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DIGITAL CAPACITIES IN MANUFACTURING SECTOR IN KOSOVO

PREPARED BY:
RIINVEST INSTITUTE

SEPTEMBER, 2022

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EXECUTIVE SUMMARY

The approaching Fourth Industrial Revolution, with increasing use of advanced technologies and robotics, is expected to have a major impact on the manufacturing process globally. The question we address is whether the processing sector in Kosovo is on the right path to harness the digital revolution to boost their growth and exports or whether they are far behind. We examine how a growing digital economy affects Kosovo's manufacturing sector exports, and we discuss the policy implications.

A key message of this report is that the private sector and the government need to better prepare for the digital future. New evidence presented in this report suggests that Kosovo not only faces a significant digital divide but also benefit less from increasing levels of digitalisation. To digitalise the processing sectors, Kosovo needs to increase access to the digital infrastructure and other information and communications technologies (ICT). This can be achieved through implementation of effective policies that will alter country-specific conditions and contribute towards improving the investment climate, firm capabilities, national innovation systems and ICT infrastructure, direct financing opportunities, and participation in global value chains.

Taxes and incentives can serve as important drivers for bridging the digital divide with the regional and European markets, while policies targeting public-access solutions can increase access to digital technologies. Financial support from the government needs to be extended – not only to manufacturing and services start-ups but also to ecosystem enablers such as technological and innovation hubs.

With technology increasing at a faster rate than skills, the risk of a skill mismatch is also rising. To increase the development impact of digitalisation, it is crucial for Kosovo to develop complementary skills. Becoming future-ready involves revising and reorienting the curriculum in the educational institutions around science, technology, engineering and mathematics (STEM) subjects. A special focus needs to be given to technical and vocational education and training (TVET).

Using new evidence on the digitalisation of manufacturing firms in Kosovo, this research report finds that substantial share of firms is not implementing any state-of-the-art digital technologies and do not have plans to invest in digitalisation. However, there is also a substantial share of firms that are already partially or even fully implementing state-of-the-art digital technologies in their businesses and that plan to further increase their digitalisation investments.

While business owners perceive their businesses as highly digitalized, the digitalization index exposes the discrepancies between firm's own perception and actual depth of digitalization of manufacturing sector in Kosovo. Indexes calculated at the firm level and also aggregated at industry level show that Kosovo firms are lagging behind the EU peers in digital adoption. The mean value of the index at firm level is 35.7 compared to 63 at the EU level.

Survey results suggest that most of the firms use adequate software for management, marketing and online sales, and management of operations. Also, empirical estimation confirms the initial hypothesis that there statistically significant relationship between digitalization of firms and exporting. The sign and significance of the main explanatory vari-

BOX 1. RECOMMENDATIONS TO ADVANCE DIGITALIZATION PROCESS (EXTRACT FROM EXPERT INTERVIEWS)

"An Information campaign to increase the awareness of top managers/owners of businesses on advantages and benefits of digitization along with promoting success stories and cases is necessary."

''Campaigns for increasing the awareness while governmental institutions should take a more active role in this part."

"We must start with capacity-building in human resources, first to identify needs for digitalization and using equipmentin production processes."

""I think, first of all, it should be the request by businesses for the digitalization processes. Also, business associations and companies of ICT should make more efforts"

"The government should allocate grants for the digitization of businesses in export sector."

"Capacity building in businesses and trainings for young professionals."

able, namely firm's export share, across different specifications illustrates the strong correlation between exposure to export markets and the level of digitalization.

Overall, our analysis showsthat policymaking should be concerned about the lack, and particularly about thelong-standing lack, of digital investment by some firms. SMEs in manufacturing are likely to be in the danger zone of permanent digital inactivity and deserve special policy attention. Addressing barriers to skills should be a priority for policymakersin order to support firms to digitalise further, irrespective of where they stand inrelation to the digital divide. Similarly, addressing the regulatory burden and the uncertainties regulation can create should also be high on the digital policy agenda.

The higher sensitivity of EU firms and frontrunners to competition when investing in digitalisation is a reminder for Kosovo policymakers of the importance of digitalisation. This underpins the call for an industrial policy which should have the single market and competition policy as its core horizontal instruments, to ensure a large, competitive market environment that will push firms to invest in digitalisation.

On skills, there is a role for policymakers to provide greater support to specific national digital education initiatives and to the training and retraining of workers, would also help to address this first-order impediment to digital investment.

The evidence reported here finds access to skilled labour as well as lack of proper incentives for investment in digitalisation as a severe obstacle. Addressing these problems may therefore go a long way to deal with the Kosovo's corporate digitalisation divide.

Summary of the Methodology

This research includes both quantitative and qualitative methods. (i) Quantitative research includes a survey with 426 businesses through face-to-face interviews, conducted across Kosovo in the following sectors: a) rubber and plastics products b) food processing c) furniture manufacturing, and d) metal processing. (ii) Qualitative research which includes six (6) semi-structured in-depth interviews with subject matter experts. Using the quantitative data, a corporate digitalization index was constructed which follows the methodology of the European Investment Bank (EIB) Digitalization Index.The EIB Digitalization Index explores the degree of digital adoption in the manufacturing sector from various perspectives.This composite index, which takes the value from 0 to 100, summarizes indicators on digitalization as well as firms' assessments of digital infrastructure and investments. The higher the value of the index the higher is the digital intensity and adoption rate among firms. It consists of six components (sub-indexes), namely digital intensity, digital infrastructure, investment in software and data, investment in organizational and business process improvements, use of a strategic monitoring system, and the digital outlook. Also, using the quantitative data, the team has also employed an econometric analysis to analyse the relationship between exports and digitalization of manufacturing sectors. The hypothesis being tested is that there is a positive correlation between the level of exports and digital adoption measured by the digitalization composite index explained above. Detailed information on the methodology is provided in section 5.

1. INTRODUCTION

Strengthening strategic capabilities to gain competitive advantages is increasingly focussed on using Information and Communication Technology (ICT) tools and resources for digitalisation of business processes. This is not linked only to key activities of the value chain (inbound and outbound logistics; processing and operations; marketing and sales and services) but also support activities (MIS; finance; procurement; business intelligence). The digitalisation process is not only impacting cost-effectiveness over the value chain but has become essential for ensuring accurate information as input for qualitative decision-making on business strategy.

Achievements in this area depend on the availability of ICT technologies and capacities to use and exploit them to enable digitalisation as a business transformation process. Based on our research evidence from the surveys of SMEs in previous years and through this research could be observed, there is an improvement related to ICT exploitation for different functions in the business sector in Kosovo. Almost all active business entities use computers for basic needs and internet communications. However, when it comes to using ICT resources (hardware, software, human resources and infrastructure) for sophisticated business processes and transactions through digitalisation, there is a lack of information and analyses that would help evaluate the progress and challenges in this area. Also, there is a lack of systematically collected data that will support evidence based policies of governmental institutions, businesses and business associations and international donor organisations to support the increase of competitive capacities of firms in Kosovo through computerisation and digitalisation of their operations and transactions.[1] This is especially important for business sectors that are export oriented as they face intense competition in regional and other world markets.

Digital transformation is one of the high priorities of the European Union (EU) for the Western Balkan (WB) countries for strengthening their competitive capacities to converge with the EU. This is well related to EU efforts to support WB6 economies to enhance their regional cooperation and foster integration with the EU. This was clearly stated in WB6 leaders Sofia Declaration (November 2020) related to Common Regional Market. Digitalisation was identified as one of the key common objectives in regional cooperation.

Kosovo currently has no systematic approach to build a sound environment for developing ICT sector and boost digitalisation, although its young population and many businesses demonstrate the capacity that could be used to build a wider competitive advantage through digitalisation in other sectors as well. Also, there are some initial achievements in e-governance and the provision of public services; But as this research suggestit is necessary to focus on the broader strategy and policies for Digital Transformation and Smart Specialization. The Smart Specialization Strategy itself is still to be outlined and developed in Kosovo. The ICT sector as a key enabler for modernisation of the economy should be addressed with more active governmental policies and incentives. Following this need this research addressed primarily the state of play and common barriers and challenges at four industrial sectorsaiming to recommend policies and

1 Today, about two-thirds of the workers in Kosovan manufacturing plants have no access to computers (Kosovo Chamber of Commerce, 2019)

other measures at institutional and business level to highlight the effective way ahead.

The health emergency and measures that have led to remote schooling and teleworking have been a "turning point" in the push for ubiquitous connectivity in many countries, with businesses, society and policymakers realising the urgency to act.[2] Given the fact that 96 percent of households have access to internet, this level of access/penetration in Kosovo could be considered satisfactory.[3] and solid base for upgrading achievements so fare.

Following this background Riinvest Institute for Development Research undertook field and desk research activities to compile a baseline study (research report) that will provide necessary basic information about ICT resources availability and use in key private business sectors, especially those with export performances and outcomes). This information, if necessary for relevant stakeholders (businesses and business associations, government, and business support services in the area of ICT and digitalisation) to advance policies and engagements for increasing awareness about potentials and possibilities to support digitalisation of business processes.

The objective of this Research Report is to:

- Improve information of relevant stakeholders about ICT disposal and use for the benefit of building competitiveness capacities in key business export sectors in Kosovo

- Increase the awareness about the gaps and potentials in using ICT solutions for the digitalisation of business processes and transactions

- Propose recommendations for policy and other interventions by relevant stakeholders to advance the level of ICT use and digitalisation of business processes in Kosovo

To achieve these objectives, the research and other activities were focused on generating reliable baseline information about the level and availability of ICT and its use in essential business sectors through quantitative field research complemented also with semi structured expert interviews.The questionnaires has included requirements regarding general information of businesses and their operations, Level of currant digitalisation – ICT disposal (hardware and software), level of its exploitation for managerial proposes (MIS, DSS) and other operations (business intelligence, MIS, DSS, CNC, CAM CAD, QAS, CRM, ERP and other business solutions). The field research and semi structured expert interview aimed also to generate information about the skills and capacities of human resources to exploit ICT. Field survey included four manufacturing sectors (food processing, wood processing, metal processing, and plastics) with export performances all together about 480private businesses. In addition, we did in depth interview withsixexperts from ICT companies that provide services to private business or are advanced with digitalisation in their companies (Gjirafa and Kivo company). These interviews contributed to further analysesof the outcomes of field research and survey.

Research Report contain relevant quantitative and qualitative information to discuss this issue with interesting stakeholders andpropose necessary recommendations for governmental institutions,businesses, business associations, and other relevant stakeholders. Following this Introduction Report contains also short evidence about the digital transformation as well as the results from the survey. Also, an econometric estimation has been presented in the report.

Riinvest institute would like to thank German - Kosovar Business Association for their cooperation and initiation of this project. Also, we extend our acknowledgment to the supporters of this research report, ProCredit Bank (Kosovo) and the European Bank for Reconstruction and Development (EBRD). Riinvest Institute assumes sole responsibility for findings and conclusions of this report.

2 OECD, Digital Economy (2021) : "The G20 countries recognize that digital infrastructure is fundamental to digitalization, yet not everyone has the same opportunities to connect for access. Digital divides persist across income, age, geography, and gender
3 SAK: Survey on ICT use (2021) Fix broadband coverage in 2021 was 96%, while mobile 62.3, significant improvement from 2020 (54.3%)

1. DIGITAL TRANSFORMATION AND COMPETITIVENESS OF BUSINESSES: INDUSTRY 4.0

Since the beginning of the XXI century, the expansion of ICT technologies and their application in the digitalisation of business processes and transactions opened the way towards profound transformation of businesses. ICT became to be considered a key area for building their strategic capabilities and competitive position in the market. This is considered to be the Fourth Industrial Revolution (also referred to as Industry 4.0), which represents a new stage in the organisation and control of the industrial value chains[4] to gain a competitive advantage through intelligent networking of machines and processes for industries with the help of information and communication technology. It is a broad vision with clear frameworks and reference architectures, mainly characterised by the bridging of physical industrial assets and digital technologies to enable new capabilities in areas such as: product design, prototyping and development, remote control, services and diagnosis, condition monitoring ensuring real-time alerts and interventions, innovative service models, dynamic product improvement, increased productivity, higher up-time and, ultimately, new business models.

Integration of digital technologies in business processes and transactions contributes to a significant increase in the efficiency of operations and meeting customer expectations. There are numerous benefits to the Industry 4.0 transformation, including:

- Reducing costs by automating activities and improving the flow of information within the organisations;
- Responding to customers' needs more quickly through enabling permanent and reliable communication;
- Increasing productivity and product quality;
- Attracting and retaining talents through an enhanced technology experience.

"Businesses with high digital maturity are 62percent more likely than their peers to have experienced strong sales growth over the past three years. In these times of pandemic, the most proactive organisations will have a significant competitive advantage and will therefore benefit from it".[5]

The advantages of Digital transformation for business, including SMEs include: time saving, communication at low cost, accessing new markets and costumers, improving customer relations. All this contributes to the new corporate culture.[6]

Integration of digital technology into all areas of a business initiates substantial changes in businesses operations. Every company must embark on its digital transformation for improving its processes to ensure its competitiveness in the markets. Through Digital transformation SMEs can enable themselves to face challenges imposed by their small size, and improve their business strategy and their resilience in the face of an uncertain and changing environment. Digitisation contributes to reducing company costs by optimising existing processes. Especially it provides new

4 https://www.i-scoop.eu/industry-4-0/
5 https://www.rcgt.com/en/insights/digital-transformation-competitive-advantage-markets/
6 https://www.finelis.com/challenges-digitalization-companies/The importance of Digitalization of Companies 2021

channels to better understand the markets in which the company operates through –CRM, social networks tools to reach new potential customers. "The big data and analytics have become fundamental tools to support decision-making, as they provide relevant information to know in real time both internal factors of the company, as well as the environment in which it operates".[7] Series of technologies whose adoption is considered key in order to promote the digital transformation of SMEs:

- Fixed and mobile broadband connectivity, as the backbone of any digitisation action.

- Digital workplace and teleworking, as a guarantee for the flexibility and resilience of the organisation.

- Digital management applications (ERP) and office automation.

- Multi-channel customer management (CRM) platform, as a solution to manage and analyse interactions with customers, anticipate needs and desires, optimise profitability, increase sales and customise campaigns to attract new customers.

- Cybersecurity tools and copies of corporate business information in the cloud.

- Online store solutions and web pages.

- Internet of Things (IoT) platforms that allow connecting the digital world and the physical world

- Digital marketing tools, whose purpose is to process a large volume of information, speeding up processes and improving results.

- Business intelligence services, ranging from intelligent analysis technologies to massive data storage platforms (big data).

- Artificial intelligence systems for scenario prediction and decision support.

The best companies combine digital activity with strong leadership to turn technology into transformation toachieve Digital Maturity. Companies vary in their digital maturity, and those that are more mature outperform those that are not.[8]

One of the primary digitisation steps is the satisfaction of consumer needs, which change along with the development of technologies, namely, the creation of a more comfortable and prompt interaction between the client and the company.

There is an increasing number of organisations and countries where Industry 4.0 is becoming adopted.[9] It is a holistic approach that deals complexity and offering ideas or approaches which we can leverage in our own, increasingly digital reality of challenges and opportunities, in which industrial transformation and technologies fit. This complexity is well presented in so called McKinsey Digital Compass.[10] It has identified digitalisation through 8 layers, contributing to the impressive increase of productivity and reduction of the costs. It deals with : (1) the increase of the efficiency of resources and processing through smart energy consumption and real time optimisation (2) Improve asset utilisation in operations, maintenance and repairs remote monitoring and control (3) labour digitalisation through human – robot interactions and collaboration to improve digital performance management and automation of knowledge work (4) Digitalization of inventories management especially through real time supply chain optimisation (5) improving quality control through digital management and control of statistical data (6) ensuring better supply and demand matching through demand prediction and data driving design to value (7) reducing time to market thorough co-creation with costumers , rapid experimentation and simulation (8) reduction of maintenance costs through virtually guide self-service, remote maintenance and better planning.

Recent evidence shows that the move towards digital transformation is gaining momentum across virtually

7 https://www.business2community.com/small-business/the-digitization-of-smes-a-lever-for-competitiveness
8 MTI Sloan Management Review (2014)
9 -scoop.eu/industry-4-0/ In 'Die NeueHightech-StrategieInnovationenfür Deutschland', the government explained how it aimed to drive innovation, which wasn't just a matter of technological innovation but also about 'social innovation' with society overall put at the center, a bit like Japan's Society 5.0 Examples include also the UK (Industry 4.0 and the work around 4IR, short for 4th industrial revolution by the EEF), Japan (where there is, as mentioned already a collaboration with Japan's Robot Revolution Initiative), China (where the Industry 4.0 outline is at the basis of 'Made in China 2025') and the numerous EU initiatives of which we mentioned some previously. On March 23rd 2017, the EU alone looked at plans to align the already 12 existing and 9 coming national industry".
10 McKinsey (2015) How to navigate digitalization of the manufacturing sector

all sectors. In fact, in a survey of more than 400 global manufacturing companies, 94 percent of respondents indicated that Industry 4.0 helped them to keep their operations running during the crisis, and 56 percent said the digital transformation they undertook was essential to their pandemic responses. Conversely, for those companies that hadn't scaled—or even begun—their digital transformation, the past year has served as a serious wake-up call to review operational strategies and refocus on Industry 4.0 capabilities.[11] But equally true is that about 74percent surveyed companies by McKinsey remain in a so called "Pilot trap" when it comes to fullimplementation of Industry 4.0. A gateway from this trap according to the authors is "a clear articulation of the company's desired future, an understanding of its most pressing business problems, and a highly specific perspective about which technologies could address them".

The Harvard Business Review concluded that the digitalisation of companies can help through cloud computing, big data and mobile applications. According to the study, implementing a digital change in a company can lead to optimised business processes. "If an organisation's core activities can be transformed to a digital environment, considerable process can be gained. The digitalisation of business processes means that a company will have to work in a different way".[12]

From supply chains to production to customer experience, digitisation is transforming the way industry functions—and unleashing global opportunities for value creation. In the past few years, we have seen digitisation bring its first benefits to the industrial sector, particularly in processing and manufacturing, yet enormous untapped potential remains. Digital capabilities such as e-commerce platforms can significantly improve traditional customer-supplier experiences. Additional advances in automation, big data and analytics, and the Internet of Things (IoT) create additional opportunities for substantial gains along the entire industry value chain. Further changing the rules of the game are the decreasing costs of new processing technologies such as additive manufacturing and advanced robotics. For example, 3-D printing costs came down by 60 percent between 1990 and 2014, and industrial robot costs decreased 5 percent annually between 2000 and 2012. In the oil and gas industry, predictive maintenance is eradicating unplanned downtime and costly repairs.[13]

The fourth industrial revolution is reshaping the way individuals live and work fundamentally, and the public remains optimistic regarding the opportunities Industry 4.0. It reveals that economic sustainability functions such as production efficiency and business model innovation tend to be the more immediate outcome of Industry 4.0, which pays the way for development of more remote socioenvironmental sustainability functions of Industry 4.0 such as energy sustainability, harmful emission reduction, and social welfare improvement.[14]

ICT infrastructure is key condition to enable digitalisation of business processes and transactions. Related to this the term "digital divide" is a broad concept commonly used to refer to different levels of access and use of information and communication technologies (ICTs) and, more specifically, to the gaps in access and use of Internet-based digital services.[15] Broadband access, as a general-purpose technology, provides the physical means for using these services This should be supported by three layers : (1) the network or connectivity layer (i.e. access and uptake of communication services), (2) the application interfaces and data layer (i.e. access and transfer of data across borders; applications running on networks), (3) the end-user layer (i.e. the diffusion of digital technologies and how these are employed, taking into account the heterogeneity of firms and individuals. Digital divide between countries and digital divide within countries between urban (metropolitan) and rural areas. It relates to both geographical coverage and quality (capacity and speed).

11 https://www.mckinsey.com/business-functions/operations/our-insights/operations-blog/industry-40-adoption-with-the-right-focusBusiness looking to free themselves from the pilot trap have additional resources as well. One is the Smart Industry Readiness Index (SIRI), a neutral, third-party review that evaluates the industry 4.0 readiness of a company's production capacity. The assessment is comprehensive, reviewing processes (including operations, supply chain, and product lifecycle), technology (automation, connectivity, and intelligence), and organization (talent readiness). And it's been endorsed as a standard assessment by the World Economic Forum (WEF).

12 https://trackonline.com/digitalization-business-processes-is-inevitable/

13 Another industrial revolution early signs of the digital revolution are already here. Amazon Business, a B2B e-commerce platform launched in April 2015, turned over $1 billion in sales in its first year, growing at an impressive 20 percent per month. B2B buyers increasingly prefer digital, with 94 percent conducting some form of online research before purchasehttps://www.mckinsey.com/~/media/McKinsey/Business%20Functions/McKinsey%20Digital/Our%20Insights/Digital%20

14 MortezaGhobakhloo: Industry 4.0, digitization, and opportunities for sustainability, Journal of Clean Industry

15 OECD: Digital Economy (2021)

2. KEY FINDINGS

2.1. General features by sector

This section summarizes key general findingsat sectoral level based on the data collected from companies represented in the sample. Firms operating in food processinghave the highest level of employment on average per company followed by metal processing (table 1). It could be noted some improvements, compared our previous SME surveys regarding better genderrepresentation of thefemale owners. This is especially true for food processing. One infour firms is owned by a woman, whereas in other industries situation remain wearisome in this respect. Approximately half of surveyed firms invested in the previous year, where only 5 percent of their investment were on software services. While metal processing represents the industry with highest level of turnover, plastic industry firms have the highest margin of profit.

TABLE 01 DESCRIPTIVE STATISTICS

Indicator	Plastic industry	Metal processing industry	Wood processing industry	Food processing industry
Share in the overall sample	19.1%	27.8%	31.2%	21.9%
Number of employees	939	2470	1690	2956
Number of employees (firm average)	14.0	26.3	15.2	39.4
Gender of owners (male)	94.3%	100.0%	88.1%	75.3%
Percentage of firms that invested in 2021	45.3%	51.5%	54.5%	59.7%
Percentage of firms that Invested in 2021 in softwares	2.9%	6.1%	2.7%	6.4%
Annual Average Turnover (EUR)	446,825.4	709,770.1	369,902.9	684,859.2
Average profit margin	30.1%	26.0%	28.8%	26.7%

SOURCE: RIINVEST INSTITUTE (2022)

Table 2 shows firm's prioritization of strategic objectives aggregated at industry level. Ranking of strategic objectives is based on a scale from 0 to 100 (where 0 indicates complete disagreement and 100 complete agreement); these results are shown across four surveyed industries.Sustainable business, production growth, and growth through the introduction of new products andnetworking seems to be thea most important strategic objective for the four surveyed industries. There is less orientation towards investment in R&D and subcontracting. On the other hand, firms demonstrate quite strong anchoring with existing structures in their operations. Closing some of their activities is not seen as a strategic objective as only 12 percent of firms agreed with such a statement, and the rest either disagreed or are neutral.

TABLE 02 STRATEGIC GOALS OF THE COMPANY

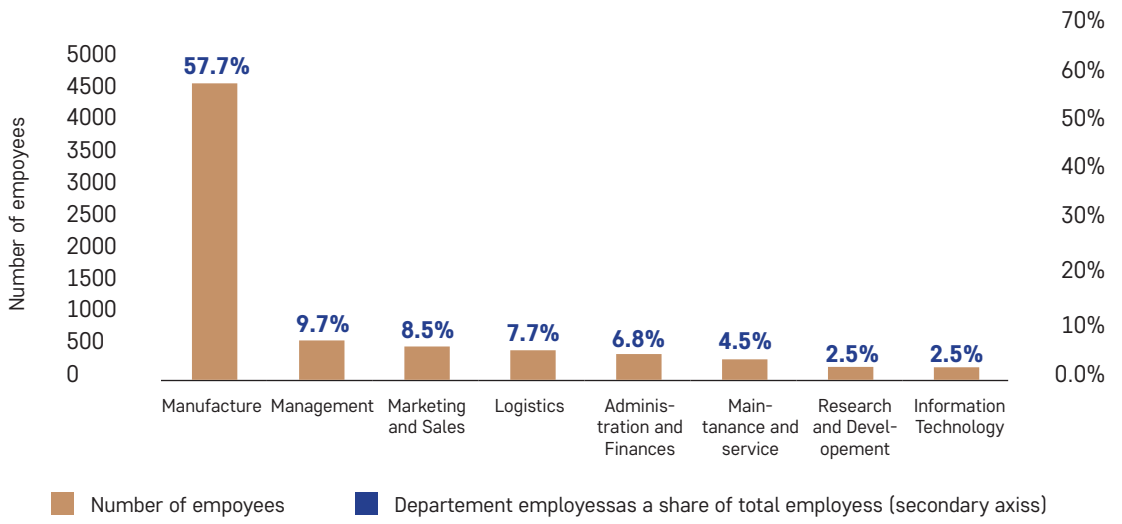
Strategic goals	Plastic industry	Metal processing industry	Wood processing industry	Food processing industry
Stable business	90.0	89.1	90.6	92.5
Growth of production	90.1	88.1	90.1	93.2
Growth through introduction of new products	85.7	82.8	88.0	91.0
Growth through acquisitions of other companies	70.5	65.8	72.2	68.3
Networking with others	81.2	78.4	81.0	76.9
New business lines	77.7	72.0	82.8	76.3
Closing some activities	45.2	39.0	45.1	47.2
Investment in R&D	72.1	75.3	74.4	75.6
Subcontracting of production	74.5	77.0	76.9	73.1
Outsourcing of research and development activities	71.3	73.8	72.7	69.8
Outsourcing of maintenance and repair activities	71.5	74.4	70.3	68.4

SOURCE: RIINVEST INSTITUTE (2022)

The share of employees in different departments of the surveyed firms as expected is dominated by operations departments,followed by management while R&D and ICT have the lowest share (2.5% each) in the overall employment at firm level (figure 1).

The share of employees in different departments of the surveyed firms as expected is dominated by operations departments,followed by management while R&D and ICT have the lowest share (2.5% each) in the overall employment at firm level (figure 1).

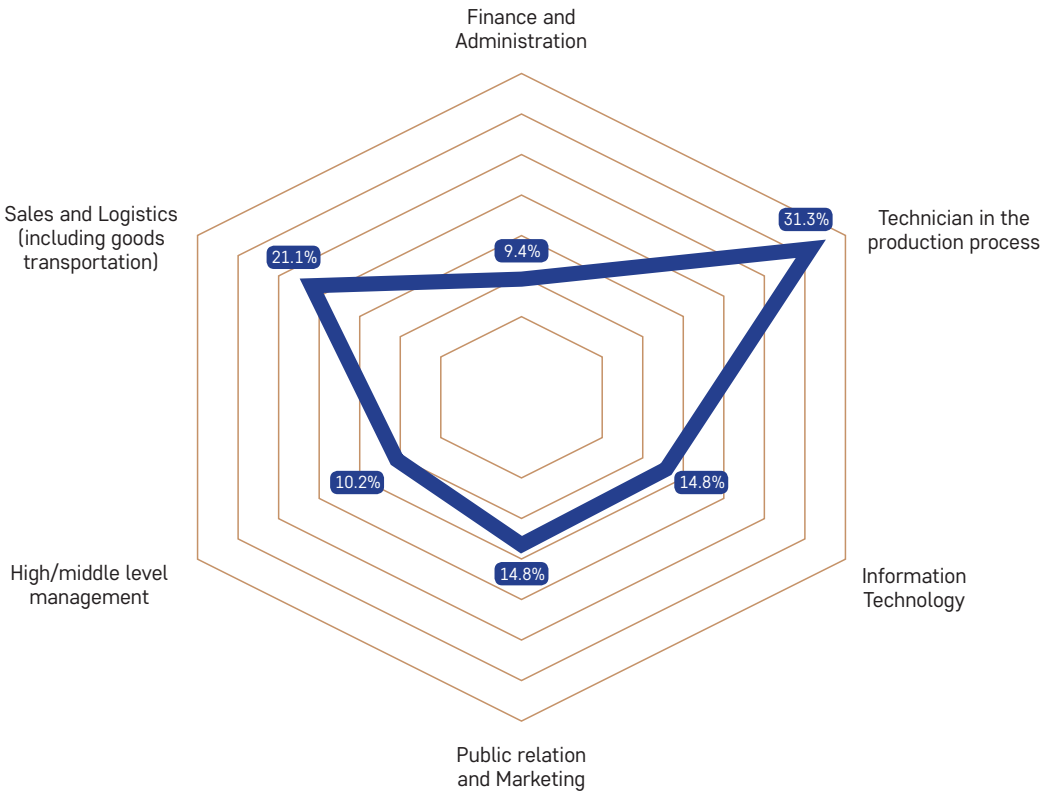
FIGURE 01 NUMBER OF EMPLOYEES BY DEPARTMENT



SOURCE: RIINVEST INSTITUTE (2022)

Technicians working in the production process represent one of the areas in which firms lack human resource capacities the most (figure 2). Similarly, firms in manufacturing sectors appear to face difficulties in hiring employees with competencies in sales and logistics. On the other hand, financial and administration seem to be less challenging for manufacturing firms with regard to human resource capacities.

FIGURE 02 BUSINESS AREAS THAT FIRMS LACK HUMAN RESOURCES CAPACITY THE MOST



SOURCE: RIINVEST INSTITUTE (2022)

BOX 2. HUMAN RESOURCES AND DIGITALISATION (EXTRACT FROM EXPERT INTERVIEWS)

''Lack of skilled workers remain a pressing issue in the private sector. Digitization of processes and transactions in businesses should go alongside specialized training activities for workers."

"The current human resources that are working in businesses meet only the basic needs of businesses for digitization, (e.g. finance, administration and communication, etc.). If businesses require higher digitization, they need to increase their human resource capacities."

"The process of digitization in businesses, as the main part, should include the training of workers to use computerized equipment and respective technologies."

"There is a considerable lack of professionals in the field, both for the installation and exploitation of software. Businesses have started to develop programs for the training of their staff, but very high cost of this may have adverse effects."

When it comes to specific skills that firms need to train their staff in the near future, technical skills in the production process are on top of the list. Soft skills, digital marketing and social networks, and customer relationship managementare also some of the highly ranked skills as far as training needs are concerned (table 3).

TABLE 03 DESCRIPTIVE STATISTICS

Skills	Percent	Percent of cases
Technical skills in the production process	19.4%	59.8%
Soft skills (ex. communication with different parties)	13.2%	40.5%
Digital marketing and social networks	11.4%	35.1%
Customer relationship management	10.5%	32.3%
Management Information System	9.6%	29.6%
IT or programming (software applications/programs)	9.4%	28.8%
Quality Assurance Service	8.9%	27.4%
Computer Numerical Control (CNC)	8.2%	25.3%
Online sales	5.5%	16.8%
Decision Support System	3.9%	12.0%
Total	100.0%	307.6%

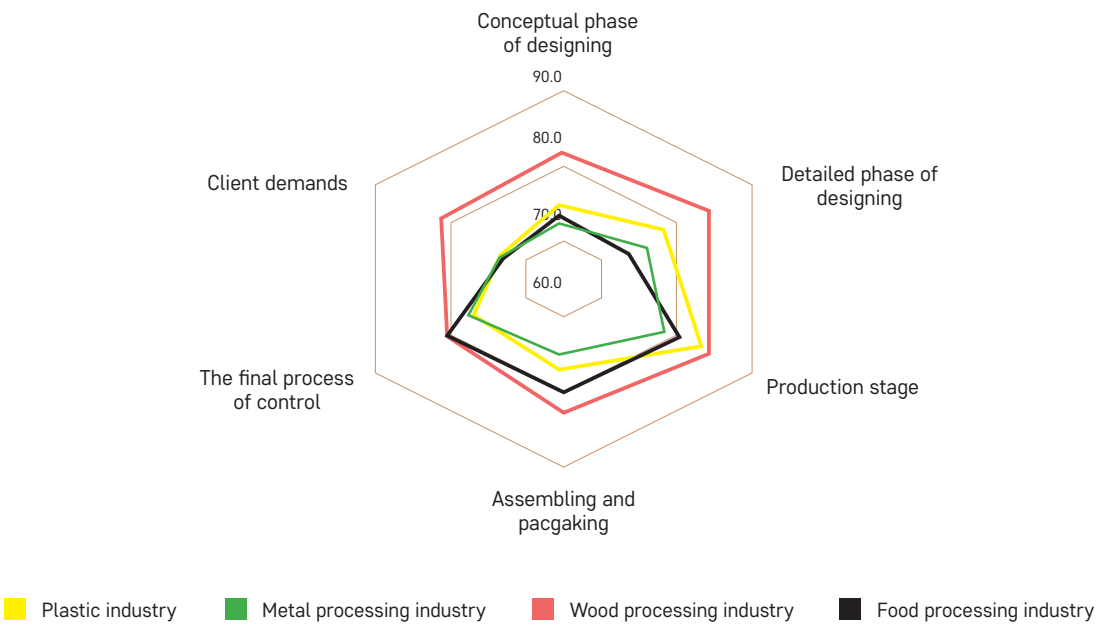
SOURCE: RIINVEST INSTITUTE (2022)

2.2 Level of digitalisation

In order to assess the level of digitalization, firms were told to use a scale of 0 to 100 (where 0 means not digitalized at all and 100 complete digitalized) for six different production stages (i.e.conceptual phase, design, client demands, manufacturing/ processing, quality control and packaging). The results are depicted in figure 3 for the four surveyed industries.

More than expected, firms from all industries consider themselves as highly digitalized in their production stages. Wood processing industry is ranked as the most digitalized followed by plastics, and food industry while metal industry lacks behind other sectors.

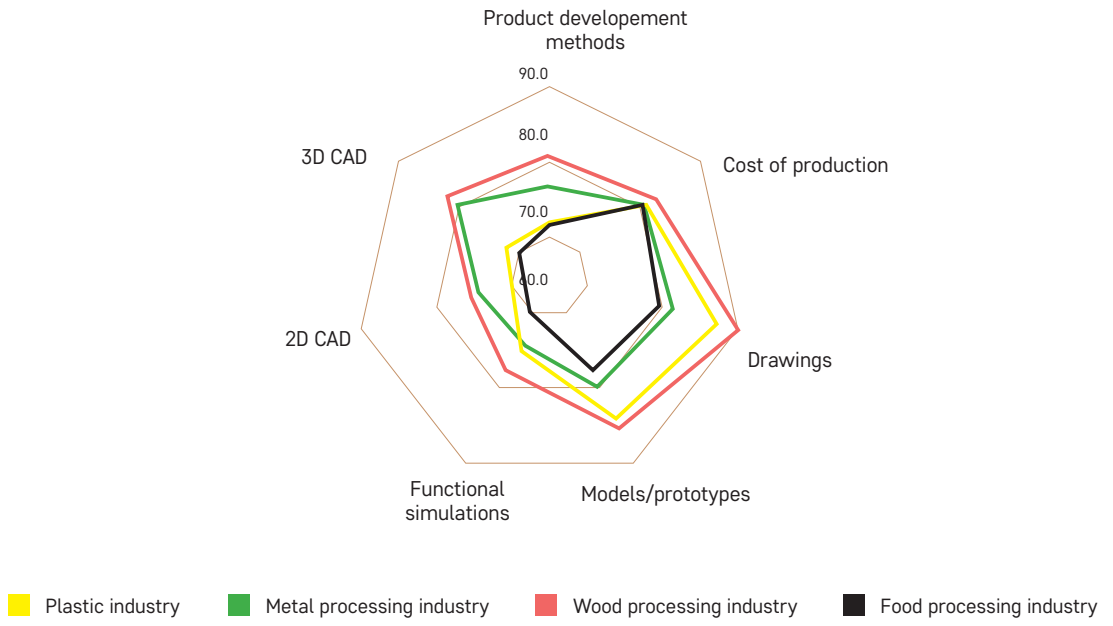
FIGURE 03 DIGITALIZATION IN PRODUCTION STAGE



SOURCE: RIINVEST INSTITUTE (2022)

In addition, data from the survey show also a high level of digitalization – as perceived by firms themselves - in the process of the design of products as well. Figure 4 reports the results generated for the level of digitalization in the process of product design for which companies used a scale from 0 to 100 (0 means not digitalized at all and 100 complete digitalized). Overall, this phase is perceived by businesses as the most digitalized one. When analysing the data at the industry level, wood processing is ranked as the most digitalized industry regarding product design, on average. Metal processing is is more digitalized in 3D CAD (computer assisted design) tools, while plastics industry leads in drawings and designing of prototypes. Food processing is digitalized more in costs simulations and calculations, quality control and packaging.

FIGURE 04 DIGITALIZATION IN PRODUCT DESIGN PHASES



SOURCE: RIINVEST INSTITUTE (2022)

Regardless of the perceived high level of digitalization, firms to a large extent agree that they have to improve and/or introduce certain aspects in order to advance their production processes. More specifically, firms agree that the establishment of cooperation's in order to benefit from a knowledge transfer is necessary in order to improve production processes. The following figure depicts firms' perception with regard to the need for improvement in several production aspectsthe need for improvement is measured using a scale of 0 to 100, where 0 indicates no need for further improvements and 100 the opposite).

BOX 3. THE LEVEL OF DIGITALIZATION IN MANUFACTURING SECTOR (EXTRACT FROM EXPERT INTERVIEWS)

"The manufacturing sector in general increased its awareness towards digitalizationafter Covid-19 pandemic, overcoming gradually their scepticism influenced by traditional approaches."

"While internet penetration remains high, the same do not apply with digitalization of their manufacturing operations and other business transactions. Additionally, there is little information about the level of digitization of businesses. Perhaps this study is the first of this kind in Kosovo."

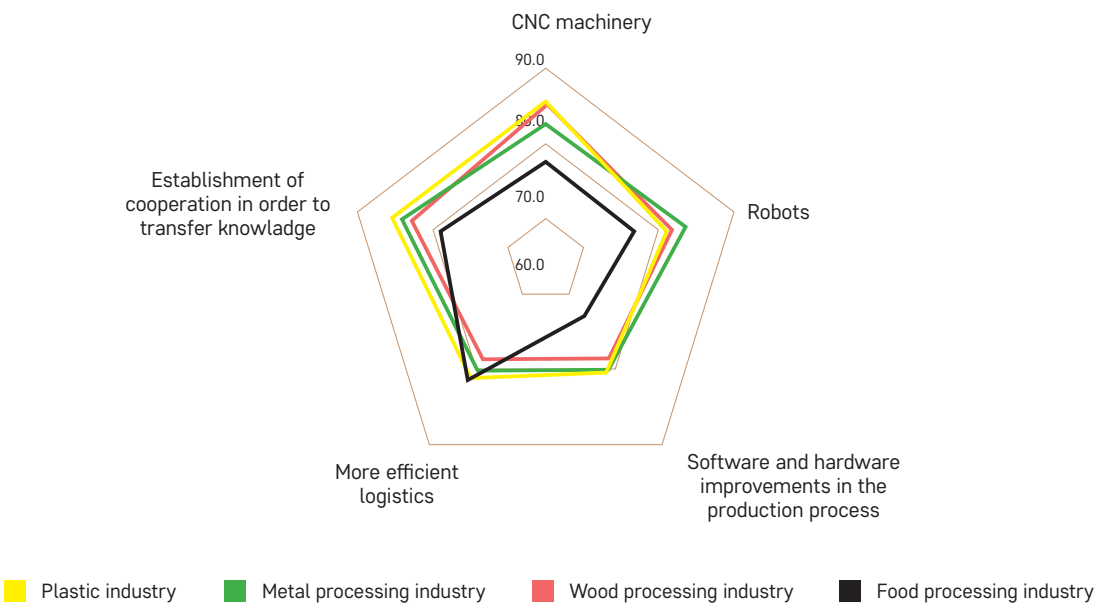
"Even though there is a clear improvement in the banking and insurance industries, there is a stagnation in the manufacturing sector. During the pandemic, the perception of businesses in digitalization has slightly changed as businesses had to adapt to the new circumstances."

"There is a new mindset after the pandemic for digitalization, but the level of digitalization still remains low. This may be due to informality and the fact that the overall business environment is not supportive for o digitalization of their business processes. The level of digitization in the field of finance and communication is better while in general businesses are not yet ready for digitization."

"I think there is a growing request from businesses for digitization, especially after the pandemic. But the level is very low."

"In the part of electronic sales, we have a lot of challenges. I think that only about 1% of businesses in Kosovo do sales through electronic platforms."

FIGURE 05 IMPROVEMENT OF THE PRODUCTION PROCESS



SOURCE: RIINVEST INSTITUTE (2022)

Overall, most of the surveyed firms use some of the main features/ functions of the Information System. Around eight out of ten companies use databases and emails for their daily business activities. Exchange (transfer) of documentation between departments/units and Product Lifecycle Data Management (PLM) are two features that are used by fewer firms.Wood processing and metal processing seem to utilize more databases for storing and processing of information for their operationswhile on average more than 40% of firms do not use product lifecyclemanagement tools (table 4).

TABLE 04 THE USE OF SEVERAL FEATURES OF INFORMATICS SYSTEM BY FIRMS

Our information structure uses:	Plastic industry		Metal processing industry		Wood processing industry		Food processing industry	
	Yes	No	Yes	No	Yes	No	Yes	No
Database	80.7	19.3	87.2	12.8	87.6	12.4	79.7	20.3
Dedicated and integrated software platforms (on server or cloud) for business data	68.0	32.0	77.6	22.4	84.0	16.0	73.6	26.4
Synchronization (of system files and data)	68.8	31.3	68.0	32.0	69.5	30.5	62.0	38.0
Exchange of files	60.0	40.0	56.4	43.6	62.3	37.7	54.9	45.1
Product Data Management (PDM)	69.4	30.6	71.8	28.2	63.0	37.0	62.1	37.9
Product Lifecycle Management (PLM)	56.8	43.2	57.3	42.7	61.3	38.7	53.7	46.3
Email in everyday business processes	78.8	21.2	90.4	9.6	90.5	9.5	82.0	18.0
WEB-portal (on-line access to documentation)	40.9	59.1	65.8	34.2	68.9	31.1	58.5	41.5

SOURCE: RIINVEST INSTITUTE (2022)

BOX 4. HOW TO IMPROVE THE LEVEL OF DIGITALIZATION IN KOSOVO? (EXTRACT FROM EXPERT INTERVIEWS)

"Businesses need to utilize digitalization in two directions: (I) digitalization of online sales, customer communication, and social media, and (ii) digitization of internal processes, information processing, and computerization of their manufacturing operations and equipment."

"Management should increase awareness about importance of digitalization of financial transactions."

"Manufacturing sector in general lacks the knowledge and capacities to identify the digitalization needs."

"As a business owner, I consider that we need a better link between the middle management and the information that comes out of the production process. Also, there is a lack of capacities in Kosovo to offer services for digitalization of manufacturing processes."

"Businesses need new modern machineries, raising internal capacities, but most importantly increasing awareness towards the importance of digitalization for increasing competitive capacities".

Another important issue for which manufacturing firms were assessed is the use of relevant software for specific processes. Survey results suggest that most of the firms use adequate software for management, marketing and online sales, and management of operations (table 5). On the other hand, fewer number of firms use the relevant software for procurement and enterprise resource planning.

TABLE 05 USE OF RELEVANT SOFTWARE TOOLS

Utilization of appropriate computer/software tools in:	Plastic industry		Metal processing industry		Wood processing industry		Food processing industry	
	Yes	No	Yes	No	Yes	No	Yes	No
Management	96.5	3.5	94.5	5.5	97.9	2.1	95.9	4.1
Operation management	73.1	26.9	83.1	16.9	81.9	18.1	73.3	26.7
Computer aided design (CAD)	62.3	37.7	71.3	28.8	66.7	33.3	54.7	45.3
Computer aided manufacturing (CAM)	67.9	32.1	70.5	29.5	75.0	25.0	67.9	32.1
Compliance and Quality Assurance (CAQA)	68.6	31.4	67.1	32.9	72.6	27.4	75.9	24.1
Logistics	72.3	27.7	67.5	32.5	70.0	30.0	64.8	35.2
Procurement	50.0	50.0	48.1	51.9	51.5	48.5	46.2	53.8
Marketing and online sales	82.7	17.3	65.0	35.0	87.5	12.5	91.9	8.1
Enterprise resource management (ERM)	47.5	52.5	43.2	56.8	53.2	46.8	57.8	42.2

SOURCE: RIINVEST INSTITUTE (2022)

2.3. Adoption of ICT

Table 6 shows results regarding information and communication technologyavailability and use. As one can observe, over two third of firms have an internal computer network, and have a back-up system for archiving data. While over 80 percent of firms do not have an ICT department, only somethingmore than half of them have a website (table 6).

TABLE 06 USE OF ICT FEATURES

	Yes	No
Does your company have an internal computer network?	65.5	34.5
Do you have your own ICT department	16.5	83.5
Do you back-up / archive your data	47.5	52.5
Have you used back-up/archive systems to retrieve or regenerate lost data	69.5	30.5
Does your company have a web site?	56.3	43.7

SOURCE: RIINVEST INSTITUTE (2022)

In order to capture sector differences, the same data are also disaggregated at industry level. Differences are more pronounced in having in-house ICT departments or units; while one quarter of firms in food processing have their own departments, only around 8% in plastics industry currently have in-house ICT related human resource capacities. Around two-thirds of firms across all industries have their internal networks and also use back-up system to regenerate lost data. On the other hand, less than half of firms use back-up system for archiving data (table 7).

TABLE 07 LEVEL OF USE OF ICT FEATURES BY SECTOR

Industry	Internal network		ICT department		Back-up / archive data		Use of the back up to regenerate the lost data	
	Yes	No	Yes	No	Yes	No	Yes	No
Plastic industry	66.2	33.8	7.8	92.2	40.3	59.7	60.6	39.4
Metal processing industry	65.3	34.7	11.1	88.9	51.1	48.9	70.4	29.6
Wood processing industry	68.2	31.8	14.6	85.4	50.5	49.5	78.4	21.6
Food processing industry	63.2	36.8	24.7	75.3	41.7	58.3	68.6	31.4

SOURCE: RIINVEST INSTITUTE (2022)

It should be noted that majority of firms, except those in plastic industry, use back-up / archive systems on monthly basis. There is also a significant number of firms that use regular weekly back-ups with the plastic industry having the highest share of firms that back-up data on weekly basis (table 8).

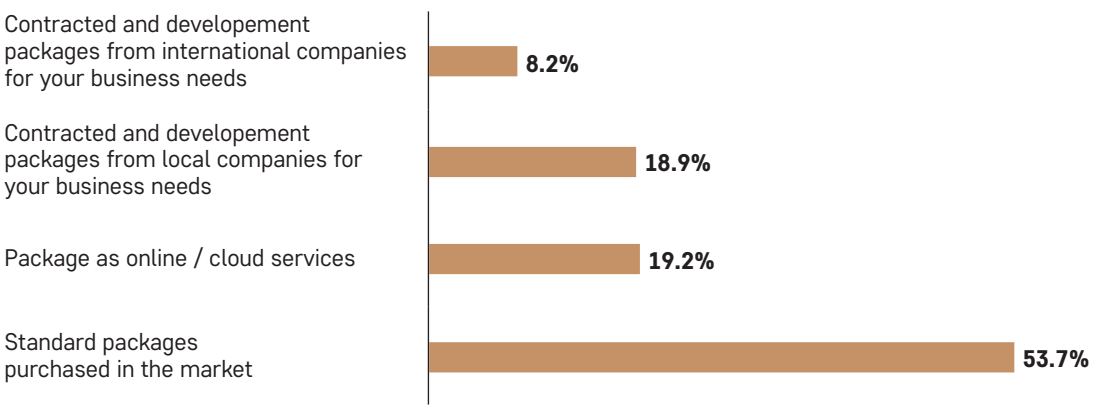
TABLE 08 THE FREQUENCY OF USE OF BACK UP / ARCHIVE BY SECTOR

How often do you back-up / archive?	Plastic industry	"Metal processing industry"	"Wood processing industry"	"Food processing industry"
Daily	14.3%	12.5%	20.0%	20.6%
Weekly	25.0%	20.8%	14.0%	14.7%
Monthly	39.3%	64.6%	58.0%	58.8%
Annual	21.4%	2.1%	8.0%	5.9%

SOURCE: RIINVEST INSTITUTE (2022)

As far as software packages are concerned, more than half of the firms use the standard packages-that are available in the market (figure 6). Around one in four surveyed firms uses contracted and developed packages from specialized companies for their needs; local companies are usually contracted for the purpose of development of these packages.

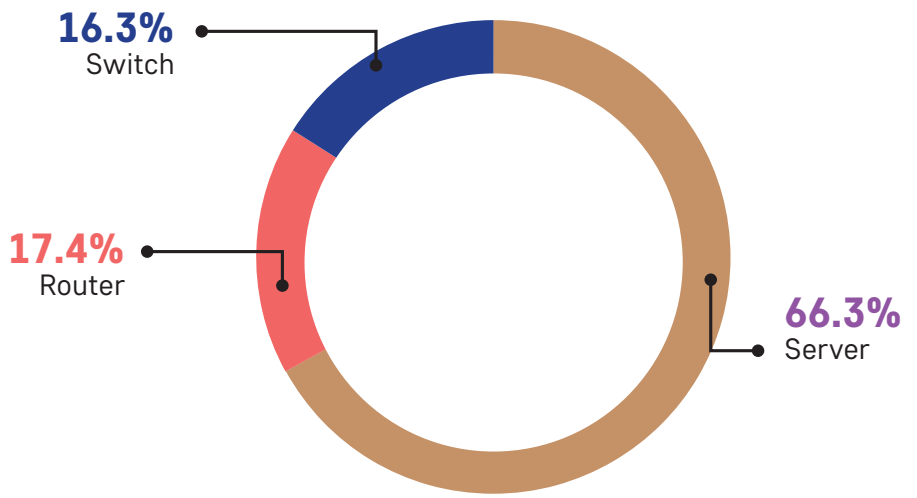
FIGURE 06 SOFTWARE PACKAGES USED BY FIRMS



SOURCE: RIINVEST INSTITUTE (2022)

Lastly, internet access form a server is the most common type used by firms as two third of firms chose this option. The remaining firms use router (17.4 percent) or switch (16.3 percent) to access the internet.

FIGURE 07 TYPES OF INTERNET ACCESS USED BY FIRMS



SOURCE: RIINVEST INSTITUTE (2022)

Two third of firms use username and password as enhanced data security measure for software applications in their company. While 21.8 percent of firms use different layers / levels of access, almost 12 percent of firms do not have security measures at all (table 9).

TABLE 09 ENHANCED DATA SECURITY MEASURES USED BY FIRMS

Security measures	Percent
Different layers / levels of access	21.8%
Username and password	66.4%
Do not apply security measures	11.8%

SOURCE: RIINVEST INSTITUTE (2022)

BOX 5. MAIN OBSTACLES TO DIGITALISATION OF BUSINESSES IN KOSOVO (EXTRACT FROM EXPERT INTERVIEWS)

‘’Businesses usually perceive digitalization as costs rather than needed investments. They are not yet ready to adapt changes imposed by the technological revolution.”

“Initially, the main problem is the capacities of managerial level and the lack of awareness of business owners about the benefits of digitalization to gain better competitive position. For example, exporting firms do not have proper staff and team approach to propose and articulate internal needs of the businessand implement digitalization projects.”

“The prevailing mindset in doing business in Kosovo is that investments are usually channeled in business activities with the highest return in a short term regardless of the sustainability for long term competitive advantages.”

“The main problem of businesses relates to the role of government and public institutions, which do not accept digital invoices, and still have not approved the Law on electronic signature, which is an additional barrier for businesses.”

3. DIGITALIZATION INDEX

In order to bring more insightsin assessing the level of digitalisation at given sectors, also through comparing with the level of EU, the research teamhas constructed (for the first time in Kosovo) the so-called digitalisation index. More specifically, based on the data collected from the survey, the study employs the European Investment Bank (EIB) Investment Survey Digitalization Index. This enables us to better assess the depth of digitalization in manufacturing sectors. The EIB Digitalization Index explores the degree of digital adoption in the manufacturing sectorfrom various perspectives. This composite index, which takes the value from 0 to 100, summarizes indicators on digitalization as well as firms' assessments of digital infrastructure and investments. The higher the value of the index the higher is the digital intensity and adoption rate among firms. It consists of six components (sub-indexes), namely digital intensity, digital infrastructure, investment in software and data, investment in organizational and business process improvements, use of a strategic monitoring system, and the digital outlook. Different components have different weights in the overall index, depending on their relevance as well as the number of indicators (questions from the survey) used to construct that particular component. Digital intensity has the highest weight (40%) on the overall index since it is composed of 4 different indicators which measures the level of firm's application of digital technologies such as 3D printing, advanced robotics, internet of things, and big data / artificial intelligence (table 10).

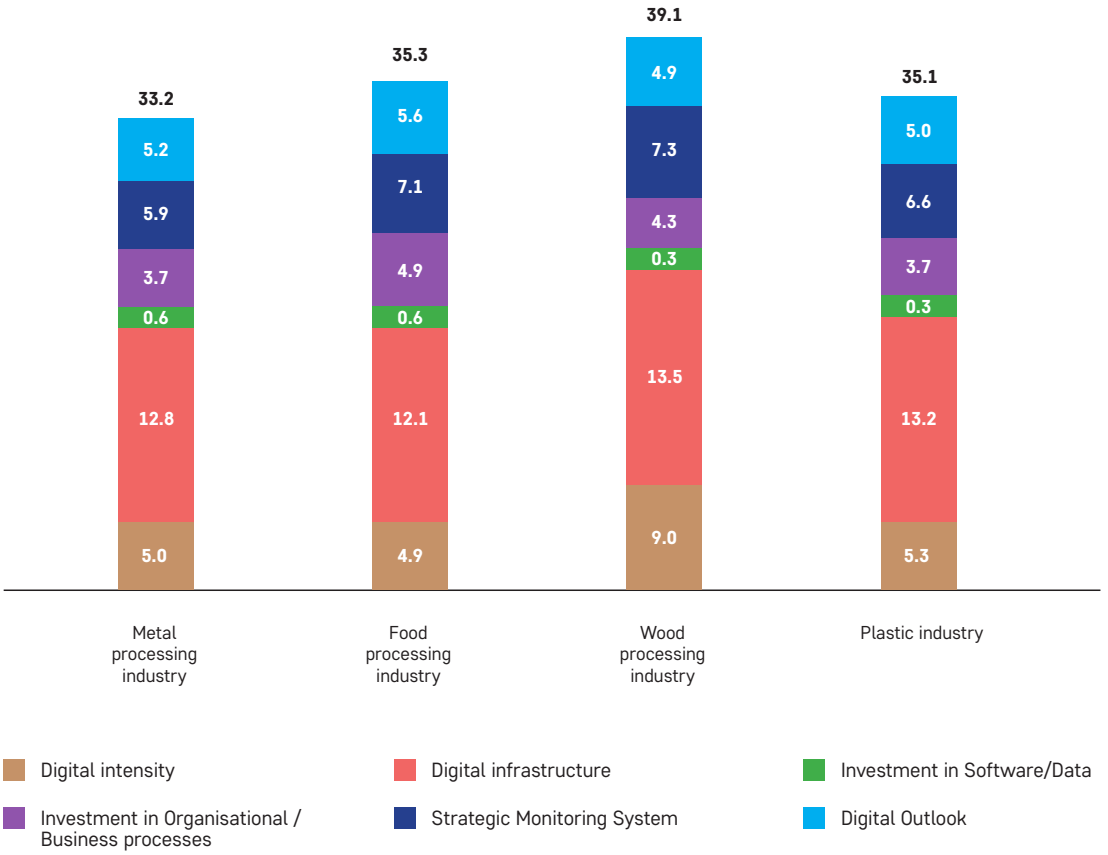
TABLE 10 DETAILED BREAKDOWN OF THE DIGITALIZATION INDEX

Sub-index	Indicators (survey questions)	Metal processing industry	Food & Beverages processing industry	Wood processing industry	Plastic processing industry	Max. score:
Digital intensity	3D printing, also known as additive	89.1	90.6	92.5	2.3	10
	Robotics: automation via advanced robotics	0.9	1.3	1.7	1.3	10
	The internet of things, such as	0.9	1.3	1.7	1.3	10
	Big data/artificial intelligence: cognitive technologies, such as big data analytics and artificial intelligence	1.5	1.4	2.4	2.2	10
Digital intensity (Total)		5.0	4.9	9.0	6.3	40
Digital infrastructure	Is access to digital infrastructure an obstacle to investment?	12.8	12.1	13.5	13.2	20
Investment in software and data	What percentage of total investment in the previous fiscal year went in software and data?	0.6	0.6	0.3	0.3	10
Investment in organizational and business process improvements	What percentage of total investment in the previous fiscal year went in organization and business process improvement?	3.7	4.9	4.3	3.7	10
Use of a strategic monitoring system	Does your company use a formal strategic business monitoring system?	5.9	7.1	7.3	6.6	10
Digital outlook	Does your firm consider that digitalization will become more in the future/ Do you consider that digitalization will become more important in the future for your company?	5.2	5.6	4.9	5.0	10
Max. score:		**33.2**	**35.3**	**39.1**	**35.1**	**100**

SOURCE: RIINVEST INSTITUTE (2022)

While business owners perceive their businesses as highly digitalized, the digitalization index exposes the discrepancies between firm's own perception and actual depth of digitalization of manufacturing sector in Kosovo. Indexes calculated at the firm level and also aggregated at industry level show that Kosovo firms are lagging behind the EU peers in digital adoption. The mean value of the index at firm level is 35.7 compared to 63 at the EU level.[17] However, when comparing with individual EU countries that are closer to the Western Balkans' region, the gap slightly narrows; the index score in Croatia and Bulgaria is 61 respectively 59.[18]

FIGURE 08 DIGITALIZATION INDEX AT INDUSTRY LEVEL IN KOSOVO

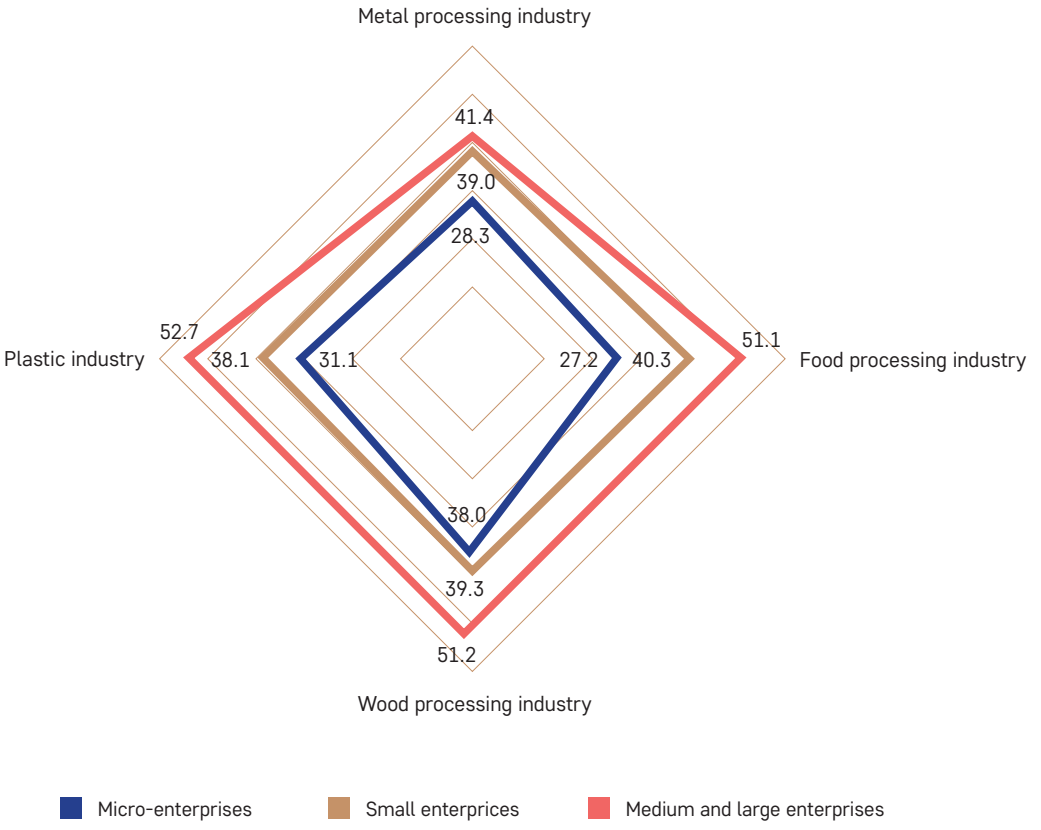


SOURCE: RIINVEST INSTITUTE (2022)

17 Digitalization Index calculated in Kosovo reflects the average of the four industries included in this study while the EU average covers the whole manufacturing sector.
18 Ibid

Aggregated data at the industry level indicate that the digitalization adoption is pretty much at the same level in all four industries covered in this study. However, wood processing industry has a higher digitalization adoption rate with an index score of 39.1 compared to other three industries range from (figure 9) Higher exposure to export markets and product complexity are assumed to be the main factors that makes the wood industry more digitalized as opposed to other industrial sectors. Size of the firm seems to be also an important predictor of the depth of digitalization in manufacturing sectors in Kosovo. Firm's size seems to be positively correlated with the value of the index across all four industries (figure 9).

FIGURE 09 DIGITALIZATION INDEX BY FIRM'S SIZE



SOURCE: RIINVEST INSTITUTE (2022)

This finding is consistent with previous empirical evidence which support the prevailing assumption that larger companies have resources to cover the cost and investment risk of digitalization.[19] Moreover, size matters not only for the overall index but for each individual component (sub-index) of the index, too (table 11).

19 Abidi N., El Herradi M., Sakha Abidi S., (2022). Digitalization and Resilience: Firm-level Evidence During the COVID-19 Pandemic. IMF Working Paper.

TABLE 11 DIGITALIZATION INDEX BY FIRM'S SIZE AND COMPONENTS

	Size	Digital intensity	Digital Infrastructure	Investment in Software	Organization	Management	Digital Outlook	Total
Metal processing industry	Micro-enterprises	4.3	9.8	0.6	3.7	5.7	4.3	28.3
	Small enterprises	6.0	16.5	0.6	3.7	6.5	5.8	39.0
	Medium and large enterprises	7.1	17.1	0.6	3.7	4.3	8.6	41.4
Food processing industry	Micro-enterprises	2.3	9.1	0.6	4.9	5.5	4.8	27.2
	Small enterprises	6.6	14.1	0.6	4.9	8.2	5.9	40.3
	Medium and large enterprises	10.6	17.5	0.6	4.9	8.8	8.8	51.1
Wood processing industry	Micro-enterprises	8.3	13.7	0.3	4.3	6.9	4.6	38.0
	Small enterprises	9.3	12.6	0.3	4.3	7.8	5.1	39.3
	Medium and large enterprises	14.0	20.0	0.3	4.3	6.7	6.0	51.2
Plastic industry	Micro-enterprises	5.3	11.1	0.3	3.7	6.1	4.7	31.1
	Small enterprises	6.6	15.2	0.3	3.7	7.1	5.2	38.1
	Medium and large enterprises	13.8	20.0	0.3	3.7	10.0	5.0	52.7

SOURCE: RIINVEST INSTITUTE (2022)

4. DIGITALIZATION AND EXPORTING: AN ECONOMETRIC ASSESSMENT

Exports, often considered as one of the most important sources of economic growth for the developing world, simulate job creation, innovation, and most importantly contribute to productivity growth. Since the sample consists of manufacturing firms only, it is reasonable to analyse separately exporters from non-exporters as the former group is expected to be more productive and digitalized as opposed to the latter.There is a plethora of empirical studies that confirm positive association of exports and productivity as well as innovation across all manufacturing sectors.[20] Considering the role of exports in productivity, and assuming that digitalization matters for productivity as well, this section examines empirically the relationship between exports and digitalization of manufacturing sectors. The hypothesis being tested is that there is a positive correlation between the level of exports and digital adoption measured by the digitalization composite index explained above. The model to be estimated exploits the survey data where the dependent variable is the actual score of the firm's digitalization index denoted as DIndexiin the equation 1 below, while the key explanatory variable in the model is the share of exports in total firm's output. The relationship between exports and digitalization at firm level is captured by the sign and magnitude of the coefficient *B*1. In order to check for the consistency of results, firm's size (Sizei) is used as a control variable. Moreover, since the data allows for aggregation of firms at the sector level, industry dummies for wood, food and beverages, and plastic industry are included in the model while metal sector is left as a reference category.[21] The basic specification is estimated using Ordinary Least Squares (OLS) regression technique as the relationship between regressors and the dependent variable is assumed to be linear.

$$DIndex_i = \alpha + \beta_1 \left(\frac{Exp_i}{Sales_i}\right) + \beta_2 Size_i + \beta_3 Dwood_i + \beta_4 Dfood_i + \beta_5 Dplastic_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Results from the basic specification (table 10; column 1) are consistent with the initial hypothesis and confirms the positive relationship between exports intensity and digitalization adoption by Kosovo firms. The coefficient of the key predictor is positive and statistically significant at one percent.[22] Holding all other variables constant, the magnitude of the coefficient can be interpreted as one unit increase in export share (i.e. one percentage point) is associated with an increase of 0.13 units of the digitalization

20 See Bernard and Jensen (1995, 1998a, 1998b, 1999a, 1999b), Yasar et al (2006), etc.
21 The decision to leave metal sector as a reference category is based on the fact that it has the lowest value of the digitalization index. However, it should be noted that ultimately it is not relevant which category is left as a reference as the regression results will not be affected.
22 Significance of the regression coefficients is measured by the level of p-value in a particular regression. A p-value less than 0.09 (typically ≤ 0.09) is considered statistically significant. It indicates strong evidence against the null hypothesis, as there is less than a 9% probability the null is correct (and the results are random). Therefore, in cases where the p-value is less than 0.09, the null hypothesis is rejected. The lower the p-value the higher is the significance. In this particular regression (column 1), the p-value was ≤ 0.09 which indicates that the null hypothesis – which in this case suggests that there is no relationship between exports and digitalization - is rejected.

index. As one would expect, size of the firm is also positively correlated with the dependent variable. In order to capture the differences between industrial sectors, specifications (2) and (3) include also sector dummies. Considering that the wood sector had the highest index score, it was included separately to compare with the three other sectors. After inclusion of the wood sector dummy, regression coefficients remain positive and significant. Being a firm in wood sector increases the index score by 4.7 points. Results are confirmed also when included three sector dummies for wood, food and beverages, as well as plastic sector. The value of R-squared is relatively low, however, this may be considered reasonable considering the small sample (i.e. 347 firms) as well as limited number of explanatory variable. In the third specification the value of R-squared is 0.078 implying that around 8 percent of variation of the index score is explained by the model. Lastly, two robustness checks are performed to test the sensitivity of results when different techniques are employed. Column (4) reports results from specification using transformed dependent variable into a dummy which equals 1 if the firm has a higher index score than the sample average and zero otherwise. Since the new dependent variable has only two possible values (0 and 1), OLS is not designed to model binary choices. As long as the dependent variable is bounded by 0 and 1, OLS probably would yield predicted values outside the boundaries of the response variable. Therefore, in this case a probit model is more adequate since it predicts the probability of an event occurring.[23] In addition, beta regression technique is also used although with slightly transformed index with a small range than the original version (i.e. from 0 to 1). The beta regression is a widely known statistical model when the dependent variable has the form of fractions or percentages.[23] In both cases, results remain consistent; coefficients are positive and highly significant. It should be noted that the actual coefficients do not have straightforward interpretation as in the case of OLS. When it comes to probit estimation, marginal effects are calculated to calculate the change in probability when regressors increases by one unit. For example, marginal effects are calculated for the specification (4) and show that an increase of export share by one unit increases the probability of a firm to have higher index score than the average by 0.3percent (see appendix 1 for the results of marginal effects). Pretty much the same results are generated from the beta regression in the last specification (column 5). Persistence of the sign and significance of the main explanatory variable, namely firm's export share, in the econometric investigation in this section illustrates the strong relationship between exposure to export markets and the level of digitalization.[25]

23 The Probit model determines the likelihood that an item or event will fall into one of a range of categories by estimating the probability that observation with specific features will belong to a particular category.
24 Beta regression is a technique that is mainly used for modelling of data for which the observations are limited to the open interval (0, 1).
25 Considering the obvious limitations of the data (low number of observations and lack of panel data), such results do not infer the causal direction of the relationship between the digitalization and exporting. The positive correlation may be interpreted as a result of firm's self-selection i.e. more productive and more digitalized firms exports or it is exporting and exposure to export markets that imposes higher degree of digitalization.

TABLE 12 DIGITALIZATION AND EXPORTING

VARIABLES	Digitalization Index			Digitalization Index (dummy)	Digitalization Index (0-1)
	OLS (1)	OLS (2)	OLS (3)	Probit (4)	Beta regression (5)
Exp/Sales$_i$	0.127***	0.130***	0.132***	0.008***	0.005***
	[0.037]	[0.036]	[0.037]	[0.029]	[0.001]
Size$_i$	0.035*	0.038**	-0.037*	0.001	0.001**
	[0.018]	[0.019]	[0.019]	[0.001]	[0.000]
Dwood$_i$		4.731**	5.277**	0.020	0.246***
		[1.818]	[2.247]	[0.146]	[0.085]
Dfood$_i$			1.137		
			[2.731]		
Dplastic$_i$			0.656		
			[2.632]		
Observations	347	347	347	347	347
R-squared	0.060	0.077	0.078		

Note: Robust standard errors are reported in parenthesis;
*** p<0.01, ** p<0.05, * p<0.1 denotes significance at 1%, 5% and 10% level.

5. METHODOLOGY

This research includes both quantitative and qualitative methods as follows:

a. Quantitative research consists of a firm-level survey with 426 businesses through face-to-face interviews, conducted across Kosovo;

b. Qualitative part is based on semi-structured in-depth interviews with six subject matter experts.

Proposed methodology for the survey

For the aims of this study, the survey covered four (4) important industries in the manufacturing sector. Selection of industries was done based on export performance from theofficial trade data over the last four years and those with the best export performance were: i) rubber and plastics, ii) food processing, iii) furniture and wood processing, and iv) metal processing industry. The sample framework used for the purpose of the survey was the database of active businesses in Kosovo provided by the Kosovo Tax Administration (KTA). There are 5,155 active businesses (Table 13) in these four industries. The sample isaround 420 businesses is statistically representative to offer results with +/- 7% margin of error at a 90% confidence level.

TABLE 13 SAMPLE SIZE

Sectors	Number of Business	Sample size
Food products	2331	120
Rubber and plastic products	735	95
Furniture and wood processing	602	113
Metal processing	1447	98
Total	5115	426

SOURCE: AUTHORS' CALCULATIONS USING KOSOVO CUSTOM'S DATA

Questionnaire design

The first draft of the questionnaire was prepared by the Riinvest Institute team. Subsequently, a coordination meeting was arranged with the contracting authority to address any outstanding issues, enable the survey team to gain a clear understanding of the issues that need to be addressed in the course of the assignment and agree on the plan of work and activities that need to be completed. The survey team ensured that the questions and instructions are straightforward, aiming to make the respondent feel comfortable so that she/he will be more motivated to answer the questions. The questions were easy to answer and the respondents were informed that it is rather quick and easy to complete. The questions were sequenced as such that they generate interest to ensure valid responses by the respondents and ensure an acceptable response rate. More difficult or personal/private questions were kept at the end of the questionnaire, as the respondents are likely committed to completing the questionnaire by then, as they could see (or were told) that the survey is in the end phase.

Testing the questionnaire

The last step in questionnaire design was to test the questionnaire with a small number of businesses before conducting the actual survey. This kind of test run revealed unanticipated problems with question-wording, instructions to skip questions, etc. It helped us see if the interviewees understand our questions and give useful answers. No changes were made after the testing phase.

Enumerators

Riinvest Institute has a pool of over 200 enumerators, with each enumerator being familiar with the local context and in particular on the regional, municipal and sub-municipal level. Enumerators have worked with various target groups, including citizens, businesses, organizations, local institutions, and similar. Most enumerators are students or recent graduates, with a large representation of female enumerators as well and including all ethnic communities. In the case of new enumerators, training programs were available, which the enumerators had to undergo before conducting the survey. To gain the best possible results, the proposed approach was to combine experienced enumerators with newly recruited ones. Riinvest Institute recruited 30 enumerators to speed up the data collection process. The number of interviews is selected to provide the enumerators with their best suitability in terms of knowledge about the local context of each region/municipality they are assigned to, provided by their provenience and experience.

Training of enumerators

A training day was organized specifically for this survey to enable the enumerators to familiarize themselves with the survey objectives, needs, and design, as well as the subject matter of the survey. The applied methodology was elaborated along with the survey administration procedure, clarifying how the data will be used. The questionnaire details were explained and the enumerators conducted pre-tests with each other as well as other test subjects to familiarize themselves with the details of each question.

Encoding, verifying, and securing data

Following data collection process, the data were analysed using SPSS to identify potential inconsistencies across variables. Changes were made as appropriate. At each stage, copies of the data were maintained with the individuals currently working on the spreadsheets and with the Survey Manager. Periodic checks were made, primarily through comparing variable means and distributions across files, to ensure data has not been altered, intentionally or otherwise.

Control and Monitoring

As part of the survey-related training activities, enumerators received a survey-specific manual explaining the importance and overall goals of the survey. Small groups (3 to 5) of enumerators were supervised by a supervisor that were assigned by the Survey Manager. Around 15percent of surveys were re-verified by the supervisors to ensure if the survey has been conducted with the respective respondents and/or if selected answers correspond to the ones filled by the enumerator. These

questions include those considered most crucial to the research effort, as well as any for which the original responses suggested possible inconsistencies. A logical control was also conducted once the questionnaires are saved and the data collection and entry were completed. Collected data were be verified by researchers to check if there are any irrational answers or non-fitting answers with previous claims.

Quality Assurance and ethical considerations

Riinvest ensures against high overall refusal rates, systematic refusals due to potentially sensitive questioning approaches, and response bias. Results from surveys that do not properly take these problems into account may have the appearance of correctness, but point to entirely false conclusions. Another assurance of quality is derived from the makeup of the survey team. The experienced, in-house, part of the team is intimately familiar with conditions in Kosovo maintains excellent control over the enumerators and all phases of data collection and encoding. Adherence to the General Data Protection Regulation of the European Union is observed.

Calculation of the digitalization index

The Digitalization Index is a composed index that summarises indicators on firms' digital technology adoption as well as firms' assessment on digital infrastructure and investments. It is based on firm-level data collected by the Riinvest's survey with four manufacturing sectors in 2022. This Index consists of five components: digital intensity, digital infrastructure, investment in software and data, investments in organisational and business process improvements, and strategic monitoring system. It is a replication of the so-called Corporate Digitalization Index which is based on a sound methodology employed by the European Investment Bank using the data from its regular Investment Survey. All six components of the Digitalization Index are based on firms' assessment of digitalisation and questions from the same survey, which makes it easy to make comparisons across sectors and countries. A thorough description and interpretation of the index is provided in a dedicated section of the report.

Methodology for implementation of in-depth interviews

The idea behind the in-depth interview method is particularly useful and can help people research and clarify their views. Interviews are a widely used techniqueand are flexible, allowing in-depth analysis from a relatively small sample size and place the focus of research on the views of participants. For the purpose of this study,semi-structured interviews were applied. The same set of questionsfor all participants was used. However, additional questions have been asked during interviews to clarify and/or further discuss certain issues. The advantages of semi-structured in-depth interviews lies in the fact that the researcher have the possibility of collecting detailed information about research questions. Moreover, in this type of primary data collection researcher has direct control over the flow of the process and has a chance to clarify certain issues during the interview, if needed.

6. CONCLUDING REMARKS

Despite the fact that manufacturing sector in Kosovo in general developed positively over the recent years, it still remains fragile and vulnerable to external shocks. However, recent trends revealed that manufacturing in Kosovo has solid growth prospects. Proper framework conditions can help the sector and related actors to grow and gain further strengths; however, these framework conditions are not really conducive for the manufacturing sector in Kosovo. Nevertheless, strengthening capabilities to gain competitive advantages is increasingly focused on using Information and Communication Technology (ICT) tools and resources for digitalisation of business processes. The digitalization process is not only affecting cost-effectiveness over the value chain but has become essential for ensuring accurate information as input for qualitative decision-making processes. The evidence from the survey in this study indicates positive developments related to ICT exploitation for different functions in the manufacturing sector in Kosovo.

This survey report provides a thorough assessment of ICT adoption and access at firm level across four manufacturing industries in Kosovo, namely metal industry, food processing, wood processing, and plastic industry. Moreover, it examines and distinguishes between the firm's own perception about digitalization and actual depth of digitalization across all four manufacturing industries covered in this study. The main findings from the firm survey are as follows:

- Sustainable business, production growth, and growth through the introduction of new products and networking seems to be the most important strategic objectives across four surveyed industries.

- Technicians working in the production process represent one of the areas in which firms lack human resource capacities the most. Moreover, manufacturing firms appear to face difficulties in hiring employees with competencies in sales and logistics, too.

- Firms in all four industries consider themselves as highly digitalized as far as production processes are concerned. Wood processing industry is ranked as the most digitalized followed by plastics.

- While business owners perceive their businesses as highly digitalized, the digitalization index exposes the discrepancies between firm's own perception and actual depth of digitalization in manufacturing sector in Kosovo.

- Digitalisation index calculated at the firm level and also aggregated at industry level show that Kosovo firms are lagging behind the EU peers in digital adoption. The mean value of the index at firm level is 35.7 compared to 63 at the EU level.

- Survey results suggest that most of the firms use adequate software for management, marketing and online sales, and management of operations.

- Empirical estimation confirms the initial hypothesis that there statistically significant relationship between digitalization of firms and exporting. The sign and significance of the main explanatory variable, namely firm's export share, across different specifications illustrates the strong correlation between exposure to export markets and the level of digitalization.

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ANNEXES

Annex 1: Case study – RITEK Construction

Digitalization and digitization of the manufacturing sector, also known as Industry 4.0, is considered as the fourth industrial revolution that is being substantiated by connecting cyber-physical systems to databases stored via cloud computing, enabling data acquisition in real-time by management programs of the productive system. Ritek Construction is a company based in Milloshevë whose main activity is the production, delivery and installation of smoke and fire protection elements made from aluminium and glass. Ritek works closely with various manufacturers of systems such as SCHECAL, WICTOP uses customized software for planning the production process. The process of production is one of the most important stages of manufacturing and is a core part in the manufacturing sector. Ritek Construction has an in-house planning and development department available to advise their clients. The process of production at Ritek starts with the PLANGRID software which is used to add data for the inception stage of the project. Their scope of services also includes preparing product-specific layout drawings, and prototypes in a fully digitalized manner with (ELUCAD software) CNC-controlled production facilities. Ritek uses the SCHECAL software to calculate the cost of production and develop the whole planning process of production. Also, Ritek uses the UNILINK software to link the data from the planning office to the production department through this software tool the company organizes the whole production process through the following steps

Initial planning stage: Ritek receives product plans and quality specifications from the customer, draw up a proposal for the manufacturing method and overall schedule, and based on this information calculate a rough cost estimate.

Product Development Phase: After the initial stage, relevant departments determine the specifications of the product in more detail by working on the design and manufacture of the dies, as well as selecting and obtaining the necessary processing machinery and tools.

Prototype production/evaluation: Based on the product plans and quality specifications received from the customer, and the product specifications and product manufacturing plans determined in the Product Development Phase, a prototype is made.

Inspection and Delivery: The manufactured goods are closely inspected manually by the machines to make sure there are no defects or flaws. Only those goods that pass the inspection phase are delivered to the customer and packed carefully to prevent contamination or other damages.

Production planning process at RITEK Construction

Annex 2: List ofexpert interviewees

- Vjollca Çavolli, CEO, STIKK
- Mërgim Cahani, Director, Gjirafa
- Valon Grabanica, Representative from KOSBIT
- Driton Hapciu, Director, Cacttus
- Visar Ramajli, Director, KIVO
- Vegim Gashi, Director, KOMTEL

Anenx 3: Marginal effects of probit estimation (specification no. 4)

Variable	Marginal effects Probit
Export share	0.003*** [0.001]