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Digitalisation in France's business sector

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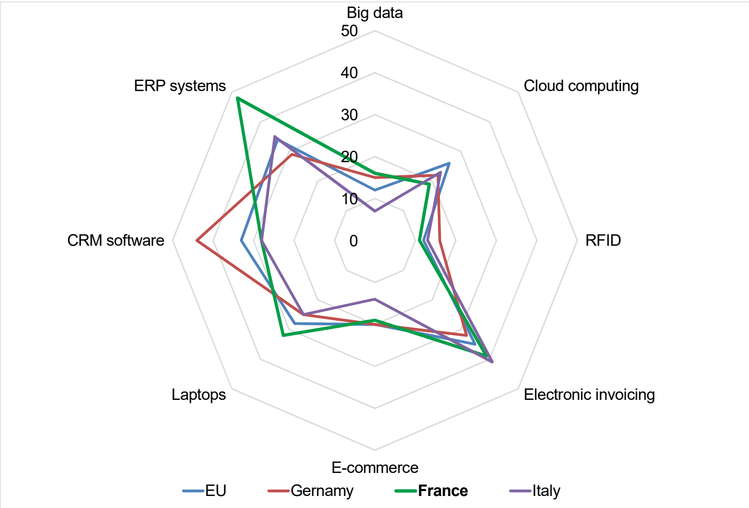
- Digital technology transforms economies: it changes how businesses and consumers interact, how businesses interact with each other, and how they organise their production processes. Digital transition is a multidimensional process, a driver of innovation and a source of productivity gains.
- The degree to which French businesses have digitalised is comparable to the rest of Europe, in terms of both mature technology (enterprise resource planning systems, automated invoice processing) and emerging technology (cloud computing, big data, artificial intelligence). In terms of robotics, the degree of automation in France's economy is notably consistent with its sectoral structure and labour force.
- In France and the rest of Europe, SMEs (and, not surprisingly, VSEs) are late adopters compared to large enterprises. The digital divide is observed across all areas of technology: SMEs and VSEs are less likely to have a high-speed or ultra-high-speed internet connection and are less likely to use management software, e-commerce, cloud computing and data analysis.
- The pandemic has shown how digital technology can contribute to greater economic resilience by allowing work to be organised more flexibly and goods to be sold remotely. A government initiative to digitalise the business sector should prioritise firms that have the most limiting financial constraints and that lack access to information on the benefits of digital technology. Any such initiative should also include infrastructure support (ultra-high-speed internet, 5G) and a coherent set of policies to encourage digital development (support for research, training, cybersecurity, etc.). This is why digitalisation features prominently in the priority measures of the recovery plan.

Percentage of businesses using information and communications technology (ICT)



Source: 2019 ICT survey (Eurostat). Scope: businesses with 10 or more employees in market sectors excluding agriculture and financial/insurance services.

1. Digitalisation has big impacts on the economy

1.1 Digitalisation drives innovation and productivity gains

The digitalisation of the economy, which encompasses a wide range of technology (see Box 1), drives productivity gains. To begin with, digital technology can be used to automate a large number of tasks, both in industry and in services.[1] Also, thanks to advances in big data and data analysis methods, businesses can more accurately predict demand and improve performance.[2] Online platforms, meanwhile, lower search costs for consumers, which fuels competition between the companies that use them.[3] And in some markets, digital technology lowers barriers to entry and helps small businesses access bigger markets: by helping to expand the European single market, e-commerce has led to efficiency gains in the distribution sector.[4]

Box 1: "Digitalisation" covers a wide range of technology

Digitalisation of the economy refers first and foremost to the advancement and expansion of information and communications technology (ICT). Produced by the ICT sector,[a] these types of technology are used across all sectors of the economy, in market services and industry alike. Since the mid-2000s, new technology has continued to emerge, thanks to lower data storage, processing and transmission costs,[b] including cloud computing, artificial intelligence (AI), big data and 3D printing. Digitalisation also refers to how activities can be improved or transformed by the rise of such technology, such as online platforms and e-commerce.

Applications for optimising production processes, through automation or robotics using enterprise resource planning systems, radio frequency identification and 3D printing, have mainly been concentrated in the industrial sector.[c] As for market services, particularly the trade sector, areas of advancement include data collection and analysis, price discrimination and targeted advertising, online auctions and comparison sites.[d] An internet presence and online sales capability are crucial in the trade sector and for some service-sector companies.[e]

The focus of this document will be limited to the scope of the INSEE's ICT survey on companies' use of information and communications technology and e-commerce, which seeks to measure how companies use digital tools in their external relations (internet, e-commerce) and in their internal operations (networks, integrated management systems). The ICT survey looks at the following representative technologies in particular: *enterprise resource planning (ERP) systems*, which allow companies to manage core business processes (HR, finance and accounting, sales, distribution, procurement, etc.); *customer relationship management (CRM) software*, which is used to store and share customer information; *laptops*, which enable employees to work remotely; *e-commerce*, which allows companies to accept online orders; *electronic invoicing*, which allows for automation of both outgoing and incoming invoices; *radio-frequency identification (RFID)*, which allows data to be collected

a. The ICT sector includes the following subsectors: ICT production sectors (manufacturing of computers and computer equipment, TVs, radios, telephones), ICT distribution sectors (computer equipment wholesale trade) and ICT service sectors (telecommunications, IT services, audio-visual services).
b. Goldfarb A. and C. Tucker (2019), "Digital Economics", *Journal of Economic Literature*, 57(1), 3-43.
c. H. Genuit (2019), "Robotique, impression 3D : des technologies propres à l'industrie", *Insee Résultats*.
d. Peitz M. and J. Waldfogel (Eds.) (2012), *The Oxford Handbook of the Digital Economy*. Oxford University Press.
e. C. Cohen (2019), "E-commerce reveals a digital divide among companies", *Insee Focus* no. 147.

(1) S. Firquet (2020), "Digital technology boosts innovation in the tertiary sector", *Insee Première* no. 1811.
(2) Tanaka M., Bloom N., David J. and M. Koga (2020), "Firm Performance and Macro Forecast Accuracy", *Journal of Monetary Economics*, 114, 26-41; Brynjolfsson, E., Hitt L. and H. Kim (2011), "Strength in Numbers: How Does Data-Driven Decision making Affect Firm Performance?", SSRN.
(3) Rivares A. B., Gal P., Millot V. and S. Sorbe (2019), "Like it or not? The impact of online platforms on the productivity of incumbent service providers", *OECD Economics Department Working Papers*, No. 1548.
(4) Cardona M., Duch-Brown N., François J., Mertens B. and F. Yang (2015), "The Macro-economic Impact of e-Commerce in the EU Digital Single Market", *WP*.

remotely, throughout the production process, by attaching RFID tags to products; *cloud computing*, where information resources are hosted by a third-party provider but accessible to the company; and *big data analytics*, where large amounts of data are collected for analysis in real-time using markers on products or social media. In addition to these indicators, this document also looks at automation with *industrial robots*, as captured by the statistics of the International Federation of Robotics.

At a macroeconomic level, the decade between 1995 and 2005 was notable for productivity gains from the digitalisation of the economy, amounting to 0.45 points per year in France (0.25 points associated with ICT adoption and 0.2 points with robotics) and 0.55 points in both the euro area (0.25 and 0.3 points respectively) and the US (0.45 and 0.1 points respectively).[5] The pace has since dropped off, by roughly 40% in both the euro area and the US, due to a slowdown in ICT adoption. However, the potential of today's bourgeoning digital technologies (cloud computing, AI) is yet to be seen: it can take several decades for the adoption of new production techniques to lead to productivity gains.[6] It requires trial and error, testing out new production processes and adapting workforce skills. This learning curve could explain why AI has not yet led to widespread productivity gains.[7]

1.2 Digitalisation appears to be neutral on overall employment levels but may eliminate manufacturing jobs

As the business sector has gone through successive waves of digitalisation, the resulting productivity gains have not led to mass technological unemployment at the overall economy level. This supports Sauvy's theory that productivity gains in one sector will invariably result in a drop in employment in that sector, but will also induce demand effects (lower prices, higher real income) which will stimulate employment in other sectors.[8]

Digitalisation has, however, contributed to polarising the labour market, allowing machines to take the place of manual labourers for repetitive, easily automated tasks, while at the same time requiring more higher-skilled workers for cognitively demanding tasks.[9] That is why industry jobs – historically intermediate routine jobs – have suffered the biggest losses from automation:[10] if more heavily automated companies outperform their counterparts in terms of overall employment and productivity, their expansion comes at the expense of other companies, with a net negative employment effect for industry.[11]

Digitalisation has also contributed to the geographic polarisation of economic activity: the areas of employment most vulnerable to robot automation are those that have registered the greatest drops in employment.[12]

That said, without any digital transition in the industrial sector, job losses would have likely been comparable or even higher due to market share losses to international competitors.

1.3 Digitalisation is not always a boon for businesses

While digitalisation can lead to productivity gains, it can also have negative effects if not managed properly. One way to quickly adopt a new technology is to choose a turnkey solution (for example, a marketplace platform, ERP system or cloud computing service), but

(5) Cette G., Devillard A. and V. Spiezia (2020), "Growth factors in developed countries : A 1960-2019 growth accounting decomposition", *Banque de France WP* no. 783.
(6) Juhasz R., Squicciarini M. and N. Voigtländer (2020), "Technology Adoption and Productivity Growth: Evidence from Industrialization in France", *NBER WP* no. 27503.
(7) Brynjolfsson E., Rock D. and C. Syverson (2017), "Artificial Intelligence and the Modern Productivity Paradox: A Clash of Expectations and Statistics", *NBER WP* no. 24001.
(8) A. Sauvy, La machine et le chômage, Dunod, 1980; Autor D. and A. Salomons (2018), "Is Automation Labor-Displacing? Productivity Growth, Employment, and the Labor Share", *Brookings Papers on Economic Activity*, Spring.
(9) Faquet R., Mas C. and G. Roulleau (2020), "Can low-skilled workers benefit from innovation in France?", *Trésor-Economics* no. 260.
(10) L. Demmou (2010), "The Decline in Industrial Employment in France Between 1980 and 2007 - Scope and Main Determinants: An Assessment", Economics and Statistics, 438-440, 273-296; Faquet R., Le Saux L. and C. Rachiq (2019), "Composition and competitiveness of the French economy", *Trésor-Economics* no. 248.
(11) Acemoglu D., Lelarge C. and P. Restrepo (2020), "Competing with Robots: Firm-Level Evidence from France", *NBER WP* no. 26738.
(12) Aghion P., Antonin C. and S. Bunel (2019), "Artificial Intelligence, Growth and Employment: The Role of Policy", *Economics and Statistics*, 510, 149-164.

this can leave the company captive to a particular service or piece of technology, with a risk of value capture by the provider. If companies turn *en masse* to technology developed outside the European Union, it could pose a risk to economic sovereignty.

On a more general level, digital technology can make companies more vulnerable: 15% of French companies experience at least one security incident every year (data corruption, data breach, system outage), a phenomenon that correlates with ICT use.[13]

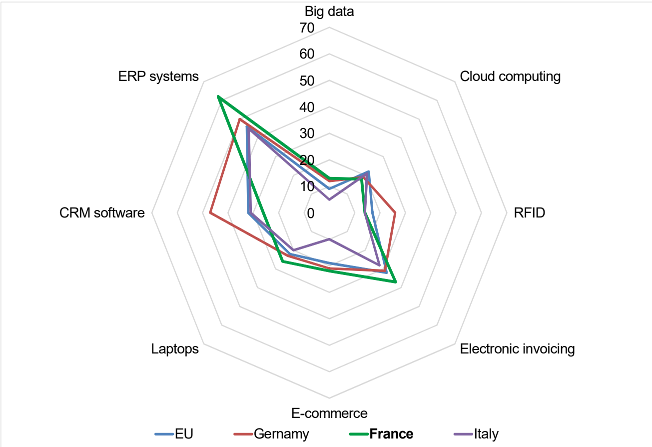
2. French companies are in line with the European average in terms of digitalisation and automation

2.1 France's manufacturing sector follows the European average

On the whole, France's manufacturing sector appears to be in line with the European average in terms of digitalised production processes, and the density of industrial robots is consistent with the country's sectoral structure and labour force (see Box 2). Where French companies lag behind, notably vis-à-vis their German counterparts, is in CRM and RFID (with French usage rates half as high as in Germany, see Chart 1), but they match or outmatch their competitors in terms of both mature technology (ERP systems, automatic invoicing) and emerging technology (cloud computing, big data). The same observation applies to market services as a whole (see chart on page 1) and when just looking at SMEs.

French industry also boasts a particularly high ICT investment rate (6.7% of manufacturing value added vs 1.3% in Germany and 2.3% in Italy).[14] While this difference can be partly explained by differences in the practices used by national statistics institutes to account for software investments, a recent study[15] suggests that, with consistent methodology, the investment rate would still be higher in France (3 points above Germany and 2 points above Italy). A likely explanation is the unique structure of France's manufacturing base, which is heavy on large international corporations that often offshore the manufacturing of their final products (compared to German plants that assemble and export their final products) but that have kept the software-intensive activities of research and design in France.[16]

Chart 1: Percentage of businesses using ICT in the manufacturing industry



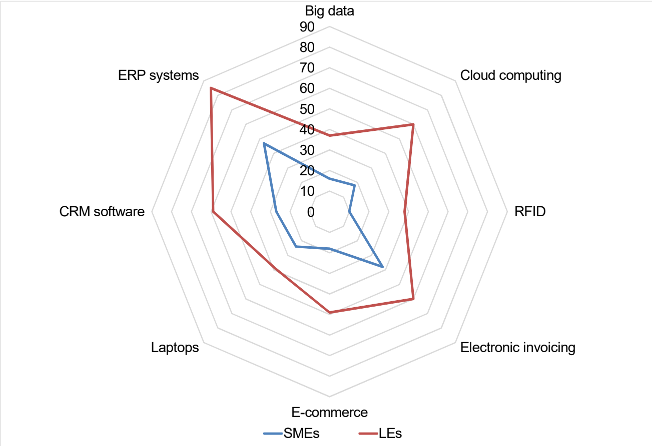
Source: 2019 ICT survey (Eurostat). Scope: businesses with 10 or more employees.

2.2 French SMEs and VSEs are less digitalised than large enterprises, as observed abroad

Uptake of ICT by SMEs lags behind that of large enterprises, in terms of mature technology, emerging technology and e-commerce (see Chart 2).

(13) N. Pradines (2020), "One Third of Large Companies Were Affected by an ICT Security Incident in 2018", *Insee Première* no. 1796.
(14) EU KLEMS data, DG Trésor calculations. ICT investments do not include robotics in national accounting.
(15) National statistics institutes use different approaches to allocate software expenditure between gross fixed capital formation and intermediate consumption. They do not always have access to sufficiently detailed data (whether or not IT services are used as inputs by customers, duration of use, etc.), which means they must make accounting assumptions. See Guillou S. and C. Mini (2019), "À la recherche de l'immatériel : comprendre l'investissement de l'industrie française", La Fabrique de l'industrie and OFCE.
(16) Sectors with particularly high software investment rates in France compared to other countries, namely transport equipment and the electrical and electronics industries, include companies whose top line is heavily dependent on foreign subsidiaries. See G.de Warren (2020), "The international strategies of France's business sector", *Trésor-Economics* no. 267.

Chart 2: Percentage of businesses using ICT by company size



Source: 2019 ICT survey (Eurostat). Scope: businesses with 10 or more employees in market sectors excluding agriculture and financial/ insurance services.

While it is a common trend across all countries for digitalisation to correlate with company size, French VSEs appear to lag behind more than most in adopting basic digital tools: in 2016, 19% of VSEs did not have an internet connection (vs 1% for other businesses), just 32% had a website (vs 68%) and only 6% were set up for e-commerce (vs 16%).[17] The divide is particularly pronounced in the accommodation and food service sector, where 39% of VSEs do not have an internet connection. Most VSEs also do not have a website or social media presence and do not use ICT for business development (content production, e-commerce, newsletters, online bookings, etc.). French VSEs are significantly less digitally advanced than their counterparts in Germany, where 93% have an internet connection and 64% have a website. As concerns SMEs, both countries have comparable digitalisation rates.

Box 2: Robotics automation in French industry

France's manufacturing industry has a low density of robot workers – 177 per 10,000 employees in 2019, vs Germany's 346 and Italy's 212[a] – but does not appear to be under-developed in this area.

In comparison with Germany, the difference can largely be explained by the sectoral structure of French industry: more structurally automated sectors such as automotive and electrical/electronics manufacturing (which account for 60% of the world's industrial robot population) only represent 14% of manufacturing value added in France, versus 33% in Germany (but 13% in Italy). The effect of these structural differences may therefore disguise the fact that France's automotive sector is significantly more automated than that of other countries.[b] Furthermore, according to the ICT survey, 21% of France's industrial companies report using robotics, versus 14% in Germany and 16% in Italy.

Differences in robot density can also be explained by the availability of labour:[c] countries experiencing more rapid demographic aging are also those with higher rates of robot adoption. Both Germany and Italy have more rapidly aging populations than France.

a. Data from the International Federation of Robotics (IFR).
b. Bharadwaj A. and M. Dvorkin (2019), "The Rise of Automation: How Robots May Impact the U.S. Labor Market", Federal Reserve Bank of St. Louis.
c. Acemoglu D. and P. Restrepo (2017), "Secular Stagnation? The Effect of Aging on Economic Growth in the Age of Automation", American Economic Review, 107(5), 174-179; Acemoglu D. and P. Restrepo (2018), "Demographics and Automation", *NBER WP* no. 24421.

(17) INSEE 2016 ICT-VSE survey data used here.

3. The 2020 crisis has revealed new benefits of digitalisation, making a case for targeted support

3.1 The pandemic has shown how ICT can boost economic resilience

The COVID-19 crisis has revealed the potential economic benefits of digital technology. It has helped to cushion the economic blow both on the supply side, by allowing people to work remotely, and on the demand side, by allowing people to make purchases remotely, as indicated by statistical analysis of household bank card data during lockdown.[18] Econometric analysis confirms the cushioning effect of digitalisation for companies in certain sectors during lockdown (see Box 3):

- In retail trade, the losses suffered during lockdown by SMEs that accept online orders were 25 points lower on average than competitors that do not sell their products online. The cushioning effect of e-commerce is strongest in non-food retail trade (difference in losses of 35 points).[19]
- In manufacturing, wholesale trade, information/communications, and specialised, scientific and technical activities, companies with pre-crisis levels of laptop use 10 points above their competitors saw a 2- to 4-point smaller contraction in their activity.

Box 3: Econometric analysis of the cushioning effect of digitalisation during the COVID-19 crisis

The INSEE's 2019 ICT survey data were matched, for each legal unit (identified by SIREN number), to the Public Finances General Directorate's database of monthly VAT tax returns, providing monthly sales figures. The resulting sample is composed of 8,438 individual observations characterised by the following economic variables:

- Sales figures reported in January, February, March and April for 2019 and 2020
- Company size: small (10 to 49 employees), mid-sized (50 to 249 employees) or large (250 or more employees)
- The company's activity sector (the 9 sectors of the ICT survey were used; retail trade and accommodation/food service were each broken down into two sub-sectors using APE codes: food retail trade, non-food retail trade, accommodation and food service)
- The proportion of employees with a company-provided laptop, as a measure of remote work capability
- An indicator of whether the company accepts online orders, as a measure of remote sales capability

Using the following linear regression, estimated using ordinary least squares for each sector, the effect of digitalisation on economic shock during lockdown can be evaluated for each company i:

$$\Delta logCA_i^{ma} = \beta_0 + \beta_1 * NUM_i + \beta_2 * ME_i + \beta_3 * GE_i + \beta_4 * NUM_i * ME_i + \beta_5 * NUM_i * GE_i + \beta_6 * \Delta logCA_i^{jf} + u_i$$

(18) Bounie D., Camara Y. and J. Galbraith (2020), "Consumers' Mobility, Expenditure and Online-Offline Substitution Response to COVID-19: Evidence from French Transaction Data", CIRANO WP. See also the 8 September 2020 economic outlook from the INSEE.

(19) This impact is consistent with bank card data analysis, which shows that the drop in online shopping during lockdown was roughly 30 points less than the drop in in-store shopping. See Bounie D., Camara Y. and J. Galbraith (2020), *op. cit.* In its 8 September 2020 economic outlook, the INSEE also used daily bank card transaction amounts to document an average difference of about 30 points between the year-on-year changes in online sales and in-store sales during lockdown.

Where:

- $\Delta \log CA_i^{ma}$: year-on-year change in sales for the months of March (m) and April (a) 2020 combined
- NUM_i : variable measuring digitalisation (laptops or online sales, see explanation above)
- ME_i : indicator designating a mid-sized company
- GE_i : indicator designating a large company
- $\Delta \log CA_i^{jf}$: year-on-year change in sales for the months of January (j) and February (f) 2020 combined, to account for the possibility that the most thriving companies pre-COVID may also be the most digitally advanced.

The coefficients of interest are statistically significant in the following sectors:

		β_1	β_4	β_5
NUM_i: Online sales	Retail trade	0.24**	–0.18	–0.26**
	- Food	–0.01	0.05	0.13
	- Non-food	0.35**	–0.17	–0.38**
NUM_i: Employees equipped with laptops	Manufacturing	0.25**	–0.16	–0.17
	Wholesale trade	0.18**	0.21**	–0.10
	Information/communications	0.16**	0.25	–0.17
	Specialised, scientific, technical activities	0.24**	–0.35	–0.07

How to read this table: The impact on sales of being set up for e-commerce is equal to 100*β_1*pp* for small companies, 100*($\beta_1+\beta_4$)*pp* for mid-sized companies, and 100*($\beta_1+\beta_5$)*pp* for large companies. The impact on sales of having 10% more employees equipped with laptops is equal to 0,1*100*β_1*pp* for small companies, 0,1*100*($\beta_1+\beta_4$)*pp* for mid-sized companies, and 0,1*100*($\beta_1+\beta_5$)*pp* for large companies. ** : Statistically significant at the 5% level.

There are two limitations of this model worth mentioning. Firstly, these estimates, which are based on 2019 ICT data, do not account for the fact that some companies may have made immediate digital investments at the beginning of lockdown. Secondly, the sample size is not very large, which precludes a more detailed sector breakdown to neutralise the impact of the company's activity sector, which can determine both the size of the economic shock it sustained and how digitally advanced it is.

3.2 Government support has proven to be effective in facilitating digital uptake

Any government digitalisation initiative will necessarily be multidimensional. Support for business investment must go hand in hand with infrastructure development (ultra-high-speed internet, 5G) and a coherent set of policies for digital development (support for research, training, cybersecurity, digitalisation within the government, etc.).

While companies' digital investments can help them achieve productivity gains, they do not generate substantial externalities.[20] In theory, then, support for such investments may not call for government intervention, since the benefits are reaped only by the companies.[21] However, the government could intervene to remove barriers to digital investment, for instance in terms of financial constraints[22] and information asymmetry, which tend to be more pronounced the smaller the size of the company.

In small companies, barriers to digitalisation include a lack of training (for both management and employees) and unfamiliarity with support schemes. A number of studies[23] show that company managers, retailers and

(20) This differentiates digitalisation expenses from other investments that can generate high levels of externalities, such as R&D or digital infrastructure (for example, expanding ultra-high-speed internet or 5G across the country), which would be funded in suboptimal quantities without government intervention.
(21) Some technologies can, however, generate network effects, such as automated invoicing.
(22) Small companies have a higher risk of default and are less able to put up collateral, which makes it difficult for them to access bank financing, even for lucrative investments. Moreover, intangible digital investments tend to run up against more market imperfections than other types of investment, due to their lack of collateral value.
(23) AFNIC survey "Réussir avec le web" (September 2018 to August 2019); CPME-SAGE survey "La transformation digitale des TPE" (August 2019).

crafts- and tradespeople tend to devote little time and resources to their digitalisation strategy or to finding the right people to help them. Many expect to run into difficulty implementing new tools due to having to transform how they work or to a lack of in-house expertise. Many of them are also sceptical that digital tools will be able to add value to what they do and improve their bottom line. These specific issues explain why VSEs lag behind SMEs and ISEs, which are more commonly in the industrial sector and more familiar with digital tools.

Any digitalisation support strategy should therefore include spending allocations for support and training of management and employees. Experience shows that the most effective tools for promoting robotics and digital solutions combine financial support and technical assistance, as was the case with the *Robot Start PME* assistance program that ran from 2013 to 2017.[24]

The same idea is behind *France Num*, a platform launched at the end of 2018 to educate and support companies as they develop and implement digitalisation strategies. The platform is based on a network of actors (chartered accountants, chamber of commerce members) who are familiar with the ecosystem in their region. It also provides information on available training, financing and specialised IT providers. It is a platform that should be better publicised to business owners.

The recovery plan has earmarked €385m to help finance companies' digitalisation strategies between now and 2022. *France Num* has been given a major boost and a plan has just been launched to help retailers digitalise their operations. A subsidy has also been introduced for digital and robotics investments by industrial SMEs and ISEs, replacing the higher depreciation allowance measure. The subsidy is designed to supplement the loans offered under BPI France's *French Fab – Technologies et usages du futur* loan program, under which SMEs and ISEs can access between €100,000 and €5m in financing for tech upgrades.

(24) Program to support companies in purchasing their first robot. It covered 10% of the investment price (up to €20,000) and offered support from experts throughout the process. See SYMOP (2017), "Bilan intermédiaire de l'action Robot Start PME".

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