_2020
CaixaBank
Sectoral
Digitalisation
Index

THE DIGITALISATION OF SPANISH COMPANIES

The state of affairs

CaixaBank
Research

All of CaixaBank Research's publications are available on the website: www.caixabankresearch.com

CaixaBank Research
www.caixabankresearch.com
research@caixabank.com

Enric Fernández
Chief Economist

José Ramón Díez
Head of International Economies and Financial Markets

Oriol Aspachs
Head of Spanish Economy

Sandra Jódar
Head of Strategic Planning

Judit Montoriol-Garriga and Àlex Ruiz
2020 CSDI coordinators

Ana Bras, Alberto Graziano and Laura Becerra
2020 CSDI contributors

Date this issue was closed:
June 2021

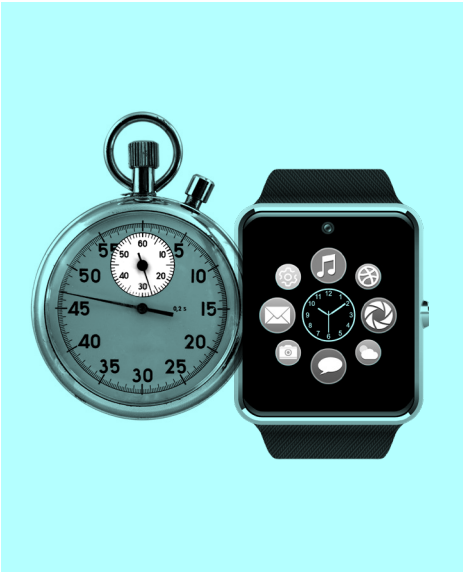
_2020
CaixaBank
Sectoral
Digitalisation
Index

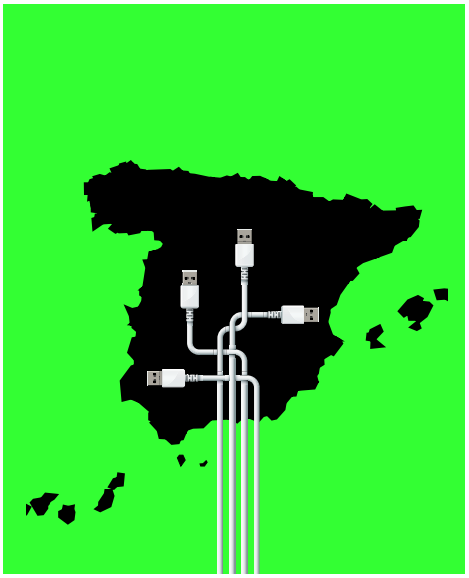
THE DIGITALISATION OF SPANISH COMPANIES

The state of affairs

CaixaBank
Research

_Contents





Executive summary

The digitalisation of companies is an unavoidable process. At times of rapid change like the present, technological disruption affects all types of businesses, irrespective of their sector of activity and size. This transformation is essential to boost business productivity, sustainable growth and high-quality job creation. This is acknowledged in the Recovery, Transformation and Resilience Plan (RTRP) launched by the Spanish Government, whose cornerstones include promoting the digital transition of the economy and society as a whole. This goal will be achieved through various initiatives that account for 30% of the total investments of Next Generation EU funds.

Given the importance of digitalisation to business competitiveness and the economic future of the country, CaixaBank Research wanted to do its bit to help to understand how the different sectors of activity in the Spanish economy are being digitalized. Hence the creation of the CaixaBank Sectoral Digitalisation Index (CSDI).

The digital transformation of businesses which, if possible, is even more pressing due to COVID-19, is a phenomenon that goes beyond the technology itself. It is a complete process that includes everything from redefining the business plan to developing new skills for workers so that they meet the needs of the present and future. To cover these many facets, the CSDI is built from highly varied sources of information (external data sources, CaixaBank's internal data and information from Twitter) and it is divided into 3 pillars (and 18 sub-pillars) that allow digitalisation to be analysed in different areas: (i) digital production assets (technological capital and the digitalisation of human resources), (ii) the digital intensity of value chain interactions (interactions with suppliers, customers, general government and financial institutions) and (iii) the intensity of use of digital technologies (from the more traditional ones to emerging technologies such as blockchain).

When we examine the degree of digitalisation of the Spanish economy from an industry perspective, there are two standout features. Firstly, this process is still occurring unevenly across different sectors: according to the 2020 CSDI, the information and communication technology (ICT) industry is in first place in the digitalisation ranking, followed quite closely by the professional, scientific and technical activities sector, a result that is to be expected given the nature of these sectors of activity. Secondly, putting aside the leading industries in terms of digitalisation, the degree of digitalisation of the remaining sectors is rather similar and, in most cases, although not extraordinarily large, their distance from the European technological frontier is not small either.

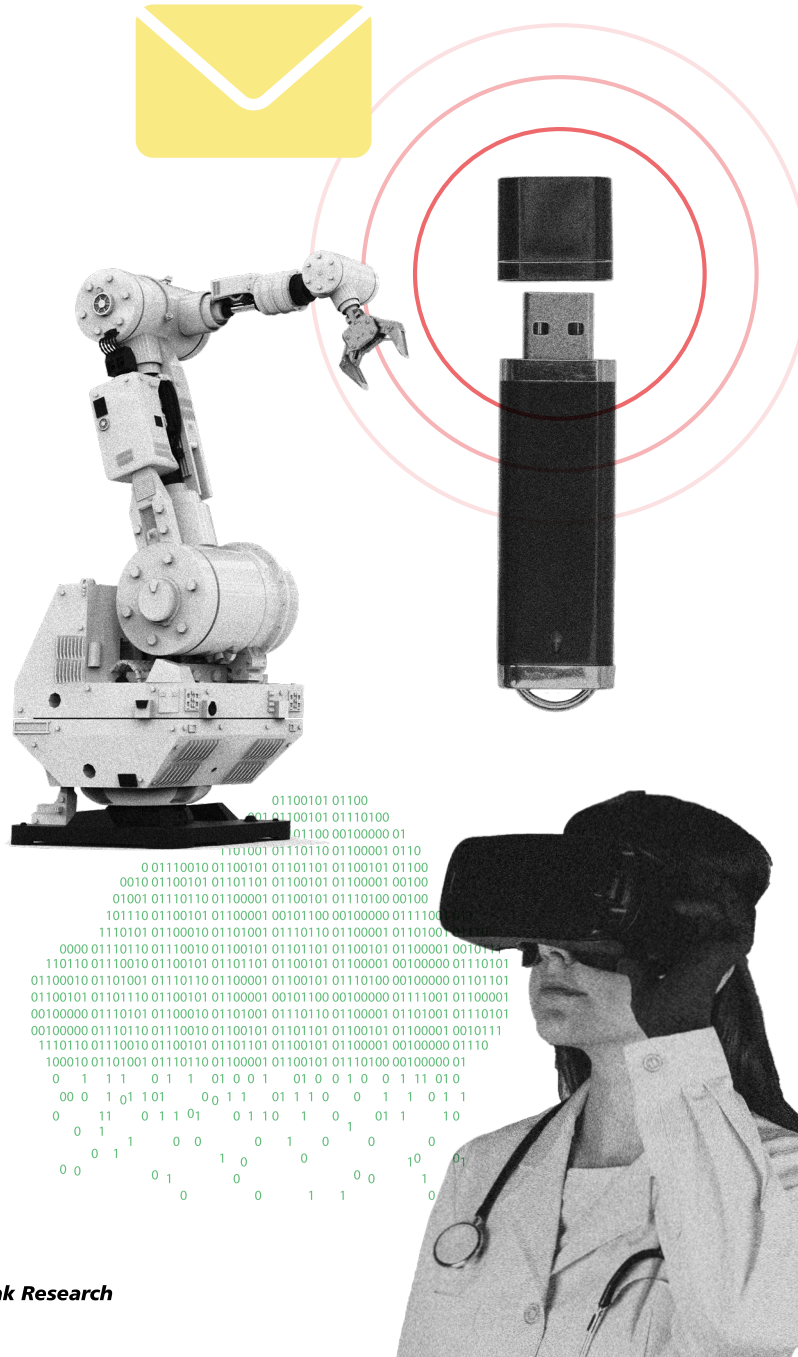
When we analyse the different areas that comprise the CSDI, we can observe that the formula for making an industry a digital leader consists of getting many aspects right and, insofar as is possible, being equipped with workers with the best digital skills. Without question, digital talent is a key factor when undertaking the digital transformation of businesses.

The digital intensity of interactions in the value chain is highly varied, but three common elements stand out. Firstly, the pull effect of general government is important, underlining the importance of digitising the government and improving digital public services, due to the strong pull effect that this has on digitising the economy as a whole. Secondly, digital interactions with customers are relatively well-developed, reflecting the emphasis placed on the customer's experience and satisfaction. However, in most sectors of activity that were analysed, digital interaction with suppliers requires further development, with one significant exception: banking. In this case, the digital intensity involved in arranging and using banking services is greater than it is with other types of suppliers.

The extent to which different digital technologies have been adopted by businesses also varies greatly: (i) what we call «predominant technologies» (email, standard office suite software, CRM and ERP tools, mobile internet and cyber security) make up the basic or essential uses of digitalisation and, as a result, they are reasonably widespread in the business world; (ii) although by their nature they offer a very broad spectrum of applications, the use of the ones that have been dubbed «expanding technologies» (cloud computing, big data, the Internet of Things, robotics) is still relatively limited, even in the most digitised industries, and (iii) what we call «emerging technologies» (artificial intelligence, 3D printing, virtual reality, blockchain, nanotechnology) are the least widespread, although differences between industries are now being observed; these are the ones that potentially have the greatest capacity for disruption.

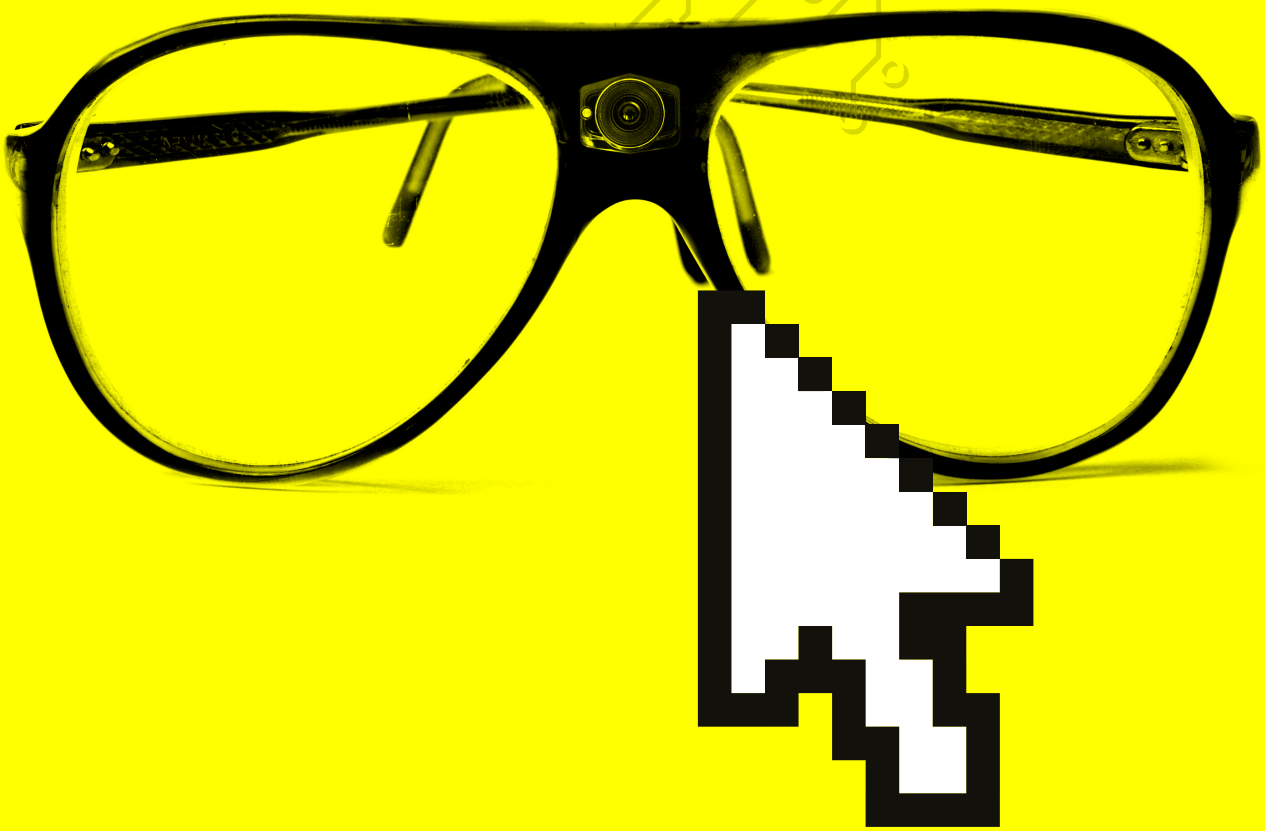
The CSDI covers a four-year period of time (from 2017 to 2020), not only providing a static view, which would be overly reductive in a fast-changing area such as digitalisation, but it also gives us a snapshot of the trends over time. An analysis of the digital take-up between 2017 and 2020 shows that incremental change strategies are being followed in most industries. However, some industries experienced a remarkable leap in digitalisation during those years and a radical change strategy is taking place. The distinguishing factor of the industries that are following the latter strategy, which is important for its potential to be replicated by other companies and would enable the necessary digitalisation of our economy, is the use of expanding technologies.

Finally, the CSDI can be a useful tool for public policy design, as it offers a holistic view of the business digitalisation process, allowing us to identify the strengths and weaknesses of the different sectors of activity in various fields by using metrics that are comparable over time. Furthermore, given the strong boost being given to the digitalisation of the economy thanks to the various initiatives being promoted by the Recovery, Transformation and Resilience Plan (RTRP), future versions of this index will allow us to assess the progress made in the digital transition of businesses in the different areas under consideration: from the changes to organisations' approaches to the development of skills and abilities associated with new technologies.



Chapter 1

The CSDI, an essential tool for the analysis of industry digitalisation



Digitalisation is an unavoidable process. Nobody is in the slightest doubt about whether or not the future of business (of the sectors of activity and, ultimately, the economy in general) will be digital. Although a few years ago people talked about the digital transformation as an issue that would affect a lot of companies, but not always something that would constitute their core business model, the outbreak of COVID-19 has accelerated the technological revolution and made it clear that all businesses should undertake the digital transition to remain successful in the market.

_Digitalisation, this vital issue for the future of the country's economy, can now be analysed with the utmost rigour and analytical depth through the new CaixaBank Sectoral Digitalisation Index (CSDI).

The CSDI is an innovative tool used to analyse the digitalisation of the Spanish economy. For the first time, it provides:

i)
Comparable metrics of the aggregate degree of digitalisation of 12 large sectors of the Spanish economy.

ii)
A measurement of the level of industry digitalisation based on digital assets (technological capital and the digitalisation of human resources), of the digital intensity of value chain interactions (interactions with suppliers, customers, general government and financial institutions) and of the intensity of use of digital technologies (from the more traditional ones to emerging technologies).

iii)
It covers a four-year period of time (from 2017 to 2020), not only providing a static view, which would be overly reductive in a fast-changing area such as digitalisation, but it also gives us a snapshot of the trends over time.

In short, the CSDI allows us to create a detailed comparative description of digitalisation between industries, between years and between areas of digitalisation and to answer three big questions: what is the current position of the various sectors of the Spanish economy with regard to digitalisation? Has the digital transformation in those sectors improved in recent years? What paths are being followed by industry digitalisation?

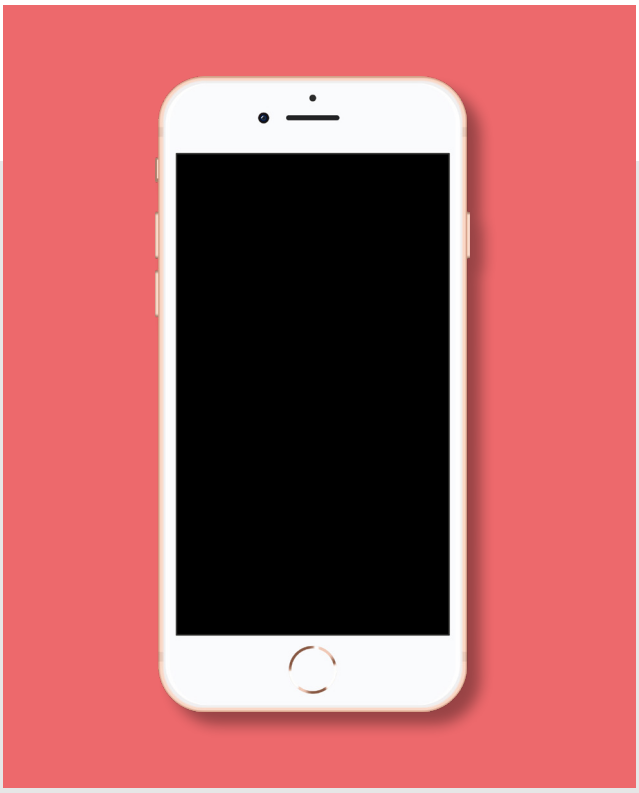
Box

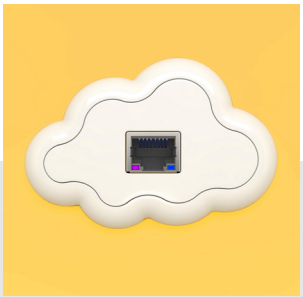
The CaixaBank Sectoral Digitalisation Index (CSDI) methodology

The CSDI is an index that classifies the industries in the Spanish economy according to their degree of digitalisation. The analysis is performed for a total of 12 sectors of activity, for the years 2017 to 2020. The index is composed of three pillars which, in turn, consist of various sub-pillars that are determined based on over 100 indicators from the following sources of information: i) public information from statistical sources (the National Statistics Institute (INE), the Conference Board and the Bank of Spain), ii) CaixaBank's internal data on the use of financial services by businesses and iii) data from social media (Twitter) and specialised forums. The index is determined in three stages:

1. Determining indicator-based sub-pillars
During the first stage, a statistical analysis is performed to summarise the information from the different indicators that make up a sub-pillar.[1] The first column in the table below shows the explained variance for each of the 18 sub-pillars.

		SUB-PILLARS EXPLAINED VARIANCE	PILLARS WEIGHTS	INDEX WEIGHTS
Pillar 1.	Digital production assets			33%
1.1.	Technological capital	58%	50%	
1.2.	Digitalisation of the workforce	74%	50%	
Pillar 2.	Interactions in the value chain			33%
2.1.	Interactions with suppliers (upstream)	64%	30%	
2.2.	Interactions with customers (downstream)	63%	30%	
2.3.	Use of digital financial services	54%	20%	
2.4.	Interactions with general government	80%	20%	
Pillar 3.	Use of digital technologies			33%
3.1.	Traditional digital technologies	62%	10%	
3.2.	Mobile internet	63%	15%	
3.3.	Cloud computing	41%	15%	
3.4.	Big data	44%	15%	
3.5.	The Internet of Things	60%	5%	
3.6.	Artificial intelligence	59%	5%	
3.7.	Robotics	75%	5%	
3.8.	Virtual and augmented reality	67%	5%	
3.9.	3D printing	59%	5%	
3.10.	Blockchain	83%	5%	
3.11.	Cyber security	66%	10%	
3.12.	Nanotechnology	78%	5%	





2. Rescaling of the sub-pillars using European benchmarks

With the aim of offering an interpretation of the results with regard to the digital frontier defined for sectors of activity across Europe, the sub-pillars are rescaled using as a benchmark the minimum and maximum values of each of the indicators for the sectors of activity in different countries in the EU-28.[2] Thus, a sub-pillar would be given a maximum value of 100 for a hypothetical sector of activity, for which all indicators that comprise that sub-pillar will be assigned the maximum value recorded by a sector of activity in the EU-28.

When we have the rescaled values for each of the sub-pillars, the three pillars are calculated as a weighted average of the sub-pillars of which they are composed, using the weights in the second column on the table above. Finally, the three pillars are added together, being assigned the same weight to obtain the final index: the CSDI for the year 2020.

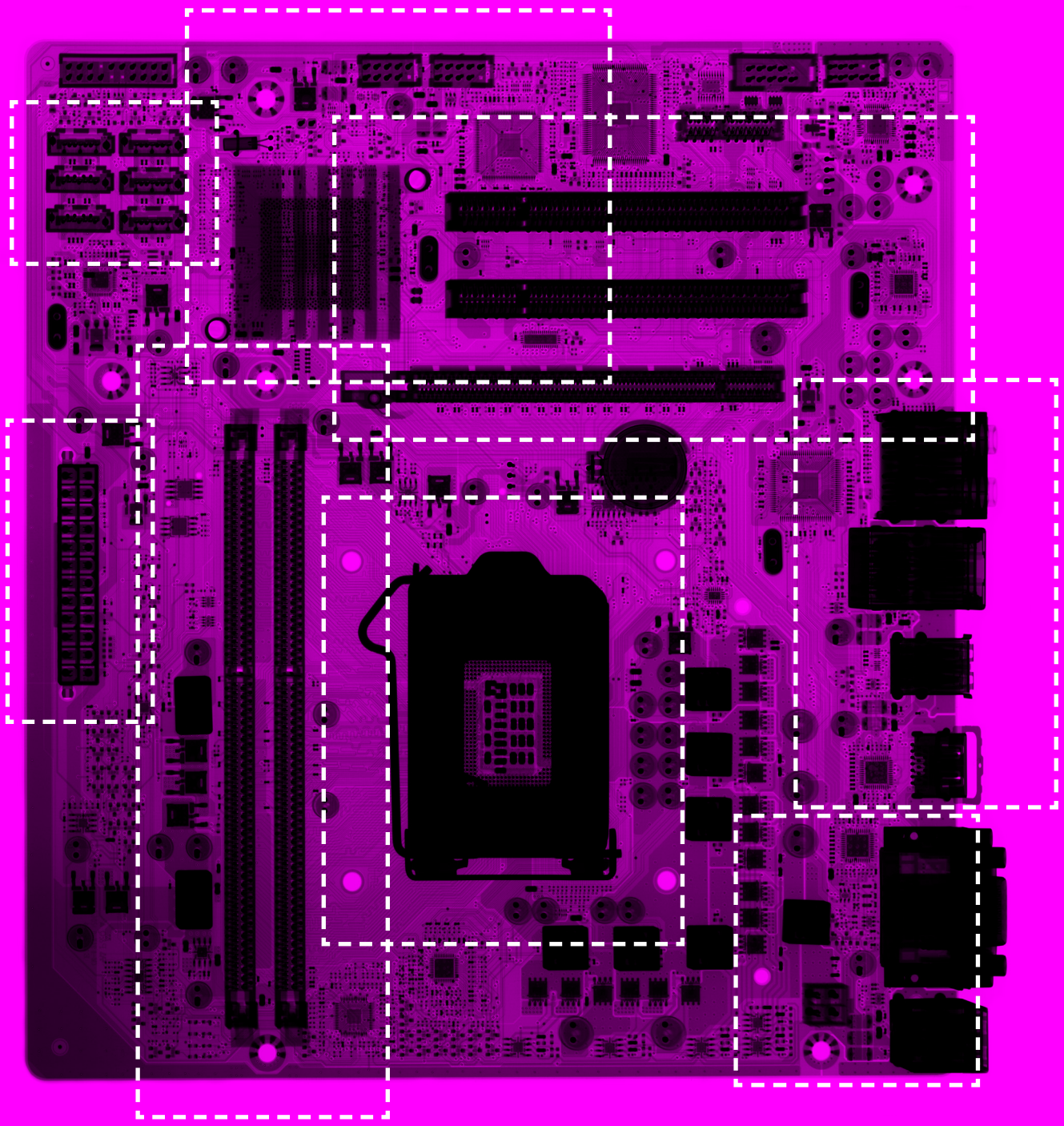
3. Standardisation of variables with regard to the benchmark year

To obtain a comparable CSDI for the years 2017, 2018 and 2019, the indicators from those years are standardised using the average and the standard deviation of each indicator in the year 2020. Then, we use the same weights as were used for the year 2020 to obtain the sub-pillars in 2017, 2018 and 2019, and these are rescaled using the same minimum and maximum benchmark European values as in the second stage. This procedure allows us to put the sub-pillars, pillars and overall index (CSDI) in the same reference system for every year, so the results are comparable over time.

1. In particular, the main components of each sub-pillar are analysed, using the data from the benchmark year (2020). See the Methodological Note for further details https://www.caixabankresearch.com/sites/default/files/content/file/2021/06/29/34454/nota-metodologica_icds_cbr.pdf.
2. For some industries, there is no equivalent indicator throughout Europe. In these cases, benchmark values are assigned subjectively (above the maximum value observed for the sector of activity and year in Spain and with zero generally being the minimum value).

Chapter 2

Spanish digitalisation by industry, an in-depth analysis



When we examine the degree of digitalisation of the Spanish economy from an industry perspective, there are two standout features: that this process is still occurring unevenly across different sectors and that, although not extraordinarily large in most cases, the distance from the European technological frontier is not small either. Nevertheless, putting aside the leading industries in terms of digitalisation, the degree of digitalisation of the remaining sectors is rather similar.

In 2020, as you would expect, the information and communication technology (ICT) industry was top of the CSDI ranking, a position that can be explained by the nature of the activities of the companies that make up the sector. This was followed by the professional, scientific and technical activities sector, real estate services, finance and insurance. These are the only industries that scored 50 or above in the CSDI. After this leading group, the eight remaining industries had similar levels of digitalisation, within a range of only 10 points.

How should these values be interpreted? By design, the CSDI (and its pillars and sub-pillars) can be given values between 0 and 100, as each of the 120 indicators that make up the CSDI have been rescaled according to their minimum and maximum values that were recorded for the different sectors of activity in the 28 member states of the EU between 2017 and 2020.[3] Thus, the CSDI would be given a maximum value of 100 for a hypothetical sector of activity, for which all 120 indicators will be assigned the maximum benchmark values. The European data shows us that the industry with the highest score for the available indicators is the ICT industry in Finland, with 82 points. In Spain, that industry obtained a score of 67, indicating that there is still a considerable gap between the most digitised industry in Spain and the EU countries that are most developed in terms of business digitalisation.[4]

The ICT industry is the most digitised according to the CSDI (index between 0 and 100)

POSITION	2020 RANKING	CSDI
1	ICT industry	67
2	Professional, scientific and technical act.	63
3	Real estate services	50
4	Finance and insurance	50
5	Retail	48
6	Accommodation services	46
7	Advanced manufactures	44
8	Transportation and storage	42
9	Primary sector	41
10	Construction	40
11	Basic manufactures	40
12	Agri-food industry	38

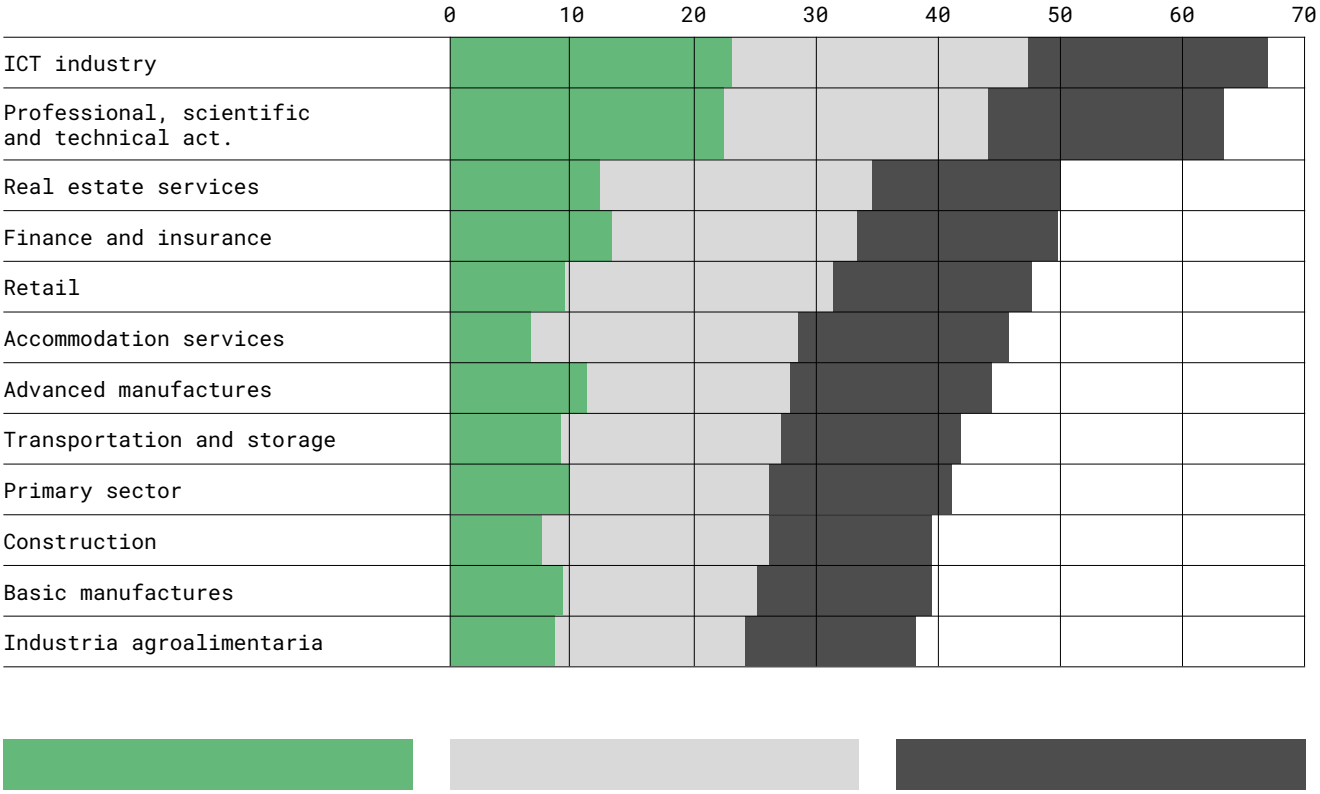
3. In particular, the minimum and maximum values of each indicator are calculated for each sector of activity, year and country. For some industries, there is no equivalent indicator throughout Europe. In these cases, benchmark values are assigned based on expert judgement (above the maximum value observed for the sector of activity and year in Spain).
4. All other sectors of activity, both in Spain and in the rest of the European countries for which there are figures, score lower than the ICT industry, reminding us that the CSDI should be interpreted with regard to a common technological frontier for all sectors of activity (i.e. not a specific frontier for each sector).

_Ways to become a leading digital industry: getting many aspects right and, insofar as is possible, being equipped with workers with the best digital skills.

There are many possible approaches to digitalisation, reflecting the disparate needs and characteristics of each industry. However, when we analyse the way to reach a certain position regarding digitalisation, certain patterns start to emerge. Firstly, the ICT industry is the absolute leader because it is also ranked first in the three main areas of digitalisation (what we call pillars): it is best equipped with digital assets, it has greater digital intensity in the different stages of its value chain and it uses digital technologies more intensively.

This complete dominance in all pillars of digitalisation is not normal when we move towards less digitised industries, with the relative exception of the first pillar. There it can be seen that, generally speaking, the greater the amount of digital assets, especially regarding availability of the labour factor, the higher the aggregate level of digitalisation. To a certain extent, it seems that having a high level of digital capital and labour is a basic condition for dealing with a wide range of digital interactions and intensive use of digital technologies.

The CSDI and its three areas: production resources, interactions in the value chain and the use of digital technologies in businesses



PILLAR 1: RESOURCES
Measures the degree of digitalisation of production assets (physical and human capital).

PILLAR 2: INTERACTIONS
Measures the intensity with which businesses use new technologies in value chain interactions.

PILLAR 3: TECHNOLOGIES
Measures the level of adoption and «popularity» of 12 specific digital technologies (including cloud computing, artificial intelligence and big data).

The digital intensity of interactions in the value chain is highly varied: the pull effect of general government is important, digital interaction with suppliers requires further development and the digital customer is still king.

Therefore, resources (assets or inputs) are essential and the most digitised industries are better equipped in this regard. The question is what these resources are going to be used for. Firstly, to develop a dense network of production and commercial interactions which generates economic value, an area of digitalisation that the CSDI covers in the second pillar: «interactions in the value chain».

Breakdown of Pillar 1 and Pillar 2 of the CSDI

	2020 CSDI
ICT industry	67
Professional, scientific and technical act.	63
Real estate services	50
Finance and insurance	50
Retail	48
Accommodation services	46
Advanced manufactures	44
Transportation and storage	42
Primary sector	41
Construction	40
Basic manufactures	40
Agri-food industry	38

Overall, the digital intensity of interactions across the value chain is generally high in the various sectors of the Spanish economy and, relatively speaking, it is more homogeneous than for the other two main aspects (remember, inputs and the use of digital technologies). However, certain significant differences can be seen, according to the type of interaction.

An initial observation is that interactions with general government are very digital. In fact, this is the sub-pillar in which all industries are closest to the technological frontier. This probably confirms the significant efforts made by the different areas of general government to move towards a digital model.[5] Given the nature of the interactions between businesses and the government, it is reasonable to believe that it is ultimately acting as an important pull factor for business digitalisation.

However, interactions with suppliers seem to be different in nature. The levels of digitalisation in this area suggest that, in the global value chain,

	SUB-PILLARS			SUB-PILLARS			
PILLAR 1 INPUTS	1.1 CAPITAL	1.2 LABOUR	**PILLAR 2 INTERACTIONS**	2.1 SUPPLIERS	2.2 CUSTOMERS	2.3 BANKING	2.4 GENERAL GOVT.
70	68	73	72	81	67	43	93
67	78	57	65	50	58	66	95
38	26	49	66	36	62	87	95
41	39	42	60	54		67	
28	22	35	65	64	62	51	86
20	15	26	65	47	93	35	83
34	35	34	49	35	52	29	86
28	17	39	54	35	55	42	91
30	23	36	49	37		67	
24	17	30	55	29	44	78	85
28	27	29	47	28	56	25	84
26	24	29	47	28	56	23	84

the need for «upstream» digital interactions is not as high (as we will see later) as it is for «downstream» interactions, i.e. with customers. There are certainly obvious exceptions, for example the ICT industry and retail, but generally the level of digitalisation of this industry is not very high. There is one significant exception: banking.

Banks are a type of supplier with their own, distinct characteristics, for example, with very specific types of digital services, which warrants them being treated differently to other suppliers.[6] In this case, the digital intensity involved in arranging and using banking services is greater than it is with general suppliers but, above all, it illustrates a notable disparity between industries.

However, as remarked above, without reaching the levels of interactions with general government, «downstream» interactions, i.e. with customers, are more digital than those with suppliers or banks, and this situation is fairly common in all sectors of activity. What is probably happening is a shift towards the digital realm in the customer-centric approach - in particular in terms of customer experience and satisfaction - in the current stage of a market economy where competition tends to be fierce. In this regard, it is not surprising that the industry that stands out most for its high level of digital interaction with customers is accommodation.

5. Spain is the second ranked country (after Estonia) for having the most digital public services according to the 2020 DESI indicator published by the European Commission. See https://ec.europa.eu/digital-single-market/en/digital-economy-and-society-index-desi
6. The indicators relating to this area were obtained entirely from CaixaBank's internal data, based on the transactions carried out by client companies via the various channels available for transacting. Specifically, channels are classified as digital and others (for example, transactions in branches).

Box

How to use the information from the CSDI. The industry-based perspective and the area-based perspective

The CSDI provides extremely valuable information about the level of digitalisation of the companies that make up the different sectors of activity. From an industry standpoint, the CSDI allows us to identify the strengths and weaknesses of a sector of activity in terms of its degree of digitalisation and level of adoption of different digital technologies. At the same time, the CSDI allows us to analyse a specific area of digitalisation across the board. For example, the sectors in which a given technology is prevalent and the ones that are still only starting to adopt it. Both of these approaches give us an overall perspective of the digital transformation process that the Spanish business sector is currently undergoing.

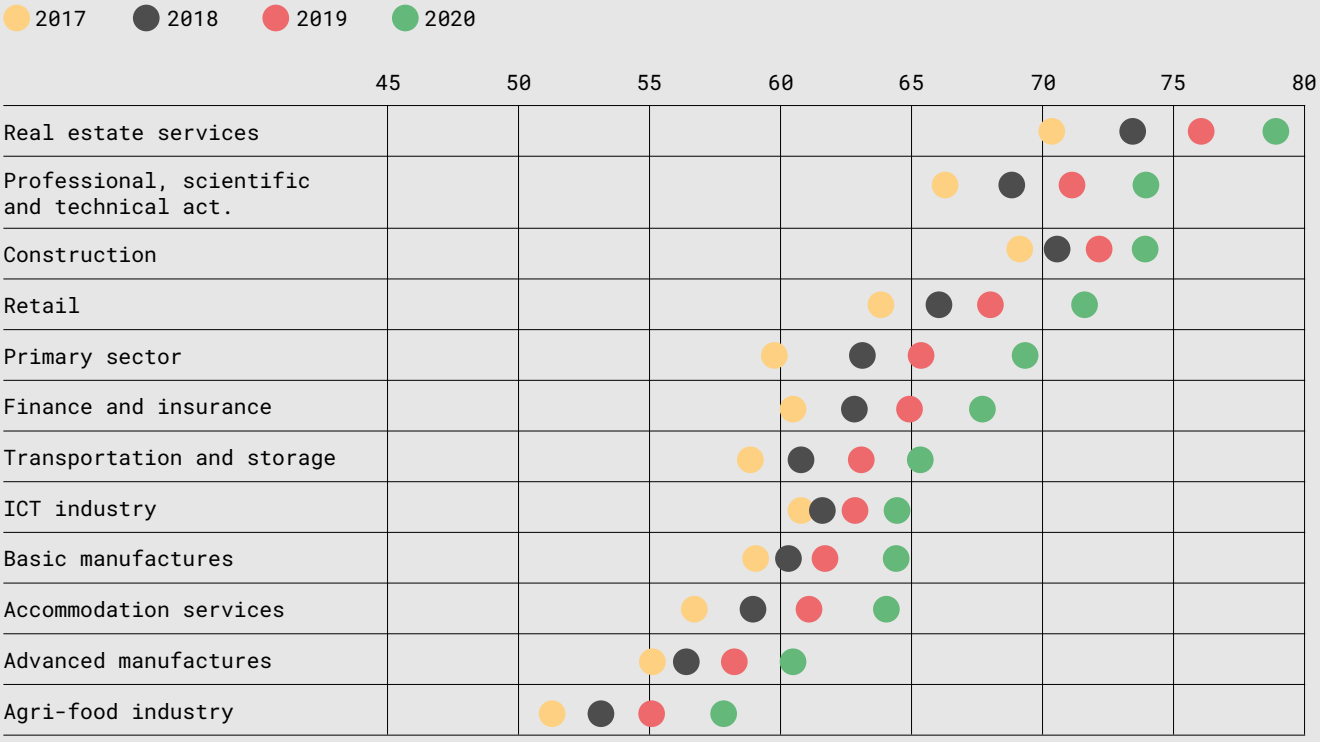
Industry-based perspective:
If, for example, we take the accommodation services industry, we can see that it was in sixth place in the overall ranking of the CSDI in 2020, with a score of 46. This industry received a low score in Pillar 1, production resources, and this is because the two sub-pillars of which this is composed. Therefore, we can conclude that one of the industry's weaknesses is the low level of digitalisation of its production inputs, both physical capital and human capital. However, the accommodation industry stands out positively in the second and third pillars. In particular, sub-pillar 2.2, which measures the degree of digitalisation of interaction with customers, reflecting the high degree of penetration of online shopping for hotel bookings and other types of accommodation. The outstanding position of the accommodation industry in the third pillar can be explained by the high degree of penetration of big data analytics.

Area-based perspective:
In addition to the industry-based perspective, the data can be analysed according to conceptual areas, to

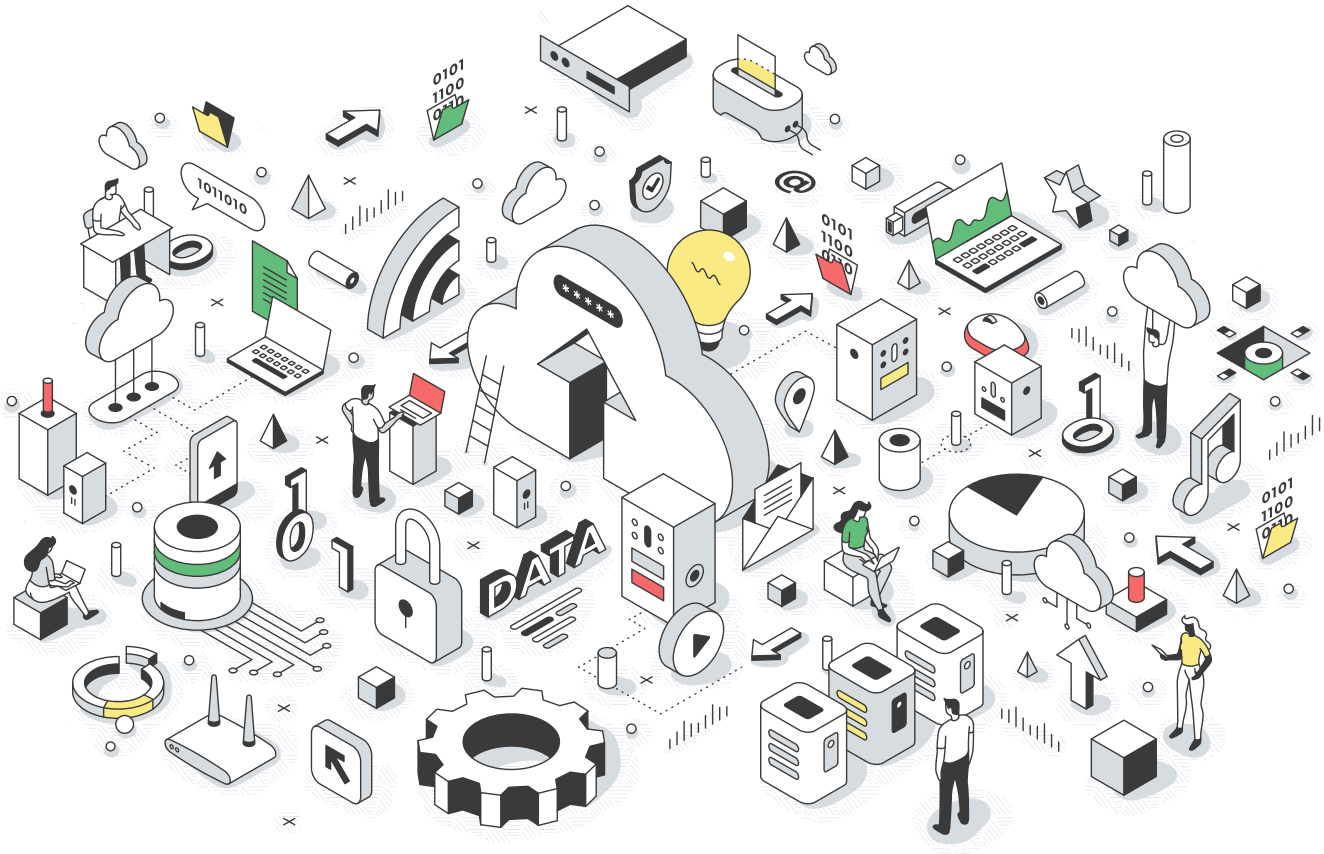
answer questions such as: which industries' human capital is best prepared to adopt digital tools? An issue of particular interest is the use of digital financial services by sectors of activity, as there is generally very limited industry-wide information about this matter.[7] In this case, the indicators that relate to this area were obtained entirely with CaixaBank's internal data, based on the transactions carried out by client companies via the various channels available for transacting. Specifically, channels are classified as digital and others (for example, transactions in branches, ATMs, etc.). The following chart shows one of these indicators: the percentage of transfers completed using digital channels. It is clear that, year on year, without exception, the companies from all sectors of activity are using digital channels more frequently for this type of transaction. It can also be seen that the degree of penetration differs greatly between sectors of activity, an indication of the path that still lies ahead until the banking services used by businesses in certain industries are fully digitised.

7. The IT survey by the National Statistics Institute (INE) does not include any questions about the use of digital financial services by businesses.

Financial services: percentage of transfers via digital channels



Source: CaixaBank Research, from internal data.



_Technology «families» help us to understand the wide range of situations regarding the use of digital technologies in businesses: what we call «predominant technologies» are reasonably widespread in the business world, the ones that have been dubbed «expanding technologies» are used less, while what we call «emerging technologies»are the least widespread, because they are incipient in nature.

The industry digitalisation analysis process becomes increasingly complex as further areas of analysis are added. To recap, while the production resources pillar was quite limited (digital capital and labour) and the interactions pillar would vary greatly within a narrow range (general government, suppliers, banking and customers), when we identify the different digital uses, we have a broad overall view. To gain a clear picture of this analytical focus, we have identified 12 digital technologies and, in turn, these have been grouped into three types of technology families, which we have dubbed predominant, expanding and emerging technologies, respectively.

Classification of digital technologies based on their level of use in businesses

	PREDOMINANT TECHNOLOGIES	EXPANDING TECHNOLOGIES	EMERGING TECHNOLOGIES
ICT industry	87	47	26
Professional, scientific and technical act.	71	40	55
Real estate services	64	44	17
Finance and insurance	66	36	35
Retail	67	41	31
Accommodation services	69	47	21
Advanced manufactures	64	41	42
Transportation and storage	63	38	24
Primary sector	60	40	23
Construction	53	36	27
Basic manufactures	60	34	32
Agri-food industry	59	33	30

Note: average value of the sub-pillars that make up each group of technologies.

Predominant technologies (email, standard office suite software, CRM and ERP tools, mobile internet and cyber security) make up the basic or essential uses of digitalisation. Consequently, these technologies have been widely adopted by all kinds of companies, regardless of their sector of activity, although there is a strong correlation between the overall level of digitalisation of an industry (i.e. the industry has a high CSDI value) and the intensity of use of those predominant technologies by businesses. The level of adoption of these technologies is not as high as in the most digitised European industries because, although virtually all businesses have computers, an internet connection or computer security measures, the adoption of certain tools such as CRM, ERP or advanced security measures (such as biometric identification) is still some way off.

However, although by their nature they offer a very broad spectrum of applications, the use of **expanding technologies** (cloud computing, big data, the Internet of Things, robotics) is still relatively limited, even in the most digitised industries. Indeed, their level of adoption is further behind the most digitised European industries: for example, 69% of Spanish companies in the ICT industry bought a cloud computing service over the internet in 2020, a high percentage, but far below the 96% of businesses in the Finnish ICT industry (the European industry with the highest level of adoption of this technology). Consequently, the industry average CSDI value for this technology family is lower than that of predominant technologies.

The emerging technologies (artificial intelligence, 3D printing, virtual reality, blockchain and nanotechnology) have an even lower level of adoption and, in fact, they are used very selectively, being limited to specific applications in particular industries (for example, blockchain in the finance and insurance industry). In this case, the distance from the European technological frontier is even greater.

Box

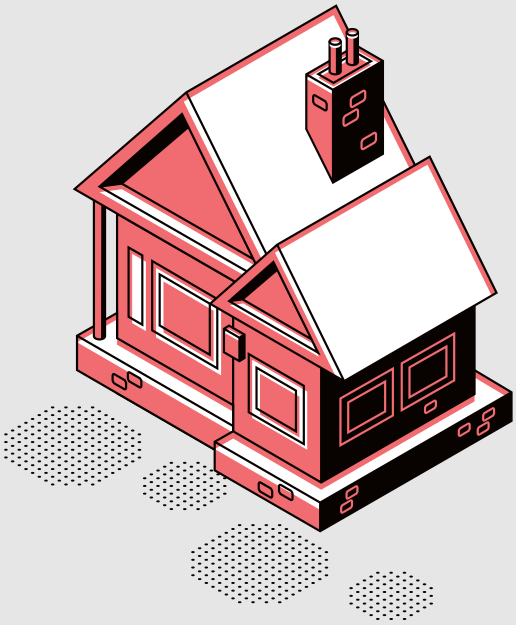
The «popularity» of digital technologies: what does Twitter tell us?

In this box we present an innovative analysis of the «popularity» of new digital technologies in the different sectors of activity based on information from Twitter. Although tweets do not provide information about the current implementation of different technologies, it can provide highly valuable information to identify new future trends. For this analysis, we processed information from over 24 millions tweets that were posted by individual users and digital media outlets during the 2017-2019 period. Using natural language processing techniques, we categorised the tweets according to references to different digital technologies, while also taking into account the sector of activity to which the tweet related.[8]

What are the most popular digital technologies according to Twitter?

Based on the number of tweets categorised under each technology and the sector of activity, we calculated a concentration rate, taking into account the frequency with which each digital technology is mentioned in each industry's tweets compared to the other industries. Therefore, the concentration rate measures the relative popularity of a technology in an industry in comparison with the other industries.[9]

According to our analysis, **the construction industry is notable for 3D printing and robotics**.[10] These are two technologies that are essential to support the industrialisation of the home construction process, a process that consists of incorporating elements that were produced in factories (for example, façades, bathrooms or partition walls). This provides numerous benefits, such as standardising production methods with more accurate engineering tools and cutting costs and manufacturing times. Additionally, industrialisation leads to more specialised and skilled employment and reduces workplace accidents, one of the endemic problems of the construction industry.

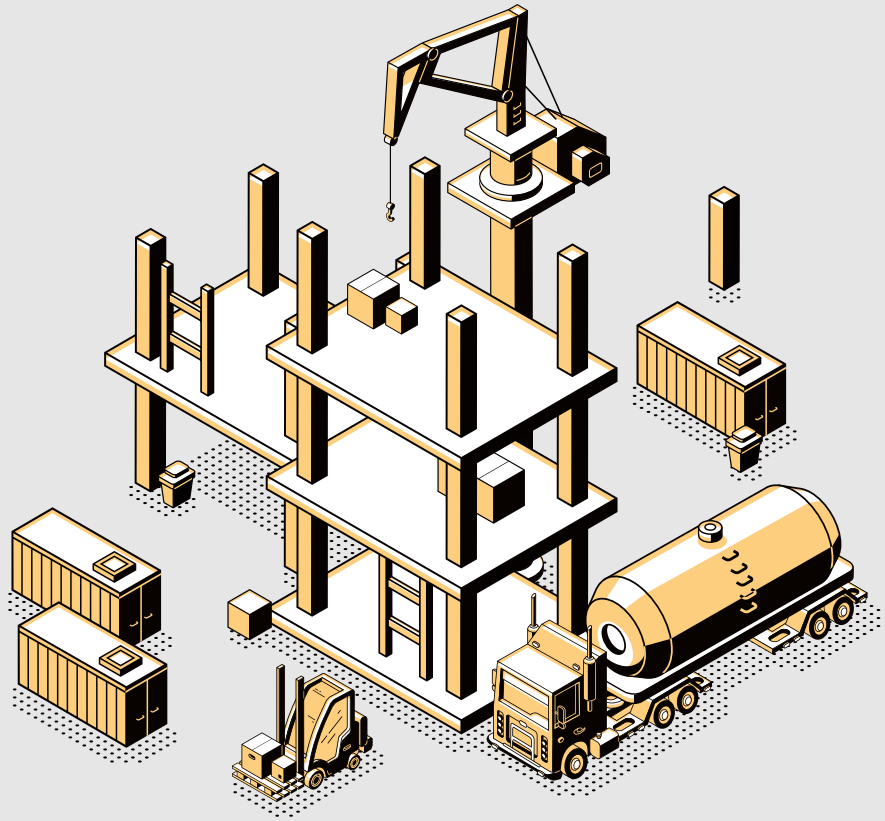


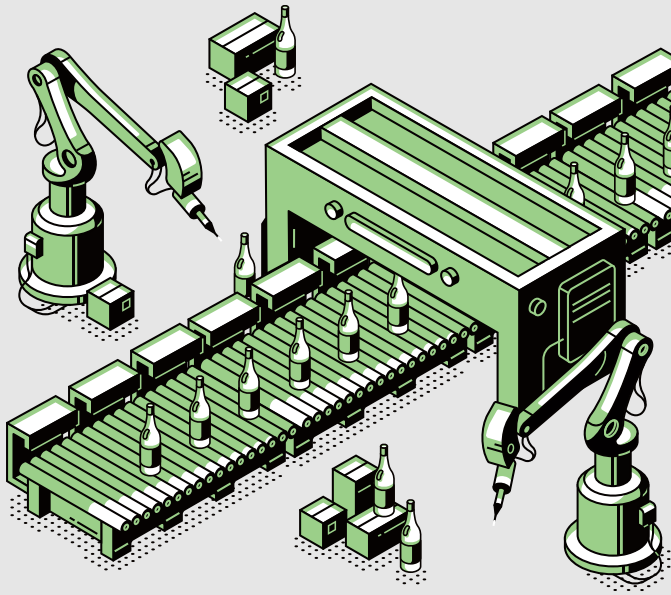
3D printing is also relatively popular in the production of basic manufactures, with new applications in numerous industries. For example, the textile industry is experimenting with 3D printers that are capable of printing on fabric with spectacular results and strong potential to revolutionise the fashion world.

Real estate services achieve a high concentration rate for the Internet of Things and virtual reality. A trend that has taken hold during the pandemic, as the industry has implemented numerous initiatives to make it easier to buy and sell real estate digitally, for example, through virtual tours of properties.

Virtual and augmented reality is also a relatively common technology in the agri-food industry, in retail and in accommodation services. In the case of retail, virtual reality makes it possible to offer customers a virtually enhanced and personalised shopping experience: for example, the immersive visualisation of complex products can make it easier to reach important decisions about the product.

8. This analysis was performed in conjunction with Citibeats, a company that specialises in unstructured natural language processing.
9. The concentration rate is calculated as the ratio between (i) the percentage of tweets for a technology and industry with respect to the total tweets for that technology and (ii) the percentage of tweets for an industry with respect to the total tweets for all industries. Values above 1 indicate that the technology is relatively more popular in that industry.
10. 11% of all tweets posted by all industries about 3D printing originate from the construction industry, a much higher percentage than the 2% of tweets posted by the construction industry out of all tweets analysed. The concentration rate equals 5.4 in this case.





Box (continuación)

The «popularity» of digital technologies: what does Twitter tell us?

The primary sector is notable for big data. A clear example of the application of big data in this industry lies in what are called «precision agriculture» techniques, which require large amounts of information to be analysed in order to optimise decision making to increase production and, in turn, ensure sustainability. These techniques require a large amount of data that is updated in real time, obtained through smart sensors, so **the Internet of Things is also a key technology for this industry**.

We can also see that advanced manufactures and the primary sector are notable for nanotechnology. This technology is not generally popular in any industries (only 1.7% of tweets are about this technology), but it is a little more popular in advanced manufactures and the primary sector. For example, genetic engineering makes it possible to increase crop yields through the development of plants that are resistant to extreme weather conditions and pests.

Tweet concentration rates of each technology relative to other industries

	SUB-PILLAR 3.1	SUB-PILLAR 3.2	SUB-PILLAR 3.3	SUB-PILLAR 3.4
	TRADITIONAL	MOBILE INTERNET	CLOUD COMPUTING	BIG DATA
ICT industry	1.0	1.2	3.0	0.7
Construction	1.7	0.3	0.6	1.3
Accommodation services	1.1	0.9	0.9	1.3
Retail	1.2	1.1	0.8	0.8
Professional, scientific and technical act.	2.0	0.3	1.0	1.8
Transportation and storage	1.2	0.8	2.3	0.9
Real estate services	0.8	0.7	0.4	1.0
Primary sector	0.5	0.3	0.2	3.0
Finance and insurance	0.3	1.8	0.3	0.5
Agri-food industry	1.2	0.4	0.6	0.7
Basic manufactures	0.8	0.5	1.2	0.6
Advanced manufactures	1.2	0.6	0.6	1.3

Note: The concentration rate is calculated as the ratio between (i) the percentage of tweets for a technology industry with respect to the total tweets for all industries. Values above 1 indicate that the technology is
Source: CaixaBank Research, from data from Twitter.

The finance and insurance industry excels in blockchain, a technology that is usually associated with cryptocurrencies. However, this technology has many other applications in finance (for example, the international payment system) and in other sectors such as the agri-food industry (for example, for the traceability of products across the food chain, from farm to table).

There are numerous examples of the application of new digital technologies in different sectors of activity.

There is no doubt that we are witnessing a revolution that is destined to change the value chains of all sectors of activity. In this regard, the information from Twitter allows us to identify the most popular digital tools in each sector of activity, information that can give us a useful insight into the future direction of the digital transformation that the different production sectors are undergoing.

SUB-PILLAR 3.5	SUB-PILLAR 3.6	SUB-PILLAR 3.7	SUB-PILLAR 3.8	SUB-PILLAR 3.9	SUB-PILLAR 3.10	SUB-PILLAR 3.11	SUB-PILLAR 3.12
INTERNET OF THINGS	ARTIFICIAL INTELLIGENCE	ROBOTICS	VIRTUAL REALITY	3D PRINTING	BLOCKCHAIN	CYBER SECURITY	NANOTECHNOLOGY
0.9	0.5	0.3	0.4	0.4	0.3	1.8	0.3
1.3	0.6	4.0	1.7	5.4	0.3	0.3	1.3
0.9	1.0	1.7	2.1	0.6	0.5	2.1	0.3
1.8	1.3	1.3	2.4	1.4	0.5	0.8	0.9
0.7	1.3	1.4	0.9	1.3	0.6	1.3	2.1
1.3	0.6	1.3	1.2	1.3	0.6	0.6	0.6
3.5	0.6	1.1	2.0	1.6	1.0	0.4	0.3
2.4	0.8	1.6	0.5	0.4	0.3	0.1	2.4
0.3	1.0	0.2	0.3	0.0	1.8	0.7	0.1
1.2	0.8	2.1	2.5	1.4	1.7	0.6	1.5
1.5	1.1	1.4	1.2	3.4	1.0	2.5	1.6
1.1	1.7	1.8	2.2	1.5	0.5	1.1	3.4

and industry with respect to the total tweets for that technology and (ii) the percentage of tweets for an relatively more popular in that industry.

Chapter 3

A timeline of industry digitalisation: the coexistence of the radical and incremental digital transformation

_An analysis of the digital take-up between 2017 and 2020 shows that incremental and radical change strategies are being followed simultaneously in industries. The key factor of the latter, which is important for its potential to be replicated and thus accelerate the necessary digitalisation of our economy, is the use of expanding technologies.

The previous sections have clearly described the current situation regarding industry digitalisation in the Spanish economy. However, one important question remains: how did we get where we are today in 2020?

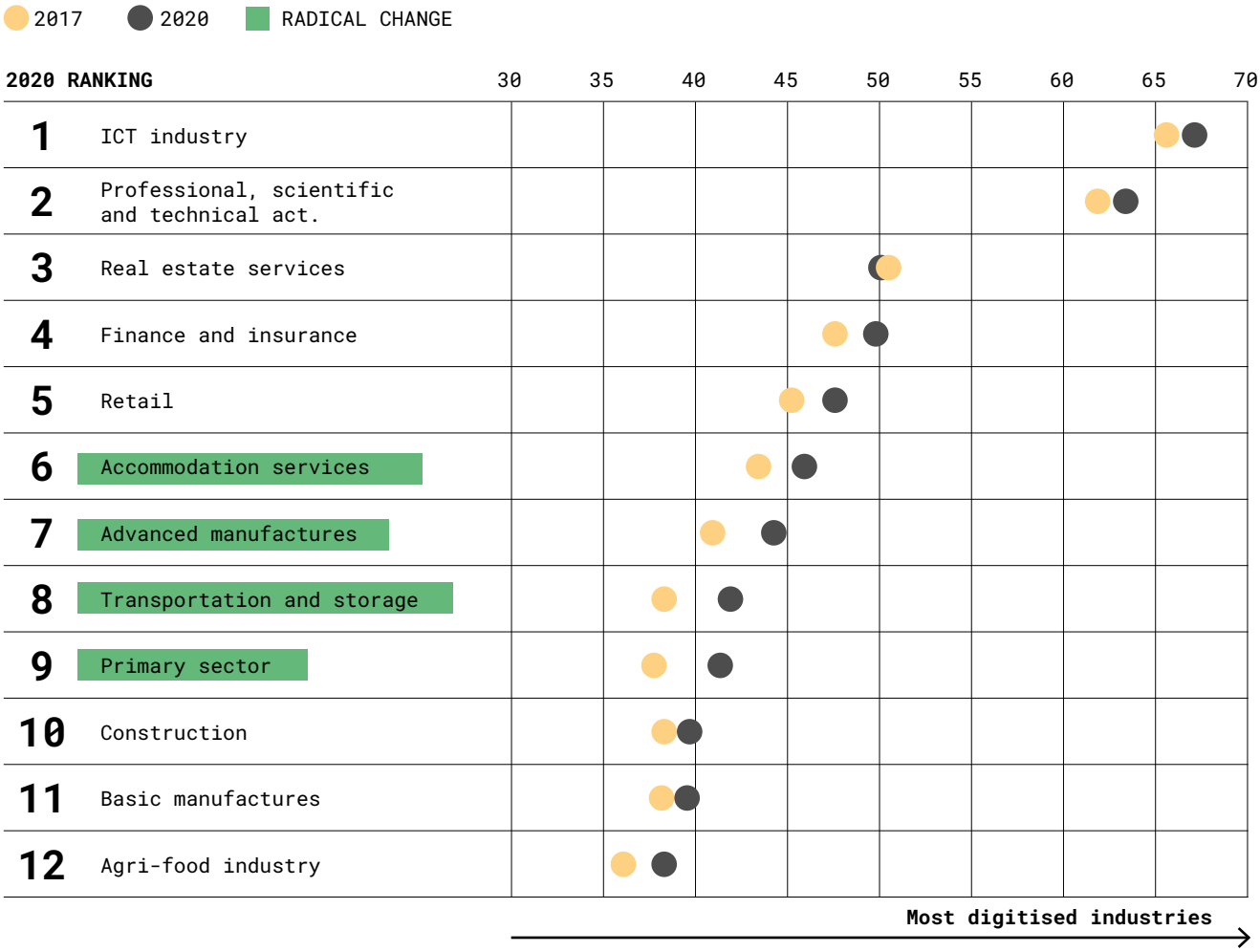
The analysis of the trajectory of industry digitalisation is similar in nature to analyses of innovation and technology diffusion processes. In these cases, it is common to distinguish between two main technology diffusion approaches: incremental and radical. Therefore, in the area of digitalisation, we would expect certain industries - the majority - to progress gradually, incrementally, while the others - the minority - would be capable of skipping some stages and make discontinuous progress in the process.

When you compare the current situation, i.e. 2020, with that of 2017, the first year with available data, it is indeed confirmed that the incremental approach is more common.[11] In fact, the best predictor of the current degree of digitalisation is the level of digitalisation three years ago.

However, a few industries have managed to make greater progress: accommodation services, advanced manufactures, transportation and storage and the primary sector (see the chart on the following page). These four years are useful, because they may contain an important lesson for economies like the Spanish economy, in which making the «leap» to higher levels of innovation would be advisable. So, what is the secret?

11. Ideally, to identify radical change approaches we would require a broader time frame. Nevertheless, the data available for the 2017-2020 period already shows that certain industries are progressing more quickly than others. Also note that the 2020 CSDI does not fully reflect the impact of the pandemic on business digitalisation as most of the data from 2020 relates to the first quarter of the year (with the exception of CaixaBank's internal data on the use of financial services). It is likely that in the following update, the CSDI will reflect an important change in business digitalisation resulting from the pandemic.

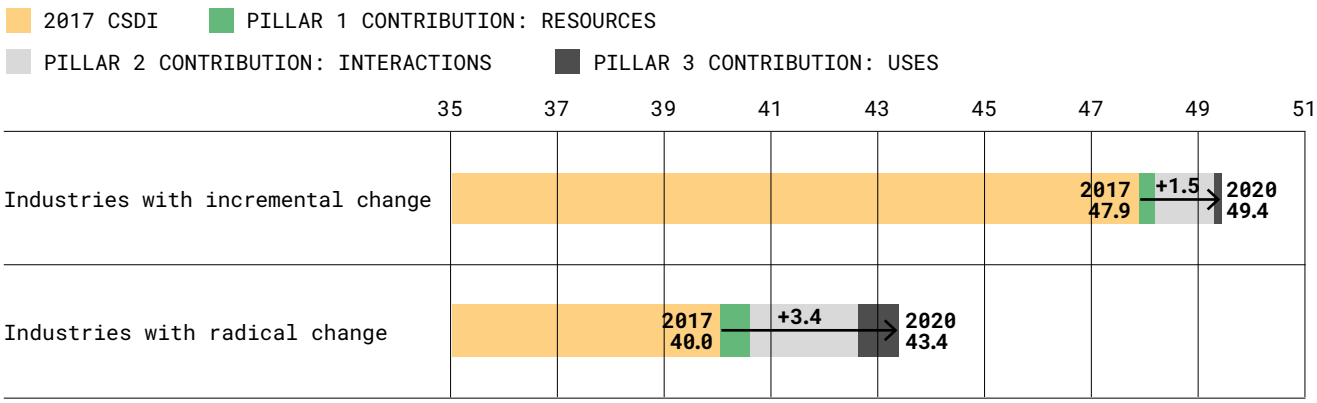
Some industries have made notable «leaps» in their digitalisation between 2017 and 2020

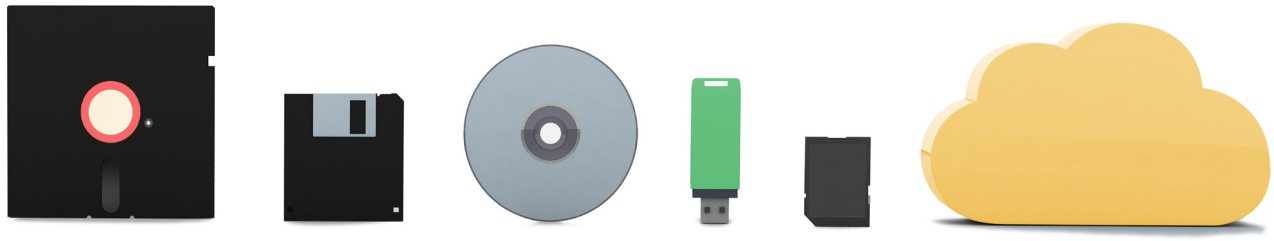


In the first place, the key does not appear to lie in the shared characteristics of each industry: the industries are quite different to each another. The key element is actually provided by the digitalisation indicators themselves.

The industries with more advanced levels of digitalisation have developed more digital interactions in the value chain

Change in the CSDI between 2017 and 2020



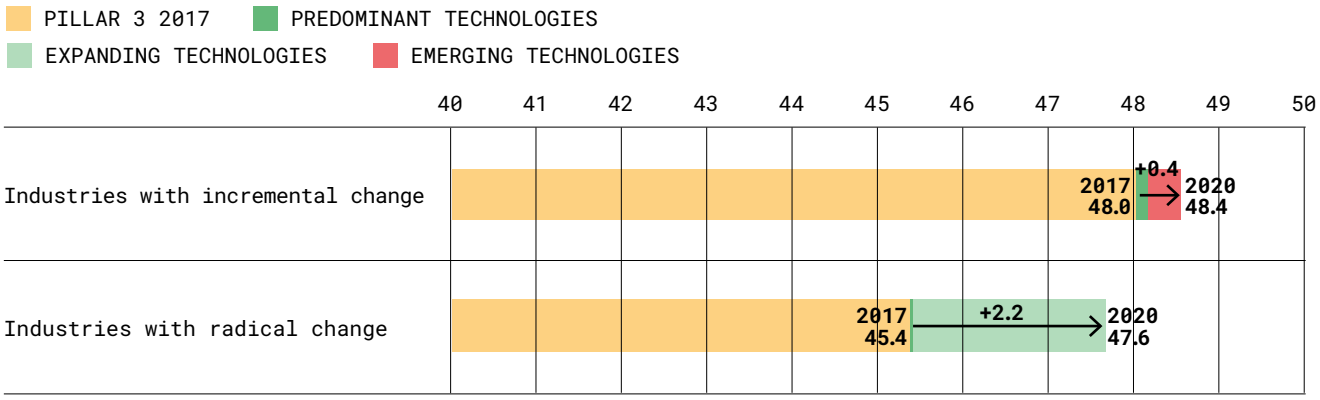


When we analyse which of the three main areas (resources, interactions and uses) had the biggest impact on increasing the CSDI between 2017 and 2020, we find that the degree of digitalisation of the interactions in the value chain is the area where most notable progress has been made, especially among industries that have undergone a «radical» change in the degree of digitalisation. The use of digital technologies also appears to be a distinguishing factor between both types of industries. As we have already seen, technologies can belong to one of three main types: predominant technologies, expanding technologies and emerging technologies.

Therefore, our theory is that the relative configuration of these three categories of technologies differs between industries that follow the radical approach and those on the incremental path. And indeed, the data confirms that there is a significant difference in the patterns of use of digital technology: while no major differences are observed in the areas of predominant and emerging technologies, the leap forward in expanding technologies is significant for industries undergoing a radical change. Therefore, our reading of this would have to be, in terms of the wider use of digital technologies, that the most disruptive industries are such not because they opt for technologies that form the basis of digitalisation - the ones we call predominant technologies - nor because they make the leap to emerging uses, but because they are making progress in relatively new technologies with a very broad spectrum of applications. Within expanding technologies, we can observe notable progress in cloud computing, especially in the advanced manufactures and accommodation services industries, and in the use of *big data*. In the latter case, in addition to the two aforementioned industries, the primary sector is also making great strides in adopting *big data*, which is linked to the advances in precision agriculture techniques.

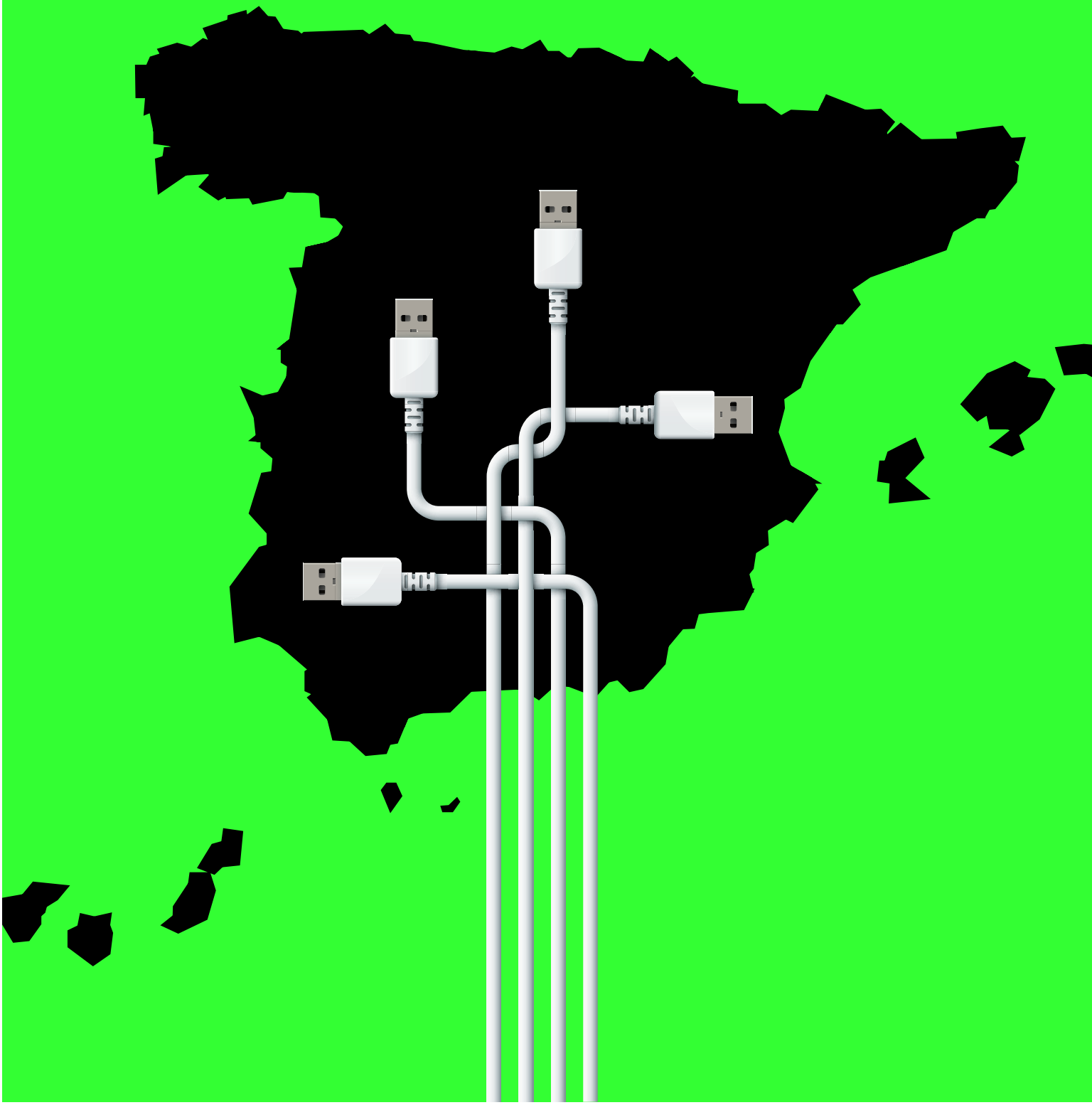
Industries undergoing a «radical» change have increased their use of expanding technologies

Change in the level of use of digital technologies between 2017 and 2020



Chapter 4

Conclusions



We are able to identify at least four main ideas from this analysis of the situation regarding industry digitalisation in the Spanish economy. Additionally, they can each serve as the basis for certain recommendations on how to boost the digitalisation of our production sectors:

1)
If you do not measure it, it does not exist. This is true. Thus, we cannot afford to ignore a phenomenon like digitalisation, which is essential for improving the productivity of businesses and, therefore, the economy as a whole. CaixaBank Research has made its contribution by creating the CaixaBank Sectoral Digitalisation Index (CSDI), to allow us to understand how our industries are being digitised.
Recommendation: the CSDI can be a useful tool for public policy design, as it offers a holistic view of the business digitalisation process, allowing us to identify the strengths and weaknesses of the different sectors of activity in various fields by using metrics that are comparable over time. Furthermore, given the strong boost being given to the digitalisation of the economy thanks to the various initiatives being promoted by the Recovery, Transformation and Resilience Plan (RTRP), future versions of this index will allow us to assess the progress made in the digital transition of businesses in the different areas associated with the digital transformation: from the changes to organisations' approaches to the development of skills and abilities associated with new technologies. Moreover, the CSDI may be useful for any businessperson interested in gauging how their business is placed in terms of digitalisation, compared to other businesses within their sector of activity.

2)
The leading industries share a common pattern: they are leaders in all aspects of digitalisation. In other words, in terms of accumulating digital resources (capital and labour); in the degree of digital interactions with suppliers, customers, banks and general government and, finally, in the user of digital technologies. However, if there is one thing for which they are especially notable, it is the remarkable labour factor at their disposal. In other words, like so many other factors, digital talent exists and is a key factor.
Recommendation: it will be difficult to increase the number of digital workers if their availability does not improve significantly, which inevitably involves increasing the formal and on-the-job training of our young people and the workers currently in this field. In this regard, various components of the Recovery, Transformation and Resilience Plan (RTRP) are rightly aimed at improving the digital skills of workers and the population as a whole.[12]

12. The National Digital Skills Plan is outlined in components 19, 20 and 21 of the Recovery, Transformation and Resilience Plan (PRTR).

3)
As the sector that exerts a pull effect on all production sectors, the role of general government has been crucial for increasing the degree of digitalisation. And it must continue to be so in the future.
Recommendation: the general government is possibly fully aware that it plays this active role, but in any event it would be advisable for it to consider further progressing digital interactions, while also bearing in mind the pull effect that this has on the economy as a whole.[13] The digitalisation of general government will not only simplify and tailor interactions between businesses and the public sector, it should also serve as a point of support and lever for the digital transition of the business sector.

4)
From this analysis of the industries undergoing a radical digital transformation, it follows that one of the keys to any future - and desirable - acceleration of industry digitalisation lies in further development of expanding technologies, assuming that there is a sufficient resource base (as seems to be the case in virtually all industries).
Recommendation: relatively little is known about the most determining factors behind radical technological change in the digital realm. Despite this, given the still inadequate level of adoption of expanding technologies, focusing digital public policies on promoting these technologies, such as cloud computing and *big data*, seems a reasonably strong option. However, the methods that have worked in the past do not guarantee future success. Especially in such a changing environment as new digital technologies. In this sense, public policies should also promote the development of emerging technologies such as artificial intelligence and strengthen the progress made in predominant technologies like cyber security or new mobile technologies (5G), as they are also continuously developing. Thus, public policies should also promote the development of emerging technologies such as artificial intelligence[14] and the deployment of telecommunications infrastructures that enable the development of future generations of mobile technology,[15] since this will promote the adoption of predominant technologies, such as the more traditional digital technologies and cyber security, among all types of businesses, including SMEs.[16]

13. The general government's Digitalisation Plan, one of the key elements of component 11 of the RTRP, includes reforms and investment to improve accessibility to public services and promote the digitalisation of areas such as health and justice.
14. The National Artificial Intelligence Strategy (component 11 of the RTRP) is aimed at promoting the penetration of this technology in our economy and boosting scientific research and innovation in AI.
15. In this area, it is worth noting the Strategy to Promote 5G (component 15 of the RTRP), which is vital to boosting hyperconnectivity and will serve as an enabler of other technologies (such as the development of Industry 4.0, precision agriculture and new forms of mobility).
16. In this area, the SME Digitalisation Plan (component 13 of the RTRP) includes the Digital Toolkit programme, aimed at boosting the basic digitalisation of businesses by funding the SME adoption of a set of existing basic packages of digital solutions that have yet to be implemented in many companies (such as websites, ERP resource management systems, CRM customer management systems, online sales, digital marketing, cyber security, etc.).

Annex

In this annex we provide the details of all of the pillars and sub-pillars that make up the CSDI for the years 2017 to 2020. The CSDI is composed of 3 pillars and 18 sub-pillars.

The first pillar measures the degree of digitalisation of the production inputs. It consists of a sub-pillar that measures the technological capital of the sector of activity and the intensity of investment in R&D by businesses in the industry. A second sub-pillar reflects the degree of digitalisation of the workforce, i.e. how «digital» the workers are from companies in the different sectors of activity (for example, the percentage of businesses that offer ICT training to their employees or the percentage of workers who regularly or occasionally work remotely). It also considers whether businesses offer resources to allow workers to become more digital, as digitalisation of the workforce can also be facilitated by the company itself (for example, offering them devices with internet connections).

The second pillar measures the degree of digitalisation of the interactions in the value chain, taking into account the extent to which companies use digital tools in interactions with suppliers or upstream in the value chain (sub-pillar 2.1), customers or downstream in the value chain (sub-pillar 2.2), financial institutions (sub-pillar 2.3) and general government (sub-pillar 2.4). For example, using electronic billing, e-commerce sales and purchases or bank transfers by digital means. In the latter case, CaixaBank's internal information about the intensity of use of digital financial services is essential. Specifically, indicators of the degree of digitalisation of each customer are calculated according to their intensity of use of digital channels compared to physical channels and the results are added together across the whole sector of activity.

Finally, the third pillar measures the intensity with which businesses use different digital technologies (e.g. big data or artificial intelligence), but they also take into account the «popularity» of the different technologies in each sector of activity. Indeed, some industries are still at a very early stage of adopting some digital tools; however, their popularity is growing quickly, which may indicate a trend towards rapid adoption in the near future. To cover this aspect, we use the information from social media (Twitter) and the internet (forums and specialised blogs).[17] Based on the information about 12 digital technologies, indexes are created to measure the most widely used technologies in each sector of activity and their trends.

17. See section II.5 of the Methodological Note for details about the process followed to obtain this data, with the support of the company Citibeats.

		INPUTS	INTERACTIONS	TECHNOLOGIES	CAPITAL	LABOUR	SUPPLIERS	CUSTOMERS
	IDS	**P 1**	**P 2**	**P 3**	**S-P 1.1**	**S-P 1.2**	**S-P 2.1**	**S-P 2.2**
Year 2017								
ICT industry	66	69	70	58	61	76	84	65
Professional, scientific and technical act.	62	68	61	56	77	59	43	55
Real estate services	50	33	71	47	23	43	50	59
Finance and insurance	48	42	49	52	42	42	54	
Retail	45	29	58	48	21	36	58	60
Accommodation services	43	20	60	50	11	29	45	91
Advanced manufactures	41	34	44	44	34	34	31	51
Construction	38	23	53	40	14	31	23	45
Transportation and storage	38	25	47	43	14	36	28	54
Basic manufactures	38	27	44	43	23	31	26	58
Primary sector	38	28	41	44	19	36	36	
Agri-food industry	36	25	42	40	21	29	26	58
Year 2018								
ICT industry	63	63	67	59	50	77	76	68
Professional, scientific and technical act.	59	59	62	56	61	56	48	55
Real estate services	50	33	69	49	22	44	47	61
Finance and insurance	46	39	48	50	36	42	55	
Retail	45	27	57	50	21	33	58	61
Advanced manufactures	41	33	41	47	35	31	29	52
Accommodation services	40	19	55	46	11	27	40	90
Transportation and storage	39	24	50	43	16	32	38	55
Construction	38	22	52	39	15	29	28	45
Primary sector	38	28	41	44	20	36	39	
Basic manufactures	37	27	43	42	25	29	25	56
Agri-food industry	35	25	40	41	21	28	26	56

BANKS	GENERAL GOVERNMENT		TRADITIONAL	MOBILE	CLOUD COMPUTING	BIG DATA	THE INTERNET OF THINGS	ARTIFICIAL INTELLIGENCE	ROBOTICS	VIRTUAL REALITY	3D PRINTING	BLOCKCHAIN	CYBER SECURITY	NANOTECHNOLOGY
S-P 2.3	S-P 2.4		S-P 3.1	S-P 3.2	S-P 3.3	S-P 3.4	S-P 3.5	S-P 3.6	S-P 3.7	S-P 3.8	S-P 3.9	S-P 3.10	S-P 3.11	S-P 3.12
38	88		77	94	81	50	49	53	16	8	34	6	79	7
67	92		51	89	60	36	34	80	31	28	57	13	72	77
100	93		59	85	58	33	64	31	31	30	6	15	55	2
41			42	94	58	38	40	74	17	22	24	81	60	7
33	82		58	86	55	23	49	49	32	55	39	11	53	20
17	80		59	87	62	42	38	40	19	34	16	9	74	3
16	82		46	82	42	1	37	44	59	37	49	13	65	53
76	86		32	81	49	14	32	34	57	22	38	2	47	21
28	83		39	84	55	21	51	39	20	34	14	13	52	23
14	79		43	81	46	16	40	44	38	21	35	23	62	20
49			46	84	58	22	44	36	32	18	25	2	49	51
6	79		40	81	45	15	29	34	48	15	32	21	57	13
30	86		82	96	80	53	51	56	16	9	34	9	72	6
65	92		52	89	57	32	36	78	30	38	56	26	74	78
95	88		55	92	64	40	61	22	31	29	7	28	51	3
36			43	90	58	31	36	64	17	15	24	92	62	6
23	83		58	86	57	27	46	48	30	51	40	17	56	22
3	80		45	83	46	9	35	63	63	40	48	13	52	77
1	81		56	86	58	38	40	38	17	19	16	14	60	3
26	84		43	83	51	23	49	42	21	27	15	21	52	14
68	85		31	82	43	15	34	40	46	18	36	9	46	17
44			45	84	57	25	48	42	40	3	24	10	49	29
14	79		40	80	50	15	28	42	41	20	34	28	58	22
0	79		40	79	48	15	27	32	44	15	32	43	51	17

		INPUTS	INTERACTIONS	TECHNOLOGIES	CAPITAL	LABOUR	SUPPLIERS	CUSTOMERS
	IDI	**P 1**	**P 2**	**P 3**	**S-P 1.1**	**S-P 1.2**	**S-P 2.1**	**S-P 2.2**
Year 2017								
ICT industry	69	74	71	61	70	78	87	68
Professional, scientific and technical act.	62	66	61	58	74	58	47	58
Real estate services	51	41	66	47	28	53	53	58
Finance and insurance	47	40	51	49	38	42	54	
Retail	45	28	60	48	21	35	59	62
Accommodation services	43	20	58	50	15	26	44	90
Advanced manufactures	42	35	45	48	36	33	31	52
Construction	39	23	50	44	15	32	34	53
Transportation and storage	39	29	44	43	28	29	29	59
Basic manufactures	39	29	41	45	23	36	37	
Primary sector	38	26	45	42	23	29	29	59
Agri-food industry	37	23	49	39	15	30	19	44
Year 2018								
ICT industry	67	70	72	59	68	73	81	67
Professional, scientific and technical act.	63	67	65	58	78	57	50	58
Real estate services	50	38	66	46	26	49	36	62
Finance and insurance	50	41	60	49	39	42	54	
Retail	48	28	65	49	22	35	64	62
Advanced manufactures	46	20	65	52	15	26	47	93
Accommodation services	44	34	49	49	35	34	35	52
Transportation and storage	42	28	54	45	17	39	35	55
Construction	41	30	49	45	23	36	37	
Primary sector	40	24	55	41	17	30	29	44
Basic manufactures	40	28	47	43	27	29	28	56
Agri-food industry	38	26	47	42	24	29	28	56

BANKS	GENERAL GOVERNMENT		TRADITIONAL	MOBILE	CLOUD COMPUTING	BIG DATA	THE INTERNET OF THINGS	ARTIFICIAL INTELLIGENCE	ROBOTICS	VIRTUAL REALITY	3D PRINTING	BLOCKCHAIN	CYBER SECURITY	NANOTECHNOLOGY
S-P 2.3	**S-P 2.4**		**S-P 3.1**	**S-P 3.2**	**S-P 3.3**	**S-P 3.4**	**S-P 3.5**	**S-P 3.6**	**S-P 3.7**	**S-P 3.8**	**S-P 3.9**	**S-P 3.10**	**S-P 3.11**	**S-P 3.12**
32	92		84	97	85	50	50	61	16	12	36	9	79	9
55	92		50	92	65	34	33	90	29	34	50	24	69	84
81	84		58	93	60	33	64	26	23	21	7	21	50	8
47			44	91	60	29	35	59	18	9	24	75	62	6
33	84		59	87	60	22	48	52	28	46	34	13	51	16
6	82		60	89	69	36	40	45	24	33	14	10	62	6
16	83		49	84	58	5	36	56	59	30	48	11	53	65
30	87		45	83	63	21	52	45	21	28	16	17	51	10
7	83		46	81	56	6	24	33	49	20	35	19	51	54
47			45	85	59	28	45	43	30	4	24	8	48	38
11	83		46	80	55	6	26	37	46	3	31	42	47	36
67	86		31	84	47	13	31	40	42	33	36	7	40	20
43	93		85	97	76	45	50	61	16	12	38	9	80	9
66	95		53	91	69	31	33	90	29	34	42	24	69	84
87	95		56	89	63	35	64	26	14	21	7	21	47	8
67			44	91	60	29	35	59	18	9	24	75	62	6
51	86		60	88	66	22	48	52	28	46	29	13	51	16
35	83		56	89	74	48	40	45	27	33	12	10	62	6
29	86		50	82	56	16	36	56	55	30	47	11	59	65
42	91		49	87	62	18	52	45	20	28	18	17	52	10
67			45	85	59	28	45	43	30	4	24	8	48	38
78	85		32	83	61	8	31	40	43	33	35	7	43	20
25	84		46	84	54	7	24	33	50	20	35	19	51	54
23	84		45	84	54	7	26	37	47	3	32	42	47	36

Design and production: www.cegeglobal.com

_Follow us on:

www.caixabankresearch.com

@CABK_Research

Newsletter

CaixaBank

CaixaBank
Research