



INVESTMENTS IN INDUSTRY 4.0

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NATIONAL CONFEDERATION OF INDUSTRY– CNI

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CNI. THE STRENGTH OF THE BRAZILIAN INDUSTRY

INVESTMENTS IN INDUSTRY 4.0

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PRESENTATION

Developing Industry 4.0 solutions is the key element of the strategies of major industrialized nations and of the world's leading companies.

When widely applied in industrial activity, digital technologies yield benefits such as increased operational efficiency and cost reduction, more flexible production lines and shorter product launch intervals, apart from making room for the creation of products, digital services and business models.

Implementing Industry 4.0's enabling technologies is a decisive step toward improving the competitiveness of companies and promoting Brazil's integration into global value chains.

This study contributes to explaining the evolution observed in the use of technologies associated with Industry 4.0 by Brazilian industries.

The results presented here show that the number of large industrial companies using digital technologies has increased in recent years and that a significant percentage of these companies have plans to invest in this area in 2018.

We hope that this publication will be useful for guiding companies in defining their strategies and for stimulating the implementation of public policies that will help Brazil to respond to these transformations appropriately.

I wish you a good reading.

Robson Braga de Andrade
President of the Brazilian National Confederation of Industry (CNI)



1 SUMMARY OF RESULTS¹

The recent years have seen an increase in the number of Brazilian industries that use digital technologies, that is, that are in Industry 4.0, albeit at an early stage. From early 2016 to early 2018, the percentage of large companies that use at least one of the digital technologies considered in the surveys edged up from 63% to 73%.

Large industrial companies prioritize digital technologies to increase efficiency of production processes and improve business management, particularly *Digital automation with process control sensors*.

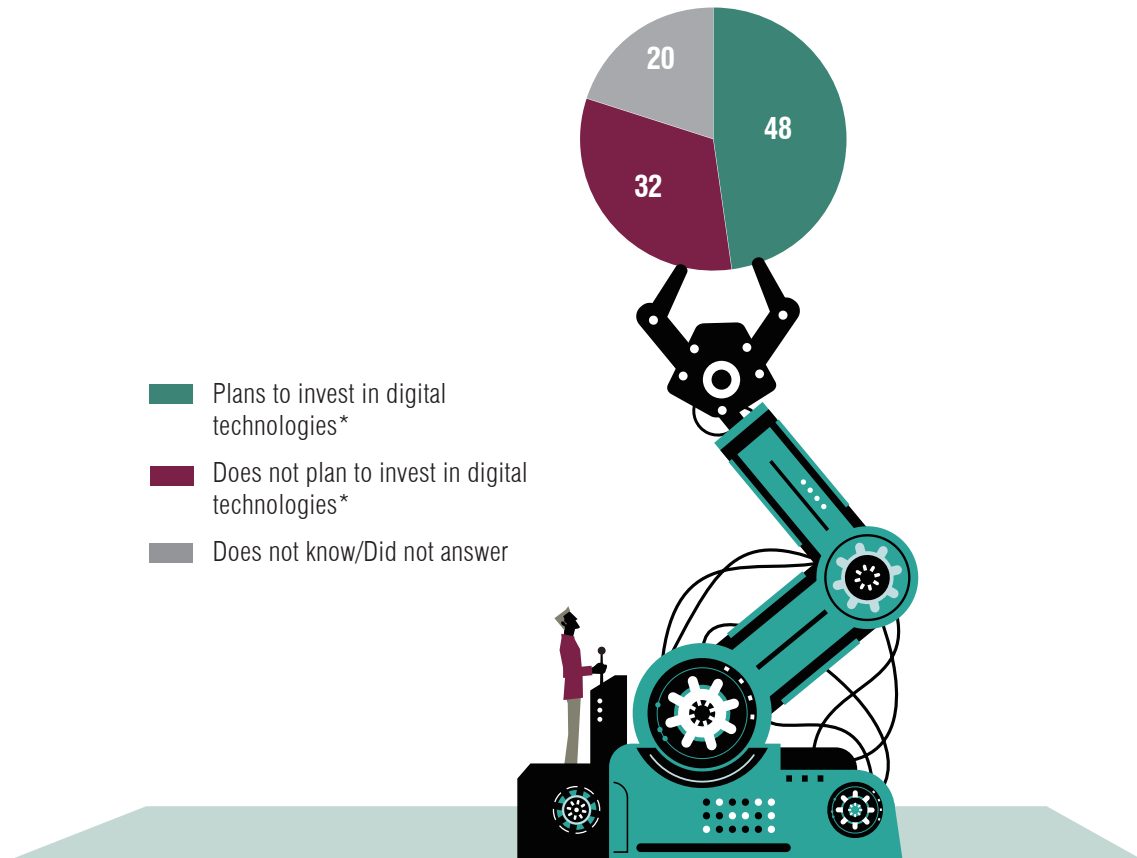
Almost half (48%) of large industrial companies have plans to invest in these technologies in 2018.

Companies have begun to take action to incorporate digital technologies beyond production processes, i.e. technologies applied to product development and in products and business models. Investment plans have a less concentrated distribution across digital technology types than the current distribution of technology use.

¹ Study based on a special block of the Investment in Industry 2018 survey, conducted with large companies (250 or more employees).

Nevertheless, **most companies intend to invest in technologies they already use.** While the technology is already used by the company, the plan to invest in this same technology suggests that it has not yet been fully implemented.

FIGURE 1 - FORECASTED INVESTMENTS IN DIGITAL TECHNOLOGIES IN 2018
Percentage of responses among all respondent companies (%)



* Plans to invest in at least 1 of the 13 digital technology options listed. See Table 1 for the list of technologies considered.

** Includes companies that do not intend to invest in 2018 and companies that have plans to invest but not in one of the 13 digital technologies listed.



2 USE OF DIGITAL TECHNOLOGIES

2.1 USE OF DIGITAL TECHNOLOGIES BY BRAZILIAN INDUSTRY IN 2018

Seven out of ten large industries already use digital technologies

Among large industrial enterprises, 73% are already in Industry 4.0, although in early stages of technology deployment. These companies adopt at least one type of the digital technologies presented in a list with 13 options (see Table 1).

Digital automation with process control sensors is the most used technology by companies (46% of answers). Ranking next is *Integrated engineering systems for product development and product manufacturing* (37% of responses).

Technologies that enable more flexible, integrated and autonomous lines are not yet in widespread use: 23% use *Digital automation with sensors for products and operating conditions identification, flexible lines*. Coming next with close percentages are *Collection, processing and analysis of large quantities of data (big data) about the company* (21%) and *Remote monitoring and control of production through systems such as MES and SCADA* (19%).

TABLE 1 - COMPANIES USING DIGITAL TECHNOLOGIES
Percentage of responses among all respondent companies (%)

FOCUS	TECHNOLOGY	COMPANIES THAT USE IT
Production process/ business management	Digital automation without sensors, use of Programmable Logic Controller (PLC) without sensors	30
	Digital automation with process control sensors	46
	Digital automation with sensors for products and operating conditions identification, flexible lines	23
	Collection, processing and analysis of large quantities of data (big data) about the company	21
	Remote monitoring and control of production through systems such as MES and SCADA*	19
	Additive manufacturing, collaborative robots (cobots)	13
	Intelligent management systems such as M2M (machine-to-machine) communication, Digital Twin, and Artificial Intelligence (AI)	9
Product development	Integrated engineering systems for product development and product manufacturing	37
	Rapid prototyping, 3D printing and the like	16
	Simulations/analysis of virtual models for design and commissioning (Finite Element, Computational Fluid Dynamic, etc.)	13
Product/new business models	Collection, processing and analysis of large amounts of data (big data) about the market; monitoring product use by consumers	9
	Use of cloud services associated with the product	16
	Incorporation of digital services into products (Internet of Things or Product Service Systems)	11

Note: The sum of percentages exceeds 100% because of the possibility of multiple responses.

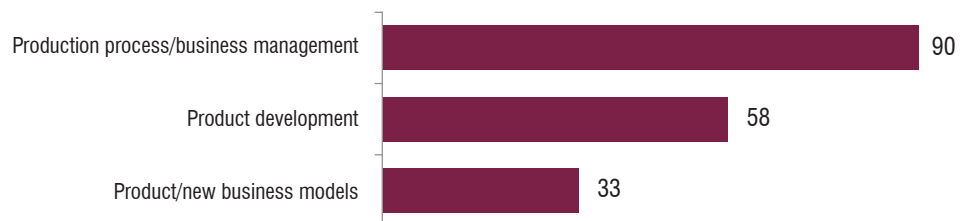
*MES – Manufacturing Execution Systems; SCADA – Supervisory Control and Data Acquisition.

Focus lies on technologies applied to production processes and/or business management

In the transition to Industry 4.0, Brazilian industrial companies have prioritized digital technologies to increase efficiency of production processes and improve business management. Among the large companies that use digital technologies, the vast majority (90%) use at least one technology focused on production processes and/or business management.

Digital technologies applied to product development are used by 58% of companies. As for technologies targeted toward products and new business models, the percentage drops to 33%.

FIGURE 2 – FOCUS OF DIGITAL TECHNOLOGIES USED
Percentage of responses among companies that use digital technologies*



Note: The sum of percentages exceeds 100% because of the possibility of multiple responses.

* Companies that use at least one of the 13 digital technologies listed. See Table 1 for the list of technologies considered.

The low percentage of companies that use more advanced digital technologies (such as additive manufacturing, collaborative robots, intelligent management systems, simulations and analysis of virtual models, and the Internet of things) comes as no surprise. Advancing toward these applications requires a greater transformation in modes of production and business models. Most Brazilian industries are still in the early stages of incorporating digital technologies.

2.2 EVOLUTION BETWEEN 2016 AND 2018

More companies are using 4.0 Industry technologies, although in early stages

In early 2016, according to **Special Survey 66: Industry 4.0**, 63% of large companies were using digital technologies (CNI, 2016). This percentage increased to 73% in early 2018, but the focus remains on technologies applied to the production process.

No significant changes were seen in the ranking of most used technologies, even though the options of technology types listed in the two surveys are not identical. *Digital automation with process control sensors* and *Integrated engineering systems for product development and product manufacturing* are still the most commonly used technologies. It is worth noting that in the first case, the percentage of companies using the technology rose from 40% to 46% and, in the second case, it increased from 27% to 37% (see table 2).

Digital automation without sensors ranked third in 2016, with 15% of the answers. The associated option in 2018 is *Digital automation without sensors, use of Programmable Logic Controller (PLC) without sensors*. This type of technology also ranks third, with 30% of companies using the technology.

All technologies saw an increase in the percentage of companies that use them, but *Cloud services associated with the product* was the only one that moved up in the ranking (ahead of *Simulations/analysis of virtual models for design and commissioning*, *Finite Element*, *Computational Fluid Dynamic*, etc.). Despite the change, it remains among the least used digital technologies.

TABLE 2 - COMPANIES THAT USE DIGITAL TECHNOLOGIES: COMPARISON BETWEEN 2016 AND 2018
Percentage of responses among all respondent companies (%)

FOCUS	TECHNOLOGY	SPECIAL SURVEY 2016*	INVESTMENT IN INDUSTRY 2018 SURVEY
Production process/ business management	Digital automation without sensors	15	..
	Digital automation without sensors, use of Programmable Logic Controller (PLC) without sensors	..	30
	Digital automation with process control sensors	40	46
	Digital automation with sensors for products and operating conditions identification, flexible lines	13	23
	Collection, processing and analysis of large quantities of data (big data) about the company	..	21
	Remote monitoring and control of production through systems such as MES and SCADA**	10	19
	Additive manufacturing, collaborative robots (cobots)	..	13
	Intelligent management systems such as M2M (machine-to-machine) communication, Digital Twin, and Artificial Intelligence (AI)	..	9
Product development	Integrated engineering systems for product development and product manufacturing	27	37
	Additive manufacturing, rapid prototyping or 3D Printing	9	..
	Rapid prototyping, 3D printing and the like	..	16
	Simulations/analysis of virtual models for design and commissioning (Finite Element, Computational Fluid Dynamic, etc.)	8	13
Product/new business models	Collection, processing and analysis of large quantities of data (big data)	13	..
	Collection, processing and analysis of large amounts of data (big data) about the market; monitoring product use by consumers	..	9
	Use of cloud services associated with the product	7	16
	Incorporation of digital services into products (Internet of Things or Product Service Systems)	4	11

Notes: The sum of percentages exceeds 100% because of the possibility of multiple responses.

.. This option was not available in the survey in question.

*Source: CNI (2016).

**MES – Manufacturing Execution Systems; SCADA – Supervisory Control and Data Acquisition.

3 INVESTMENT IN DIGITAL TECHNOLOGIES



3.1 INTENTION TO INVEST IN DIGITAL TECHNOLOGIES IN 2018

In 2018, 48% of large companies have plans to invest in digital technologies, that is, in Industry 4.0. According to CNI (2018), 81% of large companies plan on investing in 2018. Thus, six out of ten companies with investment plans (60%) intend to invest in digital technologies.

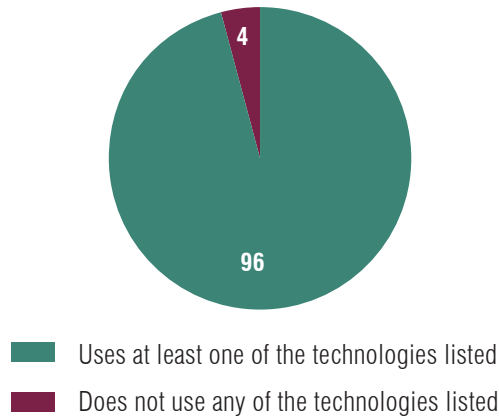
The percentage of companies that have no plans to invest in these technologies stands at 32%. Note that 20% have investment plans, but did not know or did not want to answer if these investments include digital technologies.

Almost all companies that will invest in digital technologies have already experience with such technologies

Investments in digital technologies in Brazil are very concentrated in companies that already use these technologies. Virtually all companies with plans to invest in digital technologies (96%) already use at least one of the 13 technologies listed (Figure 3).

**FIGURE 3 - COMPANIES WITH PLANS TO INVEST IN DIGITAL TECHNOLOGIES
BROKEN DOWN BY COMPANIES THAT ALREADY USE AND DO NOT USE DIGITAL TECHNOLOGIES**

Percentage (%) of responses among companies with plans to invest in digital technologies*

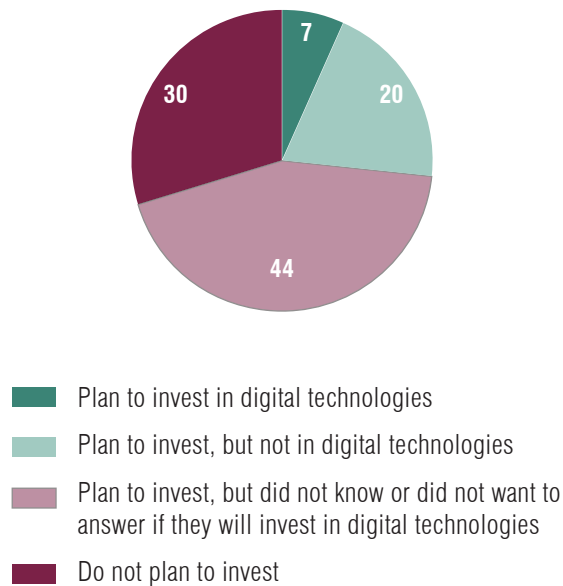


* Companies with plans to invest in at least one of the 13 digital technologies listed. See Table 1 for the list of technologies considered.

Another way to verify the low number of new companies planning to use digital technologies is by assessing investment decisions of businesses that do not use any of the technologies listed or that did not know or did not want to answer that question. In this group of companies, which still have no experience with Industry 4.0 technologies, the percentage of those that have plans to invest in digital technologies amounts to 7% (Figure 4).

FIGURA 4 - INVESTMENT INTENTIONS BY COMPANIES THAT DO NOT USE DIGITAL TECHNOLOGIES

Percentage (%) of companies that do not use digital technologies*



* Companies that do not use any of the 13 technologies listed or that could not answer.

Most companies will invest in technologies they already use

Companies that plan to invest in digital technologies will do so mainly in technologies they already use, though they may also invest in other technologies (70% of companies planning to invest will do so in more than one type of technology). On average, 60% of companies with plans to invest in a type of digital technology already use that type of technology.

This behavior is more common with *Digital automation without sensors, use of Programmable Logic Controller (PLC) without sensors and Digital automation with process control sensors*. In the first case, 84% of companies that intend to invest in the technology already use it. In the second case, the percentage stands at 80%.

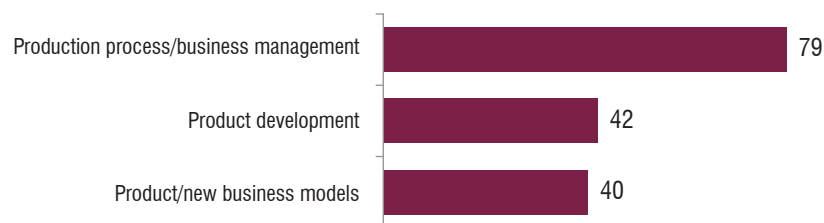
At the other extreme are *Collection, processing and analysis of large amounts of data (big data) about the market; monitoring product use by consumers* (42% of companies with plans to invest in this technology already use it) and *Cloud services associated with the product*, with 45%.

This behavior suggests that most Brazilian industrial companies are still in the early stages of digitization. Investing in technologies that are already used indicates that the process of implementing such solutions has not yet been completed, regardless of the type of technology chosen for entering the digitized world.

Some companies are already looking for more advanced technologies

It is worth stressing, however, that there are companies already looking to move into other types of technology. The distribution of companies by digital technologies in which they plan to invest in 2018 is less concentrated than the distribution of companies that use the technologies.

FIGURE 5 - FOCUS OF INVESTMENTS IN DIGITAL TECHNOLOGIES
Percentage of responses among companies with plans to invest in digital technologies*



Note: The sum of percentages exceeds 100% because of the possibility of multiple responses

* Companies with plans to invest in at least one of the 13 digital technologies listed. See Table 1 for the list of technologies considered.

When comparing with Figure 2, one can see that investment plans are relatively more focused on less-used technologies. In the case of technologies aimed at products and new business models, 40% of companies with plans to invest in digital technologies will do so in these types of technologies – a percentage higher than that of large companies that already use them (33%).

Digital technologies related to production processes or business management are also the most popular among companies planning to invest in digital technologies. However, the percentage of businesses with investment plans (79%) is lower than that of enterprises that already use them (90%).

Digital automation with process control sensors is the technology with the highest percentage of companies that included it in their investment plans for 2018 (46% of responses, considering only those companies that intend to invest in at least one of the digital technologies listed).

TABLE 3 - DIGITAL TECHNOLOGIES: CURRENT USE AND INVESTMENT INTENTIONS

FOCUS	TECHNOLOGY	COMPANIES THAT USE IT (% of total sample)	PLANS TO INVEST (% of companies with plans to invest in at least one digital technology)
Production process/ business management	Digital automation without sensors, use of Programmable Logic Controller (PLC) without sensors	30	18
	Digital automation with process control sensors	46	46
	Digital automation with sensors for products and operating conditions identification, flexible lines	23	28
	Collection, processing and analysis of large quantities of data (big data) about the company	21	25
	Remote monitoring and control of production through systems such as MES and SCADA*	19	29
	Additive manufacturing, collaborative robots (cobots)	13	19
	Intelligent management systems such as M2M (machine-to-machine) communication, Digital Twin, and Artificial Intelligence (AI)	9	17
Product development	Integrated engineering systems for product development and product manufacturing	37	30
	Rapid prototyping, 3D printing and the like	16	16
	Simulations/analysis of virtual models for design and commissioning (Finite Element, Computational Fluid Dynamic, etc.)	13	10
Product/new business models	Collection, processing and analysis of large amounts of data (big data) about the market; monitoring product use by consumers	9	18
	Use of cloud services associated with the product	16	23
	Incorporation of digital services into products (Internet of Things or Product Service Systems)	11	16

Note: The sum of percentages exceeds 100% because of the possibility of multiple responses.

*MES – Manufacturing Execution Systems; SCADA – Supervisory Control and Data Acquisition.

Three technologies are almost tied in second place: *Integrated engineering systems for product development and product manufacturing*; *Remote monitoring and control of production through systems such as MES and SCADA*; and *Digital automation with sensors for products and operating conditions identification, flexible lines*, with 30%, 29% and 28% of answers respectively. Currently, the percentages of companies that use these technologies account respectively for 37%, 19% and 23% of large industrial companies.

3.2 INVESTMENTS IN DIGITAL TECHNOLOGIES BROKEN DOWN BY OBJECTIVE AND NATURE OF MAIN INVESTMENT PLANNED FOR 2018

Advancement of Industry 4.0 requires investment in innovation

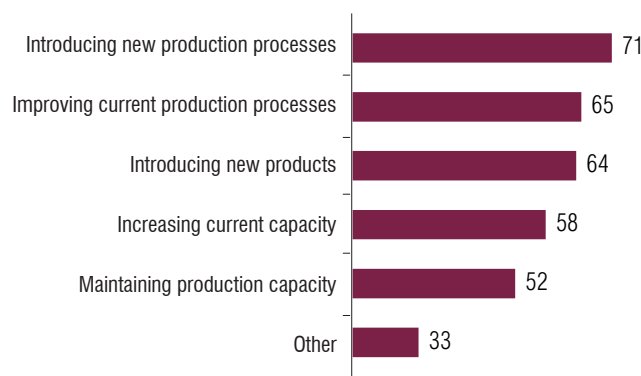
According to the **Investment in Industry 2018 survey**, more than half of all large Brazilian industrial companies (54%) with plans to invest in 2018 are focused mainly on innovation: improving production processes and introducing new processes and/or products (CNI, 2018) .

This trend contributes toward the growth of Industry 4.0 in Brazil. The percentage of companies planning to invest in digital technologies is higher among businesses whose main investment objective is to introduce a new product or introduce a new or improved production process.

Considering all companies with investment plans for 2018, 60% intend to invest in digital technologies. Considering only those companies whose main investment objective for 2018 is to introduce new production processes, 71% plan to invest in digital technologies. This percentage falls to 52% when considering only the companies that will invest mainly in maintaining production capacity.

FIGURE 6 - INVESTMENT IN DIGITAL TECHNOLOGIES BY MAIN INVESTMENT OBJECTIVE ANTICIPATED FOR 2018

Percentage (%) of companies that indicated the respective objective as their main investment goal

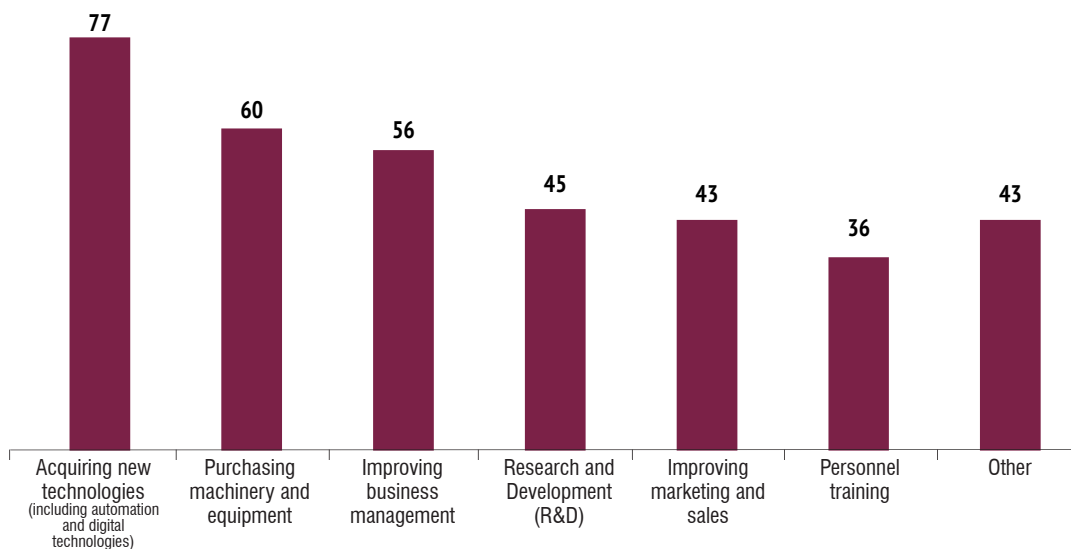


With respect to the investment nature, among the companies whose investments in 2018 will be focused mainly on acquiring new technologies, almost eight out of ten (77%) have plans to invest in digital technologies.

Among those companies that will invest mainly in purchasing machinery and equipment or improving business management, the percentages are smaller, but also significant (60% and 56%, respectively).

In the case of companies whose main investments for the year are targeted mainly toward carrying out Research and Development (R&D) activities, the percentage of those that plan on investing in digital technologies falls to 45%. This low percentage makes sense, as investments in R&D precede innovation – be it for the introduction of a new product or process or for the improvement of a product or production process.

FIGURE 7 - INVESTMENT IN DIGITAL TECHNOLOGIES BY NATURE OF MAIN INVESTMENT IN 2018
Percentage (%) of companies that indicated the respective nature





4 FACTORS AFFECTING INVESTMENT DECISIONS

The expected recovery of demand is the main factor encouraging industrial investments in 2018. Technical factors – i.e. technology, labor and raw materials – have also affected investment decisions positively. Financial resources and regulation or red tape in turn have had a negative impact on investment (CNI, 2018).

When comparing the companies with plans to invest in digital technologies with those that intend to invest but not in digital technologies, it is observed that the former have a more positive perception of the impact of these four factors, mainly with regard to technical factors.

Demand recovery is the biggest investment driver among large industrial companies. Among companies planning on investing in digital technologies, 69% indicated that their investment decisions as a whole have been stimulated by demand in 2018. For 18% of these businesses, demand hindered their investment intentions. In the case of companies that plan to invest, but not in digital technologies, demand was considered an encouraging factor by 61% of companies and a limiting factor by 27%.

Companies planning on investing in digital technologies are more technically prepared

There is a clear difference between companies that will invest in digital technologies and those that will not in terms of their assessment of the impact of technical factors (technology, labor, raw material, etc.) on their investment decisions.

Over half of all companies with plans to invest in digital technologies (53%) said that technical factors encouraged them to invest. For 16%, these factors hindered their investment decisions.

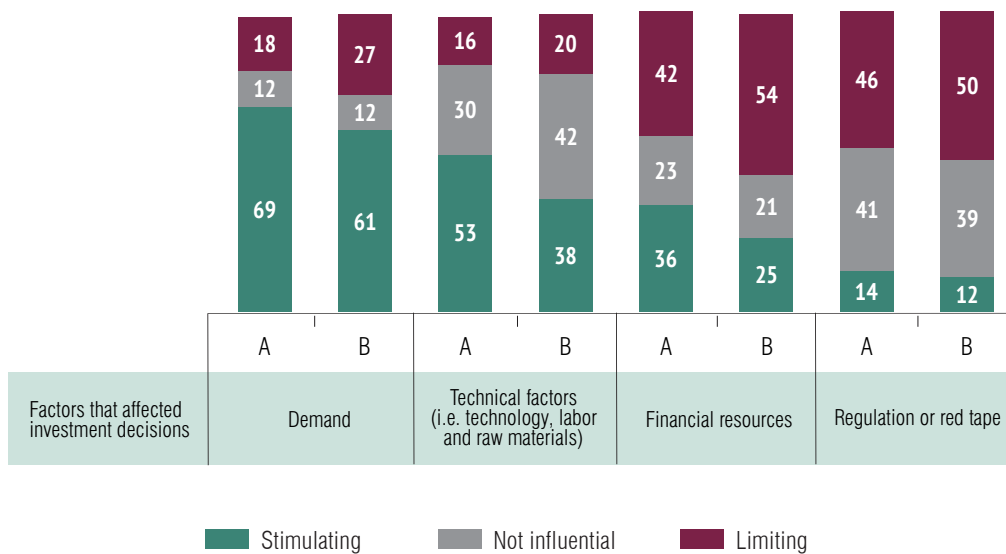
In the group of companies that will not invest in digital technologies, 38% considered technical factors to be encouraging and 20% considered them to be limiting.

Regulation/red tape is the main factor hindering investments

Almost half of all large industrial companies that plan to invest in digital technologies (46%) mentioned regulation/red tape as a factor hindering their investment decisions and 14% said this factor encouraged them to invest. This is to say that the percentage of companies that consider this factor limiting is 32 percentage points higher than that of businesses that consider it stimulating.

The Financial Resources factor also shows a negative difference between the percentage of companies that consider it to be stimulating (36%) and that of businesses that consider it a limiting factor (42%).

FIGURE 8 - FACTORS AFFECTING INVESTMENT DECISIONS
Comparison between companies that intend (A) and do not intend (B) to invest in digital technologies
Percentage of responses (%) among companies with plans to invest in 2018



A: companies with plans to invest in digital technologies
B: companies with plans to invest, but not in digital technologies

Note: The sum of percentages exceeds 100% because of the possibility of multiple responses. Companies that did not answer how these factors affected their investment decisions were not considered.

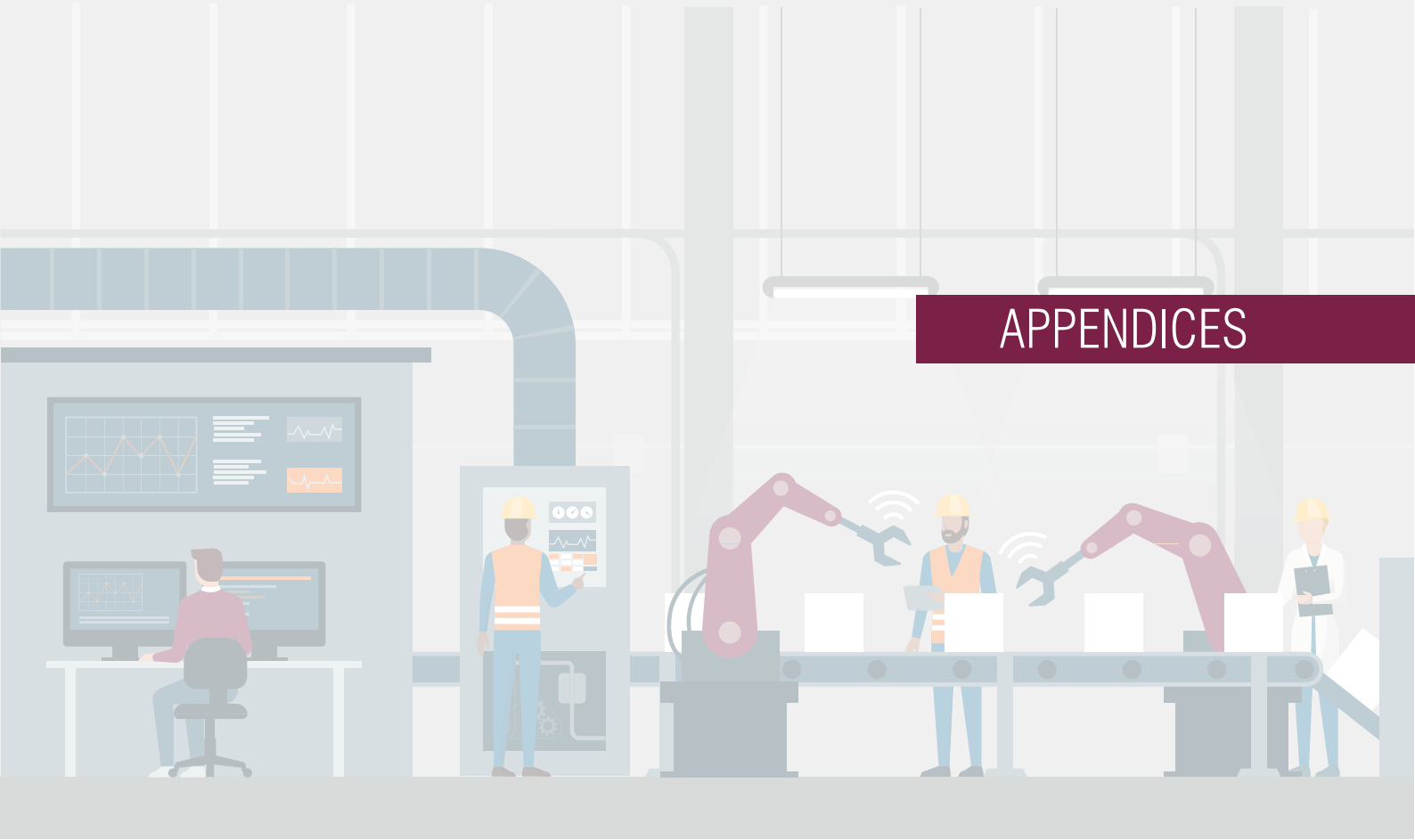


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APPENDICES



APPENDIX A – TECHNICAL NOTES

The **Investment in Industry 4.0** survey was based on two questions included in the questionnaire of the **Investments in Industry 2018** survey.

The survey is carried out by the National Confederation of Industry (CNI) with large industrial companies. It is a business opinion survey designed to identify not only the investment intentions of Brazilian industry, but also the main drivers and obstacles faced by companies in carrying out their investment plans.

The questions on Industry 4.0 (available in Appendix B) aim to understand the use of digital technologies and companies' intentions to invest in these technologies.

LOCATION	Brazil
DATA COLLECTION PERIOD	January 24 to March 19, 2018
UNIVERSE	The survey unit used are national companies with at least 250 employees (large companies) and whose main economic activity is classified as manufacturing or mining and quarrying industry, according to IBGE's National Classification of Economic Activities (CNAE 2.0). The survey population is made up of 3,581 companies.
SAMPLING METHOD	The sampling method used is the simple random sample with proportional allocation to the sectors. The sample was designed to have a maximum error of 5% at a 95% confidence level.
ACTUAL SAMPLE	632

For more information on the **Investments in Industry** survey, visit www.cni.com.br/e_investindustria

APPENDIX B – QUESTIONNAIRE

Investment intentions in 2018 – Digital technologies

1. Mark the **digital technologies** your company **already use**: (Mark all appropriate answers)

- Computer-aided manufacturing projects CAD/CAM*
- Integrated engineering systems for product development and product manufacturing
- Rapid prototyping, 3D printing and the like
- Simulations/analysis of virtual models for design and commissioning (Finite Element, Computational Fluid Dynamic, etc.)
- Digital automation **without sensors**, use of Programmable Logic Controller (PLC) without sensors
- Digital automation **with process control sensors**
- Digital automation **with sensors** for products and operating conditions identification, flexible lines
- Remote monitoring and control of production through systems such as MES and SCADA*
- Intelligent management systems such as M2M (machine-to-machine) communication, Digital Twin, and Artificial Intelligence (AI)
- Additive manufacturing, collaborative robots (cobots)
- Collection, processing and analysis of large quantities of data (big data) about the company
- Incorporation of digital services into products (Internet of Things or Product Service Systems)
- Collection, processing and analysis of large amounts of data (big data) about the market; monitoring product use by consumers
- Use of cloud services associated with the product
- None of the items listed
- Does not know

** 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 technology, 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." For this reason, its choice was not computed as digital technology use.*

2. Mark in which **digital technologies** your company **intend to invest in 2018**: (Mark all appropriate answers)

- Computer-aided manufacturing projects CAD/CAM*
- Integrated engineering systems for product development and product manufacturing
- Rapid prototyping, 3D printing and the like
- Simulations/analysis of virtual models for design and commissioning (Finite Element, Computational Fluid Dynamic, etc.)
- Digital automation **without sensors**, use of Programmable Logic Controller (PLC) without sensors
- Digital automation **with process control sensors**
- Digital automation **with sensors** for products and operating conditions identification, flexible lines
- Remote monitoring and control of production through systems such as MES and SCADA*
- Intelligent management systems such as M2M (machine-to-machine) communication, Digital Twin, and Artificial Intelligence (AI)
- Additive manufacturing, collaborative robots (cobots)
- Collection, processing and analysis of large quantities of data (big data) about the company
- Incorporation of digital services into products (Internet of Things or Product Service Systems)
- Collection, processing and analysis of large amounts of data (big data) about the market; monitoring product use by consumers
- Use of cloud services associated with the product
- None of the items listed
- Does not know

** 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 technology, 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." For this reason, its choice was not computed as an intention to invest in digital technology.*

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