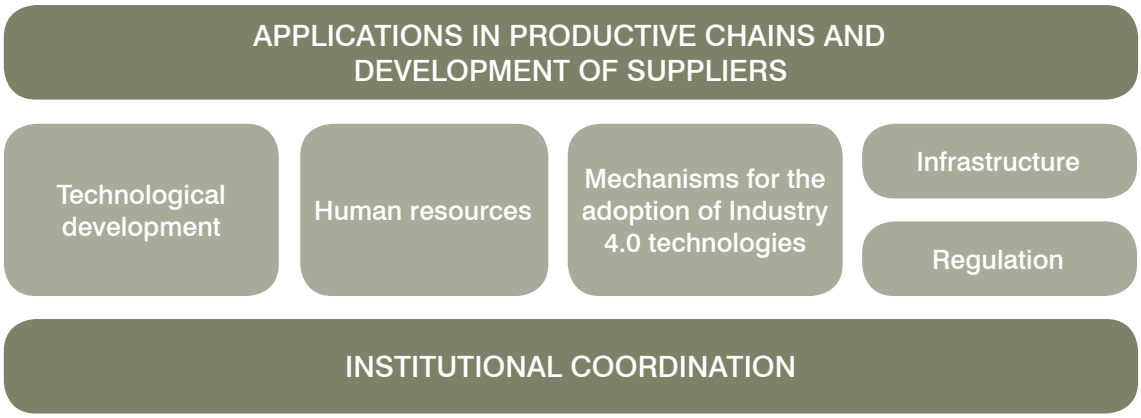
- Participating in and setting up working roups composed of representatives of different government agencies that deal with the topic;
- Drawing up a joint plan with ministries and institutions designed to promote the development of Industry 4.0 in Brazil and assigning a centralized managing agency to explore synergies and integrate policy instruments under the control of different agencies;
- Promoting fairs, seminars and congresses on the topic.

5.1 RELATIONSHIPS BETWEEN THE DIMENSIONS

The dimensions defined in this study are complementary and follow a specific logic for determining the design of the proposals. From this perspective, the dimension “Applications in productive chains and development of suppliers” is as a key element for developing the others, because each sector requires its own distinct development mechanisms due to its own unique features. Besides

this determining dimension, the "Institutional Coordination" dimension is the base for sustaining and implementing the proposals, as coordinated cooperation between the different public and private players will be of fundamental importance for Brazil to be able to take advantage of all the opportunities associated with the incorporation and development of these solutions in the country.

FIGURE 7 - RELATIONSHIPS BETWEEN THE DIMENSIONS



Source: Prepared by the authors.

6 INITIATIVES TAKEN IN OTHER COUNTRIES TO PROMOTE THE DEVELOPMENT OF INDUSTRY4.0

In recent years, Industry 4.0 has found space on the industrial development agenda of a number of countries, including Germany, United States, China, Japan and South Korea.

In Germany, developing Industry 4.0 has been a priority for the country to improve its competitiveness. The subject is dealt with through a set of actions taken by institutions and companies[13]. A report issued in 2013 by the German Academy of Science and Engineering (ACATECH) entitled Recommendations for implementing the strategic initiative Industrie 4.0[14] is one of those initiatives[15]. That report sets out a strategy for the country to become the main supplier of intelligent production technologies and to integrate its production into that of other leading countries with the aim of keeping up with technologies and coming up with standards.

[13] GERMANY TRADE & INVEST. Industrie 4.0: Smart manufacturing for the future, Jul. 2014. Available at: <http://www.gtai.de/GTAI/Content/EN/Invest/_SharedDocs/Downloads/GTAI/Brochures/Industries/industrie4.0-smart-manufacturing-for-the-future-en.pdf>. Accessed on: Jan. 1st, 2016.

[14] FORSCHUNGSUNION; ACATECH. Securing the future of German manufacturing industry: recommendations for implementing the strategic initiative industrie 4.0. Apr. 2013. Available at: <http://www.acatech.de/fileadmin/user_upload/Baumstruktur_nach_Website/Acatech/root/de/Material_fuer_Sonderseiten/Industrie_4.0/Final_report_Industrie_4.0_accessible.pdf>. Accessed on Jan. 1, 2016.

[15] ACATECH. Works and results. Apr. 2013. Available at: <http://www.acatech.de/uk/home-uk/work-and-results.html>. Accessed on Jan. 1, 2016.

In 2012, the United States introduced the Advanced Manufacturing Partnership (AMP), which is made up of representatives of companies, universities, the government, and research institutions, to discuss and present proposals for the development of Industry 4.0 in the country. This initiative is coupled with the reindustrialization measures that have been developed in the USA over the last decade. In 2014, the group presented the Report to the President. Accelerating U.S. Advanced Manufacturing[16], featuring a series of measures for promoting the development of technologies associated with this method of production. The report also proposes the implementation of a national strategic plan for Industry 4.0.

In China, the 12th Five-year Plan (2011-2015) presents Industry 4.0 as one of the seven emerging items supported by the Chinese government and establishes five priority sectors: modern equipment, automotive, steel, petrochemicals and shipbuilding.

In Japan, the National Institute of Advanced Industrial Science and Technology (AIST) created in 2008 the Advanced Manufacturing Research Institute (AMRI), which is made up of an assortment of research groups focused on exchanging knowledge and developing joint projects.

In South Korea, the Korea Advanced Manufacturing System (KAMS) was created as a project designed to develop new processes and technologies for managing and integrating manufacturing systems. The project was set up by the Korea Institute of Industrial Technology (KITECH) with the support of the Ministry of Trade, Industry and Energy and of the Ministry of Science and Technology.

In Brazil, the Ministry of Communications[17] created in late 2014 the Machine-to-Machine (M2M) and Internet of Things Chamber with the aim of developing the "National M2M and Internet of Things Communications Plan." This Chamber is composed of representatives of a number of associations and ministries divided into several sub-groups, including the Industrial Productivity and Industry 4.0 sub-group, of which CNI is a member. Recently, the Ministry of Development, Industry and Foreign Trade (MDIC) set up an Industry 4.0 Working Group made up of representatives of several institutions, including CNI, with the goal of drawing up an action plan for Industry 4.0 in Brazil.

[16] UNITED STATES OF AMERICA. Accelerating U.S. advanced manufacturing. Oct. 2014. Available at: <https://www.whitehouse.gov/sites/ default/ files/microsites/ostp/PCAST/amp20_report_final.pdf>. Accessed on Jan. 1, 2016.
[17] BRAZIL. Ministry of Communications. Ruling No. 1.420, of October 8th 2014. Available at: <http://editoramagister.com/ legis_26044825_ PORTARIA_N_1420_DE_8_DE_OUTUBRO_DE_2014.aspx>. Accessed on May. 30, 2016.

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