



SPECIAL SURVEY

Industry 4.0



National Confederation of Industry
Brazil
CNI. THE STRENGTH OF THE BRAZILIAN INDUSTRY

Industry 4.0: a new challenge for Brazilian industry

The use of digital technologies in Brazilian industry is not widespread. Of all industries, 58% of companies are aware of the importance of these technologies for industrial competitiveness and less than half are actually using them.

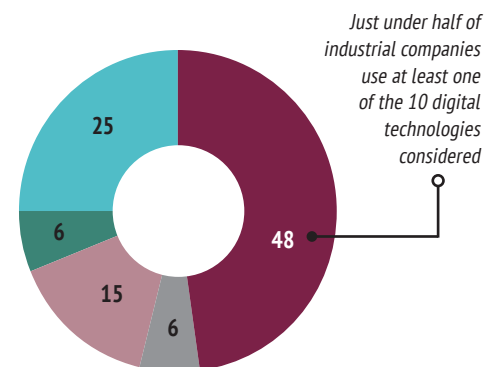
The focus has been on improving the production process, increasing productivity. Albeit this is a positive focus, it is limited, as it leaves opportunities open in the supply chain development stage and in the exploration of new business models. Brazilian industry has been following a path that seems natural: initially, it focuses on increasing efficiency and then on applications more geared to developing new products and new business models. However, considering Brazil's competitive position in the global economy, it would be most advisable to concentrate the digitization effort on all dimensions simultaneously.

The progress of Industry 4.0 in Brazil depends on greater knowledge by companies of the gains derived from digitization, both with regard to increased productivity and to opportunities for new business models, flexibility and customization of production and for reducing the time to launch products on the market. The high costs of digitization, which the surveyed companies referred to as a major constraint, can be mitigated by implementing it in stages. Greater access to information and the identification of partners will help to reduce uncertainties and to change corporate culture.

It is possible to contribute to fostering digitization in Brazil by promoting digital infrastructure, investing and stimulating professional training and promoting the creation of specific funding lines. Setting up demonstration platforms could be an effective initiative to stimulate the dissemination of the concept and the establishment of partnerships between customers and suppliers of new technologies.

Use of at least one of the 10 listed digital technologies

Percentage of responses (%)



- Uses at least one technology
- Uses only CAD/CAM
- Doesn't use any of the listed technologies
- Does not know
- No response



DIGITAL TECHNOLOGIES IN MANUFACTURING

Adopting digital technologies is essential for competitiveness

The digitization applied on a large scale in industrial production gave rise to the concept of advanced manufacturing. Due to the significant impact of digitization both on production and product development and on ways of doing business, some consider such changes as the fourth industrial revolution, giving rise to the term Industry 4.0 as an alternative to the advanced manufacturing expression.

Regardless of how such changes are called, there is no doubt that companies that fail to adopt digital technologies will face a lot of difficulties to remain competitive and active on the market.

Advanced manufacturing involves the integration of physical and digital technologies, the integration of all stages of the value chain, from development to the end use of a product and the services linked to it, the autonomous operation of networks. It is much more than the automation of the industrial process. It consists, for example, in the integration between machines and systems (including between different factories in the same supply chain). It is the digital connection between machines and products.

One of the impacts of digitization is a more efficient production process or improved productivity. By being able to monitor the entire

process, companies can allocate their machines efficiently, identify problems quickly and reduce bottlenecks, optimize processes, reduce defects in products and even prevent problems before they build a factory or develop a prototype. They can also increase resource efficiency such as energy efficiency, thereby contributing to reduce costs.

Using sensors on the machines and in parts and components of products allows for more flexible production lines and reduces the need for high production scales to achieve a competitive average cost advantage. This technology allows for greater customization of production, expanding the market to be served by the company.

Integrating development and manufacturing processes and using virtual simulations both for products and production processes reduce the time for a new product to be introduced in the market. The result is a faster return on innovations.

Finally, companies can embed digital technology into products, making it possible to create new business models and/or to promote increased interaction with customers and/or suppliers.

DIGITIZATION OF BRAZILIAN INDUSTRY

Low knowledge constitutes an obstacle to utilization

Brazilian industry is still becoming familiar with the impacts of digitization or of advanced manufacturing on sectors and business models¹. Among the companies surveyed, 43% could not identify which digital technologies in a list of 10 options have the greatest potential to boost the competitiveness of industry². This unawareness is significantly higher among small enterprises (57%). Among large enterprises, the percentage of those that could not identify any of the 10 digital technologies presented as important for competitiveness dropped to 32%.

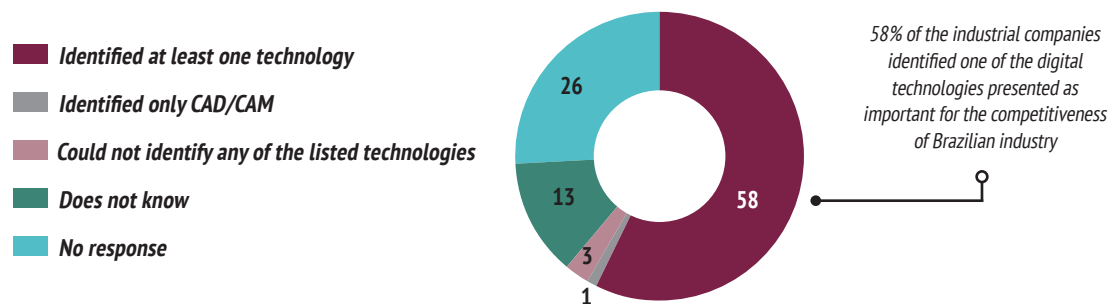
Classifying manufacturing industries according to technology intensity³, it was seen that 52% of the companies in the low-technology industries could not identify any of the 10

digital technologies presented as important for competitiveness. This percentage drops to 40% among companies operating in medium-high technology industries.

Among the companies from the Wearing apparel industry, 63% could not identify one of the listed technologies, followed by the Repair and installation and the Leather and related products industries both with 59%, the Wood products industry with 57% and the Rubber products industry with 56%. Among those with the lowest percentages of lack of awareness, companies in the following industries stand out: Machinery and equipment (30%), followed by Electrical equipment (31%) and Motor vehicles, trailers and semi-trailers (37%).

Chart 2 – Identification of at least one of the 10 digital technologies listed as important for the competitiveness of industry

Percentage of responses (%)



Note: The sum of percentages may be different from 100% for rounding reasons.

* CNI thanks the respondent companies for taking part in the survey and is grateful for the comments from João Fernando Gomes de Oliveira and José Borges Frias Júnior, exempting them from any responsibility.

¹ In this Survey, companies in the mining and quarrying and manufacturing industries were interviewed. The results for industry as a whole are weighted averages of company sizes. The weights that were used are the following ones: small enterprise (0.246), medium enterprise (0.259) and large enterprise (0.496).

² In fact, 11 choices were presented, but 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". See Table 2.

³ The classification developed by the OECD aggregates the manufacturing industries under four categories: High, medium-high, medium-low and low-technology industries. For more details, see the box on page 13.



High-tech industries are the ones that make greater use of digital technology

Lack of awareness is accompanied by low use of digital technologies in industry. Of all industries, 48% of companies use at least one of the listed technologies. This percentage rises to 63% among large companies and drops to 25% among small ones.

Considering the importance of digitization to increase the efficiency of companies, to improve products and develop new business models, the low use of digital technologies in Brazil has

negative effects on the competitiveness of the country in the global economy.

The higher the technological intensity of industrial activity, the greater the use of digital technologies. Among companies from the high-technology industries, 47% use digital technologies. This percentage drops to 36% among companies from the low technology industries.

Table 1 - Companies that use at least one of the listed digital technologies
Ranking of sectors

Percentage of responses per sector (%)

SECTORS THAT USE DIGITAL TECHNOLOGY THE MOST		%
Computers, electronics and optical products		61
Electrical equipment		60
Coke, refined petroleum products and biofuel		53
Machinery and equipment		53
Basic metals		51
Plastics products		49
Other manufacturing		49
Textiles		47
Motor vehicles, trailers and semi-trailers		46
Chemicals (exc. Soap and detergents, cleaning preparations and others) (1)		45
SECTORS THAT USE DIGITAL TECHNOLOGY THE LEAST		%
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

The Other transport equipment stands out for the lowest percentage of companies that use digital technologies (23%) and also for the highest percentage of companies that marked only the choice related to CAD/CAM-aided manufacturing projects (27%).

(1) Soap and detergents, cleaning and polishing preparations, perfums and toilet preparations.

Digitization is focused on improving processes

Another feature of digitization in Brazilian industry is the focus on processes, i.e. on increased efficiency and productivity. Among the companies that adopt at least one of the listed digital technologies, 73% have adopted at least one technology related to the production process; 47% related to the development stage of the production chain and 33% to products and new business⁴.

Regarding the importance of digitization in the entrepreneurs views, the focus remains on

processes, but the percentage of response choices related to products and new business models increases. Therefore, there is a greater awareness of the importance of technologies focused on development and products in relation to what is actually used.

This result suggests that Brazilian industry is following a path that can be seen as natural. Initially, it takes advantage of the opportunities afforded by digital technologies to optimize

Table 2 – Use and importance for competitiveness of digital technologies

Percentage of responses (%)

STAGE/FOCUS	TECHNOLOGY	USE	IMPORTANCE FOR COMPETITIVENESS
Process	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
Development/reduction in time to market	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
Product/new business models	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 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."

⁴ The digital technologies were classified according to their use in the stages of the production chain (development, production process and product). [See Table 2.](#)



processes to then move to applications more focused on development, products and new business models. However, considering that Brazilian industry needs to compete globally and that it is lagging behind in this race, skipping steps is necessary. It is necessary to promote digitization in all dimensions simultaneously.

In relation to digital technologies applied to processes, Brazilian industrial companies are still far from adopting more flexible and dynamic lines. Of all industries, 27% of companies (a little more than half of companies that adopt digital technologies) adopt digital automation with sensors for process control. Regardless of company size, this is the most used digital technology in industry, although among large companies this percentage rises to 40% (63% of large companies that use digital technology).

Digital automation with sensors to identify products and operating conditions, which allows for flexible and autonomous lines, is still little used by Brazilian industry: only 8% of companies use it (13% of the large companies). Adopting more flexible production lines allows to implement the concept of mass customization, which reduces the minimum scale for efficient production and allows companies to serve customers of different tastes and needs, that is, in addition to reducing production costs, it increases the market in which they operate.

Digital automation with sensors to identify products and operating conditions is seen as the next natural stage of digitization of the production process. It is noteworthy that it was cited as important for the competitiveness of industry by 21% of companies, ranking second, almost matching by the digital automation with process control sensors option (20%).

The second most used digital technology in Brazilian industry can be classified as focused on product development, reducing the time to make products available to consumers: integrated engineering systems for product development and product manufacturing, which are being adopted by 19% of companies. Special mention should be made, however, of the rare use of the other technologies to reduce development costs and the set-up of manufacturing processes. Simulations and analysis with virtual models are used by only 5% of companies, as well as additive manufacturing, rapid prototyping or 3D printing.

Little use is also made of technologies focused on products: 9% of companies collect, process and analyze large quantities of data (big data), 6% use cloud services associated with products and 4% incorporate digital services into products (internet of things or product service systems).

High- and medium-high tech sectors make greater use of development-related technologies

Among the companies that adopt least one of the listed digital technologies, 61% of companies from the high-technology industries and 58% of companies from the medium-high technology sectors adopt at least one technology related to the development stage of the production chain. The percentages fall to 42% in the low-technology industries and to 44% in the medium-low technology industries.

In the manufacturing industry, in terms of ranking, the two most widely used technologies across all technology intensity categories are digital automation systems with process control sensors and integrated engineering systems for product development and manufacturing, as shown in Table

3. However, the percentage of companies in high- and medium-high technology industries indicating the option “integrated engineering systems” (20% and 21%, respectively) – a technology linked to the production chain development stage – was almost twice as high as that in medium-low and low-technology industries (13% and 12%, respectively).

In addition, high- and medium-high technology industries also make greater use of other development-related technologies. Additive manufacturing, rapid prototyping or 3D printing is used by 9% of companies in the high-technology industries, while simulations and analysis of virtual models are used by 10% of companies in the medium-high technology industries.

Table 3 – Use of digital technologies

Percentage of responses by technological intensity (%)

STAGE/FOCUS	TECHNOLOGY	TECHNOLOGICAL INTENSITY			
		HIGH	MEDIUM-HIGH	MEDIUM-LOW	LOW
Process	Digital automation without sensors	12	9	9	8
	Digital automation with process control sensors	25	23	20	17
	Remote monitoring and control of production through systems such as MES and SCADA (1)	8	5	5	5
	Digital automation with sensors for products and operating conditions identification, flexible lines	12	6	6	6
Development/reduction in time to market	Integrated engineering systems for product development and product manufacturing	20	21	13	12
	Additive manufacturing, rapid prototyping or 3D printing	9	5	4	2
	Simulations/analysis of virtual models (Finite Element, Computational Fluid Dynamic, etc.) for design and commissioning	3	10	3	2
Product/new business models	Collection, processing and analysis of large quantities of data (big data)	8	7	8	6
	Use of cloud services associated with the product	8	6	4	5
	Incorporation of digital services into products ("Internet of Things" or Product Service Systems)	9	4	4	3
	Computer-aided manufacturing projects CAD/CAM (2) (3)	32	41	26	20
	None of the items listed	20	19	20	20
	Does not know	5	4	7	7
	Did not answer	22	19	29	30

Note: The sum of 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 option "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. It was included in the answer options to make clearer the difference from "Integrated engineering systems for product development and product manufacturing."

Computers, electronics and opticals products stand out for making the most use of digital technologies across all production chain stages

The Computers, electronics and opticals products sector shows the highest percentage of companies that use at least one of the 10 digital technologies under analysis: 61% of companies (see Table 1). This sector ranks first in use of technology across all production chain stages: 43% of companies use process-oriented technologies; 41% use technologies related to the development stage, and 22% use technologies focused on product or new business models.

The Electrical equipment and the Computers, electronics and opticals products sectors are virtually tied in terms of percentage of enterprises that use at least one of the digital technologies in general (60%). With respect to the use of digital technologies according to the production chain stages, Electrical equipment also holds a leading position in the rankings of use of technologies focused on development and on product. In relation to the use of process-

oriented technologies, the sector ranks fourth (36% of answers).

As shown in Table 4, besides Computers, electronics and opticals products, the following sectors deserve special mention in the production process stage: Coke, refined petroleum products and biofuel (43%) and Basic metals (42%). The Machinery and equipment sector, which ranked fourth in the overall ranking, is not among the top ten sectors in the production process stage. With 27% of companies in Machinery and equipment using at least one of the process technologies, the sector is tied in 13th place with Soap and detergents, cleaning preparations and others and Metal products. Ranking sixth in the overall ranking, Other manufacturing is also not in the top ten sectors in the process stage. With 31%, the sector ranks eleventh.

In relation to technologies applied in the production chain development stage, the Motor vehicles, trailers and semi-trailers and the Machinery and equipment sectors also deserve special mention (besides the above-mentioned sectors), as they ranked third (36%) and fourth (35%), respectively. Other manufacturing and Footwear and parts ranked fifth and sixth, respectively, with 28% and 24% of companies in these sectors using at least one of the digital technologies related to development. Coke, refined petroleum products and biofuel, which ranked third in the overall ranking, occupied the seventeenth place in the ranking of use of development-oriented technologies, along with Rubber products, with 11% of answers. Textiles and Chemicals (except Soap and detergents, cleaning preparations and others) also did not make the top 10 sectors that make the most use of technology at this stage (see Table 5).

When analyzing the use of digital technology focused on products and on creating new business models, Computers, electronics and opticals products and Electrical equipment sectors are tied for first place (both with 22% responses). Note that, ranked amongst the top 10 are: Other transport equipment, Soap and detergents, cleaning preparations and others, Footwear and parts, Printing and reproduction, and Leather and related products – sectors that are not among those with the highest percentage of companies using digital technologies in general. Machinery and equipment, Coke, refined petroleum products and biofuel, Basic metals, and Motor vehicles, trailers and semi-trailers did not make the top ten sectors making the most use of technology at this stage (see Table 6).

Table 4 – Use of digital technologies focused on processes – Ranking of sectors

Percentage of responses (%)

Position	Sector	%
1	Computers, electronics and opticals products	43
1	Coke, refined petroleum products and biofuel	43
3	Basic metals	42
4	Electrical equipment	36
4	Plastics products	36
6	Textiles	35
6	Chemicals (exc. Soap and detergents, cleaning preparations and others) (1)	35
6	Motor vehicles, trailers and semi-trailers	35
9	Pulp and Paper	34
10	Food	32

(1) Soap and detergents, cleaning and polishing preparations, perfums and toilet preparations.

Table 5 – Use of digital technologies focused on development – Ranking of sectors

Percentage of responses (%)

Position	Sector	%
1	Computers, electronics and opticals products	41
2	Electrical equipment	40
3	Motor vehicles, trailers and semi-trailers	36
4	Machinery and equipment	35
5	Other manufacturing	28
6	Footwear and parts	24
7	Metal products (except machinery and equipment)	22
7	Basic metals	22
7	Furniture	22
10	Plastics products	21
10	Pulp and Paper	21

Table 6 – Use of digital technologies focused on products – Ranking of sectors

Percentage of responses (%)

Position	Sector	%
1	Computers, electronics and opticals products	22
1	Electrical equipment	22
3	Plastics products	19
4	Textiles	17
4	Chemicals (exc. Soap and detergents, cleaning preparations and others) (1)	17
4	Other transport equipment	17
7	Soap and detergents, cleaning preparations and others (1)	16
8	Footwear and parts	15
9	Printing and reproduction	14
9	Leather and related products	14

(1) Soap and detergents, cleaning and polishing preparations, perfums and toilet preparations.

Reducing costs and increasing productivity are the most sought-after benefits

The focus on processes becomes even clearer when evaluating the benefits that companies expect to achieve by implementing digital technologies. The two main expected benefits are reducing operating costs, as indicated by 54% of enterprises, and increasing productivity, with 50%. Optimizing automation processes (35%) ranked fourth.

The item “improving the quality of products or services” was indicated by 38% of companies as one of the main benefits expected from digitalization and ranked third. With 24%, the options “developing

more customized products or services” (related to product) and “improving decision-making processes” (related to management) ranked fifth.

For large companies, improving the quality of products or services ranked fourth, with 39% of responses. The three benefits most mentioned by large companies are focused on processes: reducing operating costs, with 63%; increasing productivity, with 58%; and optimizing automation processes, with 46%.

Table 7 – Expected benefits from adopting digital technologies

Percentage of responses by company size (%)

STAGE/FOCUS	BENEFITS	INDUSTRY	FIRMS BY SIZE		
			SMALL	MEDIUM	LARGE
Efficiency	Reducing operating costs	54	41	51	63
	Increasing productivity	50	39	47	58
	Optimizing automation processes	35	21	29	46
	Increasing energy efficiency	18	10	18	22
Efficiency/management	Increased visibility and control of business processes (value chain, production, etc.)	17	11	16	21
	Improving decision-making processes	24	16	23	28
Development/reduction in time to market	Reducing the time to market for new products	10	6	10	12
Product	Improving the quality of products or services	38	36	38	39
	Developing more customized products or services	24	21	24	26
	Creating new business models	6	9	6	5
Environment	Improving sustainability	8	7	8	9
Worker	Compensating for the lack of skilled workers	7	10	9	5
	Improving worker safety	19	13	17	22
	Reducing labor claims	4	4	5	4
Does not know/no response		28	39	30	21

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

High implementation cost is the main internal barrier

For 66% of companies, implementation costs constitute the main internal barrier to the adoption of digital technologies. The items “lack of clarity in defining return on investment” and “corporate structure and culture” are virtually tied for second place with 26% and 24% of answers, respectively.

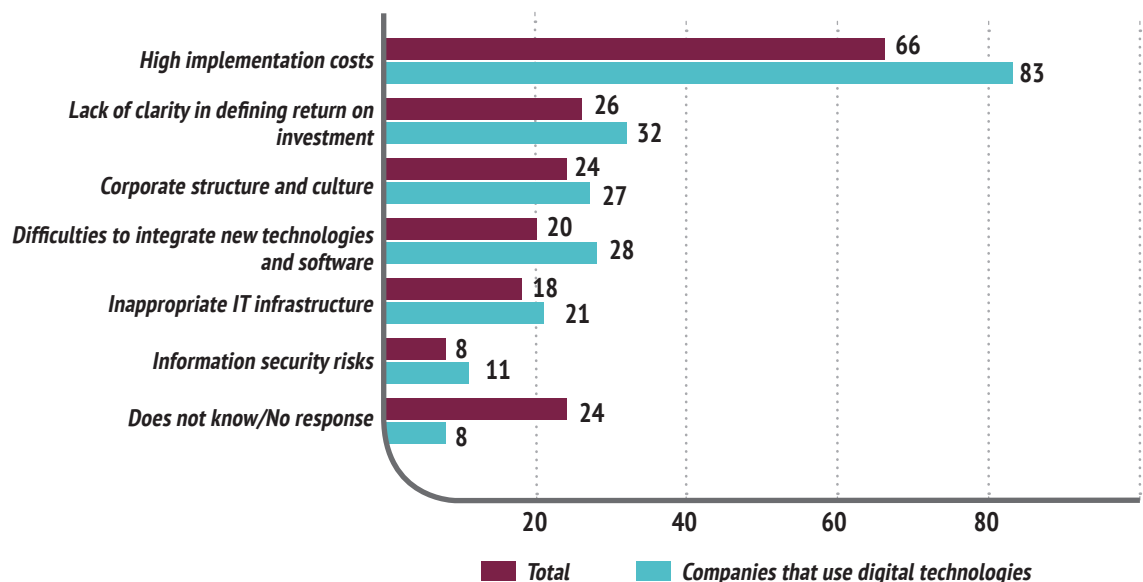
When the analysis is restricted to the group of companies that use digital technologies, it can be seen that corporate structure and culture decline in importance as an internal barrier. This option is virtually tied with “difficulties to integrate new technologies and softwares” with 27% and 28% of responses, respectively. The item “lack of clarity in defining return on investment” ranked second (32% of responses). The high implementation cost is the main internal barrier, as indicated by 83% of companies.

Across all sectors, the most mentioned item was “high implementation costs”. In high-tech sectors, the percentage of answers was as high as 74%. The highest percentages were recorded in Computers, electronics and opticals products (80%), followed by Soap and detergents, cleaning preparations and others (78%), Machinery and equipment (77%), and Motor vehicles, trailers and semi-trailers (72%).

Other major barriers faced by most sectors are a lack of clarity on return on investment and issues surrounding corporate structure and culture. The only exceptions are Soap and detergents, cleaning preparations and others, Computers, electronics and opticals products, and Electrical equipment, with companies in these sectors placing greater emphasis on “difficulties to integrate new technologies” or “inappropriate IT infrastructure” than on “corporate structure and culture”.

Chart 3 – Internal barriers hindering the adoption of digital technologies

Total companies and companies that use digital technologies
Percentage of responses (%)



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

Lack of skilled workers is the biggest challenge among external factors

Among all external barriers, special mention should be made of lack of skilled workers, with 30% of answers. The other items show similar percentages (ranging from 24% to 26%), except for “lack of technical standards” and “inadequate regulation”, which were not seen as major issues.

For large companies, country’s insufficient telecommunications infrastructure ranked first, virtually tied with the issue of lack of skilled workers (30% and 28% of answers, respectively).

The importance of external barriers also varies across industrial sectors. Only companies in the low- and medium-low technology industries consider the issue of lack of skilled workers to be the main external barrier. The Printing and reproduction sector stands out with the highest percentage of enterprises indicating lack of skilled workers (43%), followed by Leather (42%) and Wood products (39%).

For companies in medium-high technology industries, the two most mentioned factors were “difficulties to identify technologies and partners” and “lack of appropriate credit lines”, with 29% of responses each.

The Other transport equipment sector shows the highest percentage of companies indicating the issue of lack of appropriate credit lines (40%), followed by Motor vehicles, trailers and semi-trailers (37%), and Machinery and equipment (33%).

The percentage of answers for difficulties to identify partners and technologies was highest in Soap and detergents, cleaning preparations and others (35%), followed by Motor vehicles, trailers and semi-trailers (34%) and Other transport equipment (33%).

Chart 4 – External barriers hindering the adoption of digital technologies

Percentage of responses (%)



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



Government should focus on infrastructure and education

Forty-six percent of industrial enterprises believe that the government should promote the development of digital infrastructure (broadband, sensors) to accelerate the adoption of digital technologies in Brazil. Education ranks second: for 42% of companies, investing in new educational models and training programs should be one of the top three priorities. This option is followed by the need to establish specific credit lines (37%).

Other issues related to the establishment of regulatory frameworks and technical standards and to data transfer and security are not listed among the most important measures.

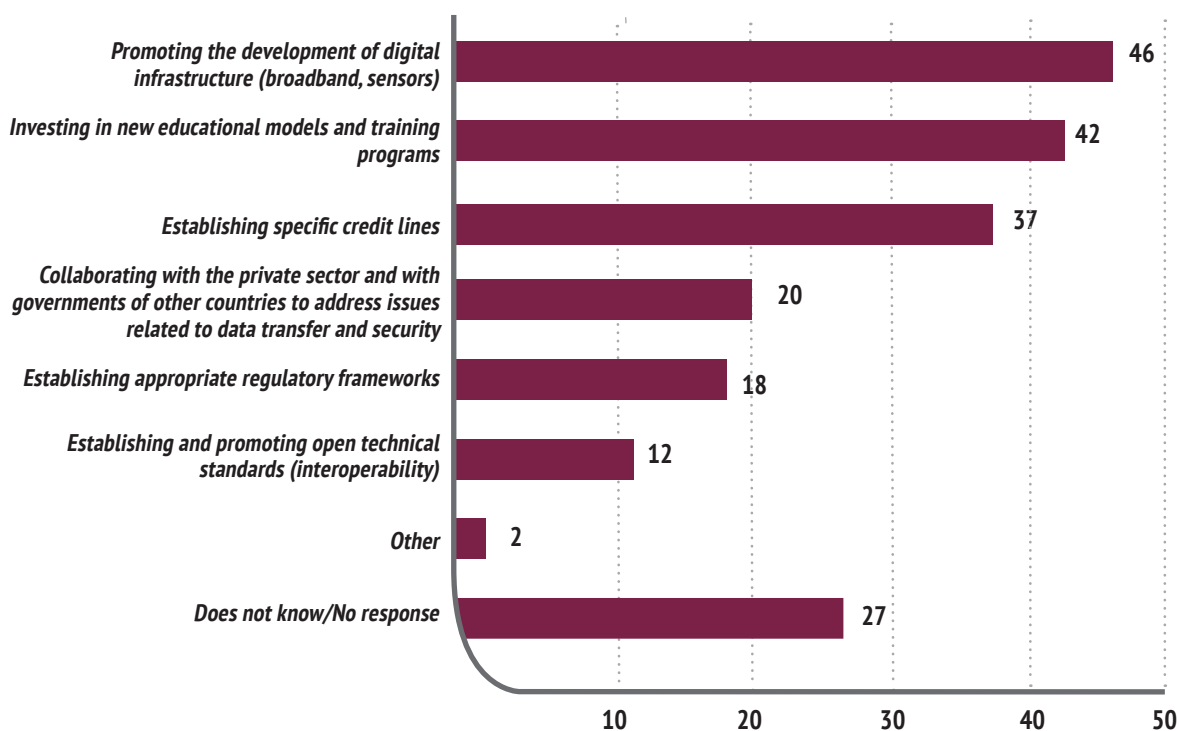
Government investment in new educational models and training programs is as important as the development of digital infrastructure for companies in low-technology (42% and 43% of

answers, respectively) and medium-low technology (39% and 40% responses, respectively) industries.

Another measure highlighted by companies across all sectors is the establishment of specific credit lines. The only exceptions are Electrical equipment and Leather and related products, as companies in these two sectors believe that working in collaboration with the private sector and with governments of other countries to address issues related to data transfer and security is as important as establishing specific credit lines. In the Electrical equipment sector, issues concerning data transfer and security were mentioned by 31% of companies, while the establishment of specific credit lines was indicated by 29% of them. In Leather and related products, these figures stood, respectively, at 26% and 23%.

Chart 5 – Government measures to accelerate the adoption of digital technologies

Percentage of responses (%)



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



Classification by technological intensity (%)

SECTORS	CATEGORIES
Pharmaceutical chemicals and pharmaceuticals	High
Computers, electronics and opticals products	
Chemicals (exc. Soap and detergents, cleaning preparations and others)	Medium-High
Soap and detergents, cleaning preparations and others (1)	
Electrical equipment	
Machinery and equipment	
Motor vehicles, trailers and semi-trailers	
Other transport equipment	
Coke, refined petroleum products and biofuel	
Rubber products	Medium-Low
Plastics products	
Non-metallic mineral products	
Basic metals	
Metal products (except machinery and equipment)	
Repair and installation	
Food	
Beverages	
Tobacco	
Textiles	
Wearing apparel	
Footwear and parts	
Leather and related products	
Wood products	
Pulp and Paper	
Printing and reproduction	
Furniture	
Other manufacturing	

Source: Classification prepared by CNI based on OECD. *ISIC REV 3 Technology Intensity Definition*, 2011.
(1) Soap and detergents, cleaning and polishing preparations, perfums and toilet preparations.



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Survey data

Sample profile: 2,225 enterprises, including 910 small, 815 medium and 500 large companies.
Data collection period: January 4-13, 2016.