Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project

Problem Identification report (D.4)

European Commission

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PPMi

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Smart Industrial Remoting: remote working in non-digitalised industries

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Abbreviations

Abbreviation	Definition
AI	Artificial intelligence
AR/VR	Augmented reality/virtual reality
BIM	Building information modelling
COVID-19	Coronavirus disease 2019
CRM	Customer relationship management
DESI	Digital Economy and Society Index
DIH	Digital Innovation Hub
DMA	Digital Maturity Assessment
EDIH	European Digital Innovation Hub
EIB	European Investment Bank
ERM	Enterprise resource management
ERP	Enterprise resource planning
EU	European Union
GDP	Gross domestic product
GVA	Gross value added
HIPA	Hungary Investment Promotion Agency
HPC	High-performance computing
ICT	Information and communication technologies
I-IoT	Industrial Internet of Things
IoT	Internet of Things
IT	Information technologies
OEM	Original equipment manufacturer
R&D	Research and development
RRP	Recovery and Resilience Plan
SIR	Smart industrial remoting
SMEs	Small and medium-sized enterprises
UX	User experience
WMS	Warehouse management system

Executive summary

Digitalisation is a key contributor to a company's resilience, growth, and competitiveness. Yet, some companies risk falling behind in their digitalisation journeys. Several factors contribute to difficulties faced by companies in implementing digital technology. This report uncovers the main problems at the company level in relation to the adoption of digital technologies in five country-industry pairings: agrifood in Lithuania, automotive in Hungary, construction in Romania, retail in Poland and textile in Portugal.

The Problem Identification report is part of a study 'Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project'. The objective of the study is to put forward recommendations for industry digitalisation with a focus on SMEs and companies of low digital maturity. The analysis of the study focuses on the five country-industry pairings.

The company level problems have been identified by taking into account the findings of the gap analysis conducted in a previous phase of the study and further elaborated through interviews with local company representatives as well as through a dedicated Company Digitalisation survey. The report first presents the over-arching findings from the Company Digitalisation survey. It then deep dives into the specific findings per country-industry pairing. For each country, the report presents a broader description of the industry, main problems identified, as well as company examples.

Synthesis of the identified company-level problems reveals several cross-cutting issues faced by companies in their attempts to digitalise:

- **Structural issues**: the current economic conditions have caused companies to deprioritise investments in digitalisation across the industries of focus. More specifically, supply chain shocks in the automotive sector in Hungary and spikes in inflation in the construction industry in Romania have limited the resources available for companies' digitalisation efforts. Additionally, limited availability and high costs of advanced digital solutions in certain industries, such as the Hungarian automotive sector and Lithuanian agrifood sector, hinder companies' ability to adopt digital technologies. Information asymmetries and fears of vendor lock-in also impact companies' willingness to engage with external suppliers.

- **Financial resource and public support-related issues:** lack of financial resources is a significant barrier to digitalisation for many companies. Yet, existing support initiatives do not always address companies' needs. For example, companies in the Lithuanian agrifood and Romanian construction industries experience substantial financing gaps when seeking funds in the credit market. This is often due to the large upfront costs associated with implemented digital technologies. Furthermore, SMEs and companies of low digital maturity greatly benefit from implementing simple 'off-the-shelf' solutions. Yet, existing public support programmes tend to focus on the implementation of more advanced technologies instead of basic digital solutions. Public initiatives with a focus on capacity building, collaboration, and providing training and support are of particularly high relevance for less digitally mature companies looking to digitalise.

- **Issues relating to human resources and skills:** the shortage of skills is considered a significant barrier to digitalisation across all industries studied. Companies lack dedicated staff responsible for identifying digital technologies, managing relationships with suppliers, and accessing funding opportunities. Concerns over insufficient skills to implement and operate new technologies may discourage investments in digitalisation. Companies often rely on external providers

for digital technology implementation. Yet, for companies that lack internal resources and skills to manage such relationships, digitalisation projects risk running overtime without achieving the desired goals. Evidence from the Polish retail, Portuguese textile, and Lithuanian agrifood industries shows that working with external providers sometimes brings challenges such as high costs, delays, and lack of integration with the already implemented technologies.

- **Awareness and risk aversion-related issues:** limited awareness and risk aversion towards new technologies hinder company digitalisation. Some companies do not prioritise digitalisation due to other pressing concerns, while others lack awareness of the benefits of specific technologies for their business. Evidence shows that SMEs may find it difficult to identify appropriate digital investments for their company. Risk aversion toward digitalisation also impedes technology adoption. For example, companies in the Polish retail industry associated new technology integration with a drastic overhaul of company processes. Yet, such overhaul is often a precondition for success. In turn, change management and employee capacity building are important components for successful digitalisation.

The findings of the report feed into the next stages of the study – identification of best practices, digitalisation pilots and the development of the Digitalisation Toolbox.

Introduction

This report forms part of a study entitled 'Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project'. Smart industrial remoting (SIR) measures refer to those measures that support the uptake of digital technologies, undertaken by businesses to facilitate their remote operations internally or externally. The objective of the study is to propose SIR measures for five ecosystems in which a particularly high proportion of small and medium-sized enterprises (SMEs) have been hit hard by the COVID-19-related crisis: agrifood, automotive, construction, retail and the textile sector. These industries are analysed in order to formulate user-friendly and targeted advice on digitalisation. Each industry is studied in the context of a specific country,[1] resulting in the following five country-industry pairings:

- automotive in Hungary;
- agrifood in Lithuania;
- construction in Romania;
- retail in Poland;
- textiles in Portugal.

The study encompasses five main tasks, as illustrated in Figure 1 below. Throughout the study, these tasks are complemented by several promotion and dissemination activities.

Figure 1. Study tasks

1.Gap analysis	2. Problem identification	3. Best practice identification	4. Experiments/ case studies	5. Toolbox development
Assessment of the gaps and strengths associated with digitalisation in each country-industry pairing.	Identification of the main problems faced by SMEs in each country-industry pairing in their attempts to digitalise.	Identification of examples of good practices implemented by European companies to address the problems identified in previous steps.	Five interventions with companies based on their specific digitalisation needs and capabilities; each lasting for a period of six months.	Development of five digitalisation toolboxes that contain recommendations, best practices and lessons learnt.

6. Promotion and dissemination

Source: authors' own elaboration.

The purpose of this report is to present the main problems at company level in relation to the adoption of digital technologies in each of the selected country-industry pairings, and to identify specific examples of companies facing such problems. The problems have been identified by taking into account the findings of the gap analysis, and further elaborated through interviews with local company representatives as well as through a dedicated 'Company Digitalisation' survey. The key takeaways of this report will feed into further phases of the study such as collecting best practices, experiments/case studies, and the development of a toolbox for each industry.

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[1] The selection of countries is described in more detail in the report 'Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project: Gap Analysis report'.

The Problem Identification report is structured as follows:

1. **Chapter 1 Methodology** outlines the methodological approach taken to conduct a company digitalisation survey and to identify the main problems and company examples in each country-industry pairing.
2. **Chapter 2 Company Digitalisation survey results: a closer look at cross-cutting themes** presents the overall findings from the Company Digitalisation survey.
3. **Chapter 3 Overview of key findings by industry** includes a description of the main problems and company examples in each country-industry pairing.
4. **Chapter 4 Conclusion** outlines the overall conclusions from the identification of industry problems and company examples.

1. Methodology

This chapter describes the methodology used in the preparation of this report. Section 1.1 describes of the approach used to conduct the Company Digitalisation survey. Section 1.2 the goes on to present the approach used to identify the main problems in each industry, along with selected examples of companies experiencing these problems.

1.1. Company Digitalisation survey

As part of the study, PPMI implemented an online survey targeting companies in the five country-industry pairings. The goal of the survey was to gather additional insights into the most prevalent problems encountered by industrial companies in relation to digitalisation. The survey also served the secondary purpose of raising awareness about the study and expanding its network. Participants were asked whether they would like to receive further updates on the study and to participate in future associated events.

The survey fieldwork was carried out between 25 July and 17 August 2022. Dissemination was carried out via two channels – online panel survey aggregator CINT[2] and an open-invitation survey available at the PPMI website and disseminated via email campaigns, social media posts, a phone campaign and other means.

A total of 1,545 responses were collected during the fielding period. Out of these, 396 were complete, 194 were partially completed, and 955 were disqualified. After the data were cleaned, some of the partial and complete responses were marked as 'removed' if they did not fulfil data quality criteria, while a few of the other partial responses were reclassified as complete (see Section 1.1.3 in Annex 1 for more detail).

As a result, the total sample of valid responses from companies operating within the five country-industry pairings was 350. The breakdown of responses per country-industry pairing was as follows:

- 77 responses from automotive companies in Hungary;
- 51 responses from agrifood companies in Lithuania;
- 67 responses from retail companies in Poland;
- 75 responses from textile companies in Portugal;
- 80 responses from construction companies in Romania.

The survey was developed and run in three key phases: pre-fielding, fielding and post-fielding. For more information about these phases and about the survey's methodology, see Annex 1.

1.2. Identifying problems and company examples

For each country-industry pairing, this report describes between one and three digitalisation problems. In this context, problems are understood as company-level challenges to digitalisation.[3] Such problems were identified through an analysis of:

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[2] More information available at: https://www.cint.com/.

[3] Industry gaps are explored in the 'Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project: Gap Analysis report'.

- the conclusions from an online workshop on 'European industry digitalisation – the challenges ahead' organised on 28 June 2022 as part of this study;[4]

- the results of the gap analysis;[5]

- the results of the Company Digitalisation survey conducted as part of this study (a description of the survey methodology is available in Section 1.1 of this report; detailed results are available in Annex 3);

- the conclusions from semi-structured interviews with local company representatives;

- the results of desk research into relevant secondary data and information.

In addition, up to three examples of companies were identified that experience some or all of the problems highlighted for each country-industry pairing.

The research on the five country-industry pairings was led by five Digital Innovation Hubs participating in the study: Agrifood Lithuania DIH,[6] representing the agrifood industry; Innomine[7] in Hungary, which represents the automotive industry; Iceberg+[8] in Romania, leading research on the construction industry; dih4.eu[9] in Poland, providing insights on retail; and CITEVE[10] in Portugal, which focuses on the textile industry. In addition, industry-specific insights were contributed by experts specialising in each of the industries included in the study.

The presentation of the company-level problems identified, together with the company examples, is structured around the five selected country-industry pairings. It includes a brief overview of each industry, a description of its main digitalisation problems and examples of companies that exhibit these problems. The results of this research can be found in Chapter 3 of this report.

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[4] More information available at: https://ppmi.lt/news-insights/workshops-take-aways-european-industry-digitalisation-challenges-ahead.

[5] Results are available in the 'Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project: Gap Analysis report'.

[6] More information available at: https://agrifood.lt/.

[7] More information available at: https://innomine.com/.

[8] More information available at: https://www.iceberg.ro/en/digital-innovation-hub/.

[9] More information available at: https://dih4.eu.

[10] More information available at: https://www.citeve.pt/.

2. Company Digitalisation survey results: a closer look at cross-cutting themes

This chapter introduces the main cross-cutting themes observed in the results of the Company Digitalisation survey. Analysis of the survey findings helped to identify cross-industry drivers of, and barriers to, digitalisation, as well as the effect that the COVID-19 pandemic had on the adoption of digital technologies.

The survey respondents were asked to assess the digital maturity of their company in comparison with other companies operating within their industry. Most companies assessed their digital maturity as being higher than average (43%), with 35% of respondents reporting their maturity as 'average', and 22% 'below average'.[11] It should be noted that the concept of digital maturity lacks a universally accepted definition. Therefore, self-assessment may not reflect the true level of digitalisation among the companies surveyed. Nonetheless, when the responses are broken down by company size, some noteworthy findings can be observed. The proportion of respondents from large[12] companies who considered their company's digital maturity below average was lower than among companies with fewer than 250 employees. Fewer companies with between one and nine employees evaluated their digital maturity as above average (36.4%), in comparison to enterprises in other size categories (44.9%-48.8%) (see Figure 2).[13]

Figure 2. Company Digitalisation survey: digital maturity, all five industries, by company size, 2022
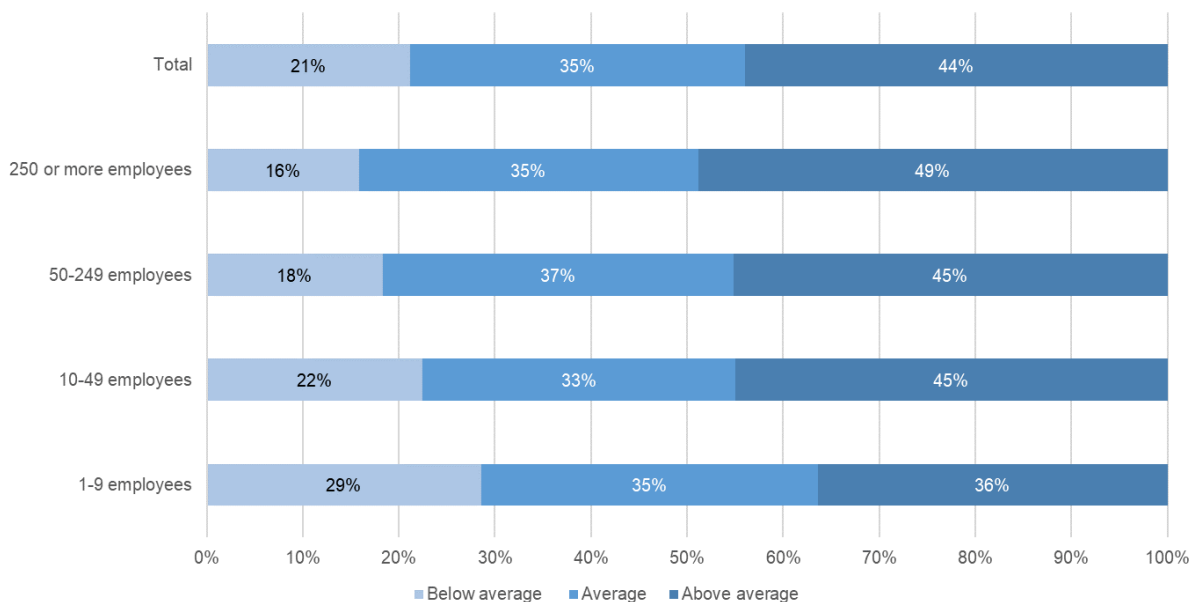
Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study (2022).[14]

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[11] Respondents who answered 'I don't know' were excluded from the total. Non-weighted average.

[12] In this case, 'large companies' are defined as companies with more than 250 employees. SMEs are defined as companies with fewer than 250 employees.

[13] Non-weighted averages.

[14] Notes: Question 6 'How would you assess your company's digital maturity as compared to similar companies operating in this industry?', by the number of people employed at the company; respondents who did not indicate a size class or answered 'I

The survey data suggest that the effect of COVID-19 on digitalisation varied. Approximately one-third of respondents stated that the pandemic did not influence their company's investment in digital technologies. Slightly more (38.6%) indicated that COVID-19 had accelerated the uptake of digital technologies in their company. Less than one-fifth (18.4%) of survey participants said that the COVID-19 crisis caused them to drop or postpone investments relating to the adoption of digital technologies (see Figure 3).

Figure 3. Company Digitalisation survey: effect of COVID-19 on digitalisation, all five industries, by company size, 2022
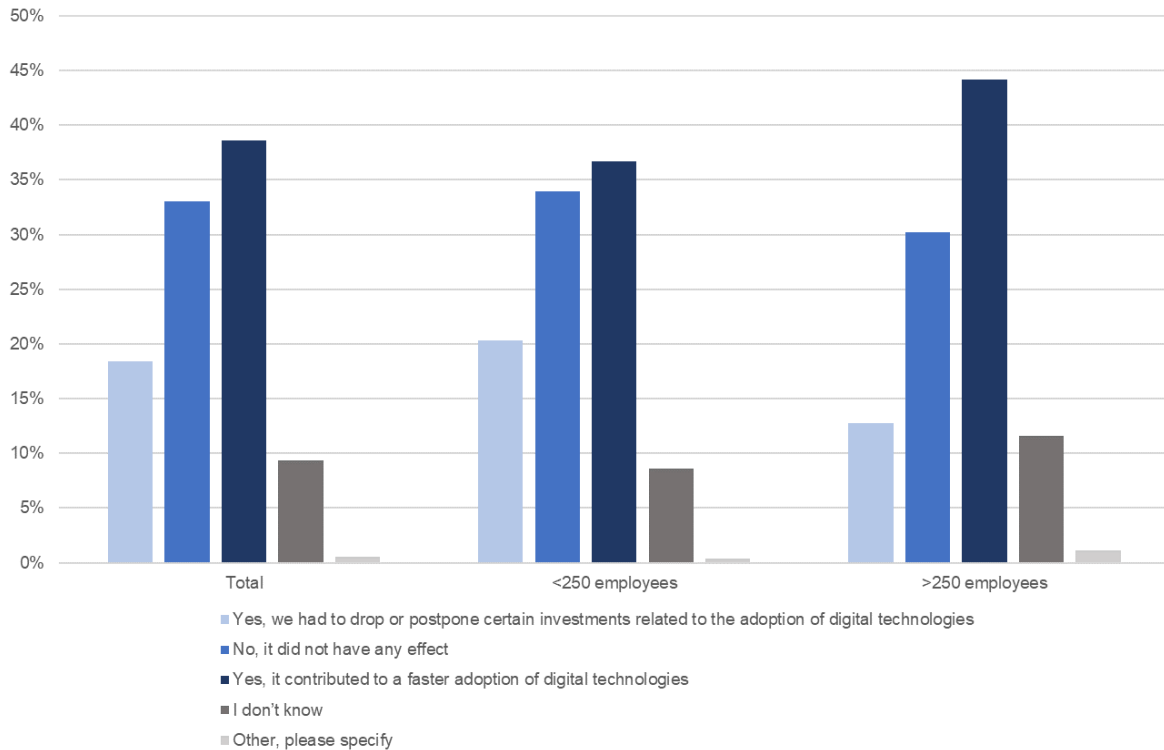
- Yes, we had to drop or postpone certain investments related to the adoption of digital technologies
- No, it did not have any effect
- Yes, it contributed to a faster adoption of digital technologies
- I don't know
- Other, please specify

Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study (2022).[15]

Financial and competitiveness-related factors were identified by respondents as being the most important drivers of investment in digital technologies, with 'increasing profitability' (selected by 49.7% of respondents), 'financial support' (35.7%), and 'increasing market share' (27.7%) being the most frequently selected factors influencing company decisions. In addition, 26.1% of respondents indicated strengthening resilience to external shocks as one of the factors driving investment in digital technologies. Companies with fewer than 250 employees were more likely than larger companies to select 'financial support', 'strengthening resilience to external shocks' and 'tax breaks'[16] (see Figure 4).

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don't know' excluded; non-weighted averages; N=330 (1-9 employees: 77; 10-49 employees: 89; 50-249 employees: 82; 250 or more employees: 82). 'Below average' refers to the proportion of respondents who answered 'somewhat less digitally mature than other companies operating in my industry' or 'much less digitally mature than other companies operating in my industry'; 'above average' refers to the proportion who answered 'much more digitally mature than other companies operating in my industry' or 'somewhat more digitally mature than other companies operating in my industry'.

[15] Notes: Question 16 'Did the COVID-19 pandemic have any effect on of the adoption of digital technologies (tools, solutions, processes) in your company?', by the number of people employed at the company; respondents who did not indicate a size class excluded; non-weighted averages; N=342 (1-249 employees: 256; 250 or more employees: 86).

[16] Answer options where the difference between the proportion of respondents from smaller and larger companies exceeded one percentage point.

Figure 4. Company Digitalisation survey: factors influencing the decision to invest, all five industries by company size, 2022
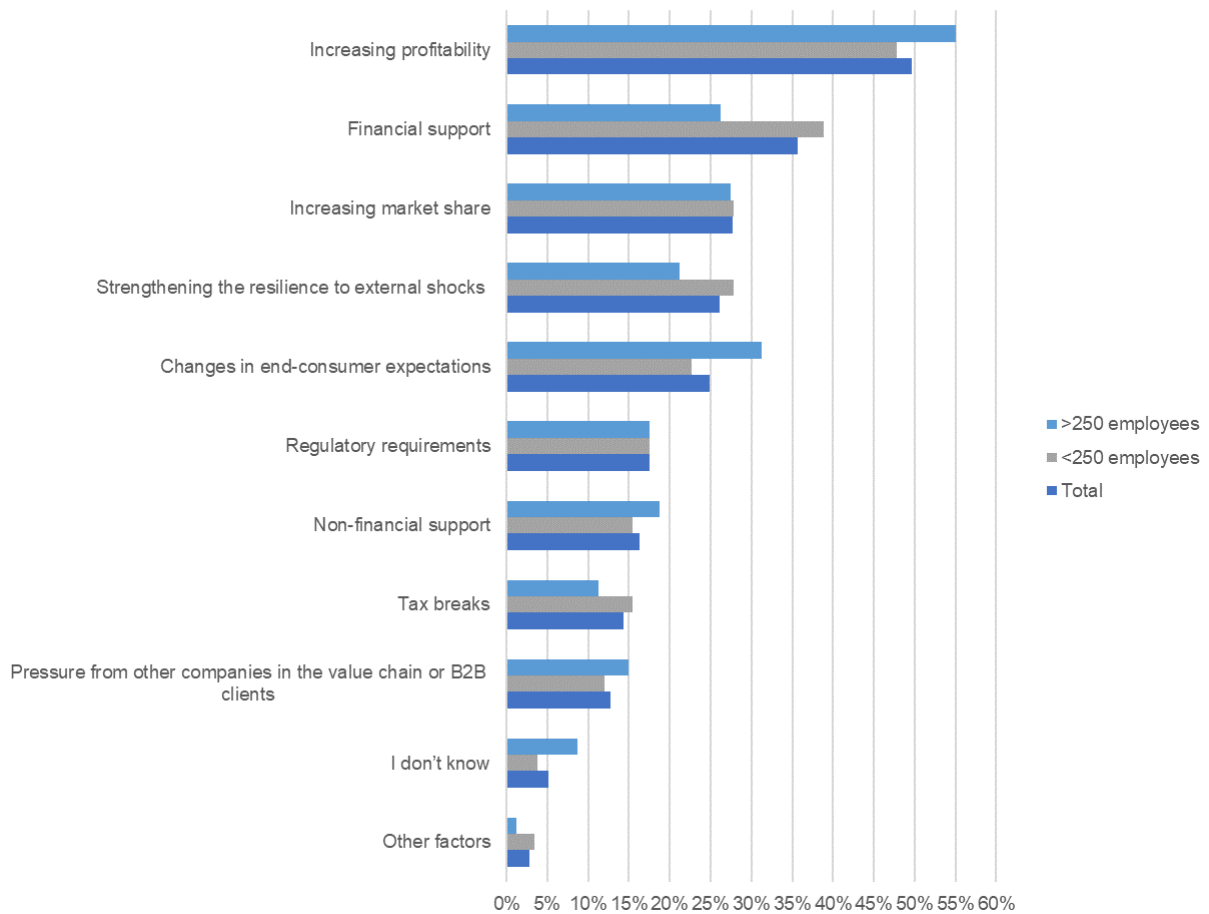
Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study (2022).[17]

The main obstacles to adopting digital technologies identified by survey respondents related to resources, skills and knowledge. 'Lack of financial resources' at 43% and 'lack of human resources' at 36.5% were the top obstacles selected by respondents. These were followed by 'lack of knowledge about relevant digital technologies' and 'lack of skills to implement the latest technologies' at 25.7% and 22.2%, respectively. Companies with fewer than 250 employees indicated insufficient financial resources, skills and knowledge more frequently than larger companies. They were also more likely to state that digital technologies did not fit their processes and business model, or would not bring value due to the company's size (see Figure 5).

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[17] Notes: Question 9 'What are the key factors driving your company's decision to invest in digital technologies?', by the number of people employed at the company; respondents who did not indicate a size class excluded; non-weighted averages; N=314 (1-250 employees: 234; >250 employees: 80).

Figure 5. Company Digitalisation survey: obstacles to adopting digital technologies, all five industries by company size, 2022
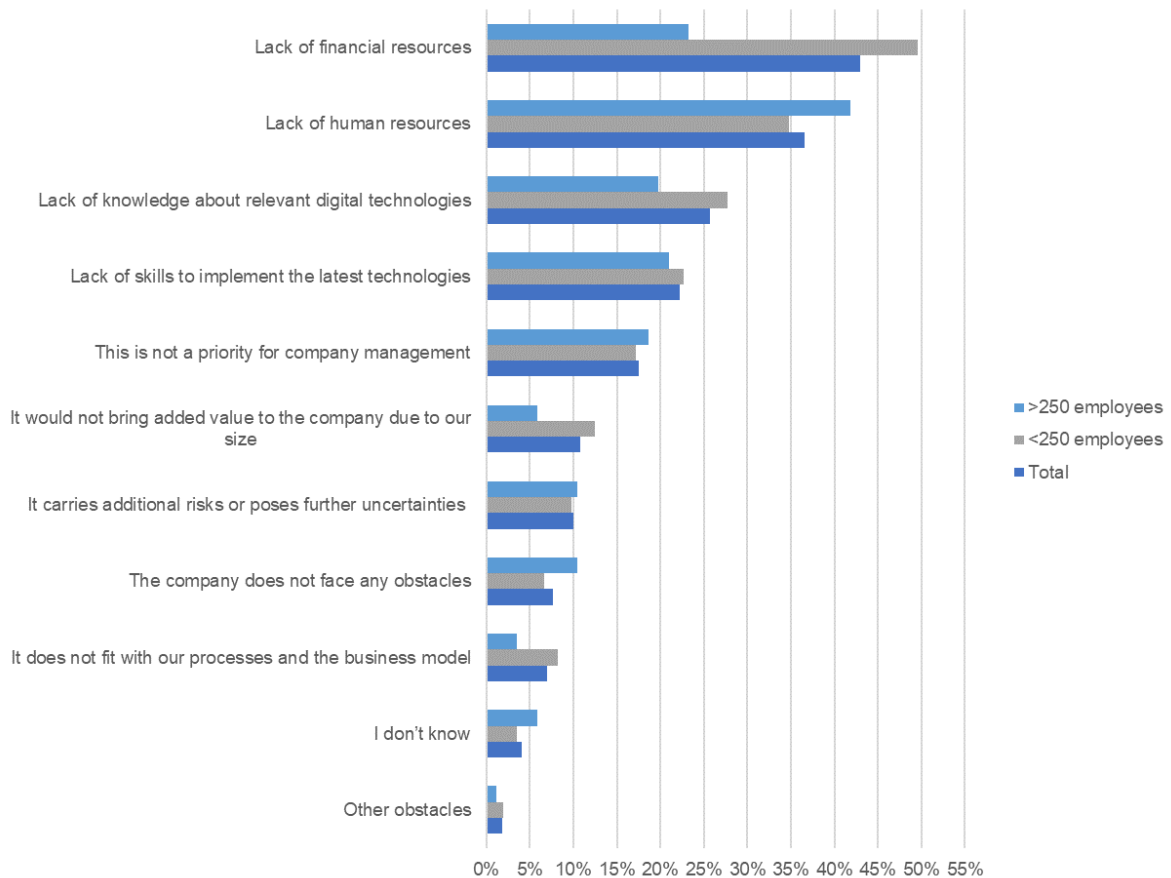
Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study (2022).[18]

Overall, the results of the Company Digitalisation survey suggest that the COVID-19 crisis had varying effects on digitalisation among the survey respondents, with around one-third of companies experiencing no effect, 38.6% stating that it had accelerated technology uptake, and 18.4% reporting that they had dropped or postponed investments. The main drivers of digital investment identified by respondents related to access to financing, market share and profitability considerations. Meanwhile, issues relating to resources, skills and knowledge were identified as the main obstacles to the adoption of digital technologies.

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[18] Notes: Question 9 'What are the key factors driving your company's decision to invest in digital technologies?', by the number of people employed at the company; respondents who did not indicate a size class excluded; non-weighted averages; N=342 (1-250 employees: 256; >250 employees: 86).

3. Overview of key findings by industry

This chapter presents the problems identified by this study, together with company examples for each of the five country-industry pairings. For each country-industry pairing, an overview of the ecosystem is first presented. This is followed by a description of the main digitalisation problems faced by companies, together with descriptions of companies that exhibit these problems. Table 1 below includes a summary of the main problems identified.

Table 1. Summary of identified problems per industry

Industry	Problems
Retail sector in Poland	**Problem 1:** Objective tools to assess digital maturity are not widely used within the retail sector
	Problem 2: Companies do not have sufficient human resources for the adoption of digital technologies
	Problem 3: Insufficient preparation creates issues during and after implementation
Automotive sector in Hungary	**Problem 1**: Companies lack the necessary expertise to implement digital solutions
	Problem 2: Companies lack the financial resources to invest in digital technologies
Textile sector in Portugal	**Problem 1:** Skills shortages are a barrier to adopting and using digital technologies
	Problem 2: Digital solutions may be unfeasible or expensive to implement on a small scale
	Problem 3: Difficulties in interacting with solution and technology providers can negatively affect the implementation of new technologies
Agrifood sector in Lithuania	**Problem 1**: Risk aversion and cautious attitudes held by agrifood companies are slowing down digitalisation
	Problem 2: Lack of digital skills and knowledge prevents companies from effectively adopting digital technologies
	Problem 3: Companies lack the financial resources to implement digital technologies
Construction sector in Romania	**Problem 1**: Current structure and properties of the Romanian construction market do not create incentives for digitalisation
	Problem 2: Companies face a shortage of the skills and personnel necessary to implement digital technologies
	Problem 3: Companies lack appropriate financial resources for digitalisation

Source: authors' own elaboration.

As is evident from the main obstacles to digitalisation presented in Chapter 2, most of the problems identified in the five country-industry pairings concern the pre-implementation stage of digital technology adoption. This finding may partly be explained by the focus of the study, which concentrates on companies with relatively low levels of digital maturity. Companies that are at the beginning of their digitalisation journey may not yet have had the chance to observe the challenges that relate to the implementation and post-implementation phases of digital technology adoption, thus explaining the resulting selection of problems. Nonetheless, the problems identified concern important aspects of digital transformation, and will be of high relevance during later stages of the study.

3.1. Retail sector in Poland

This section provides a description of the retail sector in Poland, the main digitalisation problems observed at company level, as well as examples of companies that exhibit those problems.

3.1.1. Description of the industry

In June 2021, the Polish retail sector consisted of 98,017 shops in total.[19] Almost all Polish retailers are SMEs (99.92%), and almost one in every five SMEs in Poland operates within the retail sector.[20] However, the Polish retail market has been undergoing market consolidation for several years, with smaller retailers increasingly struggling to remain competitive.

According to Eurostat, most companies in the Polish retail sector have a 'low' or 'very low' level of digital intensity.[21] In 2021, less than half (46%) had a website and only one in five sold online.[22] Poland ranks behind other Central European countries in many e-commerce indicators.[23] According to EcommerceDB, the major e-commerce players in Poland are large retail companies that have transitioned to omnichannel sales, while adoption among SMEs remains relatively low.[24]

The Company Digitalisation survey conducted for this study revealed additional insights into digitalisation in the Polish retail sector. Analysis of survey results helped to identify specific factors experienced by companies that affect their investment in digital technologies.

More than half of survey respondents from the Polish retail sector pursued digitalisation in two areas: purchasing and procurement; and marketing, sales and customer services. Almost 50% of survey participants stated that they had invested in inbound logistics and warehousing. When asked what motivates their spending on digital technology, the respondents ranked 'increasing profitability', 'increasing market share' and 'financial support' as the top three reasons (see Figure 6). 'Changes in end-consumer expectations' and 'strengthening resilience to external shocks' were selected by more than 20% of respondents.

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[19] NielsenIQ (2021). *Retail market 2021. Structure, numbers of facilities, trends. Results, quantity and structure research trade in June 2021 according to NielsenIQ.* Available at: https://foodfakty.pl/rynek-detaliczny-2021-struktura-liczebnosc-placowek-trendy-wyniki-badania-liczebnosci-i-struktury-handlu-w-czerwcu-2021-wg-nielseniq.

[20] Polska Agencja Rozwoju Przedsiębiorczości (2021). *Status report on the sector of small and medium-sized enterprises in Poland* (p. 107). Available at: https://www.parp.gov.pl/component/publications/publication/raport-o-stanie-sektora-malych-i-srednich-przedsiebiorstw-w-polsce-2021.

[21] Eurostat (2021). Tables ISOC_E_DII, NACE sector G47.

[22] Eurostat (2021). Tables ISOC_EC_ESELN2, ISOC_CIWEB, NACE sector G47.

[23] Suska, M. (2022). E-commerce: the pillar of the digital economy. In L.K Dąbrowski & M. Suska (Eds.) *The European Union Digital Single Market* (pp. 63-91). Routledge. Available at: https://www.taylorfrancis.com/chapters/edit/10.4324/9781003262534-4/commerce-magdalena-suska.

[24] ecommerceDB (n.d.). *The eCommerce market in Poland.* Available at: https://ecommercedb.com/en/markets/pl/all.

Figure 6. Company Digitalisation survey: summary of results on past investment in digital technologies, retail sector, Poland, 2022
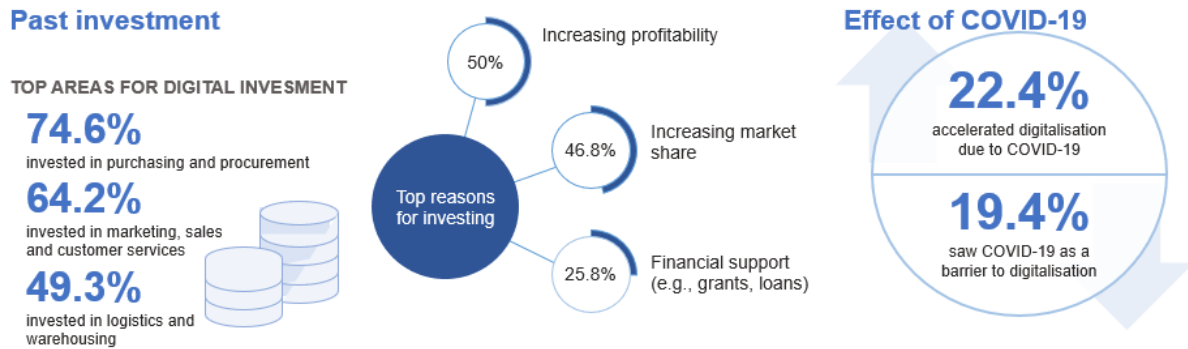
Source: Company Digitalisation survey conducted as part of this study, compiled by the research team. [25]

The COVID-19 pandemic affected company incentives to undertake digitalisation projects. The survey findings suggest that more than half of respondents saw a reduction in their turnover due to the COVID-19 crisis. Around 30% experienced supply chain issues. Nonetheless, the crisis only affected digital technology-related investment in 41.8% of cases. Of those companies whose digitalisation plans were affected, the split was almost even between cases in which COVID-19 delayed digitalisation versus those where it accelerated the process. Around one in five companies reported having to drop or postpone investments. Slightly more (22.4%) said the pandemic had accelerated their adoption of digital technologies. However, this effect varied by company size. Companies with more than 250 employees were more likely to experience a positive effect on the adoption of digital technologies when compared with SMEs. Furthermore, large companies were also less likely to state that the COVID-19 crisis had a negative effect on their investment in digitalisation.

In terms of potential future investment, survey respondents from the Polish retail sector ranked having an online presence (selected by 38.8% of respondents), the adoption of artificial intelligence (AI) and big data analysis (35.8%), and cloud computing (26.9%) as the top digital technologies necessary to remain competitive. Moreover, 35% of respondents indicated that they are planning to adopt all of the technologies needed to maintain competitiveness during the next two years. More than one in five or 21.7% of respondents had no such plans in place, however. Adoption of some of these technologies was planned in 36.7% of cases. These results indicate that, while companies recognise the need to adopt certain digital technologies, some of them face barriers which prevent them from planning to do so (see Figure 7).

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[25] Notes: The figure is compiled on the basis of responses to the following questions from the Company Digitalisation survey: Question 7 'Which areas of your company's operations have been the focus of digital technology related investments in the last 2 years?', N=67; Question 9 'What are the key factors driving your company's decision to invest in digital technologies?', N=62; Question 16 'Did the COVID-19 pandemic have any effect on of the adoption of digital technologies (tools, solutions, processes) in your company?', N=67.

Figure 7. Company Digitalisation survey: summary of results on future investment in digital technologies, retail sector, Poland, 2022
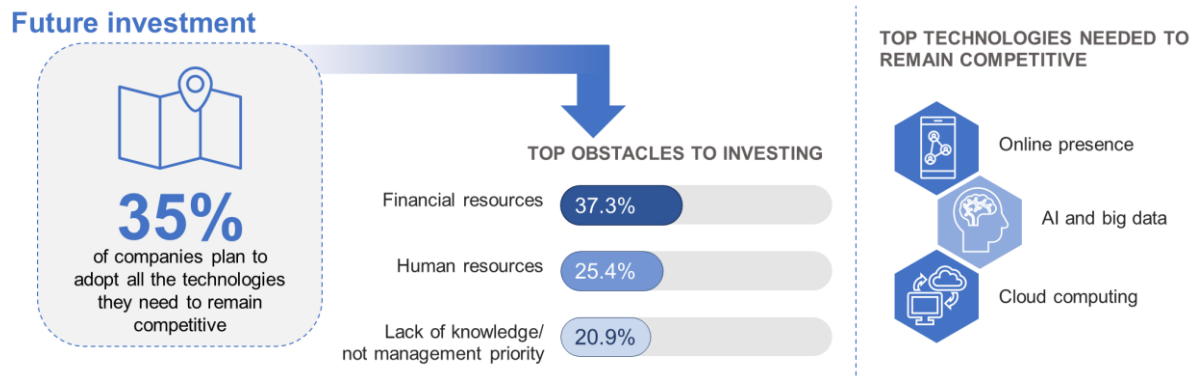
Source: Company Digitalisation survey conducted as part of this study, compiled by the research team.[26]

Based on the results of the survey, the main digital technology adoption obstacles experienced by Polish retail companies are resource-related. Lack of financial resources was ranked as the most important obstacle, at 37.3%. One in four respondents considered the lack of human resources a significant barrier. These options were followed by insufficient knowledge about the relevant digital technologies, or digital technology adoption not being a priority for company management, at 20.9%. These results point to certain company-level problems, which are further elaborated upon below.

3.1.2. Main problems identified in the industry

This section describes the three main company-level digitalisation problems identified in the Polish retail sector. The first of these relates to a lack of objective tools for assessing digital maturity. The second problem concerns a lack of availability of the ICT skills required to develop in-house solutions or to manage the implementation of solutions developed by external providers. Lastly, the third problem covers preparation for digital transformation projects.

3.1.2.1. Problem 1: Objective tools to assess digital maturity are not widely used within the retail sector

One of the main problems faced by companies in the retail sector in Poland is a lack of available tools for third-party digital maturity assessment. The concept of 'digital maturity' does not have a universally accepted definition, and is therefore subject to interpretation.[27] A 2016 study on digitalisation among SMEs suggests that when objective third-party assessments are not available, it is common for companies to overestimate their own digital maturity.[28] The use of an objective methodology for assessing company digital maturity in the retail sector could

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[26] Notes: the figure has been compiled on the basis of the following answers from the Company Digitalisation survey: Question 11 'To what extent is your company planning to take action to adopt these digital technologies in the next 2 years?', N=60; Question 10 'Which of the below technologies are currently not present in your company but would be necessary to adopt in the next 2 years for your company to remain competitive?', N=67; Question 12 'In your opinion, what are the main obstacles your company faces in adopting digital technologies?' N=67.

[27] Aslanova, I.V., & Kulichkina, A.I. (2020, May). Digital maturity: Definition and model. In *2nd International Scientific and Practical Conference "Modern Management Trends and the Digital Economy: from Regional Development to Global Economic Growth"(MTDE 2020)* (pp. 443-449). Atlantis Press.

[28] Bley, K., Leyh, C., & Schäffer, T. (2016). *Digitization of German Enterprises in the Production Sector-Do they know how "digitized" they are?* Szedlak, C., Leyendecker, B., Reinemann, H., & Pötters, P. (2019, July). Methodology for assessing digitalization readiness and maturity of small and medium-sized enterprises. In *International Joint conference on Industrial Engineering and Operations Management* (pp. 101-111). Springer, Cham.

be useful for benchmarking against peers and pinpointing digitalisation gaps. In turn, assessments could support companies in making more informed decisions when investing in digital technologies.

The results of the Company Digitalisation survey suggest that most respondents from the Polish retail sector considered their digital maturity to be similar to (40.6%) or higher than (39.1%) that of peer companies. This distribution of answers implies that survey respondents on average perceived their digital maturity as being higher than that of similar enterprises operating within the sector (see Figure 8). More SMEs[29] considered their digital maturity to be above average, compared with the proportion among large companies. There could be several explanations for this. The first, as stated above, is that the concept of digital maturity lacks a common definition; therefore, respondents may have interpreted it in various ways. Second, because the question asked respondents to assess themselves against 'similar companies operating in the sector', participants may not have evaluated their digital maturity against the same peer group. Third, the survey was not representative, and the sample of participants may have been biased towards companies with relatively high levels of digital maturity. Lastly, if the results do accurately reflect perceptions of digital maturity among the Polish retail sector, it may point to a relatively high self-evaluation among retail companies, particularly SMEs.

Figure 8. Company Digitalisation survey: digital maturity, retail sector, Poland, 2022
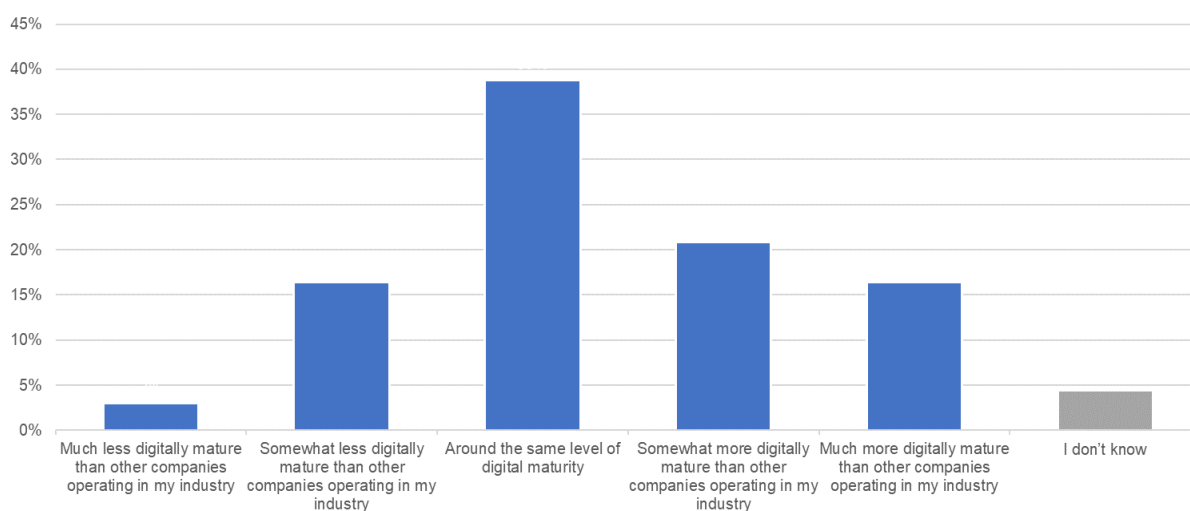
Source: Company Digitalisation survey conducted as part of this study, compiled by the research team.[30]

The conclusions drawn from stakeholder interviews suggest that companies do not use a common framework to assess their levels of digitalisation. Some companies consider having a website for online sales or a basic customer relationship management (CRM) system as being enough to classify them as digitally mature. At the same time, some interviewees who have already implemented advanced digital tools evaluate their digital maturity as being lower than that of other, similar companies. This suggests that digital maturity may not have a universally accepted definition in the Polish retail sector.

Methods to profile companies and their digital needs, such as digitalisation audits and assessments, could be useful for companies to identify gaps and benchmark their level of

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[29] Due to the limitations of the sample size, size breakdown was performed based on employee number only, using a threshold of 250 employees.

[30] Notes: Question 6 'How would you assess your company's digital maturity as compared to similar companies operating in this industry?', N=67.

digitalisation compared with peers. Such methods could reduce some existing awareness-related barriers to digital technology adoption among retail companies. Findings from the Company Digitalisation survey suggest that these types of barriers are faced by certain companies in the sector. 'Lack of knowledge about digital technologies' was ranked by respondents as the third[31] most important obstacle to the adoption of digital technologies (see Figure 9).

Digital maturity assessment is a core service provided by DIHs.[32] The experiences of the dih4eu Hub suggest that the use of tools to assess company digital maturity and raise awareness can bring significant added value for companies attempting to obtain external financing. Of those companies that have undergone a digital maturity assessment and been provided with a development plan for the implementation of digital technologies, over 70% applied for funding to support their digitalisation efforts. Where companies were successful in their funding application, this usually resulted in them increasing their level of digitalisation. However, stakeholder interviews indicate that objective digitalisation assessment methods are currently not widely used within the Polish retail sector.

Figure 9. Company Digitalisation survey: obstacles to adopting digital technologies, retail sector, Poland, 2022
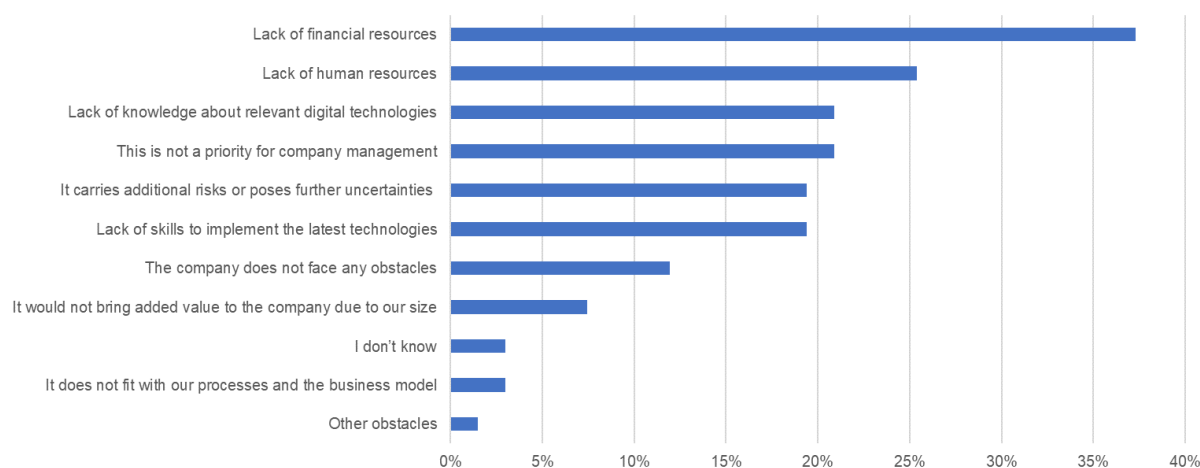
Source: Company Digitalisation survey conducted as part of this study, compiled by the research team.[33]

In summary: self-assessments of digital maturity are not comparable between companies, as the concept of digital maturity may be interpreted differently by various stakeholders. Polish retail companies could benefit from the services offered by DIHs to assess their digital maturity. Tools that provide an objective and comparable assessment of a company's level of digitalisation may be useful to support decision-making with regard to the adoption of digital technologies.

3.1.2.2.   Problem 2: Companies do not have sufficient human resources for the adoption of digital technologies

The second key digitalisation problem faced by retail companies in Poland is that SMEs often do not have sufficient human resources for the implementation of digital technologies. Firstly,

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[31] Joint-third place with 'this is not a priority for company management'.

[32] Hervás-Oliver, J.L., & Artés, A.A. (2021). The Digitization of European business: the Digital Innovation Hubs, what is next? *ESIC Digital Economy and Innovation Journal, 1(1),* 39-58.

[33] Notes: Question 12 'In your opinion, what are the main obstacles your company faces in adopting digital technologies?', N=67.

this restricts the ability of retail companies to develop solutions in-house. Secondly, it can reduce the ability of the company to successfully manage the outsourcing of solution development and implementation.

This problem mainly relates to small retail chains in Poland. Standalone stores can benefit from a wide range of ready-made solutions, such as intermediary marketplaces, digital marketing and fulfilment services. However, SMEs with multiple shops are less likely than standalone stores to find it feasible to use these solutions, due to the relative complexity of their operations. Instead, small retail chains must either obtain customised solutions externally, or develop them in-house.

Adapting to the digital market offering (marketing, advanced CRM systems, base linkers, marketing automation, AI for planning and UX customisation) and interacting with external solution providers requires certain ICT competencies. Many SMEs do not employ developers on a full-time basis. According to Eurostat data from 2018, 45% of retail companies in Poland mainly used outsourcing to perform ICT functions.[34] In 2021, only 16% of Polish retail enterprises employed ICT personnel.[35] Moreover, the proportion of enterprises reporting hard-to-fill vacancies for jobs requiring ICT skills rose from 38% in 2019 to 44% in 2020 (see Figure 10).[36]

Figure 10. Enterprises reporting hard-to-fill vacancies for jobs requiring ICT specialist skills as a % of enterprises that recruited/tried to recruit, Retail, Poland, 2019-2020
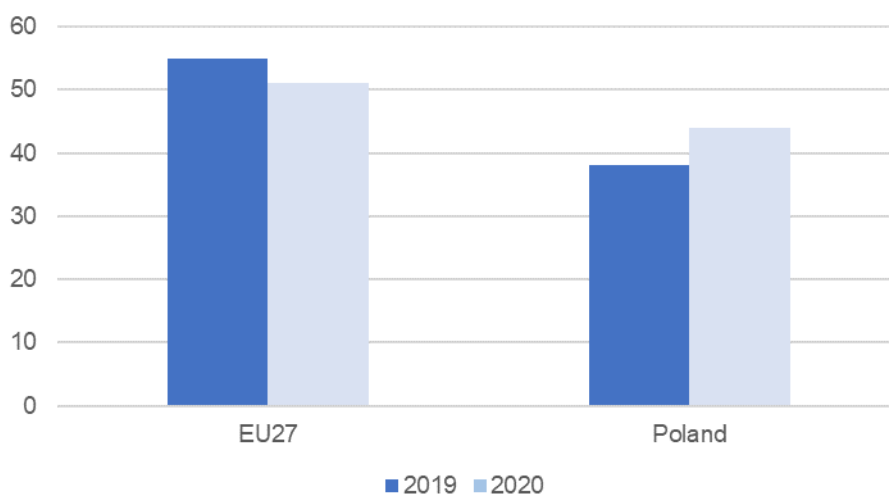
Source: compiled by the research team from Eurostat (2019/2020). Table ISOC_SKE_ITRCRN2, NACE sector G47.

While the reskilling of existing employees could be a possible solution to this problem, only 14% of Polish retail companies provided their staff with ICT training in 2021 according to Eurostat.[37] Moreover, according to RetailNet, only 12% of retail enterprises in Poland state that they are planning to invest in employee training and development in the coming years.[38]

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[34] Eurostat (2018). Table ISOC_SKE_FCT.

[35] Eurostat tables ISOC_SKE_ITSPEN2 and ISOC_SKE_ITTN2, NACE sector G47.

[36] Eurostat (2019/2020). Table ISOC_SKE_ITRCRN2, NACE sector G47.

[37] Eurostat tables ISOC_SKE_ITSPEN2 and ISOC_SKE_ITTN2, NACE sector G47.

[38] SCF News – Retailnet.pl (2022). *Handel czeka dalsza cyfryzacja i optymalizacja procesów.* Available at: https://retailnet.pl/2022/02/18/95081-raport-parp-handel-czeka-dalsza-cyfryzacja-i-optymalizacja-procesow/

Consequently, the insufficient availability of digitally skilled personnel who can develop or manage the outsourced development of digital solutions creates barriers to technology adoption. This is also reflected in the results of the Company Digitalisation survey, with respondents ranking 'lack of human resources' as the second most important obstacle to adopting digital technologies. Lack of knowledge and of skills were also considered important barriers, ranked third and sixth respectively (see Figure 9).[39]

Stakeholder interviews suggest that the provision of expertise through public support programmes could be useful for companies that do not have access to suitable ICT specialists internally. The Future Industry Platform is an example of a programme that has successfully supported companies in this way. However, many digitalisation support instruments in Poland target industries other than retail, or are industry-agnostic. As a result, retailers may find it difficult to adapt their projects to selection criteria that may not reflect the specifics of the retail sector.

In conclusion, many retail companies in Poland do not have access to suitable ICT specialists to carry out digitalisation projects, whether these are conducted internally or outsourced. As indicated by respondents in the Company Digitalisation survey, this is a significant barrier to the adoption of digital technologies.

3.1.2.3.   Problem 3: Insufficient preparation creates issues during and after implementation

The third problem affecting digitalisation identified in the retail sector relates to preparations for the implementation of digital technologies. This problem is closely linked to the previous two problems described above. Objective, third-party assessments of digital maturity, as well as the availability of expertise, could be useful for companies to plan the implementation of digital technologies on the basis of their capabilities. However, without sufficient availability of either, companies may find it difficult to adequately prepare for the implementation phase.

According to the stakeholders interviewed, decisions in relation to the adoption of digital technologies are often taken as a response to external shocks, rather than as part of longer-term development plans. For example, retail companies in Poland had to rapidly adopt e-commerce in response to restrictions imposed due to the COVID-19 pandemic. According to the European E-Commerce report, of the 11,000 shops that went online in Poland from March to December 2020, 30% were unsuccessful. This statistic could be explained by the rapid pace of implementation required in this situation. Other reasons might include high levels of competition, the economic impact of the pandemic, and the inherent risks associated with e-commerce.[40] Furthermore, one company representative also pointed out that the need to ensure continuous operations in retail limits the ability of companies to update their IT systems. When implementation must be carried out within a short timeframe, some retail companies may not have the chance to prepare sufficiently for digitalisation projects (calculate costs, plan implementation steps, consider risks and possible mitigation measures, plan integration with existing technologies, etc).

According to the stakeholders interviewed, this lack of preparation can contribute to significant challenges both during and after implementation. These issues include insufficient analysis of the future costs associated with additional modules, a lack of integration with previous implementations and a sub-optimal combination of closed and open-source solutions. Some

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[39] Company Digitalisation survey conducted as part of this study.

[40] Ecommerce Europe (2021). *European E-Commerce report 2021.* Available at: https://ecommerce-europe.eu/wp-content/uploads/2021/09/2021-European-E-commerce-Report-LIGHT-VERSION.pdf

stakeholders also expressed concerns that making decisions quickly could contribute to some companies falling into 'vendor lock-in' situations and becoming dependent on specific solution providers. Thus, the management of digitalisation efforts without sufficient consideration being given to trends, drivers and the consequences of digitalisation, can reduce retail companies' competitiveness.[41]

Figure 11. Company Digitalisation survey: plans to adopt technologies needed to remain competitive, retail sector, Poland, 2022
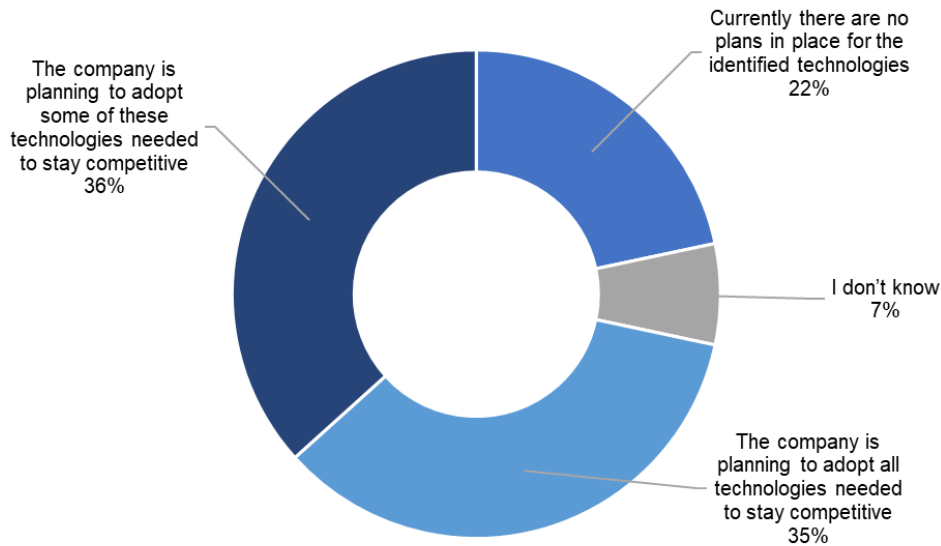
The company is planning to adopt some of these technologies needed to stay competitive
36%

Currently there are no plans in place for the identified technologies
22%

I don't know
7%

The company is planning to adopt all technologies needed to stay competitive
35%

Source: Company Digitalisation survey conducted as part of this study, compiled by the research team.[42]

In conclusion, retail SMEs in Poland often make decisions relating to digitalisation in response to external shocks. This limits the ability of companies to prepare sufficiently for the implementation of digital technologies, and contributes to several later challenges, such as a lack of integration between IT systems. While external guidance might be useful during the preparation phase, some companies find it difficult to access public support due to the need to adapt their projects to fit non-retail specific criteria.

3.1.3.   Company examples

Three examples of companies from the retail sector in Poland are presented below. The problems faced by these companies are characteristic of the sector.

3.1.3.1.   Company 1

The challenges described above are illustrated well by the case of Company 1. This company specialises in selling, renting and repairing sports goods. The company operates an internet store as well as two physical retail stores in different cities in northern Poland. In addition, the company owns a warehouse. The main items sold at the stores are sports equipment for skiing,

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[41] Malenkov, Y., Kapustina, I., Kudryavtseva, G., Shishkin, V.V., & Shishkin, V. I. (2021). Digitalization and strategic transformation of retail chain stores: Trends, impacts, prospects. *Journal of Open Innovation: Technology, Market, and Complexity, 7(2),* p. 108.

[42] Notes: Question 11 'To what extent is your company planning to take action to adopt these digital technologies in the next 2 years?', N=60.

snowboarding and surfing. The company is currently considering refocusing its business model from retail to higher-margin activities such as rental and repair services.

The representative of the company who was interviewed does not consider his company digitally mature. The company used only one software platform (a sales management system). In addition, the company has an online presence, and conducts omnichannel sales via social media. Due to the seasonal nature of the equipment sold by the company, it needs to change its assortment regularly. Changes in the assortment must also be applied to the webstore and orders coming from there. To avoid doing this manually, the company will need to implement an **integrated web system and infrastructure**. The company will also need to improve its internet connection to support the new tools it plans to implement.

Recently, the company has updated its marketing strategy to expand online sales. As a result, company's webstore now successfully serves the entire EU market. However, having been initially set up as a physical store, the company was **insufficiently prepared for the development of its IT infrastructure**. The company also finds it difficult to update its systems due to the need to maintain a continuous service for its customers. Consequently, the company is encountering issues in integrating its physical facilities and its webstore. For example, because the webstore does not always provide accurate information on the availability of goods, company employees frequently need to follow up with customers who have ordered online to inform them that their goods are not available.

The company also would benefit from the improved **availability of human resources and expertise** when it comes to planning and carrying out its digitalisation efforts. The company representative mentioned that the company's current employees cannot manage the integration of IT systems, and the company has been unable to hire a new person to do so either. The company representative also indicated that external guidance would have been useful in this case.

3.1.3.2. Company 2

Company 2 is an alcohol beverage retail chain established in 2016. It is an SME that operates in three physical locations in Warsaw, Poland.

The company has already **implemented some digital solutions** such as cashless payment systems and a semi-computerised monitoring system to manage its inventory. At the same time, the pricing of goods in the shop is still carried out manually. Updating product prices in the shop usually takes around two working days, and needs to be done frequently due to recent inflation. Like the majority of grocery retailers, cash operations constitute most of the company's activities. In the absence of digitalised systems, this contributes to a relatively large labour overhead. Similarly, deliveries are coordinated over the phone and on paper, which makes the process time-consuming.

When discussing possible digitalisation opportunities, company representatives recognised the potential benefits of implementing solutions such as a computer system for stock management, as well as increasing sales via e-channels, e-marketing and other types of online presence. However, they note that currently, the company **lacks the resources to implement new digital technologies**.

This problem is closely related to that described in the case study above – i.e. the availability of ICT specialists. The company's representatives suggested that they would benefit from **additional expertise and information on digitalisation opportunities and their implementation**. This type of support could be provided within the scope of a public digitalisation support programme.

A further problem for the company is that it **does not have sufficient financial resources available** to implement such changes. This is in part due to reduced profitability as a result of increased competition in the Polish retail market.

3.1.3.3.   Company 3

Company 3 is a retail wholesaler specialising in tobacco and tobacco-related goods, including reselling to smaller retailers. The company has operated in the market for more than 30 years. During that time, it has developed a general wholesale business model and created its own brand of other goods such as thimbles. The company is located in a small town in northeastern Poland.

The company has benefitted from various national and EU grants. With the help of its business development manager, the company constantly works on improving its operations. At the same time, the company faces several challenges in relation to digitalisation.

For example, the company's enterprise resource planning (ERP) and warehouse management (WMS) system has been in existence since the business was founded, and has thus become somewhat obsolete. Because the ERP/WMS system has been in operation for so long, the company now faces significant difficulty in redesigning it. Thus, the issue of **legacy infrastructure** has complicated the adoption of new technologies.

Despite having achieved some success in digitalising its manufacturing business, company representative reports that it **does not have available the necessary knowledge and expertise** needed for digitalisation. This issue is closely related to Problem 2 described above.

Furthermore – and closely related to the above-described problems – the company is **facing challenges when attempting to purchase expertise externally**. Company representatives point out that, at the moment, a lot of the information they have available comes from the solution providers themselves. Consequently, the company is concerned about being nudged into a vendor lock-in situation.

3.2.   Automotive sector in Hungary

This section provides a description of the automotive industry in Hungary, followed by the main two company-level digitalisation problems observed, together with examples of companies that exhibit these problems.

3.2.1.   Description of the industry

The automotive industry is an important part of the Hungarian economy. The country hosts approximately 700 automotive companies, which generate 4.1% of its GDP.[43] Of these companies, five are major car manufacturers, three are major engineering service providers, eight are original equipment manufacturers (OEMs), and 66 are Tier 1 suppliers.[44] Those that remain – the majority of companies in the sector – are mid- and lower-tier suppliers.[45]

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[43] HIPA (2021). *Automotive Industry in Hungary*. Available at: https://hipa.hu/main#publications.

[44] HIPA (2019). Automotive Industry Hungary 2019: Automotive CEO Survey. *Hungarian Investment Promotion Agency, Budapest.* Available at: https://hipa.hu/images/dokumentumok/hipa-automotive-ceo-survey-2019.pdf.

[45] HIPA (2019). Automotive Industry Hungary 2019: Automotive CEO Survey. *Hungarian Investment Promotion Agency, Budapest.* Available at: https://hipa.hu/images/dokumentumok/hipa-automotive-ceo-survey-2019.pdf.

The overall level of digitalisation within the industry remains relatively low, with 83% of automotive enterprises in Hungary exhibiting 'low' or 'very low' digital intensity. This figure is slightly higher than the EU average for the automotive sector of 76%.[46] SMEs in particular struggle to introduce digital technologies due to their position in the value chain and a lack of economies of scale.[47] Many SMEs in the Hungarian automotive industry are mid-tier suppliers. Hence, concepts such as the digitalisation of end products or the implementation of 'manufacturing as service' have limited relevance to their business operations. Due to these factors, large multinationals are more likely to adopt and benefit from digital technologies, compared with smaller companies.

The Company Digitalisation survey conducted as part of this study revealed additional insights into digitalisation in the Hungarian automotive industry. Analysis of the survey helped to identify incentives and barriers affecting the adoption of digital technologies in the sector.

According to the survey findings, the number one driver of digital investments among automotive companies in Hungary was increasing profitability (43% of respondents), followed by financial support (40%) and changes in end-customer expectations (31%). Respondents also indicated that most of the digital investments that have occurred over the past two years have focused on operations, inbound logistics and warehousing, or product/service design and support functions (see Figure 12).

Figure 12. Company Digitalisation survey: summary of results on past investment in digital technologies, automotive industry, Hungary, 2022
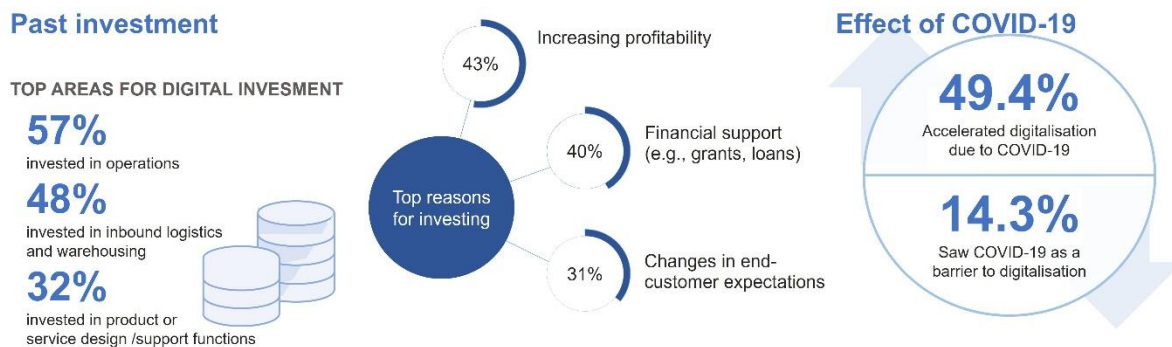
Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study (2022).[48]

Only 14.3% of survey respondents considered COVID-19 a barrier to company digitalisation. Meanwhile, 49.4% stated that the pandemic had accelerated the adoption of digital technologies. Nevertheless, many respondents reported experiencing negative economic effects associated with the pandemic. For example, almost half (48.1%) cited 'reduced turnover' as a major impact of the crisis.

In terms of future investment plans, information management systems, robotics, and remote business collaboration tools were cited as the three top technologies necessary to remain competitive in the automotive industry. As demonstrated in Figure 13 below, the survey found

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[46] Eurostat (2021). Tables ISOC_E_DII, NACE sectors C29-30.

[47] Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project. Gap Analysis report.

[48] Notes: this figure is compiled on the basis of responses to the following questions from the Company Digitalisation survey: Question 7 'Which areas of your company's operations have been the focus of digital technology related investments in the last 2 years?', N=77; Question 9 'What are the key factors driving your company's decision to invest in digital technologies?', N=72; Question 16: 'Did the COVID-19 pandemic have any effect on of the adoption of digital technologies (tools, solutions, processes) in your company?', N=77.

that 24.6% of the companies surveyed plan to adopt such technologies over the next two years. Almost half of respondents (49.3%) reported that they aim to introduce at least some of them.

Figure 13. Company Digitalisation survey: summary of results on future investment in digital technologies, automotive industry, Hungary, 2022
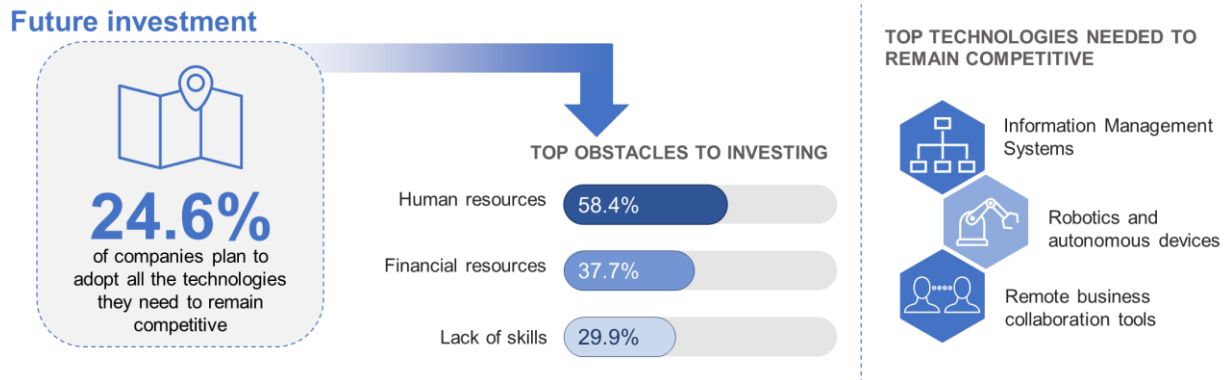
Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study (2022).[49]

The most frequently reported obstacle to the adoption of digital technologies was a lack of human resources (according to 58.4% of respondents), followed by a lack of financial resources (37.7%) and a lack of skills to implement digital technologies (29.9%). This points to the two main company-level digitalisation problems faced by automotive companies in Hungary being a lack of digital expertise among the workforce, and an inability to access the financial resources necessary for digital investments.

3.2.2. Main problems identified in the industry

This section describes the two main company-level problems identified in the Hungarian automotive industry. First, a shortage of digital skills among the workforce dissuades companies from investing in new technologies. Second, companies lack sufficient financial resources to implement digital technologies. These two problems are further elaborated upon in the sections below.

3.2.2.1. Problem 1: Companies lack the necessary expertise to implement digital solutions

Hungary is experiencing a shortage of labour, which the International Labour Organization has deemed the country's most pressing challenge at present.[50] This is the result of a persistent outflow of skilled workers from the country with the remaining workforce being less suited to highly skilled positions required for the implementation of digital technologies.[51] This has hindered the ability of many automotive enterprises to adopt new technologies. A 2019 survey of automotive CEOs by the Hungary Investment Promotion Agency (HIPA) found that 69% of

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[49] Notes: this figure is compiled on basis of responses to the following questions from the Company Digitalisation survey: Question 11 'To what extent is your company planning to take action to adopt these digital technologies in the next 2 years?', N=69; Question 12 'In your opinion, what are the main obstacles your company faces in adopting digital technologies?' N=77. Question 10 'Which of the below technologies are currently not present in your company but would be necessary to adopt in the next 2 years for your company to remain competitive?' N=77.

[50] ILO (2022). *About the ILO in Hungary.* Available at: https://www.ilo.org/budapest/countries-covered/hungary/WCMS_473724/lang--en/index.htm.

[51] Eurofound (2017). *Hungary: Short-term solutions to the issue of labour shortages*. Available at: https://www.eurofound.europa.eu/fr/publications/article/2017/hungary-short-term-solutions-to-the-issue-of-labour-shortages.

respondents considered 'problems concerning the workforce' as a key risk associated with the Hungarian supply chain.[52]

The same HIPA survey revealed that 62% of respondents reported having permanently unfilled vacancies for manufacturing roles. The need for a high degree of education and specialisation in highly skilled positions was cited as a common reason for this.[53] Similarly, according to Eurostat, 18% of automotive enterprises in Hungary attempted to recruit personnel for specialist ICT positions in 2020.[54] As illustrated in Figure 14 below, out of those companies, 63% reported having hard-to-fill vacancies. This was above the EU-27 average of 55%.[55]

Figure 14. Enterprises with hard-to-fill vacancies for jobs requiring ICT specialist skills as a % of enterprises which recruited/tried to recruit, automotive, Hungary, 2019-2020
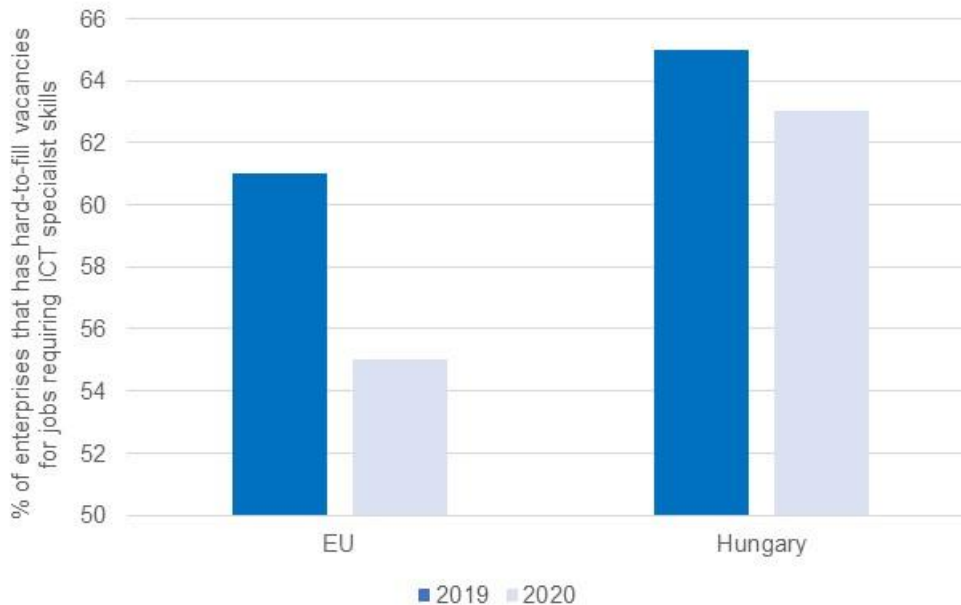
Source: compiled by the research team from Eurostat (2019/2020) Table ISOC_SKE_ITRCRN2, NACE sector C29-30.

To address this skills shortage, some automotive companies have entered into collaboration with higher education institutions in Hungary. In 2021, two-thirds of respondents to the HIPA survey were participating in dual education programmes with tertiary education institutions.[56] However, these activities have been carried out predominantly by large multinational companies that have a greater capacity to engage in such activities.

Some automotive enterprises also provide in-company ICT skills training. Eurostat data from 2020 shows that 36% of automotive enterprises in the country provided their staff with training in ICT skills, which is slightly above the EU average of 31% (see Figure 15 below).[57] Meanwhile, SMEs in Hungary's automotive sector struggle to attract workers with digital skills and have

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[52] HIPA (2019). Automotive Industry Hungary 2019: Automotive CEO Survey. *Hungarian Investment Promotion Agency, Budapest.* Available at: https://hipa.hu/images/dokumentumok/hipa-automotive-ceo-survey-2019.pdf.

[53] HIPA (2019). Automotive Industry Hungary 2019: Automotive CEO Survey. *Hungarian Investment Promotion Agency, Budapest.* Available at: https://hipa.hu/images/dokumentumok/hipa-automotive-ceo-survey-2019.pdf.

[54] Eurostat (2020). Table ISOC_SKE_ITRCRN2, NACE sector C29-30.

[55] Eurostat (2019/2020). Table ISOC_SKE_ITRCRN2, NACE sector C29-30.

[56] HIPA (2021). *Automotive Industry in Hungary*. Available at: https://hipa.hu/main#publications.

[57] Eurostat (2019/2020) Table ISOC_SKE_ITTN2, NACE sector C29-30.

limited resources to invest in employee training.[58] This suggests that the current level of education and in-company training is not enough to solve the lack of expertise experienced by Hungarian automotive companies.

Figure 15. Enterprises that provided training to their personnel to develop their ICT skills, automotive, Hungary, 2019-2020
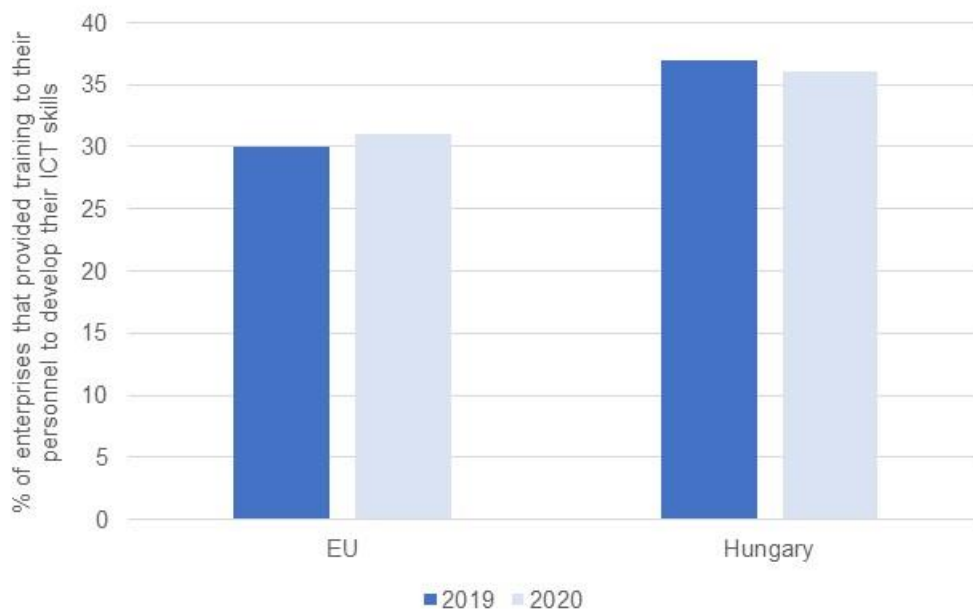
Source: compiled by the research team from Eurostat (2019/2020). Table ISOC_SKE_ITTN2, NACE sector C29-30.

Hence, the labour shortage in Hungary presents an obstacle to the uptake of digital technologies among automotive companies, particularly SMEs. This finding aligns with the results of the Company Digitalisation survey, in which 50.6% of respondents reported a lack of skills and/or knowledge as significant obstacles to company digitalisation. Furthermore, 58.4% indicated human resources as an important obstacle, making this the most frequently selected option by survey participants (see Figure 16 below).

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[58] HIPA (2019). Automotive Industry Hungary 2019: Automotive CEO Survey. *Hungarian Investment Promotion Agency, Budapest.* Available at: https://hipa.hu/images/dokumentumok/hipa-automotive-ceo-survey-2019.pdf.

Figure 16. Company Digitalisation survey: obstacles to adopting digital technologies, automotive industry, Hungary, 2022
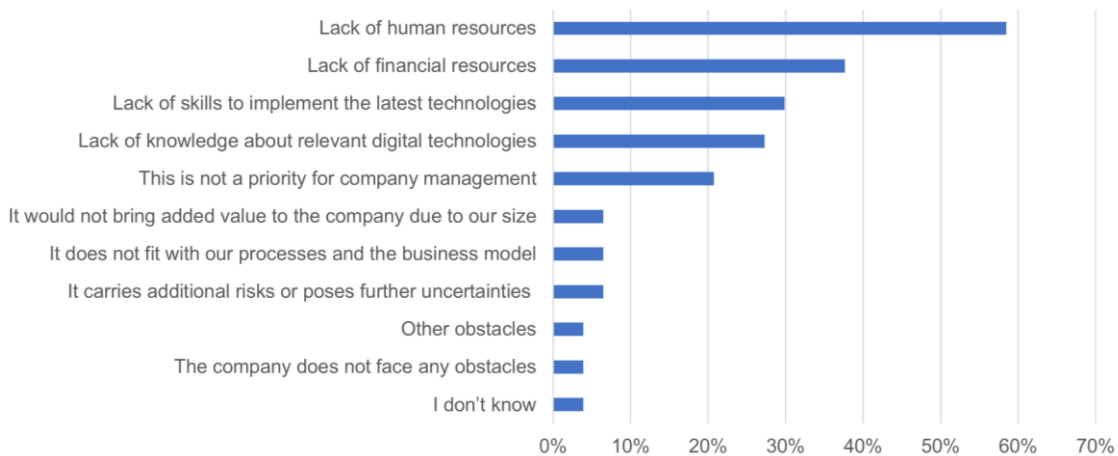
Similarly, the 2019 survey conducted by HIPA revealed that the availability of a skilled workforce was the most critical factor for CEOs when considering extending the company's investments in R&D, reported by 61% of survey respondents. This was followed by the availability of support schemes and tax incentives.[60]

Evidence from stakeholder interviews also suggests that the shortage of skilled labour may slow down company investments in digital technologies. This is because existing company employees may not have the skills necessary for the implementation of digital solutions. According to some interviewees, this has created an additional 'mindset problem' in certain companies. Those in managerial positions may be reluctant to invest in digital technologies due to a lack of previous experience and knowledge of how to apply various technologies.[61] A 2022 study found that only 10.4% of managers in the industry who were interviewed had already developed a digital transformation plan that they were using in their daily work.[62] This may be due to company managers having limited digital skills, or a limited appreciation of the benefits that digital technologies can bring to their companies.

In conclusion, the labour shortage in Hungary has resulted in a limited number of workers being available who possess the skills needed for the implementation of digital technologies. SMEs in particular are impacted by the issue, as they struggle to compete with large multinationals with regard to collaborating with educational institutions and providing skills training. This has resulted in low levels of digital investment among many companies in the automotive sector.

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[59] Notes: Question 12 'In your opinion, what are the main obstacles your company faces in adopting digital technologies?', N=77.

[60] HIPA (2019). Automotive Industry Hungary 2019: Automotive CEO Survey. *Hungarian Investment Promotion Agency, Budapest.* Available at: https://hipa.hu/images/dokumentumok/hipa-automotive-ceo-survey-2019.pdf.

[61] Stakeholder interviews conducted as part of this study.

[62] Kaszás, N., Ernszt, I., & Péter E. (2022) *The emergence of digital transformation in the automotive industry – Industry 4.0 in Hungary.* doi: 10.21845/comp/2022/1−2/1.

3.2.2.2. Problem 2: Companies lack the financial resources to invest in digital technologies

Another company-level problem faced by automotive enterprises in Hungary is the lack of financial capabilities to invest in digital technologies. Many smaller enterprises struggle to generate the revenue needed to purchase expensive digital technologies themselves. However, they also frequently are unsuccessful in securing external sources of funding such as grants and loans, which could assist them in making such investments. This may be due to limited awareness among companies about the existence of such programmes.

Some automotive enterprises in Hungary view financial constraints as an obstacle to company digitalisation. This was reflected in the Company Digitalisation survey, in which 37.7% of respondents cited 'lack of financial resources' as a significant obstacle to the adoption of new technologies (see Figure 16).[63] This problem is further exacerbated by external shocks, such as the COVID-19 pandemic, which has had an adverse impact on automotive production in Hungary. Based on evidence from stakeholder interviews, many companies did not meet production and revenue forecasts due to lockdown measures and supply chain issues. As a result, many companies now have fewer internal financial resources to devote to digital investments, as their main priority over the past two years has been maintaining their operations.[64] In addition, interviewed stakeholders stated that adoption of digital technologies may lead to reduced productivity in the short-term, arising from the need to change company processes and the learning curve associated with implementation. This creates opportunity costs associated with digital technology adoption. Not all companies have sufficient resources to undergo this process.

Due to their reduced turnover, companies may look to external sources of financial support for digital investments. Several programmes aimed at industry 4.0 digitalisation exist in Hungary, and many of these target SMEs.[65] For example, the Irinyi Plan, which was adopted in 2016, identifies the production of vehicles, including passenger cars, buses, and fixed-track vehicles, as a priority area to be supported through development and investment. According to the OECD, SMEs received HUF 6 billion (almost EUR 15 million) under this plan between 2016 and 2018.[66] European funding via programmes such as Horizon Europe and the Recovery and Resilience Plan also represent major opportunities for SMEs to obtain funding to support their digital transformation.[67] However, evidence from stakeholder interviews suggests that some SMEs are not applying to such programmes. One of the reasons behind this is that some enterprises may lack awareness of the relevant funding opportunities available. The 'Study on Monitoring Progress in National Initiatives on Digitising Industry' found that SMEs in Hungary have a low level of understanding regarding the support initiatives available.[68] This trend was also reflected in stakeholder interviews, which found that knowledge of public support schemes was limited among automotive companies' employees, who prioritise the demands of day-to-day business operations. Small enterprises rarely have sufficient time and resources to be able

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[63] Notes: Question 12 'In your opinion, what are the main obstacles your company faces in adopting digital technologies?', N= 77.

[64] Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project. Gap Analysis report.

[65] Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project. Gap Analysis report.

[66] OECD (2020). *Financing SMEs and Entrepreneurs 2020: An OECD Scoreboard*. Available at: https://www.oecd-ilibrary.org/sites/131f6db7-en/index.html?itemId=/content/component/131f6db7-en.

[67] Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project. Gap Analysis report.

[68] VVA & Wik Consult (2020). *Study on Monitoring Progress in National Initiatives on Digitising Industry. Country report: Hungary*. Available at: https://digital-strategy.ec.europa.eu/en/events/workshop-monitoring-progress-national-initiatives-digitising-industry-support-digital.

to designate a dedicated person responsible for the task of monitoring and applying for grant opportunities.

Hungary's limited digital infrastructure also makes the adoption of digital technologies more expensive for certain companies. In 2021, 80.6% of all Hungarian businesses had access to broadband internet. This falls well below the EU average of 93.8%.[69] According to stakeholder interviews, lack of broadband coverage is an obstacle to the adoption of digital technologies such as cloud-based services.[70] Moreover, one interviewee stated that because of the country's limited digital infrastructure, Hungary has not yet reached the point at which digital tools are widely available. As a result, there are few providers of digital solutions in the country – and those that are currently operating are in high demand. In turn, the solutions available can be unattainably expensive. One of the companies interviewed reported that even with the help of European or state subsidies, investment in new technologies is still an unrealistic goal for many Hungarian companies.

Overall, the Hungarian automotive industry has insufficient access to the resources necessary to invest in industry 4.0 technologies. Companies in the sector have faced several external shocks including the COVID-19 pandemic, a global chip shortage, and the Russian invasion of Ukraine, all of which have reduced revenues in the automotive industry. As a result, companies have fewer internal resources to devote to digitalisation efforts. Some SMEs are also unaware of the financing opportunities available to them in Hungary. In addition, low levels of access to digital infrastructure in Hungary mean that some technologies are too expensive for SMEs to adopt, even if external financial resources can be secured.

3.2.3.   Company examples

Three examples of companies from the Hungarian automotive industry are presented below. The range from small to large businesses and reflect the diversity of digitalisation problems faced by enterprises in the sector.

3.2.3.1.   Company 1

Company 1 is a small **car accessories developer and manufacturer**. Its manufacturing activities include the production of armrests, car hangers, door protectors, trunk fasteners, and car shopping baskets. The company sells its products directly to car factories as well as through online distribution channels such as Amazon.

The company estimates its **level of digitalisation to be lower** than that of automotive companies in other European countries, although it is not aware of many companies that manufacture similar products. Thus far, company's efforts to digitalise have focused on its administrative processes, such as the integrated company management system and online distribution channels. Digitalisation of the company's payroll and accounting systems is planned for the near future. Meanwhile, since the company has outsourced its production processes, these have not been an area of focus for the adoption of digital technologies.

Closely linked to the second problem identified in the automotive industry, representatives of the company reported that it has **limited knowledge of financial support programmes** that could help it to address its digitalisation gaps. Employees are immersed in their daily activities and do not have sufficient time to identify areas of the company's operations that could benefit

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[69] European Commission (2021). *Digital Scoreboard. Key indicators: broadband take up and coverage. Enterprises with a fixed broadband connection*. Available at: https://digital-agenda-data.eu/datasets/digital_agenda_scoreboard_key_indicators/visualizations.

[70] Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project. Gap Analysis report.

from digitalisation. The company also does not have enough personnel to devote to the task of consistently monitoring and applying for such programmes. Instead, the company only applies to a programme if it comes across it by chance and decides it could bring added value. Hence, the company feels it may be missing out on good opportunities to support digitalisation, due to being aware of them.

In a similar vein, the company believes that external sources of **financing should be more accessible**. The company has not been able to participate in any EU or national public programmes supporting digitalisation in the past five years. For this reason, company representative believed that the public sector could do more to facilitate access to financial assistance for digitalisation projects that SMEs wish to implement but would otherwise struggle to finance.

3.2.3.2.　　Company 2

Company 2 is a large company specialising in **metal processing and the manufacture of car parts**. The company employs 260 people and separates its activities into three divisions – automotive, machine and locksmith. The automotive division produces parts for internal combustion engines, drive chains for electrically powered cars, and clutch assemblies for passenger cars. The company began as a Hungarian-owned family business, but was recently bought by a Polish investor.

The company rates its **level of digitalisation as below average** in comparison to similar companies in the industry. However, digitalisation of production planning, optimisation and monitoring is envisaged in the medium term. In terms of administrative processes, the company began working remotely using Microsoft Teams to adapt to COVID-19-related restrictions. In addition, the company wishes to further digitalise its management, accounting, and finance systems soon.

The representative of the company mentioned **difficulties in finding employees with the necessary skills** to operate digital technologies. This represents an obstacle to digital investment. As a result, the company has digitalisation aspirations such as robotics, but without sufficient skills they cannot ensure it will improve production efficiency.

Furthermore, company representatives highlighted **digital infrastructure as a key obstacle** to digitalisation. The biggest problem the company faces is that new technologies tend to be more expensive to purchase in Hungary than in other European countries. For example, the same hardware and software are approximately 30% cheaper to buy in Poland. This issue has been exacerbated by the COVID-19 pandemic, which caused company's production levels to fall by around 25%. In addition to this, the company reports that it is difficult to obtain financial support, as most support programmes are targeted at smaller companies. As a result, the company's opportunities for digitalisation are limited.

3.2.3.3.　　Company 3

Company 3 is a large family-owned Hungarian company. Around 90% of its sales revenue and product portfolio focus on the **production of automotive products**. The company's products include parts for engine management systems and truck braking systems, as well as body parts for passenger cars.

The company rates its **level of digitalisation as lower** than that of other European companies performing similar activities. However, it aims to introduce digital technologies in the future,

with a particular focus on the automation and measurement of production. The company also has plans to introduce a data collection system and to improve its current ERP system.

The company representative cited a **shortage of expertise** as being the biggest obstacle to digitalisation faced by the company. Company staff finds it difficult to source suitable software developers with adequate skills, since those with the best expertise are in very high demand. This delays the implementation of necessary digital solutions.

The company used to consider the issue of financing an obstacle to digitalisation; however, the company has recently become familiar with available EU and Hungarian state subsidies and grant programmes. As a result, the company has **secured the necessary resources** for investment in and the implementation of new digital solutions. For example, it recently participated in the GINOP 3.2.2 programme, which was used to introduce its ERP system and for the acquisition of associated hardware and software components. Despite this, the company did note that the minimum threshold of internal resources required to qualify for such grant schemes is difficult for it to generate and still presents a challenge to the implementation of new technologies.

3.3. Textile sector in Portugal

This section provides a description of the textile industry in Portugal, the main digitalisation problems observed in the sector at company level, as well as examples of companies exhibiting these problems.

3.3.1. Description of the industry

The Portuguese textile industry employs 3.6% of the country's total workforce and makes up 4.5% of national GDP.[71] In 2020, more than 8,700 companies operated within the Portuguese textile industry, 99.2% of which were SMEs.[72] The industry represents a complete value chain for textile products and is resilient to supply chain disruptions.

The proportion of Portuguese textile sector enterprises with 'low' or 'very low' level of digital intensity amounts to 97%, compared with 88% across the EU.[73] Analysis of the industry[74] reveals certain structural factors that contribute to this. For example, a large proportion of textile companies in Portugal are SMEs, which typically have a lower level of uptake of digital technologies. Furthermore, certain processes in the industry (for example, sewing) are particularly difficult to automate.

Companies in the Portuguese textile sector will nevertheless need to embrace digitalisation as external factors, including changes in the regulatory environment and consumer expectations, will alter the industry landscape. Rapidly changing consumer expectations will require enterprises to provide customers with opportunities for customisation and digital channels for interaction. Companies will also need to become more responsive to environmental and ethical concerns through improved due diligence in the supply chain.

The Company Digitalisation survey conducted for this study reveals additional insights into digitalisation in the Portuguese textile industry. Analysis of survey results has helped to identify

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[71] Banco de Portugal (n.d.). *Quadros do Sector.* Available at: https://www.bportugal.pt/QS/qsweb/Dashboards.
[72] Banco de Portugal (n.d.). *Quadros do Sector.* Available at: https://www.bportugal.pt/QS/qsweb/Dashboards.
[73] Eurostat (2021). Tables ISOC_E_DII, NACE sectors C29-30.
[74] Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project. Gap Analysis report.

both incentivising factors and barriers affecting the adoption of digital technologies in the sector.

According to the results of the survey, 47.9% of respondents from the Portuguese textile industry consider their company's digital maturity to be above average relative to other enterprises operating in the sector. Meanwhile, almost a quarter (24.7%) reported their digital maturity to be lower than that of similar companies operating within the industry. Slightly more respondents (27.4%) believe it to be around the same level. According to the findings of the survey, the most popular areas for digital technology-related investments by Portuguese textile companies during the past two years were inbound logistics and warehousing (selected by 46.7% of respondents), purchasing and procurement (42.7%) and project planning and management or product or service design and engineering (both 41.3%). When asked, 'What are the key factors driving your company's decision to invest in digital technologies?', 51.4% of respondents selected 'increasing profitability', followed by 'strengthening resilience to external shocks' (31.9%) and 'financial support (e.g. grants, loans)' (30.6%) (see Figure 17).

Figure 17. Company Digitalisation survey: summary of results on past investment in digital technologies, textile industry, Portugal, 2022
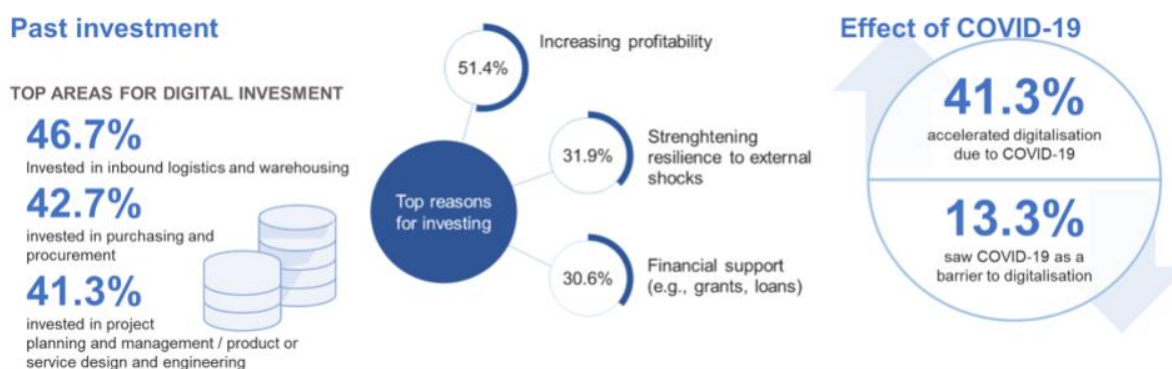
Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study (2022).[75]

The effect of the COVID-19 pandemic on the adoption of digital technologies has been heterogeneous. In the survey, 41.3% of respondents indicated that the COVID-19 crisis had contributed to the faster adoption of digital technologies by their company. In contrast, 13.3% indicated that the pandemic had forced them to drop or postpone certain investments. Furthermore, these results varied by company size. Only one-third (33.3%) of companies with fewer than 250 employees stated that the pandemic had accelerated the adoption of digital technologies, compared with 60% among larger companies.

Survey respondents were also asked to identify which technologies their company would need to adopt during the next two years in order to remain competitive. Just under one-third of respondents (32%) indicated that having an information management system and an online presence would be important. Next to this, the technologies most frequently selected were VR/AR (29.3%), AI and big data analytics (28%), and robotics and autonomous devices (26.7%). However, less than half of respondents indicated that they planned to adopt all of the technologies they would need to remain competitive. One in five (20.6%) had no plans in place

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[75] Notes: The figure is compiled on the basis of responses to the following questions from the Company Digitalisation survey: Question 7 'Which areas of your company's operations have been the focus of digital technology related investments in the last 2 years?', N=75; Question 9 'What are the key factors driving your company's decision to invest in digital technologies?', N=72; Question 16 'Did the COVID-19 pandemic have any effect on of the adoption of digital technologies (tools, solutions, processes) in your company?', N=75.

to implement the technologies in question, while 23.5% stated that they planned to adopt some of them.

Figure 18. Company Digitalisation survey: summary of results on future investment in digital technologies, textile industry, Portugal, 2022

Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study (2022).[76]
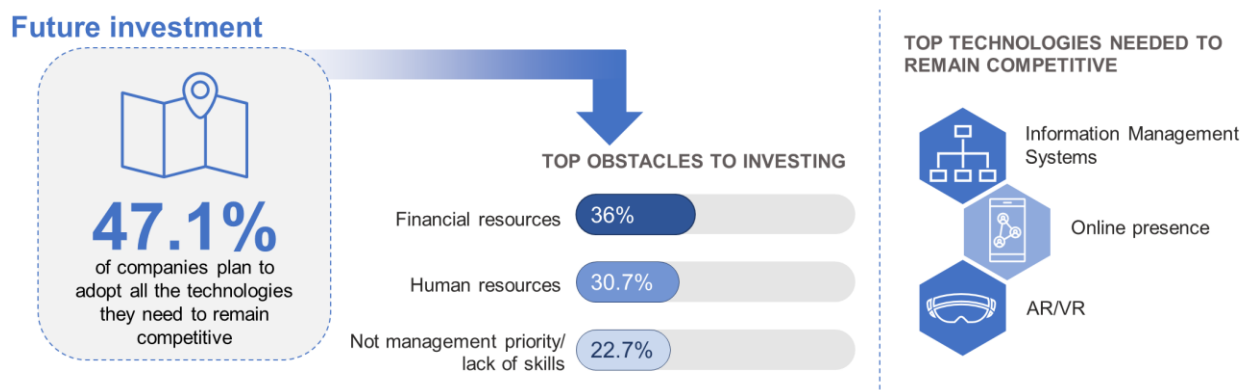
According to the results of the survey, the main obstacles to adopting digital technologies faced by companies in the Portuguese textile industry are a shortage of financial and human resources, a lack of skills to implement the newest technologies, and the fact that such investments are not a priority for company management.[77] These barriers contribute to several problems identified at company level during this study.

3.3.2.   Main problems identified in the industry

This section describes the three main digitalisation problems identified at company level in the Portuguese textile industry. The first relates to the workforce and skills shortages faced by the industry. The second concerns the fact that digital transformation can be risky and expensive due to technical complexity and to a lack of feasibility in implementing it on a small scale. Lastly, in most Portuguese textile companies, ICT functions are performed by external providers. This third problem relates to the difficulties involved in using external solution providers, such as unforeseen delays and cost increases, that can affect 'the ability of SMEs to successfully implement digitalisation projects. Each of these problems is described in more detail below.

3.3.2.1.   Problem 1: Skills shortages are a barrier to adopting and using digital technologies

One of the main problems faced by companies in the Portuguese textile industry relates to skills shortages. A broad transition towards industry 4.0, increased small-batch production, and traceability requirements are pushing textile companies to digitalise. This process requires employees and management to plan, implement and use digital technologies. The right skills and knowledge are needed to successfully implement each of those steps.

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[76] Notes: The figure is compiled on the basis of responses to the following questions from the Company Digitalisation survey: Question 11 'To what extent is your company planning to take action to adopt these digital technologies in the next 2 years?', N=68; Question 12 'In your opinion, what are the main obstacles your company faces in adopting digital technologies?', N=75; Question 10 'Which of the below technologies are currently not present in your company but would be necessary to adopt in the next 2 years for your company to remain competitive?', N=75.

[77] Detailed Company Digitalisation survey results are available in Annex 4.

The textile industry in Portugal is experiencing a significant shortage of skilled labour.[78] Over the next decade, employment in the textile industry is forecast to decrease by approximately 22,000 jobs.[79] The majority of job losses will impact workers with low levels of qualifications, while demand for a medium- and highly qualified workforce will grow.[80]

It has proven difficult for Portuguese textile companies and other stakeholders to ensure a sufficient number of skilled professionals enter the industry.[81] A negative perception of industrial jobs, lack of knowledge about career opportunities and the limited mobility of the workforce lead to difficulties in attracting new employees.[82,83,84,85] As a result, the textile industry in Portugal is experiencing an ageing workforce.[86,87] In 2019, almost one-third of employees in the textile industry were over 50 years old.[88]

A similar situation exists with regard to attracting employees with digital skills. Only one in 10 textile industry companies in Portugal employs ICT specialists, compared with 12% across the EU. Furthermore, many textile companies do not provide training in ICT and the use of digital tools, as illustrated in the figure below.[89,90,91]

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[78] Econews (2021). *Labour shortage threatens recovery in traditional sectors*. Available at: https://econews.pt/2021/11/22/labour-shortage-threatens-recovery-in-traditional-sectors/.

[79] CEDEFOP (n.d.). *CEDEFOP skills forecast.* Available at: https://www.cedefop.europa.eu/en/tools/skills-forecast.

[80] CEDEFOP (n.d.). *CEDEFOP skills forecast.* Available at: https://www.cedefop.europa.eu/en/tools/skills-forecast.

[81] CITEVE (2022). Skills Smart TCLF 2030. *National Skills strategy: the case of Portugal.* Available at: https://s4tclfblueprint.eu/wp-content/uploads/2022/06/NATION2.pdf.

[82] Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project. Gap Analysis report.

[83] Pires, A.R.F.P. (2021). Industry 4.0: effect on the value chain of the Portuguese footwear industry. *Católica Porto Business School.* P.73. Available at: https://repositorio.ucp.pt/bitstream/10400.14/34787/1/202748960.pdf.

[84] Silva F.G. (2019). Impacts of the implementation of Industry´s 4.0 technologies in the Portuguese Footwear Industry. *Católica Porto Business School.* p.79. Available at: https://repositorio.ucp.pt/bitstream/10400.14/28260/1/TFM_FranciscaSilva.pdf.

[85] Interviews with two Portuguese public sector organisations conducted as part of this study.

[86] Econews (2021). *Labour shortage threatens recovery in traditional sectors.* Available at: https://econews.pt/2021/11/22/labour-shortage-threatens-recovery-in-traditional-sectors/.

[87] CITEVE (2022). Skills Smart TCLF 2030. *National Skills strategy: the case of Portugal.* Available at: https://s4tclfblueprint.eu/wp-content/uploads/2022/06/NATION2.pdf.

[88] CITEVE (2022). Skills Smart TCLF 2030. *National Skills strategy: the case of Portugal.* Available at: https://s4tclfblueprint.eu/wp-content/uploads/2022/06/NATION2.pdf.

[89] Eurostat (2020). Tables ISOC_SKE_ITSPEN2 and ISOC_SKE_ITTN2, NACE sectors C13-15.

[90] Interreg Sudoe DigiTVC (2020). *Digital maturity diagnosis Quantitative analysis.* Available at: https://digitvc.eu/wp-content/uploads/2021/04/GT1-activity-1-2-Quantitative-Analyzes-Final-version.pdf.

[91] More information available at: https://www.clustertextil.pt/knit-force.

Figure 19. Employment of ICT personnel and ICT training, textile industry, Portugal and EU-27, 2020
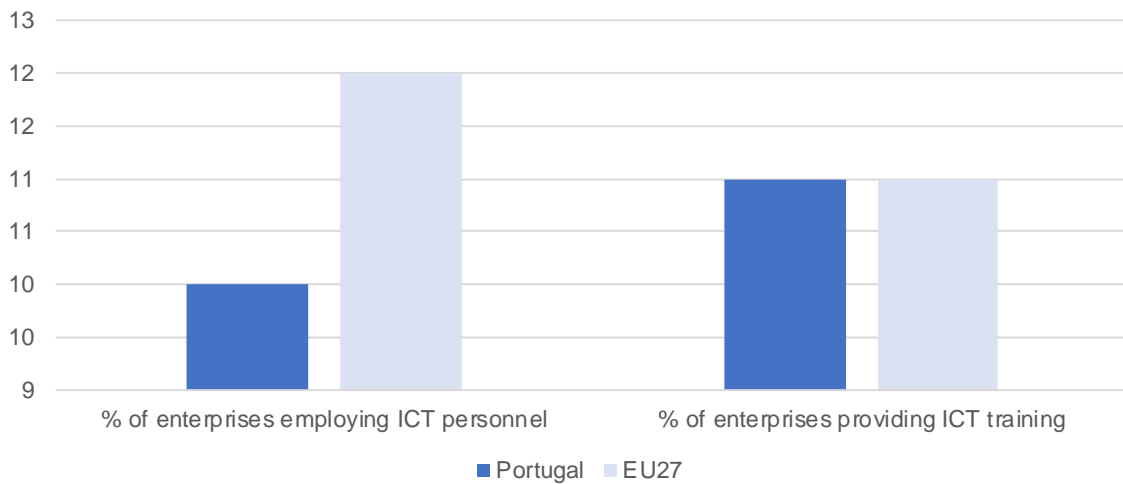
Source: author's own elaboration based on data from Eurostat tables ISOC_SKE_ITSPEN2 and ISOC_SKE_ITTN2, NACE sectors C13-15.

Skills shortages are recognised as a major barrier to digitalisation in the Portuguese textile industry.[92] In the Company Digitalisation survey, 'lack of human resources' was the second most frequently indicated obstacle in the industry, making up 30.7% of responses. 'Lack of skills to implement the latest technologies' ranked joint-third[93] with 22.7%, while 'lack of knowledge about relevant digital technologies' ranked fifth with 17.3% (Figure 20). Interviewees, as well as a recent Skills Smart TCLF 2030 study[94] agree that many enterprises do not have the available staff and skills to successfully implement changes to their processes or to operate advanced technologies. Similarly, the process of implementation itself requires skills in digitalisation project management and change management, which can be difficult to ensure given the current labour market challenges faced by the industry.

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[92] Ongoing research by the Portuguese Textile Cluster on the development of a textile industry digital transformation roadmap, conducted by a group of around 30 people representing textile SMEs and large companies, IT providers and R&D centres.

[93] Joint third place with 'This is not a priority for company management'.

[94] CITEVE (2022). Skills Smart TCLF 2030. *National Skills strategy: the case of Portugal*. Available at: https://s4tclfblueprint.eu/wp-content/uploads/2022/06/NATION2.pdf.

Figure 20. Company Digitalisation survey: obstacles to adopting digital technologies, textile industry, Portugal, 2022
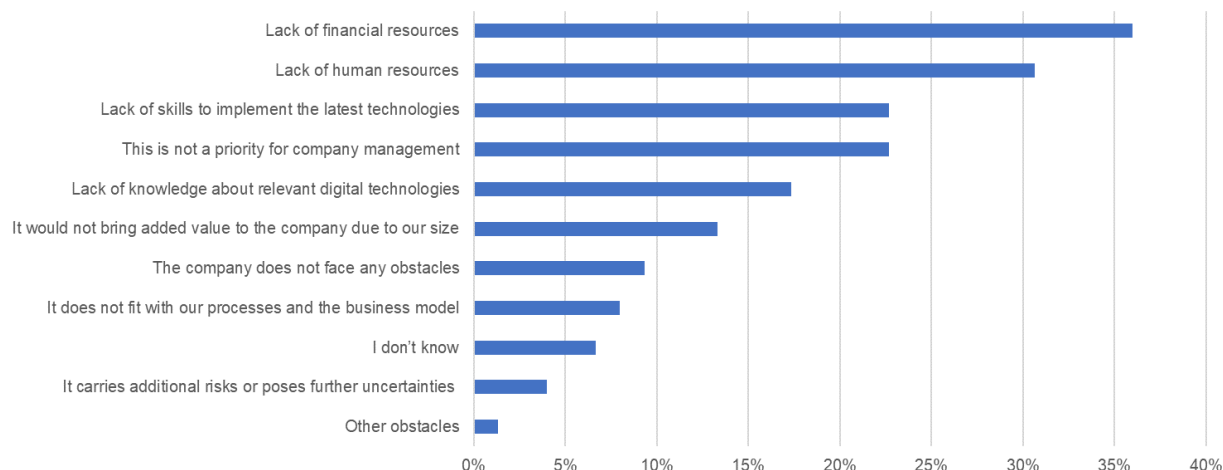
Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study (2022).[95]

As a result of the aforementioned shortage of skills, many SMEs in the industry find it difficult to devote the time and resources necessary to analyse and implement new digital solutions. For example, in the context of input price increases, some enterprises have halted their digitalisation efforts in order to focus instead on more pressing concerns.[96,97] Furthermore, without the sufficient availability of human resources, management may be reluctant to begin digitalisation projects.[98]

In summary, successful digital transformation requires the availability of a wide range of skills and knowledge. These include project and change management, the ability to analyse digitalisation opportunities, and the digital skills required to use new technologies. In an environment with an overall workforce shortage, the availability of such skills is particularly difficult to secure. In turn, this has created a significant barrier to digitalisation in the Portuguese textile industry.

3.3.2.2. Problem 2: Digital solutions may be unfeasible or expensive to implement on a small scale

Some processes in the textile industry are difficult to digitalise or automate due to the current insufficient maturity of digital solutions, especially on a small scale. Technologies that are expensive to implement, or have limited application without the benefit of scale, include

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[95] Notes: Question 12 'In your opinion, what are the main obstacles your company faces in adopting digital technologies?', N=75.

[96] Conclusions from the panel discussion during the 'Workshop on European industry digitalisation – the challenges ahead' organised on 28 June 2022 as part of the study.

[97] Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project. Gap Analysis report.

[98] Stakeholder interviews conducted as part of this study.

automated sewing,[99] robotics[100,101] and 3D printing.[102] Furthermore, ensuring sufficient interoperability between different technologies and manufacturing processes in the textile industry is challenging.[103] In turn, this structural characteristic can make it risky and expensive for small companies to implement new technologies on their own.

Almost all (99.2%) of textile enterprises in Portugal are SMEs.[104] As a result, they are likely to struggle to adopt digital technologies due to their insufficient scale. For example, a study in the Portuguese footwear sector found that companies operating in a specific niche did not see the added value of introducing digital technologies due to their size, preferring instead to manage their processes manually.[105] In the Company Digitalisation survey conducted as part of this study, 13.3% of respondents indicated that digital technologies would bring no added value to their company due to its size (see Figure 20). A total of 8% of respondents claimed that digital technologies do not fit their company's processes or its business model. While this result does not represent a majority of surveyed companies, it still indicates that some respondents have encountered such obstacles.

The working group on the digital transformation roadmap for 2030, facilitated by the Portuguese Textile Cluster, found that industry 4.0 solutions in the textile industry are often complex to adopt and their impact is hard to predict.[106] Smaller companies may find it difficult to devote time and resources to evaluating and acquiring complex solutions that require a high level of integration with existing technologies.[107] Furthermore, their implementation is usually associated with relatively high costs and a high degree of perceived risk if companies have insufficient opportunities to cooperate and share risk with other entities in the ecosystem.

Implementing digital solutions for processes that are difficult to automate carries significant costs. In the Company Digitalisation survey, respondents ranked 'lack of financial resources' as the top barrier to digitalisation (see Figure 20). In line with this finding, a 2020 study found that 55% of Portuguese textile companies considered investment cost a key barrier to digitalisation.[108] Respondents also considered the accessibility of financial support an important factor driving their decisions whether or not to invest in digital transformation, with this factor ranking third after 'increasing profitability' and 'strengthening the resilience to external shocks' (see Figure 21).

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[99] Silva F.G. (2019). Impacts of the implementation of Industry's 4.0 technologies in the Portuguese Footwear Industry. *Católica Porto Business School.* p.68. Available at: https://repositorio.ucp.pt/bitstream/10400.14/28260/1/TFM_FranciscaSilva.pdf.

[100] Salahuddin, M., & Lee, Y.A. (2022). Automation with Robotics in Garment Manufacturing. In: *Leading Edge Technologies in Fashion Innovation* (pp. 75-94). Palgrave Macmillan, Cham.

[101] Gries, T., & Lutz, V. (2018). Application of robotics in garment manufacturing. In *Automation in garment manufacturing (pp. 179-197).* Woodhead Publishing.

[102] Pires, A.R.F.P. (2021). Industry 4.0: effect on the value chain of the Portuguese footwear industry. *Católica Porto Business School.* p.73. Available at: https://repositorio.ucp.pt/bitstream/10400.14/34787/1/202748960.pdf.

[103] Ahmad, S., Miskon, S., Alabdan, R., & Tlili, I. (2020). Towards sustainable textile and apparel industry: Exploring the role of business intelligence systems in the era of industry 4.0. *Sustainability, 12(7), 2632.* Available at: https://www.mdpi.com/674766.

[104] Banco de Portugal (n.d.) *Quadros do Sector.* Available at: https://www.bportugal.pt/QS/qsweb/Dashboards.

[105] Silva F.G. (2019). Impacts of the implementation of Industry's 4.0 technologies in the Portuguese Footwear Industry. *Católica Porto Business School.* p.65. Available at: https://repositorio.ucp.pt/bitstream/10400.14/28260/1/TFM_FranciscaSilva.pdf.

[106] More information available at: https://www.clustertextil.pt/en/home-en.

[107] Ongoing research by the Portuguese Textile Cluster on the development of a textile industry digital transformation roadmap, conducted by a group of around 30 people representing textile SMEs and large companies, IT providers and R&D centres.

[108] Interreg Sudoe DigiTVC (2020). *Digital maturity diagnosis Quantitative analysis.* Available at: https://digitvc.eu/wp-content/uploads/2021/04/GT1-activity-1-2-Quantitative-Analyzes-Final-version.pdf.

Figure 21. Company Digitalisation survey: factors influencing the decision to invest, textile industry, Portugal, 2022
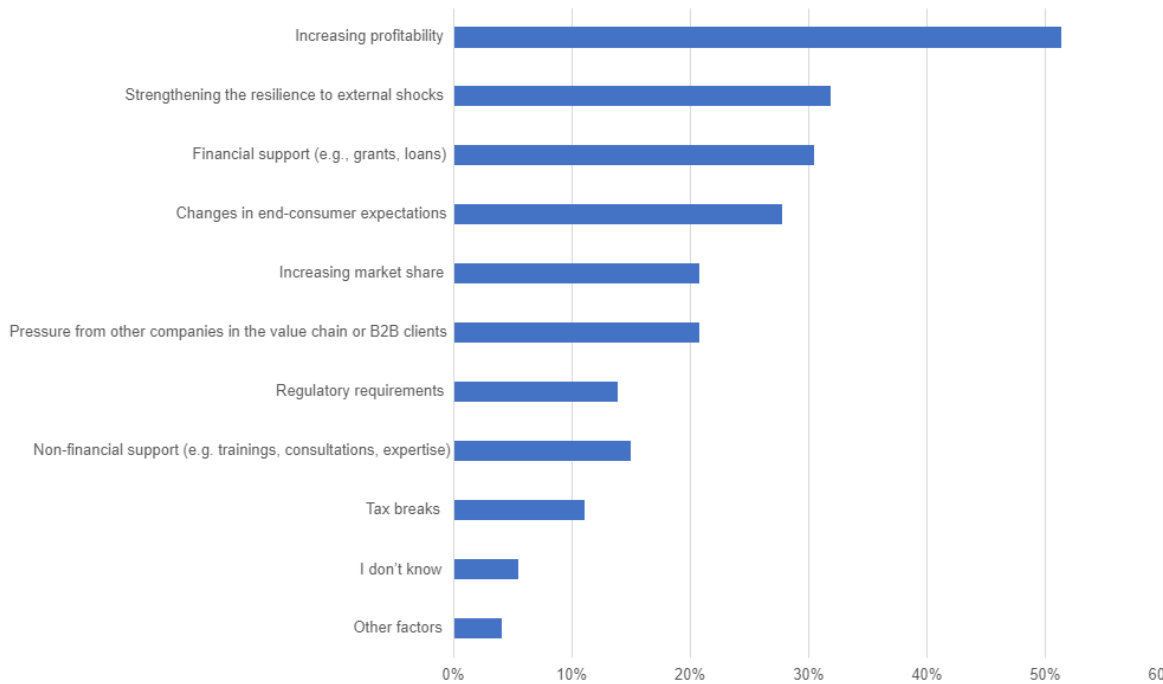
Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study (2022).[109]

In summary, some technologies in the textile industry are expensive or have limited applications on a small scale. The results of this study suggest that the costs associated with technology adoption are a significant obstacle to the digitalisation of companies in the textile industry. Risk sharing, prototyping, cooperation, common standards and public support could thus help to make digital transformation more feasible.[110]

3.3.2.3. Problem 3: Difficulties in interacting with solution and technology providers can negatively affect the implementation of new technologies

The third main problem facing digitalisation in the Portuguese textile industry concerns the difficulties companies face in interacting with solution and technology providers. The providers of digital technologies have an important role to play in the digital transformation of SMEs in Portugal. For many SMEs, the main mechanism used to implement innovations is an 'outside-in' model,[111] involving the integration of knowledge that most often comes from suppliers and clients.[112] In 2018, 64% of companies in the textile industry in Portugal mainly outsourced their ICT functions, compared with 55% across the EU.[113] Hence, companies in the textile industry need to be able to cooperate smoothly with digital solution developers. However, the interviews

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[109] Notes: Question 9 'What are the key factors driving your company's decision to invest in digital technologies?', N=72.

[110] Ongoing research by the Portuguese Textile Cluster on the development of a textile industry digital transformation roadmap, conducted by a group of around 30 people representing textile SMEs and large companies, IT providers and R&D centres.

[111] A model in which innovation happens through collaboration between different companies, individuals and/or public agencies, and depends on the exchange of knowledge with external sources.

[112] Almeida, F. (2021). Open-innovation practices: Diversity in Portuguese SMEs. *Journal of Open Innovation: Technology, Market, and Complexity, 7(3),* 169.

[113] Eurostat (2018). Tables ISOC_SKE_FCT.

with stakeholders conducted for this study suggest that companies face several challenges when interacting with external providers.

One interview with a company in the Portuguese textile industry pointed to several issues concerning interactions between the company and solution providers. The company representatives suggested that difficulties arise when dealing with the expectations and delivery plans set by IT providers, which may be unrealistic in light of the resource constraints of the given company. Similarly, the company pointed to unforeseen cost increases and delays during implementation. To some extent, these issues may be linked to the insufficient availability of the skills, knowledge and human resources necessary to manage the implementation of digital initiatives. As a result, these challenges can threaten the success and speed of implementation.[114]

Delays by IT providers can also indicate a limited ability on the part of providers to develop digital solutions for industry 4.0. Interviews carried out for this study suggest that information asymmetries may exist between solution providers and textile companies when it comes to 4.0 solutions specifically and textile industry processes specifically.[115] The industry 4.0 phenomenon will require providers to adapt in order to ensure the accessibility, interoperability, ubiquity and cybersecurity of their solutions.

To remain competitive, many Portuguese textile companies will need to adopt a number of new digital technologies. These include information management systems, online presence, and AR/VR.[116] IT solution providers will play an important role in introducing such solutions to companies, especially those SMEs that lack the knowledge and human resources to develop them internally. However, several obstacles can affect success in the outsourcing of digital solutions and technologies, such as unforeseen cost increases and delays, as well as difficulties in dealing with expectations and delivery plans. These issues are, in part, caused by the resource constraints faced by many companies in the textile industry.

3.3.3. Company examples

Two examples of companies from the textile industry in Portugal are presented below. Both companies are SMEs whose problems are characteristic of the sector.

3.3.3.1. Company 1

Company 1 is an SME that focuses on producing **'smart' jersey knit fabrics** to the fashion industry. The company has 22 years of experience and produces circular knit fabrics for the fashion, athleisure, intimate and home textiles segments.

The company **uses digital technologies** to achieve its goals of quality, performance and sustainability. Examples of the objectives of the company's digital interventions include waste reduction, as well as the automation of processes to help the company deal with labour shortages.

The first problem experienced by company relates to **interactions with IT providers**. Unforeseen delays on the part of technology providers are a significant issue for the company. These have led to setbacks in the deployment of digital solutions and can affect the success

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[114] Interview with a company in the Portuguese textile industry, conducted as part of this study.

[115] Interview with a company in the Portuguese textile industry, conducted as part of this study.

[116] Company Digitalisation survey conducted as part of this study.

of their implementation. The SME has also experienced trouble in dealing with the expectations and delivery plans of IT providers. Lastly, it has also observed **increasing costs of implementation** after the first lump sum payment. These challenges suggest improvements could be made in pre-implementation planning and communication with providers.

The second digitalisation problem encountered by the company is **the lack of capital** and the **level of risk** inherent in adopting digital solutions. Company representatives state that external financial support could help to reduce the perceived risk associated with pursuing such digital initiatives.

The company management also expressed concerns about investing in digital solutions about which they may **lack an in-depth understanding**. This issue relates to the problem of insufficient digital skills among management and employees to carry out digital initiatives. Indeed, the interview data suggest that finding people to manage digital transformation projects is a problem for the company.

3.3.3.2. Company 2

Company 2, an SME based in Guimarães, produces **household, hotel and decorative textile** products and has approximately 100 employees.

The company considers itself **more digitally mature** than other Portuguese textile companies. According to company representatives, the COVID-19 crisis pushed the company to adopt new digital tools for interacting with customers, working remotely and showcasing its collections. Furthermore, over the next two years the company plans to pursue several digitalisation projects to address existing gaps: the automation and robotisation of internal logistics, as well as the implementation of AI and computer vision for quality control, AI and analytics for predictive maintenance, and supply chain integration.

The first problem experienced by the company relates to the **availability of financial resources** for implementing digital technologies. The current economic situation may make it difficult for the company to realise its digitalisation plans. For example, input and energy price inflation may lead to the company lacking the necessary financial resources to invest in digitalisation. Similarly, the current volatile economic situation could push the company to focus on the survival of its business rather than its digitalisation efforts. As a result, the effects of the COVID-19 pandemic, Russia's invasion of Ukraine and inflation could lead to delays in the company's planned adoption of digital technologies. According to company representatives, public funding would play a major role in mitigating this problem.

The company has an internal IT team that can manage most of the development and implementation of new digital tools internally. As a result, it has managed to **minimise its dependence on third-party providers**. In situations where the company has chosen to outsource, finding the right tools and partners has proved time-consuming and challenging. According to company representatives, external providers often lack knowledge of textile industry processes and business specifics. This view is relevant to the third problem described above, concerning the difficulties companies face when interacting with solution and technology providers.

3.4. Agrifood sector in Lithuania

This section provides a description of the agrifood industry in Lithuania, laying out the main digitalisation problems observed at company level, and highlighting examples of companies that exhibit such problems.

3.4.1. Description of the industry

The agrifood industry plays an important economic and social role in Lithuania. In 2019, the industry contributed a total of 7.1% to the country's GDP. Similarly to the other four industries analysed in this report, 85% of Lithuanian agrifood companies comprises SMEs, mostly focusing on the key segments of cereals, dairy, and meat.[117] There appears to be no single measure capturing the digitalisation of the agrifood industry overall. In turn, unless otherwise indicated, the rest of this section references statistics concerning Lithuania's accommodation, food and beverage services sector and manufacturing of food, beverages and tobacco industry. Both of these segments form an important part of the agrifood industry.

Compared with the other four country-industry pairings, Lithuania has the lowest share of companies (82%) in its accommodation, food, and beverage services sector with a 'very low' and 'low' digital intensity score. The adoption of digital technologies in Lithuania's manufacturing of food, beverages and tobacco industry is also higher than the EU average. However, an industry-level analysis[117] has revealed several obstacles that impede further digitalisation in the Lithuanian agrifood sector, despite an existing need for it. These include the lack of a holistic approach to digitalisation, an absence of coordination between businesses, social partners and the government, and a shortage of human capital.

The Company Digitalisation survey conducted as part of this study brings additional insights into digitalisation in the country's agrifood industry. Analysis of the survey results has helped to identify both the main obstacles preventing the adoption of digital technologies by the companies in the sector, as well as the key factors driving it.

Overall, most survey respondents from the Lithuanian agrifood industry identified their company's digital maturity as average (38%) or above average (42%), while only 20% indicated that their digital maturity was lower than average when compared to their industry counterparts. The most popular areas for digital technology investments by Lithuanian agrifood enterprises over the past two years are product or service design and engineering (selected by 43.1% of respondents), project planning and management (31.4% of respondents), and operations-related investments (29.4%). Other relatively popular areas for investment include marketing, sales and customer services (27.5%), inter-company or inter-value chain collaboration (19.6%) and inbound logistics and warehousing (17.6%) (see Figure 22). These findings are in line with the agrifood value chain, which involves processes ranging from crop production to manufacturing, distribution and wholesale.

Survey respondents pointed to several motivating factors driving Lithuanian agrifood companies' decisions to invest in digital technologies. A total of 56.8% of respondents mentioned increased profitability as the main motivating factor, followed by strengthening resilience to external shocks, financial support, and increasing market share (each of which was reported by 34.1% of respondents), as well as changes in end-consumer expectations (27.3%) (see Figure 22).

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[117] Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project. Gap Analysis report.

Figure 22. Company Digitalisation survey: summary of results on past investment in digital technologies, agrifood industry, Lithuania, 2022

Past investment

TOP AREAS FOR DIGITAL INVESMENT
43.1%
invested in product or service design and engineering
31.4%
invested in project planning and management
29.4%
invested in operations

Top reasons for investing

56.8% Increasing profitability
34.1% Strengthening resilience to external shocks
34.1% Financial support
34.1% Increasing market share

Effect of COVID-19
41.2%
Accelerated digitalisation due to COVID-19
11.8%
Saw COVID-19 as a barrier to digitalisation
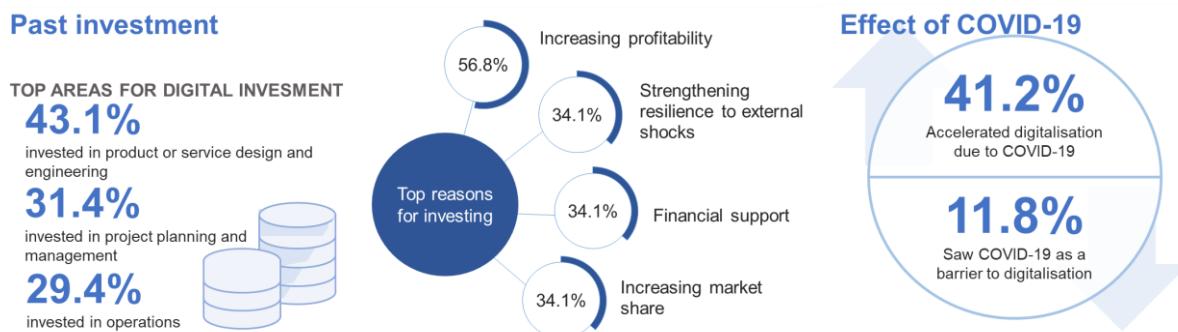
Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study (2022).[118]

COVID-19 has had a profound impact on the capacity and motivation of companies to digitalise. As the survey data show, this impact has been heterogeneous. On the one hand, 41.2% of respondents stated that the COVID-19 crisis had contributed to the faster adoption of digital technologies; on the other, 11.8% of respondents indicated that the pandemic had caused them to drop or postpone digitalisation-related investments. The results also suggest that the impact of COVID-19 depended on company size.[119] While only 6.3% of companies with fewer than 50 employees had to drop or postpone investments, 22.2% of those with more than 50 employees reported having to do so. Companies with fewer than 50 employees were also more likely to indicate that COVID-19 did not have a significant effect on digital investments. A total of 43.8% of smaller companies and 33.3% of larger ones claimed that COVID-19 had not affected their digital investments. Companies with more than 50 employees were more likely to indicate that COVID-19 had contributed to the faster adoption of digital technologies, with a total of 44.4% of such businesses claiming so. Among companies with fewer than 50 employees, 37.5% of claimed that COVID-19 had accelerated the adoption of digital technologies (see Figure 23).

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[118] Notes: The figure is compiled on the basis of responses to the following questions from the Company Digitalisation survey: Question 7 'Which areas of your company's operations have been the focus of digital technology related investments in the last 2 years?', N=51; Question 9 'What are the key factors driving your company's decision to invest in digital technologies?', N=44; Question 16 'Did the COVID-19 pandemic have any effect on of the adoption of digital technologies (tools, solutions, processes) in your company?', N=51.

[119] Due to the limitations of the sample size, size breakdown was performed based on employee number only, using a threshold of 50 employees.

Figure 23. Impact of the COVID-19 pandemic on digital technology investments by company size
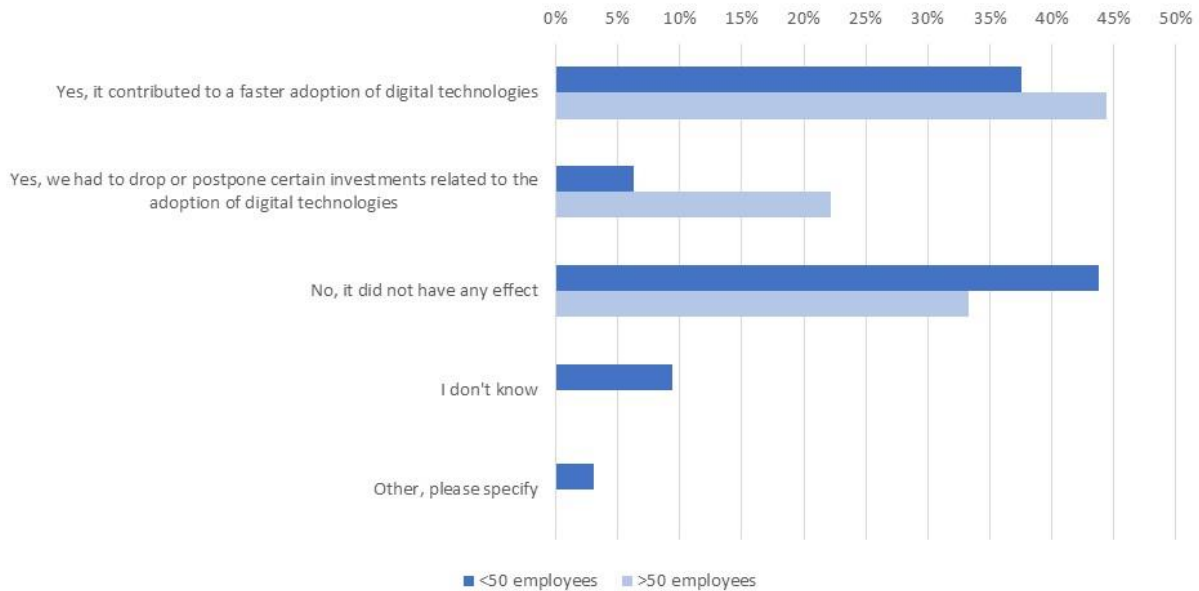
Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study.[120]

Survey respondents were also asked to highlight which technologies were necessary for their company to adopt within the next two years in order to remain competitive. The technology mentioned by the largest share (39.2%) of agrifood respondents was information management systems (e.g. resource planning, product lifecycle management, supply chain management). Robotics and autonomous devices was the second most popular response (35.3%), followed by having an online presence (27.5%). A total of 27.7% of respondents to the agrifood survey indicated that their company was planning to adopt all of these technologies, while a further 55.3% indicated that they would adopt some of them (see Figure 24). Only 14.9% of survey respondents reported no plans to implement the technologies in question.

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[120] Note: Question 16, 'Did the COVID-19 pandemic have any effect on of the adoption of digital technologies (tools, solutions, processes) in your company?'. Companies with fewer than 50 employees: N=32; companies with more than 50 employees: N=18.

Figure 24. Company Digitalisation survey: summary of results on future investment in digital technologies, agrifood industry, Lithuania, 2022

Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study (2022).[121]
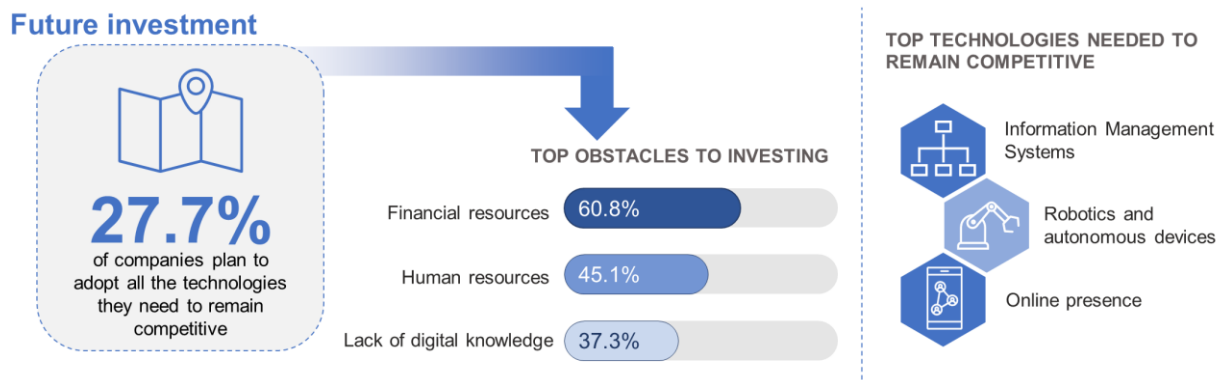
Despite the survey respondents' plans to invest in digital technologies during the next two years, the survey data point to several investment obstacles facing agrifood companies in Lithuania. More than half (60.8%) of respondents reported that a lack of financial resources as an obstacle. Shortage of human resources was the second most frequently chosen option, selected by 45.1% of respondents. Lastly, a lack of knowledge about the relevant digital technologies was mentioned in 37.3% of cases. These results point to the existence of certain company-level problems that tend to inhibit the adoption of digital technology in the Lithuanian agrifood industry.

3.4.2. Main problems identified in the industry

The company-level problems identified in the Lithuanian agrifood sector reflect broader trends observed in other country-industry pairs, as well as several more specific local factors. The first concerns certain attitudes that are held by agrifood companies in Lithuania, their managers and employees, which slow down the adoption of digital technologies. Second, the industry faces a shortage of skills and of a skilled labour force. Lastly, SMEs in Lithuania's agrifood sector find it difficult to obtain the financial resources needed to undertake costly digital technology investments. These problems are elaborated in detail below.

3.4.2.1. Problem 1: Risk aversion and cautious attitudes held by agrifood companies are slowing down digitalisation

Data gathered for this study suggests that the low level of adoption of digital technology in Lithuania's agrifood industry is affected by risk aversion and cautious attitudes held by companies in the sector. These include attitudes towards digital technologies, their providers, as well as other industry and ecosystem players. The impact of such attitudes is two-fold. First, failure to recognise the importance of digitalisation or a lack of technological awareness may directly influence company executives' decisions with regard to investments in digital technologies. Second, SMEs' efforts to pursue digitalisation may be indirectly impacted by risk

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[121] Notes: The figure is compiled on the basis of responses to the following questions from the Company Digitalisation survey: Question 11 'To what extent is your company planning to take action to adopt these digital technologies in the next 2 years?', N=47; Question 12 'In your opinion, what are the main obstacles your company faces in adopting digital technologies?', N=51; Question 10 'Which of the below technologies are currently not present in your company but would be necessary to adopt in the next 2 years for your company to remain competitive?', N=51.

aversion and a lack of trust in technology providers, as well as negative attitudes towards cooperation.

Certain attitudes towards digitalisation held by some agrifood enterprises can have a direct, negative impact on the adoption of digital technologies in the company. First, some agrifood companies do not recognise the importance and potential of the digital transition. Evidence coming from interviews with industry experts and academics points to prevailing mistrust and risk aversion towards digital technologies among farmers and farm managers. In addition, some company managers believe that digital technologies are not relevant to their business and that they will not bring about significant benefits. Such attitudes appear to be more prevalent among older farmers. This problem is exacerbated by the fact that 31% of Lithuania farmers are above retirement age.[122]

Second, some company representatives feel they lack knowledge about the best technology options for their companies, or do not have enough expertise to implement them. Both the academic literature[123] and the findings from the Company Digitalisation survey support this. A total of 37.3% of survey respondents named a lack of knowledge about relevant digital technologies as one of the main obstacles to adopting them (see Figure 25).

Figure 25. Company Digitalisation survey: obstacles for adopting digital technologies, agrifood industry, Lithuania, 2022
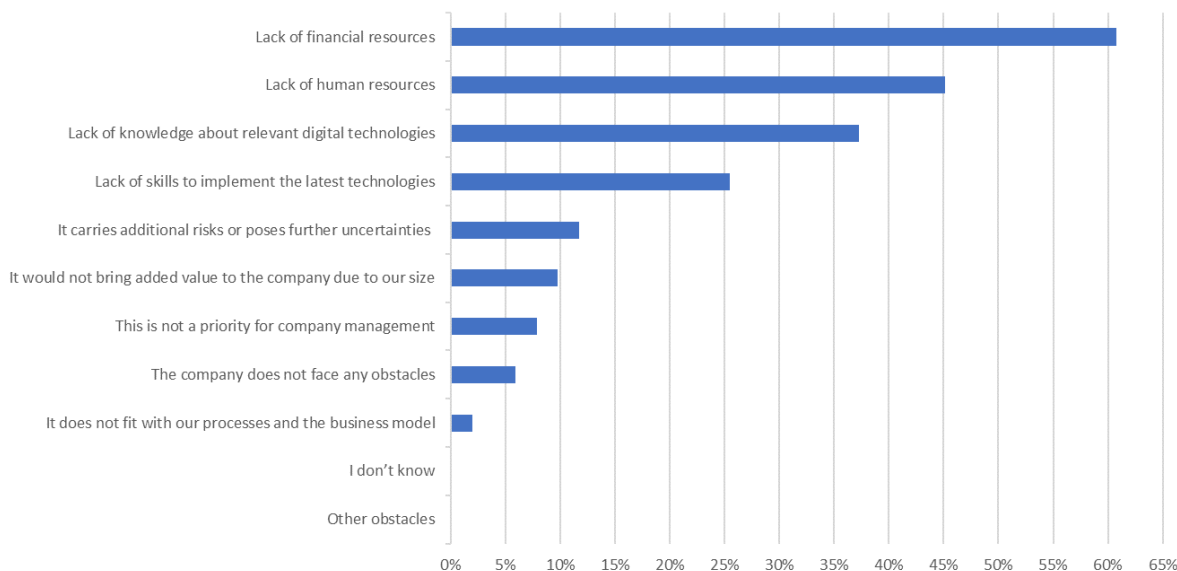
Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study (2022).[124]

Cautious attitudes and risk aversion on the part of SMEs in the agrifood industry can also have an indirect effect on digitalisation at company level. Some agrifood SMEs exhibit a lack of trust towards technology providers.[125] This may be due to the rural-urban digital skills gap, which in Lithuania stood at 20% in 2019. Given that a large proportion of agrifood companies in the

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[122] Authors' own elaboration, data for August 2022 from the Lithuanian Agriculture and Rural Business Register. Available at (in Lithuanian): https://ismain.vic.lt/VurapPublic/

[123] Bičkauskė, D.; Šermukšnytė-Alešiūnienė, K.; Simanavičienė, Ž.; Kowalska, K. (2020). Challenges of Digital Transformation in the AgriFood Sector. Sociálno-Ekonomická Revue. Vol. 2.

[124] Notes: Question 12 'In your opinion, what are the main obstacles your company faces in adopting digital technologies?', N=51.

[125] Bičkauskė, D., Šermukšnytė-Alešiūnienė, K., Simanavičienė, Ž., & Kowalska, K. (2020). Challenges of Digital Transformation in the AgriFood Sector. *Sociálno-Ekonomická Revue*. Vol. 2.

country are concentrated in rural areas, some agrifood SMEs may not trust digital service providers because they may lack the expertise and capacity to coordinate with them. In addition, such mistrust may arise due to previous experiences of such collaboration.

In addition, while some agrifood companies may benefit from the support of external providers, the technologies offered by the market do not always meet the needs of agrifood SMEs – a factor that may thus hinder the adoption of digital technologies in the sector. For example, several industry experts note that farmers often prefer to buy or rent a technology-based service, rather than investing in their own capacities. This is because, in many cases, it is more cost-effective for farmers to rent a service rather than implementing the technology themselves. However, the supply of technology-as-a-service solutions in the market is limited.[126]

Some agrifood SMEs, particularly in the agriculture segment, hold sceptical attitudes towards inter-industry and inter-ecosystem cooperation. By cooperating with one another, and thus increasing their bargaining power and reducing operational expenses, farmers may be able to share the large upfront costs of digitalisation.[125] However, unwelcome associations with Soviet-era collective farming units, farmers' distrust of each other, and a lack of awareness regarding the potential benefits result in relatively low levels of such cooperation in Lithuania.[127] The prevalence of distrust is also reflected by a lack of inter-ecosystem cooperation. To illustrate this, the number of European Innovation Partnership for agriculture productivity (EIP-AGRI) operational groups, designed to bring together farmers, researchers, advisers and other actors in cooperation projects, in Lithuania (20) is considerably lower than the EU average (63) (see Figure 26).[128]

Figure 26. Number of EIP-AGRI operational groups
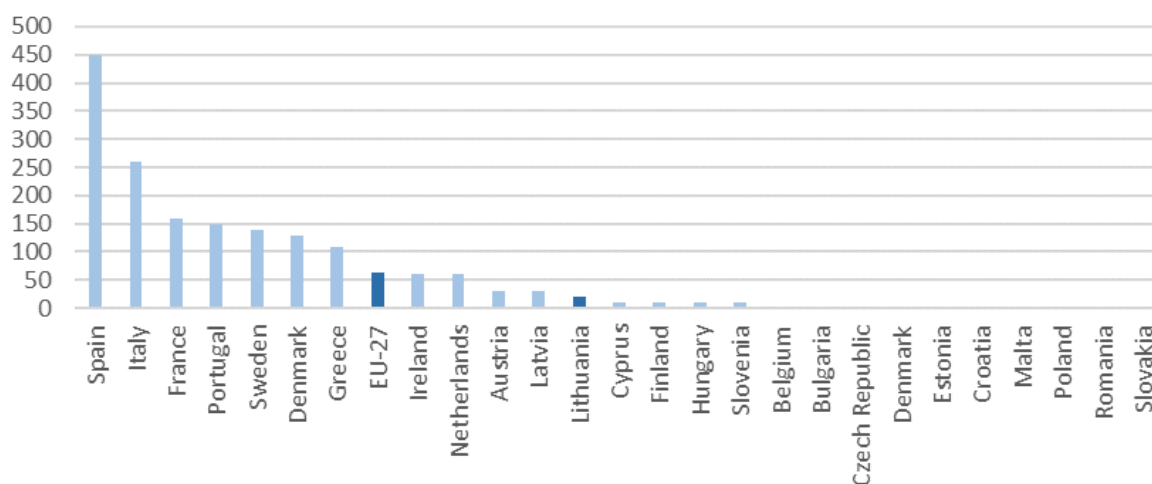
Source: authors' own elaboration based on the DG AGRI data for the CAP objectives country analytical factsheet.

Attitudes held by Lithuanian agrifood SMEs underlie a wide variety of more specific company-level digitalisation issues. While lack of technological awareness hinders digitalisation directly,

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[126] Stakeholder interviews conducted as part of this study.

[127] Droždz, J., Vitunskienė, V., & Novickytė, L. (2021). Profile of the Small-Scale Farms Willing to Cooperate—Evidence from Lithuania. *Agriculture, 11(11)*.

[128] Author's own elaboration based on the DG AGRI data for the CAP objectives country analytical factsheet. Available at: https://agridata.ec.europa.eu/extensions/CountryFactsheets/CountryFactsheets.html?memberstate=Lithuania

lack of collaboration between industry players slows down digital investment via less direct pathways.

3.4.2.2. Problem 2: Lack of digital skills and knowledge prevents companies from effectively adopting digital technologies

The lack of relevant digital skills is another factor slowing down digitalisation in the Lithuanian agrifood industry. First, a shortage of digital competencies and know-how among managers and employees prevents companies from taking full advantage of the potential benefits of digitalisation. Second, the problem is amplified by the lack of a qualified labour force, especially in rural areas, leading to a shortage of skilled personnel.

The adoption of digital technologies among Lithuanian agrifood companies is held back by lack of digital skills. Evidence points toward a general shortage of skills and training in rural areas of the country. To illustrate, the participation rate for adult learners training in agriculture has been consistently below the target of 149,000 set for 2025 in the country's Rural Development Programme. The number of adults who received training between 2014 and 2021 equalled only 16.1% of the target set.[129]

In addition, agrifood companies appear to struggle in meeting their demand for ICT specialists. In the manufacturing of food, beverages and tobacco sector, 56% of Lithuanian enterprises that recruited or tried to recruit ICT specialists had hard-to-fill vacancies in 2020 (see Figure 27).[130] This is above the EU-27 average of 41%. For the accommodation, food and beverage services sector, the same figure stood at 79%, while the EU-27 average was 19% (see Figure 28). As can be seen from the figure below, there is a large fluctuations from year to year, including a relatively large gap between the scores for Lithuania and the EU-27 in 2020. This jump in hard-to-fill ICT vacancies in 2020 may be due to the impact of COVID-19 on the industry, and the need for more employees with ICT skills.

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[129] European Agricultural Fund for Rural Development (2021). *Lithuanian Rural Development Programme Annual Implementation Report 2021*. Available (in Lithuanian) at: https://zum.lrv.lt/uploads/zum/documents/files/LT_versija/Veiklos_sritys/Kaimo_pletra/Lietuvos_kaimo_pletros_2014%E2%80%932020%20m._programa/Steb%C4%97sena%20ir%20vertinimas/Metines%20ataskaitos/2021/MIA%202021%2020202206.pdf

[130] Eurostat. Table ISOC_SKE_ITRCRN2, NACE sectors C10-12.

Figure 27. Percentage of enterprises that had hard-to-fill vacancies for jobs requiring ICT skills (manufacture of beverages, food, and tobacco)
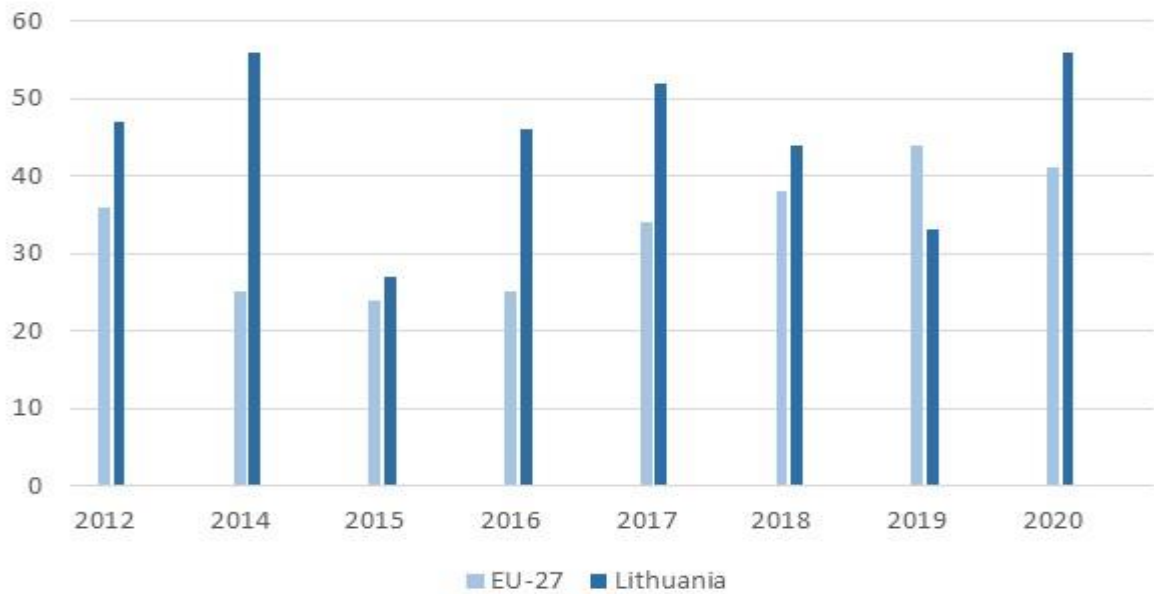
Source: Eurostat table ISOC_SKE_ITRCRN2, NACE sector C10-12.

Figure 28. Percentage of enterprises that had hard-to-fill vacancies for jobs requiring ICT skills (accommodation, food, and beverage services)
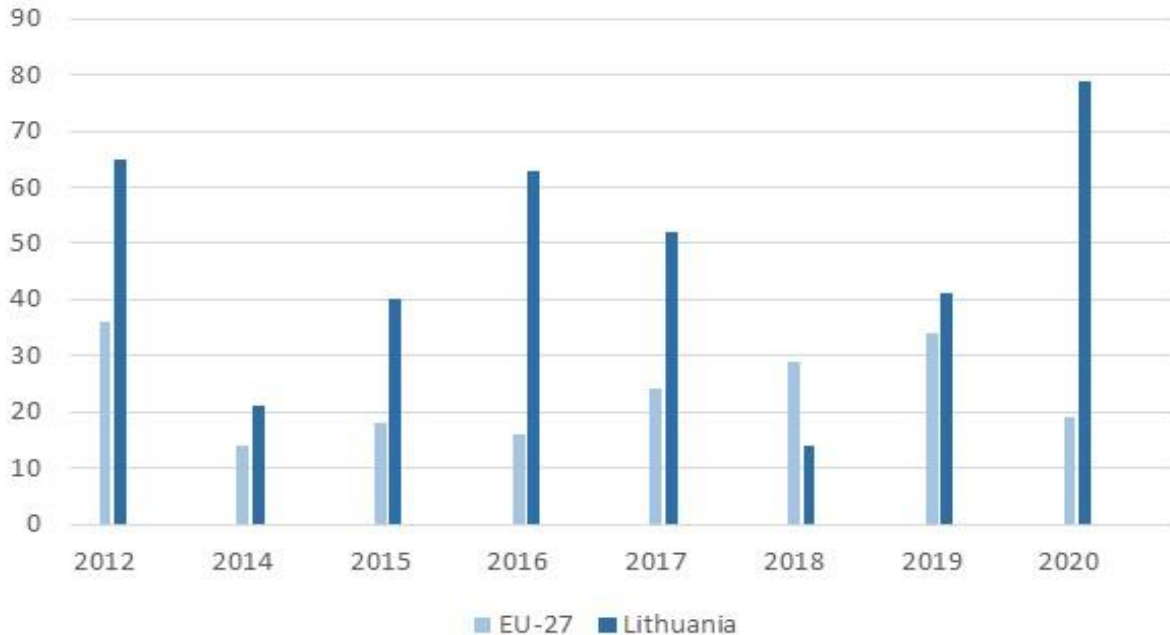
Source: Eurostat table ISOC_SKE_ITRCRN2, NACE sector I155-56

Findings from the Company Digitalisation survey also point to a skills shortage in Lithuania's agrifood industry. A total of 45.1% of respondents highlighted the shortage of human resources as one of the main obstacles to digitalisation, making it the most frequently selected option. In

addition, 25.5% of respondents pointed to a lack of the skills needed to implement digital technologies (see Figure 25).

Overall, a shortage of digital skills presents a significant obstacle to the digitalisation efforts of agrifood SMEs in Lithuania. Lack of digital competencies prevents companies from taking full advantage of digitalisation, while the shortage of qualified labour force slows down their adoption of digital technology solutions.

3.4.2.3. Problem 3: Companies lack the financial resources to implement digital technologies

The third problem behind Lithuanian agrifood companies' difficulty in digitalising is the lack of available financial resources. Several factors contribute to this issue. First, the agrifood industry's value chain – particularly in agriculture and farm production – is characterised by volatile income flows. This is due to unpredictable environmental factors, the high variability of production outcomes, market uncertainty, and changes in agriculture policy.[131] Income volatility can lead to shortages in the financial resources that can be directed away from day-to-day operations and used for investments in digital technologies. Second, many agrifood SMEs face constrained access to finance. Lastly, the small size of these companies is often insufficient to cover the upfront costs of investments in digital technologies.[132]

The problem of a lack of available financial resources is manifested by a persistent financing gap faced by agrifood companies in Lithuania. This financing gap reflects the unmet demand for credit on the part of agriculture and food manufacturing enterprises. The scope of the financing gap includes companies that have applied for lending but were unable to obtain it, those whose borrowing offers were refused by lenders, and those that decided not to apply for lending due to anticipated rejection. Data from Fi-Compass show that for the Lithuanian agriculture sector, the total value of unmet financing needs of enterprises that reported stable (non-negative) growth in turnover was estimated to be EUR 2.2 billion in 2017.[133] For the food manufacturing sector, the figure was considerably lower, at EUR 20.2 million. Lastly, data suggest that SMEs[134] account for the vast majority of this financing gap – 87% and 88% of the respective gaps in agriculture and food manufacturing.[135]

The financing gap faced by Lithuania's agriculture sector is one of the highest in the EU (see Figure 29).[136] The ratio of the estimated financing gap to the gross value added (GVA) generated by the sector stood at 179% in 2017. This is considerably higher than the average for EU countries (excluding Cyprus, Luxembourg and Malta) of 51%. Looking at the food manufacturing segment, the problem of accessing finance appears to be less severe. In 2018, the gap-to-GVA-ratio stood at 2%.

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[131] Novickytė, L. (2018). Income Risk Management in Agriculture using Financial Support. *European Journal of Sustainable Development, 7(4)*.

[132] Bokša, M., Šaroch, S., & Bokšová, J. (2020). Digitalization of SMEs. *International Advances In Economic Research, 26(2)*, 175-177. doi: 10.1007/s11294-020-09777-1

[133] fi-compass (2020). *Financial needs in the agriculture and agri-food sectors in Lithuania, Study report.* Available at: https://www.fi-compass.eu/publication/publications/financial-needs-agriculture-and-agri-food-sectors-lithuania

[134] Farms below 20 ha and firms with fewer than 50 employees.

[135] Authors' own elaboration based on the data from: fi-compass (2020). *Financial needs in the agriculture and agri-food sectors in Lithuania, Study report.* Available at: https://www.fi-compass.eu/publication/publications/financial-needs-agriculture-and-agri-food-sectors-lithuania
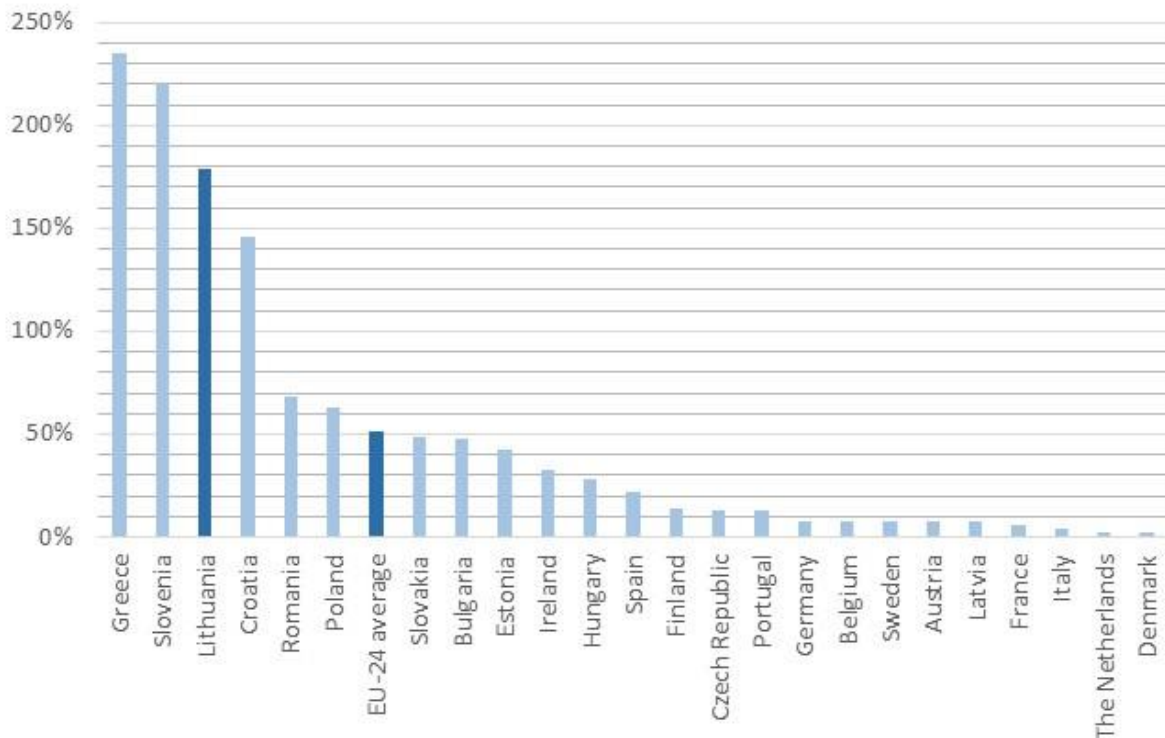
[136] fi-compass (2020). *Financial needs in the agriculture and agri-food sectors in the European Union, Summary report.* Available at: https://www.fi-compass.eu/publication/publications/financial-needs-agriculture-and-agri-food-sectors-european-union

Figure 29. Financing gap in the Lithuanian agriculture sector as a % of GVA

Source: authors' own elaboration based on fi-compass summary report (Financial needs in the agriculture and agri-food sectors in the European Union) and Eurostat data. EU-24 average was calculated by taking the average of the financing gap estimates of the 24 countries covered in the fi-compass study.

The general lack of available financing across the agriculture and agrifood sectors is confirmed by the Company Digitalisation survey. When asked to identify the most important obstacles to the adoption of digital technologies, 60.8% of respondents pointed to a lack of financial resources (see Figure 25).

Companies and industry stakeholders also highlight a lack of financial support aimed specifically at the digitalisation of the agrifood industry.[137] Historically, there has been a gap in initiatives aimed at supporting agrifood companies' digitalisation in Lithuania. For example, while the 2014-2020 Rural Development Programme for Lithuania aimed to invest in farm performance, restructuring and modernisation, digitalisation was not highlighted specifically as a target in policy documents or when promoting the programme to its beneficiaries.[138] Nowadays, increasing recognition is being given to the importance of digitalisation in existing supporting policy initiatives. According to the Company Digitalisation survey results, 49% of respondents from the Lithuanian agrifood industry indicated that their company had received financial support from regional, national or European funds aimed at promoting digitalisation during the previous five years. Yet there remains a persistent lack of digitalisation initiatives aimed specifically at the agrifood industry. To illustrate this, despite 31.5% of expenditure under the Lithuanian National Recovery and Resilience Plan being allocated to digitalisation,

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[137] Interviews with a Lithuanian public sector organisation and an expert from academia conducted as part of this study.

[138] Ministry of Agriculture of the Republic of Lithuania (2022). *Lithuanian Rural Development Programme 2014-2020*. Available (in Lithuanian) at: https://zum.lrv.lt/lt/veiklos-sritys/kaimo-pletra/lietuvos-kaimo-pletros-2014-2020-m-programa/programa-2

the plan does not include any specific tools and investments for the agrifood sector in this sphere.[139]

Furthermore, SMEs in the agrifood sector face the issue of large upfront costs associated with the adoption of digital technologies.[140,141] The stakeholders interviewed claim that adopting certain advanced digital technologies may be associated with smaller returns on investment for agricultural SMEs. However, even where long-term returns are significant, agrifood SMEs – due to their small size – often lack their own financial resources to overcome the barrier of large initial investment costs. As mentioned above, these companies are also subject to volatile income flows and constrained access to credit, manifested by a persistent financing gap. This often means that agrifood SMEs are unable to cover the large upfront costs of digital investments. In addition, small companies may also struggle to implement the technological solutions necessary for digitalisation.

Overall, above-described evidence suggests that lack of financial resources is an obstacle to digitalisation among agrifood SMEs in Lithuania. Companies wishing to digitalise may lack access to financing and face large upfront investment costs, which in turn slow down the pace of digitalisation.

3.4.3. Company examples

Three examples of companies from the Lithuanian agrifood industry are presented below. These companies reflect the diversity of the agrifood sector value chain, from agricultural production to food processing and manufacturing.

3.4.3.1. Company 1

Company 1 is a small farm (up to 300ha) that has been working in the industry for almost 20 years. The main production area and source of income on the farm is crop cultivation (wheat, barley, etc.). The farmer uses a basic digital process management solution and expresses an interest in implementing more advanced technologies.

According to the farmer, **lack of financial resources** is the most important factor that limits the adoption of digital technologies on their farm. Digital technologies are expensive to implement and given the small size of the farm, it is not clear whether they will provide a sufficiently high return on investment. According to the farmer, agriculture sensors cost a few hundred euros and are prone to theft. The price of drones is also high, at around a few thousand euros. Similarly, the adoption of certain technologies requires investments in particular infrastructure. Remote-sensing solutions require the processing of large amounts of satellite imagery in the cloud. AI techniques require GPUs. This further increases the cost of adopting digital technology.

Lack of **relevant skills and personnel** is another obstacle encountered by the farmer. The interviewee believes that their skills and those of farm employees are insufficient to realise the full potential of digital technologies. One possible solution – namely, upskilling and reskilling – requires financial resources that are currently not available.

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[139] Lithuanian National Recovery and Resilience Plan; Proposal for a Council Implementing Decision on the approval of the assessment of the recovery and resilience plan for Lithuania; expert interviews.

[140] Interviews with industry experts and a representative of an agrifood association, conducted as part of this study.

[141] Bičkauskė, D., Šermukšnytė-Alešiūnienė, K., Simanavičienė, Ž., Kowalska, K. (2020). Challenges of Digital Transformation in the AgriFood Sector. *Sociálno-Ekonomická Revue. Vol. 2.*

The **small size of the farm** is another important issue, as it often renders the implementation of various digital technologies impossible. For example, one of the alternatives to investments in drone technology for field observations is gathering the necessary data from satellites. However, the small size of the farm challenges the implementation of this alternative. Small plot sizes and the practice of planting multiple crops in the same field make it difficult to extract information for each crop in the field, as the feasible range of satellite data is too large.

3.4.3.2. Company 2

The company is a medium-sized **agriculture holding company**, with up to 3,000ha of land and mixed production. Its main areas of operation are crop cultivation and milk production.

In general, the company's team is relatively open to digitalisation and has **already implemented several digital solutions**. The company uses a smart farm management system to manage its operations, as well as smart agricultural machinery and certain robotic solutions in animal production. These include milking robots, an AI system for cattle health monitoring, and several types of sensors. However, the company notes that the adoption of new technologies can be difficult, as some are incompatible with its current farming practices and the digital solutions it has already implemented.

One of the obstacles faced by the company reflects a lack of financial resources and **returns on investment**. The main concern for the company is the slow returns on investment or, in some cases, unclear financial benefit gained from investing in a particular digital technology.

Another issue relates to the lack of skilled workers and the **need for specialised training**. The employees currently working with digital technologies at the farm possess extensive experience. However, some of them have been employed for 20 years and are likely to retire soon. The company is concerned that it will be difficult to replace them. The problem is exacerbated by the unwillingness of young people to move to rural areas for work. While robotics could provide a solution, several obstacles to successful implementation exist. The technology has not yet been tested for crop cultivation, is very expensive to implement, and requires high-skilled workers to maintain it. In addition, the returns of such an investment are very unclear and difficult to calculate.

Low levels of collaboration, limited technical support and a lack of supply for spare parts also contribute to the difficulties encountered by the company in the digitalisation process.

3.4.3.3. Company 3

The company is a medium-sized food manufacturing enterprise specialising in **confectionery production**. The company has already implemented certain digital technologies and is looking into improving its production lines by digitalising, automating and bringing in more robotics solutions.

The company is experiencing several obstacles to digitalisation that are typical of the industry. First, digitalisation efforts are inhibited by a limited budget and the **absence of a company digitalisation strategy**. In addition, the company faces obstacles due to its legacy infrastructure, with incompatibilities between its current production lines and new technology making new digital solutions harder to implement.

Second, the company experiences problems relating to **skills and personnel**. There is a lack of the expertise and specific skills needed to implement, operate and maintain complex technological investments. Furthermore, company employees do not always view the adoption

of new technologies favourably, as it may involve changes to previous working methods and the introduction of new production processes. This reluctance further complicates the implementation of technological solutions and slows down digitalisation efforts in general.

Lastly, one obstacle to digitalisation that is unique to food manufacturing and processing enterprises concerns **consumer attitudes**. Because consumers perceive the automation of the production process unfavourably and prefer traditional manufacturing practices and recipes, some production techniques cannot easily be automated. It is important to the interviewed company to project an image of maintaining traditional manufacturing methods and values to its customers.

3.5. Construction sector in Romania

This section provides a description of the construction industry in Romania, the main company-level digitalisation problems observed, as well as examples of companies that exhibit those problems.

3.5.1. Description of the industry

Construction is the third-largest sector in Romania by the number of enterprises, constituting a total of 11.1% of companies operating in the country in 2020. In the same year, the sector employed 9% of the Romanian workforce and made up 6.3% of Romania's GDP.[143]

Romania is among the least digitalised countries in the EU, ranking last in the DESI 2021. Similarly, Romania's construction sector appears to be among the least digitalised in the EU. A total of 90% of construction companies in Romania have a 'very low' Digital Intensity Index, compared with the EU average of 62%. In addition, 18.7% of respondents to the Company Digitalisation survey indicated that their company's digital maturity is below that of industry counterparts.[142]

Analysis of the industry revealed several possible explanations for this.[143] These include a lack of supportive policy initiatives and a significant labour shortage. The latter is driven by low wages, migration to Western Europe, and lack of specialist training. In addition, large differences in the level of company digitalisation are observed along the construction industry value chain. Companies that participate in high value-added activities, such as engineers, are more digitalised than manufacturers or regional companies.

The Company Digitalisation survey conducted as part of this study brought additional insights into digitalisation in Romania's construction industry. Based on the survey results, specific factors driving investment in digital technologies were identified, along with the main obstacles to their adoption.

As indicated by Romanian construction companies in the Company Digitalisation survey, the top three areas for investments in digital technology during the past two years were: product or service design and engineering (46.3% of respondents), purchasing and procurement (35%), and inbound logistics and warehousing (30%). In addition, around a quarter of respondents also mentioned project planning and management (30%), delivery and outbound

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[142] Notes: the proportion of respondents who answered 'somewhat less digitally mature than other companies operating in my industry' or 'much less digitally mature than other companies operating in my industry' to Company Digitalisation survey Question 6 'How would you assess your company's digital maturity as compared to similar companies operating in this industry?'; 'I don't know' excluded from the total, N=75.

[143] Smart Industrial Remoting: remote working in non-digitalised industries. Gap Analysis report.

logistics (26.3%), operations (25%) and cyber security and data protection (25%) (see Figure 30).

When asked to indicate the key factors driving investment in digital technologies, almost half of respondents highlighted increasing profitability (49.3%) and the availability of financial support (46.5%). Around a quarter of respondents (26.8%) also mentioned the importance of strengthening resilience to external shocks.

Figure 30. Company Digitalisation survey: summary of results on past investment in digital technologies, construction industry, Romania, 2022
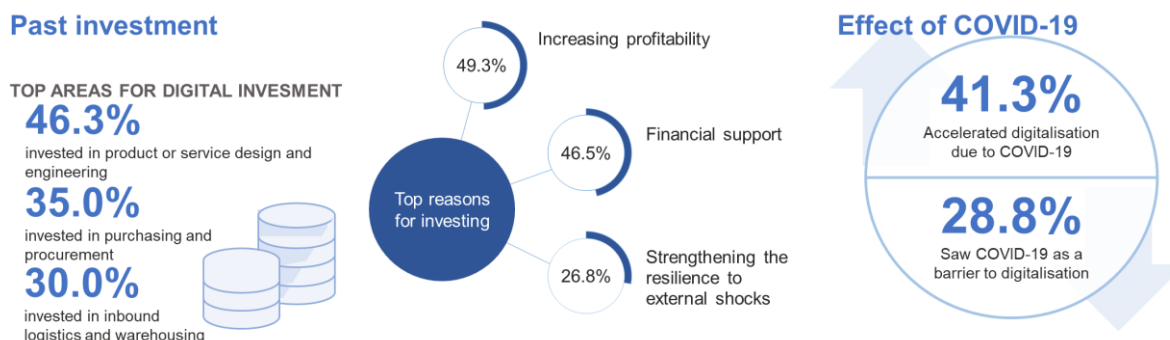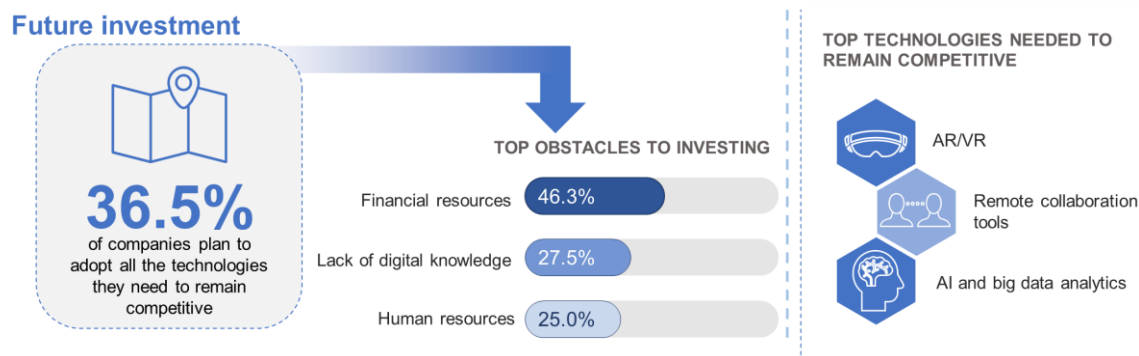

Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study (2022).[144]

COVID-19 had a heterogeneous effect on the digital technology investment decisions of the companies surveyed. Overall, 41.3% of survey respondents claimed that the pandemic had contributed to the faster adoption of digital technologies by their company. Data from interviews also confirms this. Interviewed companies claimed that some digitalisation was already taking place in the sector and the pandemic helped to accelerate it. Meanwhile, for 28.8% of survey respondents, the pandemic had meant dropping or postponing certain digitalisation-related investments.

The Company Digitalisation survey also touched upon the technologies that companies believe they should adopt during the next two years in order to remain competitive, as illustrated in Figure 31 below. Most respondents (31.3%) indicated virtual and augmented reality, followed by remote business collaboration tools (26.3%), and AI and big data analytics (26.3%). The choice of companies to invest in VR and AR tools aligns with industry characteristics, as companies can benefit from these technologies during the construction planning and engineering phases. Around one-third (36.5%) of companies were planning to adopt these technologies. Another third (35.1%) of surveyed companies were planning to adopt some of the technologies in question, while 20.3% had no plans to implement any digital technologies.

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[144] Notes: the figure is compiled on the basis of responses to the following questions from the Company Digitalisation survey: Question 7 'Which areas of your company's operations have been the focus of digital technology related investments in the last 2 years?', N=80; Question 9 'What are the key factors driving your company's decision to invest in digital technologies?', N=71; Question 16 'Did the COVID-19 pandemic have any effect on of the adoption of digital technologies (tools, solutions, processes) in your company?', N=77.

Figure 31. Company Digitalisation survey: summary of results on future investment in digital technologies, construction industry, Romania, 2022

According to the results of the Company Digitalisation survey, the main obstacles to the adoption of digital technologies in Romania's construction industry related to resource shortages. A total of 46.3% of survey respondents indicated the lack of sufficient financial resources as a barrier to digital investments. In second place, a total of 27.5% of respondents mentioned a lack of knowledge about relevant digital technologies. Lastly, a quarter of respondents indicated a shortage of human resources. These results align with the company-level problems identified that inhibit the digitalisation of Romania's construction industry.

3.5.2. Main problems identified in the industry

This section describes the three main problems identified at company level in the Romanian construction industry. First, the current structure and properties of the Romanian construction market do not create a favourable environment for technology adoption. Second, companies face shortages of digitally skilled labour. Lastly, Romanian construction enterprises lack the appropriate financial resources to undertake costly digitalisation-related investments.

3.5.2.1. Problem 1: Current structure and properties of the Romanian construction market do not create incentives for digitalisation

One of the obstacles to digitalisation faced by construction companies in Romania relates to the structure of the national construction market. Two major factors contribute to this issue. First, companies are not incentivised to adopt crucial digital technologies, such as Building Information Modelling (BIM),[146] due to a lack of standardisation initiatives or supportive policies from the public sector. Second, sector fragmentation results in limited possibilities for collaboration along the construction value chain and within the broader ecosystem, further impeding digitalisation.

Data from interviews with industry stakeholders, experts and company representatives suggest that a gap exists in regulatory and policy initiatives targeting the construction industry in

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[145] Notes: The figure is compiled on the basis of responses to the following questions from the Company Digitalisation survey: Question 11 'To what extent is your company planning to take action to adopt these digital technologies in the next 2 years?', N=47; Question 12 'In your opinion, what are the main obstacles your company faces in adopting digital technologies?', N=51; Question 10 'Which of the below technologies are currently not present in your company but would be necessary to adopt in the next 2 years for your company to remain competitive?', N=51.

[146] The relevance of BIM is elaborated upon in the Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project. Gap Analysis report.

Romania. This gap is particularly evident in public procurement processes. BIM is one of the main technologies that construction companies can adopt to remain competitive and strengthen their digital maturity. Nevertheless, less than 5% of active construction projects in Romania were employing it as of 2019.[147] Evidence from the interviews suggests that several factors have led to this. First, the use of BIM-based technologies is not a compulsory requirement in large civil engineering projects and public tenders. This may be due to a lack of necessary expertise within Romanian public administration to evaluate and operate BIM models. Consequently, companies may be less motivated to adopt such technologies, as they will not result in being given additional evaluation points in public tenders. In addition, obtaining a BIM licence, as well as implementing BIM within a project, is costly. Given that most Romanian public procurement processes are conducted according to the lowest-price principle, companies wishing to tender competitively are not incentivised to adopt costly advanced digital technologies.

The lack of performance criteria distinguishing experienced architects, constructors and designers in public procurement contracts further discourages companies from adopting digital technologies.[148] The development of a certification system among professionals in the construction sector would help to differentiate and reward companies that have the expertise to use advanced digital technologies in their operations, hence incentivising their adoption.[149]

The lack of a digitalised process for construction authorisation is another disincentive to the adoption of digital technologies in Romanian construction companies. According to the results of the European Construction Sector Observatory Survey,[150] Romania lags behind other EU countries when it comes to the digitalisation of building permit systems. As of 2020, the Romanian construction industry operated on a paper-based permit system. Most other EU Member States, by comparison, have either partially or fully digitalised permit systems featuring BIM integration.

In addition, current implementation of public contracts does not support the use of digital technologies. Many contracts do not accept digitalised deliverables, contractual agreements or quality control mechanisms. This further hampers the development of a construction market that enables digitalisation, as companies are not incentivised to use digital tools in their work. One of the stakeholders interviewed shared the example of the use of construction modelling in public contracts. Even those companies that can produce 3D models of construction plans, still need to convert them into 2D models for public authorities to be able to work with them.

The fragmentation of the construction sector and the resulting limited collaboration within the ecosystem represent another obstacle to the digitalisation of SMEs in Romania's construction sector. The absence of any unified requirement to employ BIM-based information sharing technologies means that the use of digital tools is concentrated in companies based in the capital region, often operating as subsidiaries of large multinational construction groups. Inter-industry collaboration is inhibited by the fact that those companies currently using BIM in their operations have either trained their construction teams to use the technology, or have developed a small group of partner companies with whom they work using digital processes.[151]

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[147] Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project. Gap Analysis report.

[148] Stakeholder interviews conducted as a part of this study.

[149] Interview with an international software developer and provider of training programmes for BIM in Romania, conducted as part of this study.

[150] European Construction Sector Observatory (2018). *Digitalisation of in the construction sector. Analytical report*. Available at: https://single-market-economy.ec.europa.eu/sectors/construction/observatory/analytical-reports_en

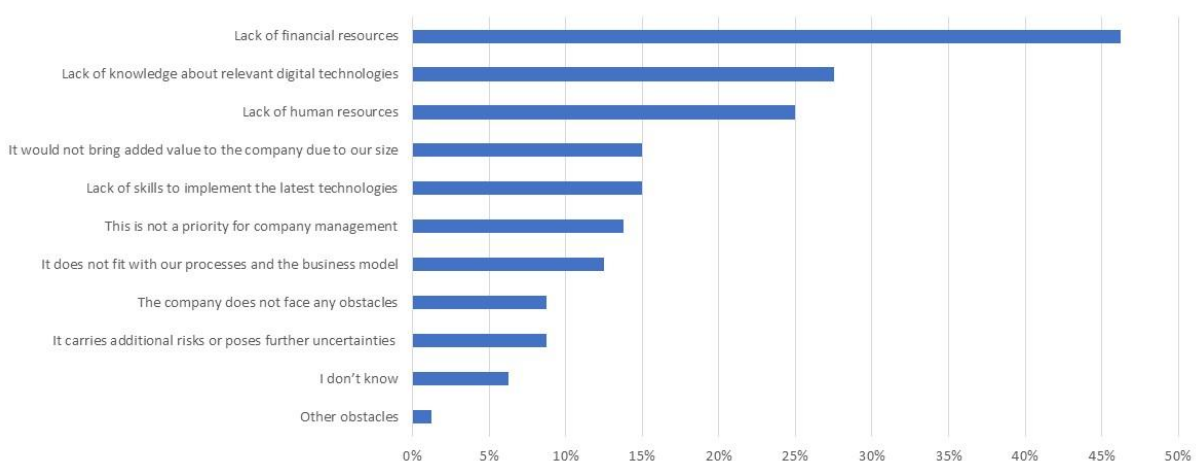[151] Stakeholder interviews conducted as a part of this study.

Overall, the structure and properties of the construction market negatively affect the motivation of companies to adopt digital technologies. Existing public sector practices disincentivise companies from pursuing investments in digital technology. In addition, sector fragmentation prevents successful inter-industry collaboration.

3.5.2.2. Problem 2: Companies face a shortage of the skills and personnel necessary to implement digital technologies

A shortage of skills and adequately trained personnel is another obstacle to digitalisation encountered by SMEs in Romania's construction sector. First, the lack of digital skills among employees impedes the adoption at company level of various crucial digital technologies, including BIM. Second, high short-term acquisition and opportunity costs related to staff organisation tend to make the transition to new digital systems less likely.

Lack of digital skills among employees, together with the unavailability of adequately trained personnel, slows down the adoption of digital technologies in the Romanian construction sector. The problem is particularly acute in relation to the adoption of more sophisticated technologies. According to a survey conducted by the BIMTech Association,[152] lack of digital skills and know-how is the number one barrier encountered by architecture and design companies in adopting the use of BIM on a large scale, mentioned by 71% of respondents. Evidence from the Company Digitalisation survey appears to confirm these trends. A total of 58.3% of respondents considered the lack of skills, knowledge about relevant digital technologies and/or human resources an obstacle to company digitalisation. Of these obstacles, the ones frequently cited were lack of knowledge (27.5%), followed by lack of human resources (25%) and skills (15%) (see Figure 32).

Figure 32. Company Digitalisation survey: obstacles for adopting digital technologies, construction industry, Romania, 2022

Source: compiled by the research team on the basis of the Company Digitalisation survey conducted as part of this study (2022).[153]

According to stakeholder interviews, the process of integrating digital technologies into companies' operations also represents a significant opportunity cost. Given the shortage of skilled personnel in the labour market, the transition to a new operating system often requires companies to take existing staff out of their regular activities. This is necessary for them to

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[152] BIMTECH (2020). *'How is BIM in RO? - Centralized results to survey – Maturity level of BIM in Romania'.* Available at: http://bimtech.ro/2020/12/28/rezultate-centralizate-sondaj-gradul-de-maturitate-bim-in-romania/

[153] Notes: Question 12 'In your opinion, what are the main obstacles your company faces in adopting digital technologies?', N=80.

receive training and develop new operational practices.[154] Hence, during the development and build-up stages of the digital technology adoption process, companies are likely to face higher short-term opportunity costs compared with a business-as-usual operational scenario. Company productivity would likely drop during this period, representing a short-term financial loss. While the stakeholders interviewed agree that the mid- to long-term returns on digital investments are relatively high, the short-term opportunity costs incurred due to staff training and technology adoption can still be a significant barrier. This is particularly relevant for companies operating outside the country's capital region, as employees with relevant skills and expertise are even less available there, and hence acquisition and opportunity costs relating to digitalisation are higher.

Existing data confirm these trends. The proportion of SMEs in Romania providing training to develop or upgrade the ICT skills of their personnel has remained significantly below the EU-27 average for some years (see Figure 33). Moreover, this discrepancy has been consistent over time, with almost no improvement in Romania's score evident since 2012. In 2020, close to 5% of Romanian SMEs provided such training, compared with the EU-27 average of 18%.[155]

Figure 33. Percentage of SMEs that provide training to develop or upgrade the ICT skills of their personnel
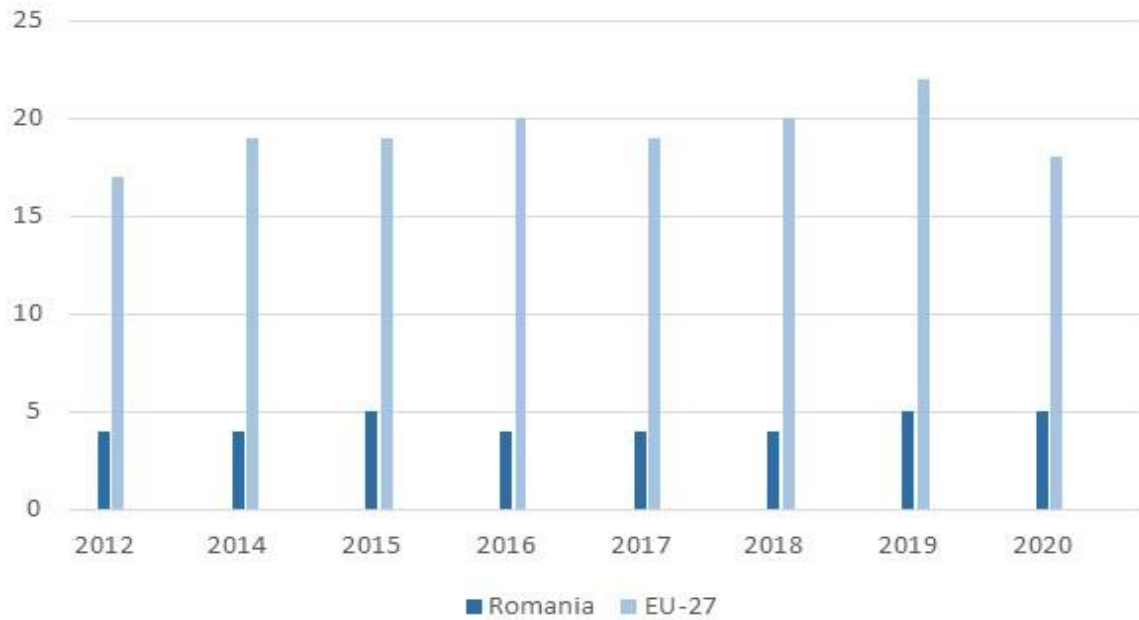
Source: authors' own elaboration based on the Eurostat table ISOC_SKE_ITTN2, NACE sector SM_C10_S951_X

Lastly, the stakeholders interviewed also highlighted that the successful adoption of digital technologies requires a certain type of company culture that can sustain active learning and openness to the adoption of new technologies. Interview data suggests that currently, such a culture is present in only a few Romanian construction companies. On the one hand, digitalisation requires support from the company management, as employees may need to have time away from business-as-usual operations to learn and familiarise themselves with these new technologies. On the other hand, it also requires flexibility, motivation and coordinated efforts from all employees. Interviews conducted for this study show that this is

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[154] Interviews with industrial company representatives conducted as a part of this study.
[155] Eurostat. Table ISOC_SKE_ITTN2, NACE sector SM_C10_S951_X.

not always the case.[156] For example, several company representatives and industry experts mentioned the prevalence of resistance to the implementation of digital technology solutions from physical construction teams.

In summary: SMEs in Romania's construction sector face a serious shortage of digitally skilled labour. This leads to high opportunity costs in relation to staff upskilling and the implementation of digital technology. Lastly, the lack of a supportive company culture further contributes to low levels of digital technology adoption.

3.5.2.3. Problem 3: Companies lack appropriate financial resources for digitalisation

Lack of sufficient financial resources is the third issue faced by Romanian construction companies in adopting digital technologies. Despite the varying levels of digital maturity exhibited by Romanian companies, lack of appropriate funding is an issue for both smaller and larger companies. Furthermore, Romanian construction companies also face high acquisition costs in relation to digitalisation, which often result in investments being deprioritised over more pressing industry issues. Lastly, the problem is exacerbated by misalignment between companies' needs and the objectives of some existing digitalisation support programmes.

Both large companies and SMEs in the Romanian construction sector may face issues concerning their access to finance. The findings from stakeholder interviews suggest that small and micro enterprises are the companies most affected by a shortage of finance, mainly because they do not have the capital to self-finance necessary investments. By contrast, larger companies, while having some capital to cover investment costs, are often discouraged from pursuing this decision due to a lack of appropriate financing mechanisms through either national government programmes or European funds. Data from the European Investment Bank (EIB) Investment Survey further highlights the prevalence of the problem. As of 2021, 12% of Romanian firms can be considered as constrained in terms of external finance, compared with the EU-27 average of 5%. Financing constraints arises from firms seeking funding in the credit market but failing to obtain it, or as a result of firms being discouraged from applying for credit in the first place.[157] Romanian SMEs and companies working in the construction industry are particularly affected. In Romania, 17% of construction companies and 19% of SMEs are constrained with regard to external finance, compared with EU-27 averages of 5.5% and 6%, respectively (see Figure 34).[158,159]

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[156] Stakeholder interviews conducted as a part of this study.

[157] Finance-constrained firms include: those dissatisfied with the amount of finance obtained (i.e. they received less than was requested/needed); firms that sought external finance but did not receive it (rejected); and those who did not seek external finance because they thought the borrowing costs would be too high (too expensive), or that they would be turned down (discouraged). Source: EIB Investment Survey 2021.

[158] European Investment Bank (2021). *EIB Investment Survey 2021 – Romania Overview.* Available at: https://www.eib.org/en/publications/econ-eibis-2021-romania

[159] European Investment Bank (2021). *EIB Investment Survey Data Portal.* Available at: https://data.eib.org/eibis/graph

Figure 34. Share of firms that are constrained with regard to external finance
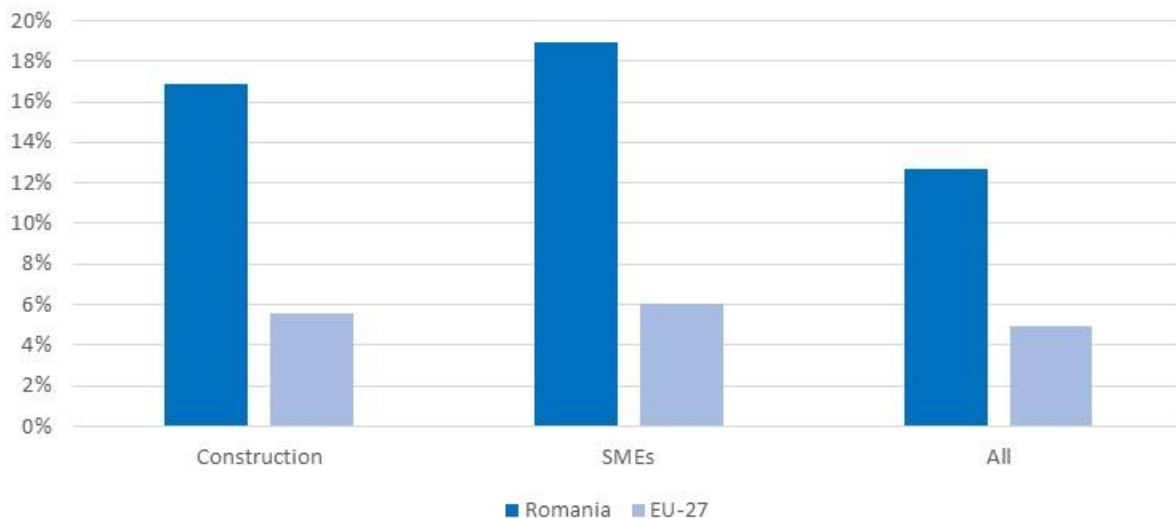
Source: authors' own elaboration, based on EIB Investment survey Romania and European Union overviews. Data available at EIB Investment Survey Data Portal: https://data.eib.org/eibis/graph.

Evidence from the Company Digitalisation survey confirms these trends. At 46.1%, lack of financial resources was the option most frequently selected by Romanian construction companies when reflecting upon the main obstacles they face in adopting digital technologies (see Figure 32).

High acquisition costs in relation to investments in digital technologies, in combination with a challenging market environment, also play a significant role in hindering the digitalisation of Romania's construction sector. Construction companies are subject to high inflation, steadily increasing costs of core materials, and a general labour shortage. For example, the Eurostat Construction cost index for Romania increased from 134.1 in Q2 of 2020 to 182.4 in the same quarter of 2022 (see Figure 35).[160]

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[160] Eurostat. Table, STS_COPI_Q.

Figure 35. Construction cost index for new residential buildings (Romania)
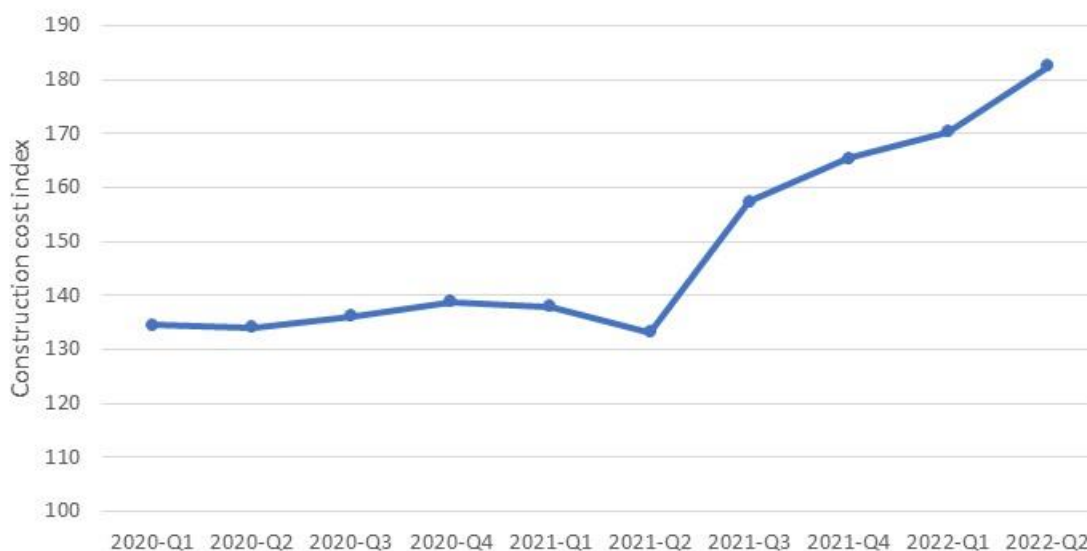
Source: Eurostat table STS_COPI_Q. Index base is 2015.

Due to current market conditions, some companies are deprioritising investments in digital technology in comparison to other, more pressing issues. According to one interview with a representative of a cluster aimed at digitalising Romania's construction industry, a large portion of construction projects are slowed down by rising material costs and labour shortages. Contractors often find it impossible to deliver on previously agreed project terms, due to the tripling of the core material costs and rising debt.

Some companies point out that existing support programmes in Romania do not always suit their digitalisation needs. According to the Company Digitalisation survey, 58.8% of companies surveyed claim not to have received financial support from any public initiatives financed by regional, national or European funds aimed at promoting company digitalisation.[161] This finding may be due to a lack of awareness among the companies surveyed about such programmes. Nevertheless, an overview of existing support programmes in Romania suggests that a gap exists in initiatives aimed specifically at in the digitalisation construction industry.[162]

Furthermore, interviewed stakeholders claim that the existing programmes aimed at digitalisation may not be suitable for the needs of less digitally mature companies. For example, funding programmes in Romania are often aimed at increasing competences in highly advanced digital technologies such as high-performance computing (HPC) or machine learning. While such programmes play an important role in advancing digitalisation, less digitally mature companies would benefit from programmes facilitating training in basic digital skills or helping them to acquire basic software for daily operations.[163]

Lastly, the stakeholders interviewed highlighted that some existing support programmes are not economically sustainable for companies in the long run. While some types of advanced digital technologies (e.g. drones, computers), require a one-time investment, others operate on a yearly licence scheme or require continuous adaptation or upgrading.[164] This includes

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[161] Notes: Question 13 'During the last 5 years, has your company received financial support from any public initiatives financed by regional, national or European funds aimed to promote the company's digitalisation?', N=80.

[162] Smart Industrial Remoting: remote working in non-digitalised industries – Pilot Project. Gap Analysis report.

[163] Interview with a representative of a Romanian construction association conducted as a part of this study.

[164] Stakeholder interviews conducted as a part of this study.

technologies such as CRM, ERP and BIM software. In these cases, even if certain financing schemes might temporarily compensate companies for the high acquisition costs of licence-based digital technologies, the sustainability of this as a long-term business model would remain uncertain. Companies would need to continue financing the use of these technologies through their own means after the end of the public financing period.

Thus, the lack of availability of appropriate financial resources inhibits company-level digitalisation in the Romanian construction industry. With a significant portion of the industry already financially constrained, the rising costs of core materials and labour shortages are forcing companies to deprioritise investments in digital technology. Existing public support mechanisms do not always meet the needs of the companies they aim to support.

3.5.3. Company examples

Three examples of companies from the construction sector in Romania are presented below. This selection was made, taking into consideration certain characteristics of the Romanian construction market. Romanian subsidiaries of large multinational construction companies are often relatively well suited to the adoption of digital technologies. Smaller local companies, often based outside of the capital region, are thus primary examples of the ways in which various obstacles to digitalisation manifest themselves in the country's construction sector.

3.5.3.1. Company 1

The company was established in 2010. As of 2021, it had 96 employees and an annual turnover of RON 2.7 million (EUR 550,000). The company works in the areas of civil construction, drilling, sewage systems and water supply, as well as in land surveying and road construction.

The company reports itself to be **above average in its level of digital maturity,** due to its use of a company intranet, project management systems and digitalised topometric measurements. However, the company still faces several digitalisation problems that are closely related to those identified in this study.

The company cites a **lack of appropriate and targeted funding mechanisms** as a barrier to further investments in digitalisation. Similarly to the issues observed across the construction sector in general, the technologies the company needs to adopt are not advanced enough for it to qualify for several EU-funded support programmes.

According to a representative of the company, the **high acquisition and opportunity costs** associated with transitioning to new, digitally advanced operations systems act as a barrier to digitalisation. While this issue is typically associated with companies in the earliest stages of adopting digital technologies, it also has negative repercussions for more digitally mature companies as well. Given that the company has already implemented several digital technologies, the need to upgrade or replace them in the future may result in significant legacy infrastructure issues, which are likely to be exacerbated by high acquisition and opportunity costs.

3.5.3.2. Company 2

Company 2 was established in 1994. As of 2021, the company had 343 employees and an annual turnover of RON 9.9 million (EUR 2 million). The company specialises in the construction of residential and non-residential buildings, the demolition of buildings and site preparation, electrical installation, technical plumbing and other construction installation works.

In terms of digital maturity, the company itself acknowledges the **gap between its current operations and best practices within the industry**. For example, the company has not yet adopted standard management software systems such as ERM.

The digitalisation obstacles faced by the company are reflective of those exhibited by the industry as a whole. While the company has an interest in digitalisation, it has had to **deprioritise investing in digital technologies** due to more pressing issues.

Like other companies in the industry, the company faces **rising inflation**. This significantly impacts the prices of construction materials. In addition, the **shortage of labour** in Romania is an issue company believes is more important to tackle in the short term than digitalisation.

The company's first investment priority in terms of digital technologies would be an enterprise resource management (ERM) system. In addition, the company highlights the importance of having a system for managing the company's administrative tasks and coordinating with public institutions on bureaucratic matters.

3.5.3.3. Company 3

Established in 2016, the company is a small architecture office with three employees. The company primarily specialises in design and planning work for the building of road, water and sewage infrastructure.

The company identifies itself as **less digitally mature than its industry counterparts**, as it lacks certain software licences and does not have a website or any online presence. In certain cases, the small size of the company is a valuable advantage. Working with several subcontractors, the company can be flexible and rely on their digital expertise and investments. However, the company is still subject to most of the digitalisation obstacles identified in this study.

First, the company lacks the **financial resources** needed to implement digital technology solutions. The costs of several key technology investments, including robotics stations (EUR 38,000) and drone software (EUR 10,000) are often too high for the company to bear. The company has recently been facing financial difficulties and cannot afford to invest in digital technologies at the moment. During the COVID-19 pandemic, for instance, the company had to take a loan and prioritise its survival over technology-related investments.

Second, in order to adopt digital technologies, the company would need to increase its **employees' digital competences**. The company representative noted that in addition to undertaking digital skills training courses, employees also need to be able and willing to learn on their own. This means taking time away from business-as-usual operations in order to train and develop processes and operational speed within the company to support the digital transition. For a small company, such requirements in terms of time and effort represent significant acquisition and opportunity costs in relation to the process of adopting digital technology.

4.   Conclusion

This chapter describes the main takeaways from the analysis presented in the previous chapters. Synthesis of the identified problems reveals several cross-cutting issues faced by companies in their attempts to digitalise.

First, some industries experience structural issues that contribute to difficulties in adopting digital technologies. These include unfavourable economic conditions and the inaccessibility or unavailability of digital solutions in the market. Secondly, out of the five industries included in this study, four highlight a lack of financial resources as a key barrier to digitalisation. Third, companies in all industries experience obstacles relating to human resources and skills. Lastly, limited awareness and risk aversion towards digital technologies among some companies slow down the adoption of digital technologies.

4.1.   Structural issues

Multiple industries have structural problems that affect the ability of companies to adopt digital technologies. First, the current unfavourable economic conditions have led to some companies deprioritising investments in digitalisation. Over the last two years, for example, the automotive sector in Hungary has been severely affected by supply chain shocks. As a result, a large proportion of companies have seen their turnover and/or production drop, thus limiting the resources they can dedicate to digitalisation efforts. Similarly, construction companies in Romania are deprioritising investments in digital technologies due to spikes in inflation.

Second, some companies may struggle to digitalise due to the limited availability of relevant digital solutions in the market. For example, in the Hungarian automotive industry, demand for some more advanced digital technologies tends to be low, which has resulted in a limited supply of such solutions in the market. In turn, those solutions that are available may be unattainably expensive. Similarly, in the Lithuanian agrifood sector, there appears to be an insufficient supply of technology-as-a-service solutions. Farmers often prefer to buy or rent technology-based services instead of investing in and learning to implement the technologies directly themselves. Despite this preference, external suppliers do not always provide solutions based on technology-as-a-service. This may be due to existing information asymmetries between agrifood companies and external suppliers. Some of the companies interviewed in Poland also expressed fears about falling into vendor lock-in situations and becoming dependent on external suppliers.

4.2.   Financial resource and public support-related issues

Four out of five industries included in this study highlight lack of financial resources as a key barrier to digitalisation. SMEs appear to have limited internal resources to plan and implement investments in digital technology. Furthermore, existing public support mechanisms are not always suitable for the needs of companies looking to adopt digital technologies.

Some companies lack the financial capital to invest in digital technologies. For example, the Lithuanian agrifood industry has one of the highest financing gaps in the EU. Similarly, Romanian construction companies face large financing constraints when seeking funding in the credit market. This may be especially problematic when the upfront costs associated with investing in certain digital technologies are significant. For example, small companies may incur large implementation costs if they decide to invest in implementing expensive technologies on a small scale. This is particularly true of textile companies considering the implementation of digital technologies such as automatic sewing, robotics and 3D printing.

Similarly, some automotive companies in Hungary claim that implementation of digital solutions leads to loss of productivity in the short-term. This results in opportunity costs that not all companies are able to incur.

Companies in several industries claim that existing public support programmes do not always address their digitalisation needs. For example, representatives of the retail industry in Poland and the agrifood industry in Lithuania point out that few public initiatives exist that target digitalisation in their specific industries.[165] In addition, smaller companies in Romania claim that the focus of some funding programmes on the implementation of more advanced digital technologies does not meet their needs. Smaller companies tend to need more basic digital technologies. Lastly, the study findings suggest that companies would also benefit from public initiatives aimed at capacity building with a focus on fostering collaboration, as well as providing training and support.

4.3. Issues relating to human resources and skills

In all industries included in this study, the shortage of skills is considered a significant barrier to digitalisation. Such shortages exist in relation to a wide range of different skill sets, including the ability to plan and manage digital transformation, monitor and apply for digitalisation and support opportunities, develop solutions, and operate digital technologies.

These shortages can have several implications. First, companies may not possess dedicated staff who are responsible for keeping up to date with available digital technologies, identifying funding opportunities and managing relationships with external suppliers. For example, many retail companies in Poland do not have ICT specialists available to carry out digitalisation projects.

Second, enterprises may choose not to invest in digitalisation, due to concerns over not having sufficient skills to implement and operate the new technologies. This is the case in the Portuguese textile industry. Similarly, one farmer interviewed in Lithuania stated similar reasons for not adopting digital technologies.

Third, companies often decide to use the services of external providers to implement digital technologies instead of developing them in-house. Nevertheless, without sufficient human resources and skills to manage interactions with external providers, companies may find it difficult to carry out digitalisation projects successfully. Stakeholders in the Polish retail, Portuguese textile and Lithuanian agrifood industries, identify several challenges in relation to interacting with external solution providers. These include unforeseen cost increases, delays, and a lack of integration with those digital technologies they have already implemented.

4.4. Awareness and risk aversion-related issues

Limited awareness and risk aversion towards implementation of new technologies on the part of some companies can be a barrier to company digitalisation. Limited awareness by companies about the benefits of certain technologies may slow down their adoption. In addition, companies in several industries show risk aversion towards digitalisation, believing that it will not bring them any benefits.

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[165] Instruments that specifically aim to improve the level of digitalisation in retail or agrifood companies. While industry agnostic instruments exist, retail companies can find it difficult to ensure that their projects fit their selection criteria, which are sometimes directed more at manufacturing-oriented sectors.

First, some companies do not consider digitalisation a priority. This may be due to these companies prioritising more pressing concerns such as maintaining profitability. However, it may also be explained by a company's level of awareness and attitudes towards the adoption of digital technology. More than one-fifth of respondents in Hungary, Poland and Portugal indicated that a lack of prioritisation by company management was a significant barrier to the adoption of digital technologies.

Second, evidence shows that some companies – particularly SMEs – find it difficult to identify the most appropriate digital investments. Tools for identifying and benchmarking digitalisation gaps may not be widely used in some industries. However, awareness of a company's level of digitalisation relative to peers can make it easier to identify specific investment needs. This is the case in Poland, where stakeholders note that tools which help companies to assess their digital maturity and to identify opportunities for digitalisation could be useful in making more informed decisions on the adoption of digital technologies.

Third, some companies with cautious attitudes toward digitalisation may view digitalisation as being irrelevant to them. Furthermore, smaller companies tend to be more risk averse toward digitalisation. For example, some construction companies in Romania may be reluctant to adopt digital technologies, as they associate them with drastic changes to their day-to-day operations. Similarly, some agricultural companies in Lithuania believe that such technologies will not bring them the necessary benefits or are unsuitable for their businesses. Successful implementation of digital technologies requires a certain company culture that is open to change and experimentation. Even if some companies believe that digital technologies will not bring them benefits, Europe is undergoing a digital transition. Unless such companies digitalise, they risk falling behind in terms of the productivity and sustainability of their businesses.