



**DELIVERABLE D3.1:
"WEAKNESSES & GAPS (SWOT ANALYSIS) –
ASSESSMENT OF SMES READINESS & ADAPTABILITY
FOR THE CHANGING TECHNOLOGY LANDSCAPE -
SURVEY (QUESTIONNAIRES) IN THE CROSS-BORDER
AREA"**

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| PB3 | Regional Chamber of Skilled Crafts Association, Haskovo | | BULGARIA |



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LIST OF ABBREVIATIONS

| | |
|------|--|
| AI | Artificial Intelligence |
| CBC | Cross-Border Cooperation |
| DESI | Digital Economy and Society Index |
| EU | European Union |
| GDP | Gross Domestic Product |
| I4.0 | Industry 4.0 |
| ICT | Information and Communication Technology |
| IoT | Internet of Things |
| IT | Information Technology |
| NSRF | National Strategic Reference Framework |
| SME | Small-Medium Enterprise |
| SWOT | Strengths Weaknesses Opportunities Threats |

1 INTRODUCTION

In the ever-evolving landscape of global business, the need for comprehensive regional assessments is undeniable. This report embarks on a journey to **illuminate the economic dynamics and readiness of the Cross-Border Cooperation (CBC) area, focusing on the neighbouring countries of Greece and Bulgaria.**

1.1 Purpose and Scope

The primary purpose of this report is to provide a comprehensive analysis of the business sector within the CBC area, with specific attention given to Greece and Bulgaria. **The goal is to illuminate the dominant economic sectors in these nations and conduct a rigorous SWOT analysis,** aiming to offer invaluable insights to stakeholders. A SWOT analysis examines sectors; internal strengths and weaknesses, along with external opportunities and threats within the market, to identify areas for growth and improvement, mitigating future risks. For the needs of the 4th industrial revolution project, completing this analysis will **highlight the direct areas of opportunity that can be exploited for SMEs activated in selected sectors of the cross-border (CBC) area,** in relation to the opportunities offered by the 4th industrial revolution.

The report's scope encompasses a multifaceted evaluation of the CBC area's economic landscape. This entails dissecting the economic strengths, weaknesses, opportunities, and risks present in both Greece and Bulgaria. **Furthermore, the readiness and adaptability of small and medium-sized enterprises (SMEs) within this region to navigate the ever-changing technology landscape are explored.** The objective is to provide a holistic view that empowers stakeholders with the knowledge necessary to make informed decisions, fostering sustainable growth and collaboration in this dynamic corner of Europe.

1.2 Deliverable Structure

The structure of this report has been meticulously crafted to ensure clarity and effectiveness in delivering insights. It is divided into several distinct sections:

Section 2 - The Business Sector of the CBC Area: This section provides an in-depth exploration of the business landscape within the CBC area.

Section 3 - SWOT Methodology and Tools: An outline of the methodology and tools used in the SWOT analysis is presented here, including the methodological framework and the survey questionnaire employed.

Section 4 - Results: Section 4 presents the findings of the analysis. It delves into both the internal and external business environments in Greece and Bulgaria and assesses the readiness and adaptability of SMEs in the CBC area.

Section 5 - Conclusion: In the final section, Section 5, key findings are synthesized, and conclusions are drawn. The aim is to provide actionable takeaways that stakeholders can leverage to drive economic growth and enhance regional cooperation.

2 THE BUSINESS SECTOR OF THE CBC AREA

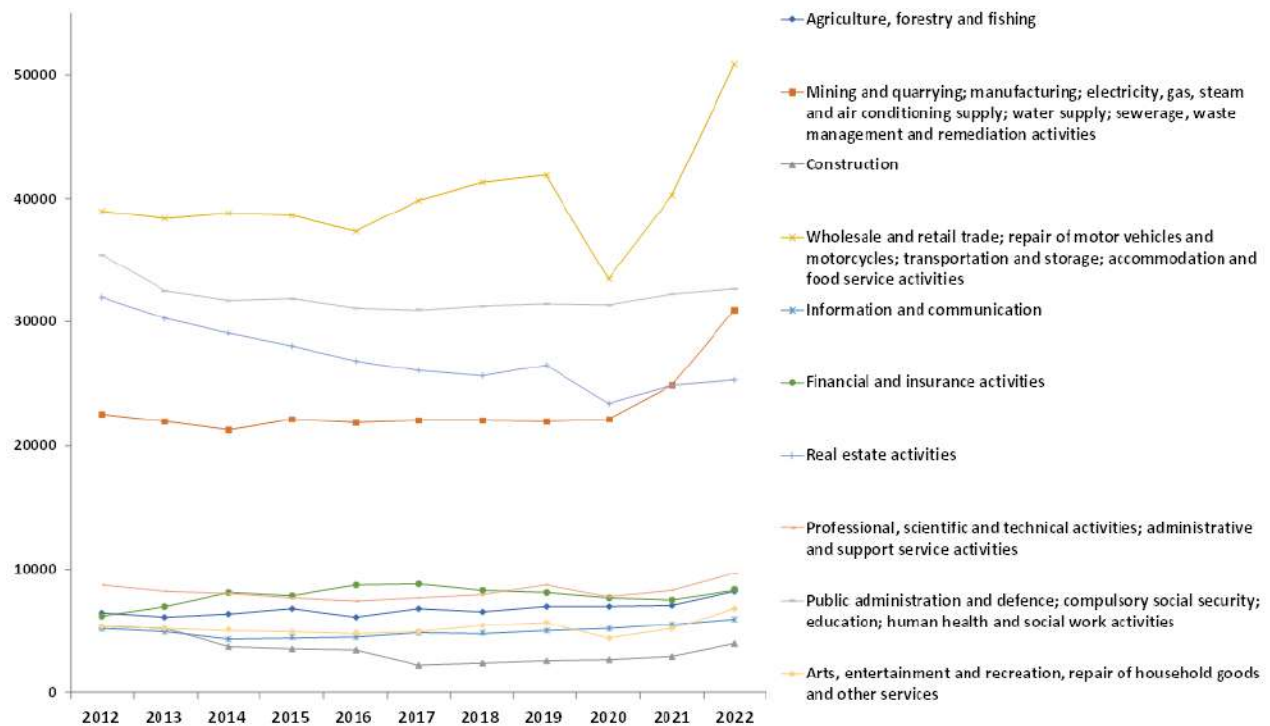
It is no secret that Greece is a country that has gone through multiple financial strifes in recent years, with the 2008 financial crisis and most recently, the COVID-19 pandemic dealing a heavy blow to its economy. Nevertheless, the country remains an integral part for the EU, with its economic sectors contributing both in its domestic stability and its role in the global economy. **In this chapter, an analysis of the main economic sectors in Greece is laid out, along with a more specific analysis of the country's most important economic sectors in the Greek-Bulgarian CBC area.**

In 2022, the **Greek economy, under the challenging global economic environment, demonstrated a dynamic recovery and achieved a growth rate of 5.9%**. Along with the increase in GDP, there was a **significant increase in exports** from €40 billion in 2021 to €54.7 billion in 2022, **as well as in investments** from 12.0% to 13.3% (% GDP) [1]. Gross public **debt slightly decreased, as well as unemployment rates**. Furthermore, **foreign direct investments reached high levels** in comparison to the previous years. In addition, **tourism reached pro-pandemic levels**. The good tourist season, in combination with economic policies of the government as well as the National Recovery and Resilience Plan are factors that protected the Greek economy and improved its economic outlook. However, high inflation restrained economic growth. The rapid increase of prices burdened households and businesses and generated feelings of economic uncertainty in the national market. The **government introduced fiscal policies** to support the citizens without undermining the target of deficit reduction. However, a continuity of global economic uncertainty may pose a threat to the resilience of the national economy [2].

Table 1: Main Economic Indicators for Greece 2018-2022 [1]

| | 2018 | 2019 | 2020 | 2021 | 2022 |
|--|-------|-------|-------|-------|-------|
| GDP at current prices (% change) | 1.5% | 2.1% | -9.8% | 9.8% | 14.5% |
| GDP at current prices (€ billions) | 179.6 | 183.4 | 165.4 | 181.7 | 208.0 |
| Inflation (annual average) | 0.6% | 0.3% | -1.2% | 1.2% | 9.6% |
| Labor productivity | -3.6% | -0.1% | -7.0% | 6.5% | 10.9% |
| Unemployment rate (annual average) | 19.3% | 17.3% | 16.3% | 14.7% | 12.4% |
| Investments (% GDP) | 11.1 | 10.7 | 12.0 | 13.3 | n/a |
| Private sector (% GDP) | 7.9 | 8.2 | 8.8 | 9.7 | n/a |
| General Government (% GDP) | 3.2 | 2.5 | 3.1 | 3.6 | n/a |
| Exports of goods at current prices (€ billions) | 33.5 | 33.9 | 30.8 | 40.0 | 54.7 |
| Imports of goods at current prices (€ billions) | 54.1 | 55.7 | 48.9 | 65.5 | 93.0 |

The contribution of individual economic sectors to Greece's overall gross added value varies (Graph 1).



Graph 1: Economic sectors' contribution to Greece's overall GVA [3]

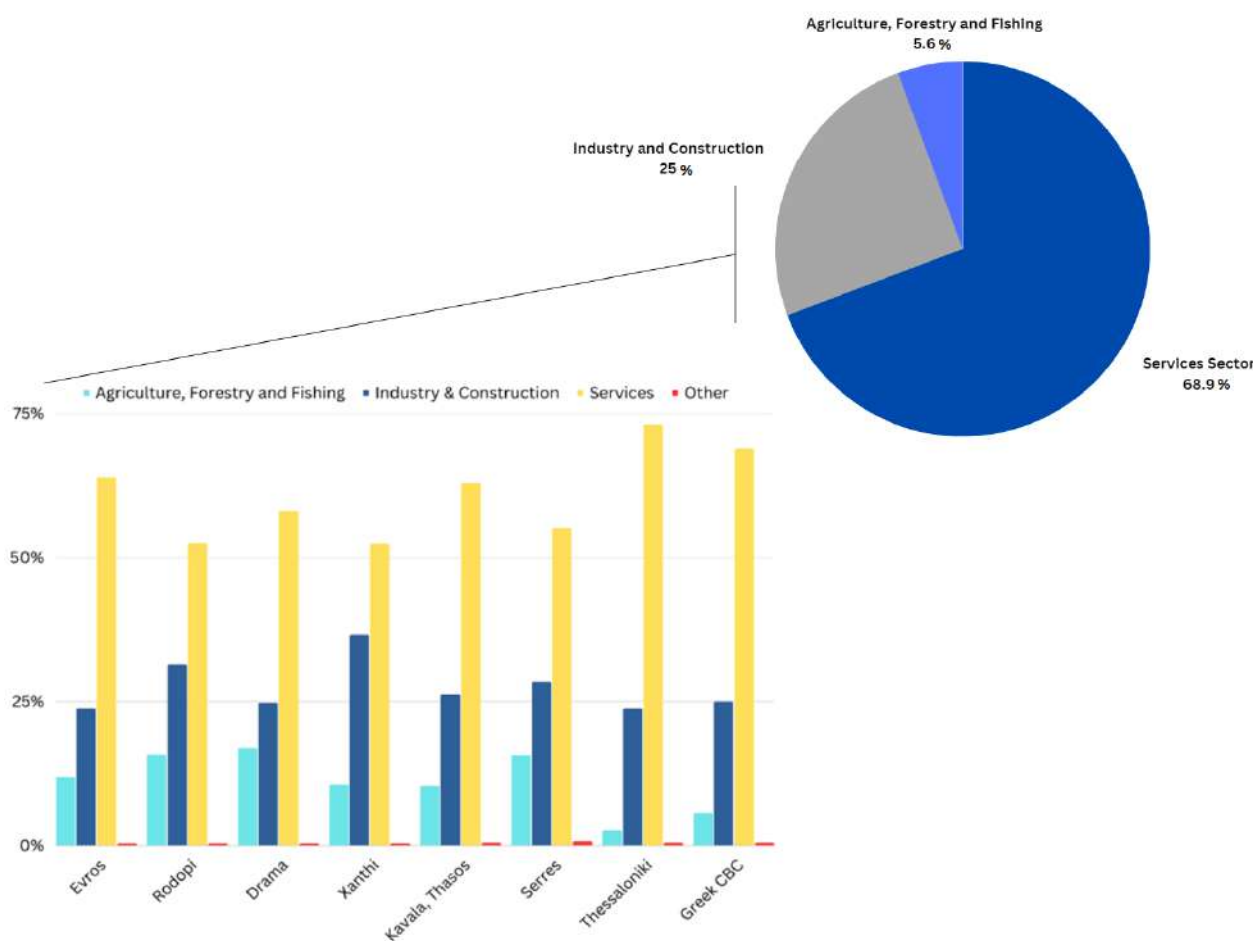
As shown in Graph 1, the share of the service sector was 76.3% in 2022, industry and construction at 19.2%, while agriculture, forestry and fishing at 4.5%. The trade, transportation and storage, accommodation and food services industry had the highest share at 27.9% of the total of gross value added followed by: public sector (17.9%), industry and manufacturing (17.0%), real estate activities (13.9%), professional, scientific and technical activities, administrative and support service activities (5.3%), agriculture, forestry and fisheries (4.5%), financial and insurance activities (4.5%), arts, entertainment and recreation, repair of household and other services (3.7%), information and communication (3.2%) and construction (2.2%) [3].

2.1 Dominant economic sectors in the Greek side of the CBC area

When referring to the Greek-Bulgarian CBC area however, there must be a more specific analysis of the economic sectors within the following prefectures that belong to it.

- Evros
- Rodopi
- Drama
- Xanthi
- Kavala, Thasos
- Serres
- Thessaloniki

As in national level, the services sector has the largest share with 68.9%, followed by industry and construction at 25% and agriculture, forestry and fishing at 5.6%. In total, these regions presented a total of 215,002 operational businesses in 2020, which produced a total income of 30,586,755,000 Euros, employing 608,931 people [4].



Graph 2: Income share of each major sector in the entire Greek CBC sector and by prefecture [4]

2.2 Dominant economic sectors in the Bulgarian side of the CBC area

The cross-border region with Greece on the Bulgarian side of the border covers the districts of Blagoevgrad, Smolyan, Kardjali and Haskovo.

Regarding the labour market, in the period from 2018 to 2021, a decrease in the number of employed persons was observed in each of the four districts (a total of 8,373 people), and it was most seriously expressed in the districts of Blagoevgrad and Haskovo, with 3,992 people and 3,895 people, respectively.

Table 2. Average annual number of employees under labour contract in the enterprises of the cross-border region with Greece on the Bulgarian side of the border, number

| District | 2019 | 2020 | 2021 | 2022 |
|--------------|----------------|----------------|----------------|----------------|
| Blagoevgrad | 88 781 | 89 026 | 83 237 | 84 789 |
| Smolyan | 31 476 | 31 982 | 30 489 | 31 136 |
| Kardjali | 31 313 | 31 428 | 30 245 | 31 167 |
| Haskovo | 53 653 | 52 870 | 48 981 | 49 758 |
| TOTAL | 205 223 | 205 306 | 192 952 | 196 850 |

| District | 2019 | 2020 | 2021 | 2022 |
|-----------------|------------------|------------------|------------------|------------------|
| Bulgaria | 2 319 762 | 2 322 561 | 2 211 773 | 2 248 934 |

Source: National Statistical Institute

About 10% of all registered enterprises in Bulgaria are located in the cross-border region with Greece. In years 2020 and 2021, there was some decrease in the number of businesses, as an economic consequence of the Covid-19 pandemic, which led to the closure of a number of companies.

In terms of the number of enterprises in the cross-border region, there is a clear preponderance of companies in the Blagoevgrad district, which in total are almost as many as in the other 3 districts combined. Second ranks the district of Haskovo with a cumulative number of enterprises as many as in the districts of Smolyan and Kardjali combined.

Table 3. Number of non-financial enterprises in the cross-border region with Greece on the Bulgarian side of the border

| District* | 2019 | 2020 | 2021 | 2022 |
|-----------------|----------------|----------------|----------------|----------------|
| Blagoevgrad | 21 907 | 21 840 | 21 008 | 20 897 |
| Smolyan | 5 233 | 5 291 | 5 183 | 5 195 |
| Kardjali | 5 061 | 5 171 | 5 104 | 5 082 |
| Haskovo | 11 865 | 12 080 | 11 787 | 11 528 |
| TOTAL | 44 066 | 44 382 | 43 082 | 42 702 |
| Bulgaria | 413 535 | 419 681 | 411 564 | 412 878 |

Source: National Statistical Institute

Note: *All economic activities, excluding sectors K, O, T u U

According to preliminary data of NSI for 2022, a notable increase in the number of enterprises is observed in Bulgaria (448,409) or almost 9% growth, which is a positive sign for the rapid recovery of the economy after the Covid-19 pandemic. Similar effects are expected to be observed in all four districts in the CBC region.

For the period from 2018 to 2021, the turnover of non-financial enterprises in the four districts was about 5% of the turnover of all enterprises in Bulgaria. It was the largest in Blagoevgrad district (share of 49.1% of the total turnover of non-financial enterprises in the CBC region), followed by Haskovo district (25.9%). The turnover of the companies in the other 2 districts is similar with a slight advantage of Kardjali district (13.5%) over Smolyan district (11.5%).

Table 4. Turnover of non-financial enterprises from the cross-border region with Greece on the Bulgarian side of the border, thousand BGN

| District | 2019 | 2020 | 2021 | 2022 |
|-----------------|--------------------|--------------------|--------------------|--------------------|
| Blagoevgrad | 7 592 886 | 7 936 405 | 7 666 469 | 9 250 623 |
| Smolyan | 1 929 149 | 2 005 201 | 1 932 403 | 2 155 316 |
| Kardjali | 1 986 421 | 2 024 710 | 2 228 378 | 2 547 024 |
| Haskovo | 4 159 594 | 4 282 474 | 4 097 266 | 4 867 878 |
| TOTAL | 15 668 050 | 16 248 790 | 15 924 516 | 18 820 841 |
| Bulgaria | 294 198 042 | 316 382 065 | 306 227 818 | 374 122 989 |

Source: National Statistical Institute

3 SWOT METHODOLOGY AND TOOLS

3.1 Background

Strategic planning methodologies, such as SWOT analysis, allow organizations to systematically identify Strengths, Weaknesses, Opportunities, and Threats pertinent to their business operations. Through the application of this analytical framework, enterprises are able to determine their strategic position within the market, and develop robust strategies for optimizing and enhancing their performance. Conducting a SWOT analysis facilitates a comprehensive evaluation of both internal and external factors that influence organizational decision-making.

The widely adopted SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis has long been a subject of intrigue regarding its origins. Research by R. W. Puyt, F. B. Lie, and C. P.M. Wilderom, sheds light on its history. The findings reveal that the original SWOT, termed the SOFT approach, was designed in the early strategic planning frameworks of the 1950s, notably by Lockheed Aircraft Corporation. R. F. Stewart, a pivotal figure at Lockheed, played a significant role in its development. The SOFT approach, which categorized planning issues as Satisfactory, Opportunities, Faults, or Threats, later evolved into the SWOT we recognize today. The research emphasizes the enduring relevance of this tool in contemporary strategic planning and its potential enhancement through digital means. At the same time, P. Learned, C. Christensen, K. R. Andrews, and W. D. Guth from Harvard published a seminal textbook on business policy [5]. This textbook indirectly introduced the foundational concepts of SWOT in strategic management. H. Mintzberg and his colleagues used this book as the basis for what they would later refer to as a "design school" model. The components of SWOT began to appear in strategic planning literature during the late 1960s and early 1970s, and by 1972, the acronym had become an established part of strategic planning literature. Similarly to SWOT, I. Ansoff introduced a 2x2 matrix representation in 1980, although it was referred to by a TOSW acronym [6].

3.2 SWOT Matrix

SWOT is an acronym that represents:

- **Strengths:** These are the elements of the project or business that give it an advantage over its competitors. An example might be a brand with a strong reputation, a team with a strong commitment, effective processes, a technology that is unique, or any other internal factor that leads to success.
- **Weaknesses:** Characteristics that put a business or project at a disadvantage. These are factors within the organization that could impede the achievement of the objective. Examples include outdated technology, a lack of capital, or a bad reputation for brands.
- **Opportunities:** External factors of which the project or a business can take advantage. This could encompass emerging markets, technological advancements, shifts in the competitive landscape, or other external dynamics.
- **Threats:** External factors that negatively affect the assessed group. Examples are regulatory changes, escalating competition, or economic recessions.

The SWOT matrix, also known as the SWOT analysis table, is a structured planning method used to evaluate the strengths, weaknesses, opportunities, and threats involved in a project, business venture, or in a business as a whole. A SWOT matrix helps organizations to understand their internal and external environments. The internal aspects refer to the features that are within the control of the business, whereas the external aspects are factors out of the businesses' control. Based on a mix of strengths, weaknesses, opportunities, and threats analyses, the SWOT technique can be used effectively to produce alternative options for a business.

The SWOT matrix is usually presented in a square divided into four quadrants, each representing one of the SWOT elements. The top half of the matrix represents the internal factors (strengths and weaknesses), and the bottom half represents external factors (opportunities and threats). The purpose of the SWOT analysis is to reveal positive forces that work together (e.g., strengths and opportunities), and negative forces such as weaknesses and threats that might lead to potential problems. When filling "Strengths", "Weaknesses", "Opportunities", and "Threats" quadrants of the SWOT matrix, it is essential to consider various aspects of the organization or project. By systematically addressing predefined questions, organizations can gain a comprehensive understanding of their inherent strengths.

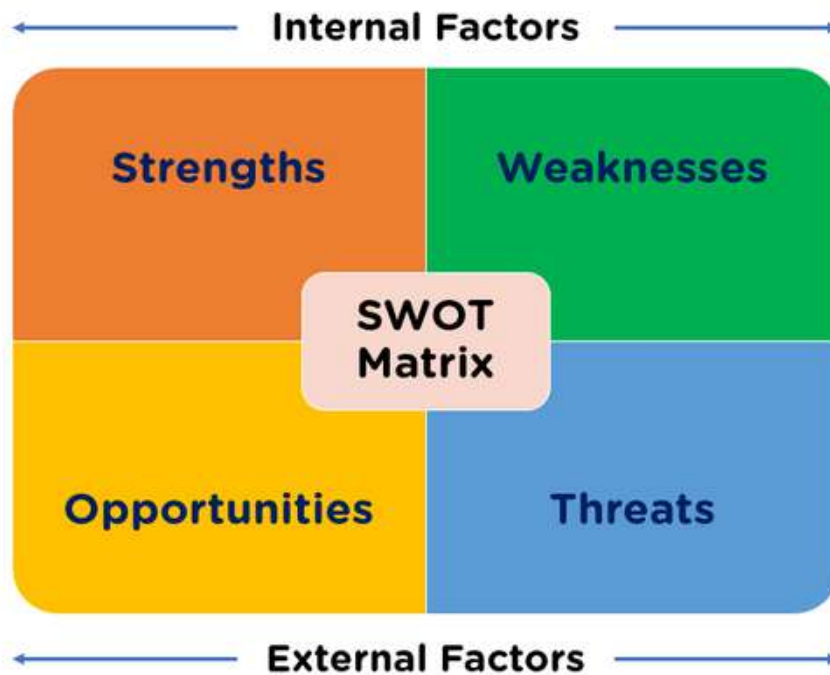


Figure 1: SWOT Analysis Matrix

In certain situations, a more relaxed structure can be advantageous. By grouping positives and negatives, it is possible to gain a comprehensive perspective on the organization and its external factors as illustrated in Figure .

| Positives | Negatives |
|---|--|
| <ul style="list-style-type: none"> • Strengths • Opportunities • Assets • Resources • Opportunities • Prospects | <ul style="list-style-type: none"> • Weaknesses • Limitations • Restrictions • Threats • Challenges |

Figure 2: SWOT Positives and Negatives

Another important variation of SWOT analysis is TOWS matrix. Introduced by Heinz Wehrich in 1999, the TOWS methodology builds upon the foundational principles of SWOT analysis, rearranging its components [7]. While SWOT primarily focuses on identifying and categorizing Strengths, Weaknesses, Opportunities, and Threats, the TOWS matrix delves deeper. It strategically interlinks these elements to formulate actionable strategies. Specifically, TOWS examines how to leverage strengths to exploit opportunities, use strengths to counter threats, capitalize on opportunities to address weaknesses, and mitigate weaknesses to defend against potential threats. While retaining the core elements of SWOT, TOWS emphasizes a strategic approach that integrates both internal and external factors.

In strategic planning, TOWS methodology facilitates a seamless connection between in-depth research and proactive strategies. The presentation of findings in a logical and coherent manner facilitates clear communication with organisational stakeholders, therefore securing their support. The TOWS has the unique ability to identify critical areas that require immediate attention. In addition, its comprehensive approach ensures that both positive drivers, as well as potential challenges, are fully considered, resulting in a holistic strategy.

An in-depth SWOT analysis is the basis for preparing a TOWS matrix. Once the SWOT analysis is completed, a list of Strengths, Weaknesses, Opportunities, and Threats will be generated. To facilitate systematic representation and ease of reference in subsequent stages, it is recommended that these elements be labeled sequentially. As an example, strengths can be denoted by S1, S2, etc., while weaknesses can be denoted by W1, W2, and so on. It is important to use this labeling system in order to simplify the process of referencing specific points when formulating strategies based on the TOWS matrix.

| | | |
|--|--|---|
| | Strengths S1 S2 S3 | Weaknesses S1 S2 S3 |
| Opportunities O1 O2 O3 | SO: Use strengths to maximize opportunities | WO: Reduce weaknesses to develop opportunities |
| Threats T1 T2 T3 | ST: Use strengths to reduce threats | WT: Avoid threats by reducing weaknesses |

Figure 3: TOWS Matrix

As the Figure 3 suggests, the following categories should be analyzed to devise suitable strategies:

1. **Strengths & Opportunities:** Use strengths to maximise opportunities (SO)
2. **Strengths & Threats:** Use strengths to reduce threats (ST)
3. **Weaknesses & Opportunities:** Reduce weaknesses to develop opportunities (WO)
4. **Weaknesses & Threats:** Avoid threats by reducing weaknesses (WT).

3.3 SWOT Tools

To enhance the effectiveness of a SWOT Analysis and help identify internal and external factors, other tools such as PESTLE, Five Forces, Competitor Analysis, Resource Audit, and MOST analysis can be used.

Pestle Analysis

While SWOT focuses on both internal and external factors, PESTLE (Political, Economic, Social, Technological, Legal, and Environmental) dives deep into external macro-environmental factors. By examining these broad categories, organizations can identify external threats and opportunities that may not be immediately evident. When combined with a SWOT Analysis, PESTLE ensures a comprehensive understanding of the external landscape and how these external factors might interact with internal strengths and weaknesses. PESTLE Analysis offers a more granular look at the external factors affecting an organization:

- **Political:** Evaluates the impact of government actions, political stability or instability, tax policies, trade restrictions, and other political facets on an organization.
- **Economic:** Investigates economic factors like inflation rates, exchange rates, economic growth patterns, and interest rates that can influence a company's operations and profitability.
- **Social:** Considers cultural, demographic, and societal changes and trends that might affect the demand for a company's products or services.
- **Technological:** Analyzes the impact of emerging technologies, research and innovation in the industry, automation, and the rate of technological change.
- **Legal:** Focuses on the impact of national and international laws, including employment, health and safety, and antitrust regulations.
- **Environmental:** Looks at environmental factors like climate change, environmental regulations, and sustainability practices that might impact a company's operations or reputation.

The external factors discovered by PESTLE can be incorporated into SWOT by populating the Opportunities and Threats sections. This provides businesses with a comprehensive and detailed view of their external environment. As a result of understanding these external influences, organizations are better able to strategize, ensuring that their internal strengths are maximized while addressing their weaknesses [8].

Five Forces

Developed by Michael Porter, the Five Forces Analysis is a tool to analyze the competitive forces within an industry: threat of new entrants, bargaining power of buyers, bargaining power of suppliers, threat of substitute products or services, and rivalry among existing competitors [5]. By understanding these forces, businesses can grasp both the strength of their current competitive position and the strength of a position they are considering moving forward. Integrating this analysis with SWOT provides insights into potential threats and opportunities in the competitive landscape. Each of these forces plays a critical role in determining profitability and strategic direction:

- **Threat of New Entrants:** Markets with high profitability potential tend to attract new players. The ease with which these new competitors can enter an industry depends on barriers such as capital requirements, economies of scale, brand loyalty, and access to distribution channels.
- **Bargaining Power of Buyers:** In sectors where buyers have considerable influence due to factors such as their purchase volume, access to comprehensive information, or product

similarity, they can apply downward pressure on prices, seek enhanced service quality, and strategically position competitors against each other.

- **Bargaining Power of Suppliers:** Suppliers gain leverage when they're few in number, offer unique resources, or face minimal competition. In such scenarios, they can demand premium prices, limit quality or services, or shift costs onto industry participants.
- **Threat of Substitute Products or Services:** The availability of alternatives outside the industry that serve a similar purpose can limit the potential returns of an industry by placing a ceiling on prices.
- **Rivalry Among Existing Competitors:** This force is influenced by factors like industry growth rate, product differences, brand identity, and exit barriers. Intense rivalry often diminishes the profitability potential as organizations might engage in price wars, ad campaigns, or innovation races⁶.

Applying the Five Forces framework alongside a SWOT Analysis offers a dual advantage. While SWOT pinpoints an organization's internal attributes and the broader external opportunities and threats, the Five Forces Analysis provides a detailed portrait of the competitive environment. Together, they equip businesses with the necessary insights to make informed strategic decisions, ensuring they leverage their strengths effectively while navigating the challenges of the industry.

Competitor Analysis

As the name suggests, a Competitor Analysis is the process of identifying and evaluating competitors' strategies to determine their strengths and weaknesses [9]. This tool is crucial to figure out market opportunities and potential areas of threat. Merging competition analysis with SWOT offers a more rounded view of where an organization stands in comparison to its competitors and can guide the strategic direction based on competitive strengths or vulnerabilities. Such an evaluation is indispensable in today's dynamic business environment for several reasons:

- **Strategy Formulation:** By discerning the strategies that competitors are adopting—whether they are growth strategies, differentiation, or focus strategies—an organization can identify gaps, anticipate competitor moves, and devise countering tactics.
- **Identifying Competitive Advantage:** A robust competitor analysis can illuminate areas where an organization has an edge over its rivals, be it in terms of technological prowess, superior customer service, or unique branding.
- **Market Positioning:** Knowing where competitors stand, in terms of market share, reputation, and service offerings, helps in better positioning oneself in the market, ensuring differentiation and targeted messaging.
- **Risk Mitigation:** Recognizing competitors' strengths and potential game-changing strategies can prompt preemptive actions, enabling businesses to manage risks more proactively.

An organization can gain a comprehensive perspective by incorporating the insights gained from Competitor Analysis into its SWOT analysis. A SWOT analysis reveals the company's strengths, weaknesses, opportunities, and threats, whereas a Competitive Analysis provides a deeper understanding of these aspects by comparing them with those of competitors in the industry. Through this dual lens, the organization is able to formulate strategies that are not only internally focused, but also contextually relevant, cognizant of external competitive pressures, and responsive to the changing market conditions.

Resource Audit

A Resource Audit is a comprehensive assessment of an organization's internal resources - human, physical, financial, and intangible assets [10]. By doing this audit, businesses can pinpoint their internal strengths and weaknesses. This deep dive into organizational resources can further refine

the strengths and weaknesses identified in a SWOT Analysis, ensuring a thorough understanding of internal capabilities and limitations. The resources span across various categories:

- **Human Resources:** This involves evaluating the skills, expertise, and competencies of employees. Organizations often thrive or falter based on the talent they nurture and the cultures they cultivate.
- **Physical Assets:** This encompasses infrastructure, equipment, and other tangible assets which support operational efficiency and product or service delivery.
- **Financial Resources:** A close examination of financial health, liquidity, access to capital, and financial flexibility helps gauge an organization's ability to fund its strategic initiatives and weather economic downturns.
- **Intangible Assets:** These are non-physical assets like brand equity, intellectual property, goodwill, and organizational culture. Often, intangibles are key differentiators in a competitive marketplace.

Resource audits provide an organization with a holistic picture of its internal environment, allowing it to align its strategic initiatives with its resource capabilities. When combined with a SWOT Analysis, a Resource Audit provides a multidimensional view of the organization. A SWOT analysis provides a comprehensive overview of strengths, weaknesses, opportunities, and threats, while a Resource Audit provides a detailed breakdown of internal resources, which facilitates informed decisions and prioritizations. Through this combination, strategic plans are not only ambitious, but also grounded in the reality of what the organization can achieve with its existing resources.

MOST

MOST stands for Mission, Objectives, Strategy, and Tactics. It is a clear framework for guiding the entire strategy development process:

- **Mission:** Forms the very core of an organization, capturing the overarching reason for its existence. A mission often outline an organization's foundational values and its intended impact in the broader ecosystem.
- **Objectives:** These are specific, measurable goals that serve as milestones on the journey to fulfilling the mission. Objectives often have tangible metrics and timelines associated with them, ensuring clarity and accountability.
- **Strategy:** This involves the broader approaches or pathways the organization will take to achieve its objectives. It encompasses the choices about where to play and how to win, based on an understanding of the internal and external environments.
- **Tactics:** These are the specific actions or initiatives undertaken to execute the strategy. Tactics are actionable, often short-term in nature, and serve as the building blocks of strategic implementation.

By aligning SWOT findings with MOST Analysis, organizations can ensure that their strategies align with their mission and objectives while leveraging their strengths and mitigating weaknesses.

3.4 Strengths and Weaknesses of the SWOT technique

Strategic planning often involves SWOT Analysis, whether for new business ventures or existing ones, product launches, or positioning in new markets. An organization may use the SWOT technique at various stages throughout its life cycle. SWOT Analysis is a valuable tool as it differentiates between an organization's internal factors, such as strengths and weaknesses, and external elements like opportunities and threats. This distinction not only facilitates strategic planning by leveraging strengths and capitalizing on opportunities but also addresses potential

weaknesses and threats. Moreover, it provides a holistic understanding of the competitive business landscape.

Strengths of the SWOT analysis:

- **Simplicity:** This method is characterized by its simplicity. A person with little or no experience with strategic analysis or planning can quickly grasp its concepts. Because it can be implemented easily, businesses of all sizes, from start-ups to large corporations, can utilize it with a minimal training [11].
- **Flexibility:** Another strength of the technique is its adaptability. It is applicable to a wide range of industries, sectors, and situations. There are a number of situations in which this method can provide valuable insight; including launching a brand-new product, entering a new market, or determining if a new project is viable [12].
- **Facilitates Decision Making:** This technique is at its core a decision-making tool. A SWOT analysis outlines the strengths, weaknesses, opportunities, and threats for businesses, allowing them to formulate strategies that leverage their strengths, mitigate weaknesses, take advantage of opportunities, and defend against threats [13].

Weaknesses of the SWOT analysis:

- **Subjectivity:** Although the technique is straightforward, biases can compromise its effectiveness. Depending on who analyses the data, the results may vary. Overly optimistic managers can overlook weaknesses or threats, while pessimistic managers can underestimate strengths [14].
- **Lack of Details:** **Simplicity can also be a weakness when it comes to complicated strategic challenges.** This method might not provide a detailed understanding of complex issues that require detailed analysis, potentially missing nuances or intricacies [15].
- **Static Analysis:** **This method provides an overview of the current situation.** As a result, it does not take into account future changes in the business environment, such as the evolution of market dynamics, technological advances or regulatory changes. Due to this static nature, businesses must regularly revisit and update their analysis in order to keep it current [16].

3.5 Methodological framework

The 4th Industrial Revolution, characterized by rapid technological advancements and digital transformation, presents both challenges and opportunities for Small and Medium-sized Enterprises (SMEs). To successfully navigate this evolving landscape effectively, it is crucial to adopt a systematic approach. The SWOT analysis, underpinned by a well-structured survey, offers a robust framework to assess the current state and future potential of SMEs in this revolution. The steps of the proposed methodology to harness the power of SWOT analysis using survey data are illustrated in Figure and described below.

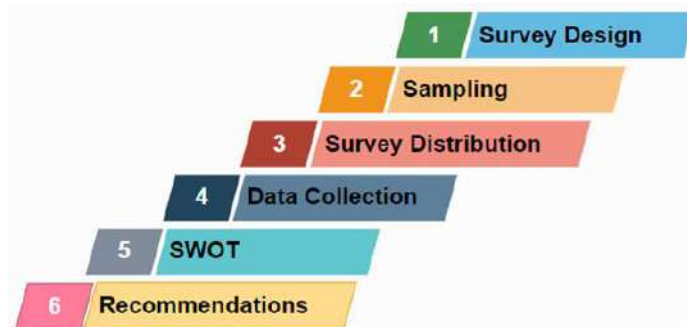


Figure 4: 4TH Industrial Revolution Methodological Framework

Step 1: Survey Design

Goal: *To create a comprehensive questionnaire aligned with the "4th Industrial Revolution" project's objectives, ensuring the collected data is both relevant and actionable.*

In our endeavors to derive data-driven insights for the "4th Industrial Revolution" project, we prioritized the development of a robust survey, recognizing it as the foundational element of our analysis. To ensure the survey's efficacy and relevance we have performed the following three sub steps:

- **1.1 Objective Setting:** We began by delineating the primary goals of the survey. This was crucial to ensure that our survey was not only comprehensive but also aligned seamlessly with the aims of the "4th Industrial Revolution" project.
- **1.2 Survey Design:** Post the objective setting, we delved into the design of the questionnaire. Here, our focus was on designing incisive questions tailored to extract specific insights. These questions were aimed at identifying the strengths, weaknesses, opportunities, and threats that the 4th Industrial Revolution poses to SMEs.
- **1.3 Survey Implementation:** We decided to utilize Google Documents, specifically Google Forms, as our primary tool for several reasons: accessibility, user-friendly interface, and real-time data collection.

Through this structured approach in the survey preparation phase, we were able to ensure that every piece of data we gathered was both relevant and actionable, setting the stage for a comprehensive analysis. When designing the Survey we were led by the Grounded Theory Approach that emphasizes the generation of theory from the data that is systematically gathered and analysed [17]. Grounded Theory prioritizes in-depth understanding over surface-level knowledge. A comprehensive questionnaire allows researchers to delve deep into participants' experiences, perceptions, and insights, providing a richer understanding of the subject. Thus, we designed a detailed questionnaire with the goal to ensure that the collected data is of high quality. The advantage of the chosen methodology is that it does not necessitate a larger sample. By focusing on a more compact group, more attention can be dedicated to each individual, leading to the acquisition of more in-depth and reflective feedback.

Step 2: Sampling

Goal: *To select a diverse and representative group of SMEs from the Greek-Bulgarian cross-border area using stratified random sampling.*

The integrity of any survey's findings is deeply rooted in the quality of its sample. Ensuring that the sample is representative of the broader target population is paramount, as it directly affects the accuracy and reliability of the results.

The following factors were carefully considered:

- **Target SMEs:** Our primary focus was on SMEs across the Greek-Bulgarian cross-border area. This encompasses a broad range of enterprises, from nascent startups to more established businesses, each with its unique perspective on the impending industrial shift.
- **Sampling technique:** To capture the heterogeneity within the SME sector, a stratified random sampling approach was selected [18]. This technique involves:
 - **Segmentation:** Before sampling, the entire SME population was divided into different categories based on the following criteria: geographical (i.e., Greece vs. Bulgaria), size (i.e., small vs. medium), and sector (manufacturing, IT services, etc.).

- **Random Sampling:** Within each stratum random sample is selected.
- **Determining the Sample Size:** The size of the sample is crucial. A too small sample might not adequately represent the diversity of the entire population, while an overly large one can strain resources. While there are complex methods like the Cochran formula to determine sample size, we have opted for a simpler approach in consultation with experts. Recognizing that larger samples might offer more precision, practicality is essential. Given our decision to use a detailed questionnaire, we believe a sample of 70-80 SMEs strikes the right balance, emphasizing the depth and quality of the insights we aim to obtain.

Step 3: Survey Distribution

Goal: *To effectively disseminate the survey to its intended audience, the SMEs, using a multi-channel approach, ensuring maximum reach and participation, and thereby collecting insights that are both comprehensive and representative of the SMEs' perspectives on the 4th Industrial Revolution.*

Ensuring the effective distribution of the survey is paramount to its success. The primary objective of a well-strategized distribution is to guarantee that the survey not only reaches its intended audience but also encourages them to participate. This, in turn, maximizes response rates, ensuring a more comprehensive data set, and enhances the overall quality of the data collected.

For the *4th Industrial Revolution* project, we adopted a multi-channel distribution approach to cater to the diverse preferences and habits of our target audience, the SMEs.

- **Email:** A direct and personalized email campaign was initiated. This method allowed us to reach out to SMEs that had previously engaged with the project or had shown interest in the 4th Industrial Revolution. The emails contained a brief introduction to the survey's purpose, its importance, and a direct link to the questionnaire.
- **Project's Website:** The survey was prominently featured on the project's official [website](#). This ensured that visitors, including stakeholders, researchers, and interested parties, had easy access to participate.
- **LinkedIn Page:** Recognizing the importance of professional networks, the survey was also shared on the project's official [LinkedIn page](#). This platform allowed us to tap into a broader audience, including industry professionals, experts, and other SMEs who might be interested in the 4th Industrial Revolution.
- **Dissemination Events:** To enhance its reach, the survey was introduced and distributed during dissemination events. These events, often attended by industry leaders, stakeholders, and SME representatives, provided an excellent opportunity to encourage direct participation and gather immediate feedback.

By leveraging these diverse channels, we ensured a broad yet targeted distribution, aiming to gather insights that are both deep and representative of the SME ecosystem's sentiments regarding the 4th Industrial Revolution.

Step 4: Data Collection & Analysis

Goal: *To accumulate the survey responses and then process and interpret this data, converting the raw feedback into meaningful and actionable insights.*

Step 5: SWOT Analysis Execution

Goal: *To systematically assess both the internal and external factors affecting SMEs, identifying their inherent strengths and weaknesses as well as external opportunities and threats.*

Step 6: Recommendations & Strategy Formulation

Goal: *To transform the insights derived from the analysis into practical strategies and initiatives that can assist SMEs in navigating the challenges and opportunities of the 4th Industrial Revolution.*

3.6 Survey questionnaire

The purpose of the questionnaire is to assess and collect information about the readiness and maturity of SMEs in the Greek-Bulgarian cross-border area to adopt Industry 4.0 concepts and underlying technologies. A paradigm shift to Industry 4.0 offers SMEs enormous opportunities while also presenting large challenges. To achieve a successful digital transformation that changes business models and creates value propositions, both top management support and substantial investments are required. The evaluation therefore requires a broad perspective on the company's strategy, organization, production, operation, and products.

As outlined in the Section 3.5, we have followed a structured approach comprised of three sub steps for the design and implementation of the questionnaire. Based on the detailed State of the Art analysis and literature review documented in D3.3, the following 4th industrial revolution dimensions were identified as relevant: (i) *Smart Product and Services*, (ii) *Smart production*, (iii) *Smart Operation*, (iv) *Business Strategy, Organization and Processes*, and (v) *Employees and Competences*. While the key characteristics of each dimension are briefly described below, more details can be found in D3.3.

Smart Products and Services are the fusion of traditional industrial capabilities with modern Information and Communication Technologies (ICTs). Smart products, embedded with sensors and communication tools, not only identify themselves but also predict future actions, such as maintenance needs. These products generate data that gives rise to Smart Services, which bridge the digital and physical worlds. These services leverage secure data management, advanced analytics, and customer-centric business models to enhance efficiency and user experience in the evolving industrial landscape.

Smart Production in Industry 4.0 signifies a highly automated and interconnected manufacturing environment. Smart factories optimize production processes in real-time using decentralized data structures. They blend the physical and virtual worlds through cyber-physical systems, facilitated by the Internet of Things. Central to this is digital modeling paired with intelligent data handling, ensuring efficient resource use. In this setup, humans, information systems, and production mechanisms collaborate seamlessly. The evolution of a company's smart production capabilities is gauged by its equipment infrastructure, IT systems, digital modeling, and data utilization.

Smart Operation in Industry 4.0 encompasses the integration of advanced technologies like IoT, AI, Big Data analytics, and Cloud Computing to enhance industrial processes. Machines and systems interconnect in real-time, facilitating autonomous decision-making based on data-driven insights. This leads to streamlined manufacturing, heightened productivity, and superior product quality. Key technologies include IoT for real-time data collection, AI for predictive maintenance and process optimization, Big Data analytics for in-depth insights, and Cloud Computing for flexible data access and storage. This digital-driven approach in manufacturing offers significant efficiency improvements, cost reductions, and a competitive edge in the global market.

Business Strategy, Organization, and Processes: Industry 4.0 is not just about enhancing products or processes with digital technologies; it offers the potential for entirely new business models. Strategically, its adoption is crucial. To harness its full benefits, evaluating the current environment's openness and cultural interaction is vital. Key considerations include the strategy's implementation level, its thorough assessment via indicators, dedicated investments, and the efficient use of

technology and innovation management. Openness and cultural integration are pivotal for Industry 4.0's success.

Employees & Competences: The digital transformation of workplaces significantly affects employees, necessitating the acquisition of new skills. Companies must provide adequate training to equip their employees for these changes. Employee readiness is gauged by evaluating their current skills and their initiative to learn new ones.

The questionnaire was adopted and modified for the specific needs of the 4th Industrial Revolution project from the following sources:

- IMPULS - Industry 4.0 Readiness Online Self-Check for Businesses [19]
- Digital Transformation Assessment Fraunhofer IPK [20]
- Industry 4.0 Survey [21]
- A Maturity Level-Based Assessment Tool to Enhance the Implementation of Industry 4.0 in SMEs [22]
- Maturity and Readiness Model for Industry 4.0 Strategy [23]
- Smart SMEs 4.0 Readiness Model [24]
- Industry 4.0 Maturity Assessment – the University of Warwick[25].

4 RESULTS

Adapting to the Fourth Industrial Revolution remains a critical competitiveness aspect. Adopting Industry 4.0 during a period of turmoil in worldwide production chains can create new investment opportunities. The significance of digital transformation in enhancing the contribution of economic sectors, particularly industry and construction, to GDP remains critical, since it improves the efficiency of production lines and supply networks. Cutting-edge technologies are a factor of survival in the post-Covid environment, while at the national level they may contribute to a new productive pattern. **In contrast to exogenous factors that affect competitiveness (such as in energy), the path to the 4th industrial age is nearly entirely dependent on each country and its businesses [1].**

4.1 Analysis of internal business environment

4.1.1 Greece

In Greece, adoption of Industry 4.0 technology is progressing faster than in the past, but not fast enough to close the gap with the EU. Although significant industrial companies are increasing technical expenditures, Greece's overall road to the fourth industrial age requires a compass and a faster rate of convergence with the rest of the EU's performance. **Listed below are both benefits and drawbacks of Greece's path to Industry 4.0 [26].**

4.1.1.1 Strengths (advantages)

As Greek SMEs embark on the journey to embrace Industry 4.0, **it is essential to recognize and leverage their unique strengths and advantages that they bring to the table as they adapt and thrive in the Industry 4.0 landscape.**

















1. Integration/ Information sharing and cross-functional collaboration

Integrated cross-departmental information sharing plays a pivotal role in the successful adoption of Industry 4.0 by Greek SMEs. It enables enhanced operational efficiency through real-time data access and data-driven decision-making, leading to cost savings and optimized resource allocation. This practice fosters a holistic view of operations, encourages collaboration and innovation, and facilitates a customer-centric approach, crucial in today's competitive landscape. Moreover, it ensures compliance with regulatory standards, promotes adaptability to evolving technologies, and ultimately enhances the competitiveness of Greek SMEs, both domestically and on the global stage. **Integrated information sharing is the linchpin that empowers these SMEs to thrive in the digital era and navigate the complexities of Industry 4.0 adoption successfully.**

It becomes clear by examining the results of the assessment survey that **integration/ information sharing is a strong suit of Greek SMEs, especially regarding integrated cross – departmental information** (Table 5).

External integration/ information sharing with costumers and/or suppliers remains in lower levels, especially in departments, such as Finance/ Accounting and Logistics.

Table 5: Internal and external integration/ information sharing

| | Internal Integration/ Information sharing between departments | External Integration/ Information sharing with costumers/ suppliers |
|---------------------------|---|---|
| Research & Development |  58% |  28% |
| Production/ Manufacturing |  37% |  25% |
| Purchasing |  51% |  23% |
| Logistics |  28% |  16% |
| Sales |  55% |  23% |
| Finance/ Accounting |  51% |  18% |
| Service |  44% |  32% |
| IT |  53% |  23% |

In addition to the above, **cross-functional collaboration and knowledge transfer are crucial for transitioning to Industry 4.0** because they facilitate the holistic integration of digital technologies across diverse organizational functions, ensuring that expertise from various departments is leveraged to maximize the benefits of advanced technologies and drive innovation.

Greek SMEs seem to have an **advantage in that department with 76.7% of the surveyed companies** reporting that they are employing digital technologies to improve cross-functional collaboration and knowledge transfer within the company.

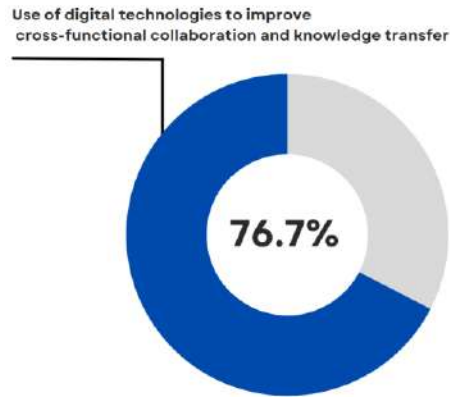


Figure 5: 76.7% of surveyed companies make use of digital technologies to improve cross-functional collaboration and knowledge transfer within the company

2. Leveraging Digital Solutions

It is imperative for Greek SMEs to harness digital software solutions for supplier management, product/service lifecycle tracking, and systematic analysis of digitally collected production and usage data. Embracing these digital tools empowers SMEs to enhance supply chain efficiency, streamline operations, and respond swiftly to market dynamics. By efficiently managing suppliers, they ensure a consistent flow of high-quality inputs. Tracking products and services throughout their lifecycle enables better product quality control and more accurate demand forecasting. Moreover, systematic analysis of data provides valuable insights for optimizing production processes and tailoring offerings to customer needs, ultimately driving competitiveness and sustainability in an increasingly data-driven business landscape.

The majority of surveyed companies are actively leveraging digital solutions as shown in Figure 6.

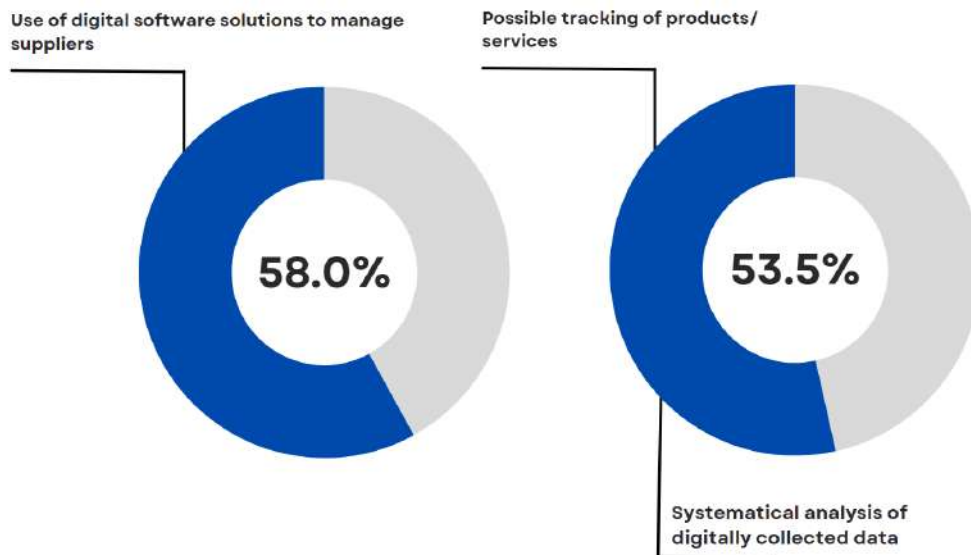


Figure 6: 58% of surveyed companies make use of digital software solutions to manage suppliers; 53.5% of surveyed companies track products/ services throughout their life-cycle and analyse digitally collected data

3. Leadership and Culture change

Leadership is essential for the successful promotion of a culture of innovation. Therefore, leaders and leadership style play a key role in the paradigm shift towards Industry 4.0 [2].

Digital leadership (leadership 4.0) is fast, cross-cutting, team-based, and collaborative leadership with a strong focus on innovation. This phase of digital transformation is very demanding and full of challenges that require non-traditional leadership skills and approach to compete in this situation for the survival of companies. Leadership 4.0 should foster an agile environment that is essential for driving innovation forward quickly and creating higher customer satisfaction. **Through leadership 4.0, on one hand, the culture of enterprises is being influenced and, on the other hand, the work of enterprises itself is being influenced** [27].

Almost all of the surveyed companies (97.6%) recognize the top management as a driver of their company's digital transformation as well as middle management as a strong supporter (88.3%).

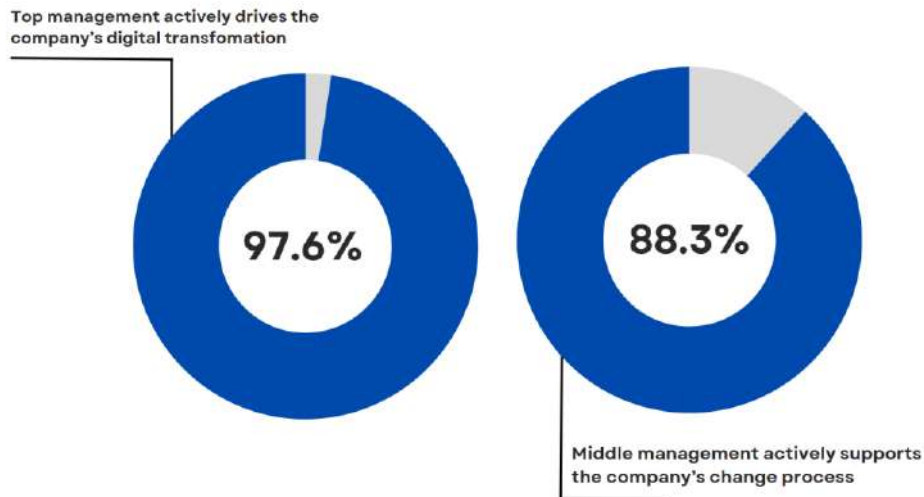


Figure 7: 97.6% of surveyed companies highlight top management as a driver of digital transformation; 88.3% of surveyed companies recognize middle management as a supporter of digital change

In conclusion, Greek SMEs are well-positioned to thrive in the Industry 4.0 landscape by capitalizing on their strengths. Integrated cross-departmental information sharing, a cornerstone of Industry 4.0 adoption, is already a strong suit for Greek SMEs, although there is room for improvement in external integration. Additionally, these SMEs are actively leveraging digital solutions for supply chain management, product lifecycle tracking, and data analysis, which bolsters their competitiveness. Furthermore, their leadership recognizes the importance of digital transformation and is actively driving the culture of innovation, with top management leading the charge and middle management providing strong support. **By embracing their unique advantages and continuing to adapt, Greek SMEs are well-equipped to excel in the era of Industry 4.0, both domestically and globally.**

4.1.1.2 Weaknesses (disadvantages)

By analyzing the assessment questionnaire results, it is possible to **identify and prioritize** the weaknesses and barriers that Greek enterprises encounter while adopting 4.0 technologies.

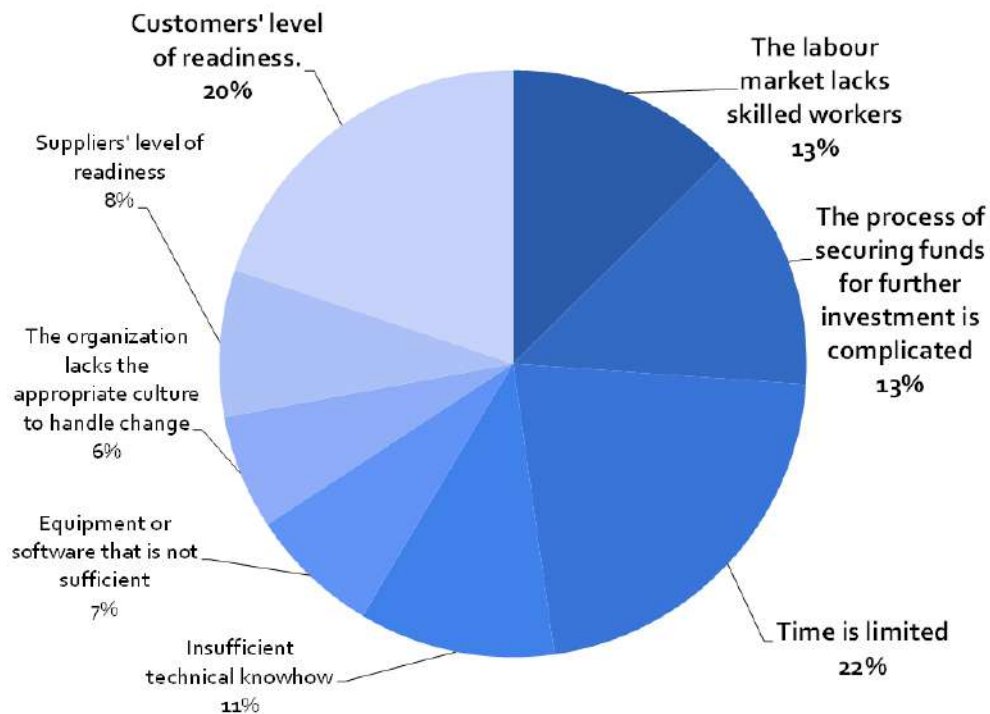


Figure 8: Weaknesses and barriers of Industry 4.0 adoption according to the Assessment Survey

As indicated in Figure 8, 22% of the surveyed organizations identify **lack of time** as a major limitation in transitioning to Industry 4.0 processes and technologies. Customers' level of readiness, limited funds, and shortage of skilled staff follow with 20, 13, and 13%, respectively.

1. Limited Time

Limited time can be a weakness when it comes to adopting I4.0 for several reasons:

- **Implementation Complexity:** Transitioning to an I4.0-enabled environment often requires significant changes to existing processes, systems, and equipment. This complexity can make it difficult to complete the transformation within a limited timeframe, leading to rushed decisions and potentially costly mistakes.

In terms of tracking the implementation status of Industry 4.0 with the ultimate goal of identifying and overcoming possible barriers all while setting clear measurable targets, **53.5% of the surveyed companies have yet to set a clearly defined approach**. In addition to that, the majority of the companies (53.5%), **have limited or no use of digital models** for continuous planning, design and monitoring their business processes, thus enhancing the Industry 4.0 implementation complexity.

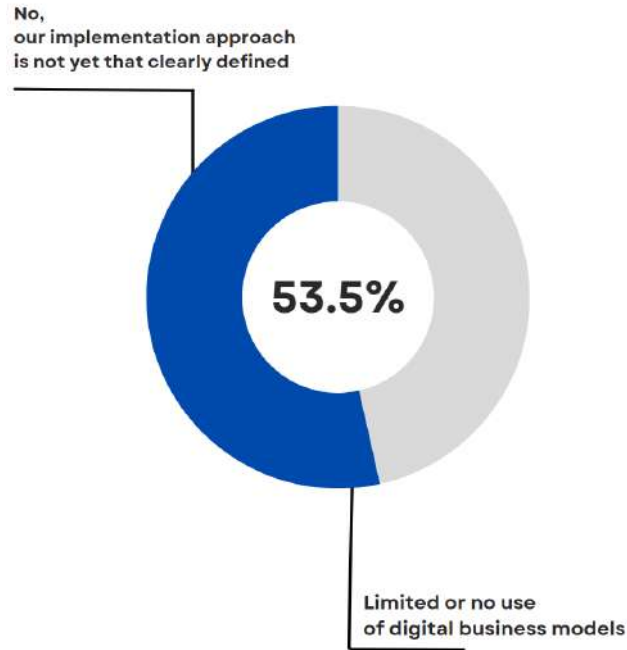


Figure 9: 53.5% of surveyed have not yet clearly defined an Industry 4.0 implementation approach and make limited or no use of digital business models

- Planning and Strategy:** Developing a comprehensive strategy for I4.0 adoption, including selecting the right technologies, assessing the organization's readiness, and designing an effective roadmap, takes time. Rushing through these crucial planning stages can result in suboptimal choices and implementation gaps.

It is very important to note that only 5% of the surveyed companies have already implemented an Industry 4.0 strategy. Most of the companies have a strategy in implementation (42%) while 30 % of the companies are in the process of developing their strategy and 12% have not even formulated one.

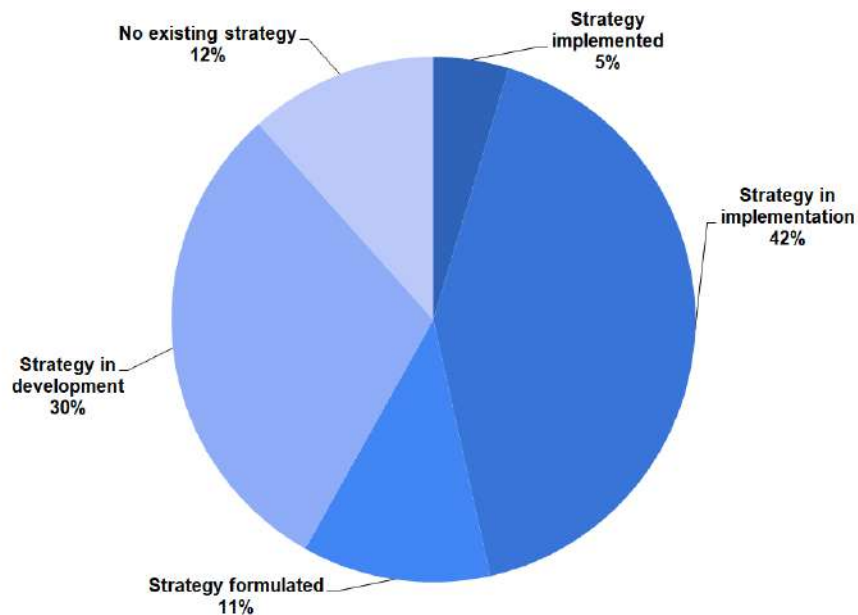


Figure 10: I4.0 strategy implementation stages of surveyed SMEs

This image of small and medium-sized businesses is consistent with the country's lack of an Industry 4.0 strategy. It is worth noting at this point that 22 of the 27 EU nations have already implemented digital transformation and Industry 4.0 policies [26].

- **Integration Challenges:** I4.0 involves integrating various technologies like IoT sensors, big data analytics, cloud computing, and automation systems. Ensuring seamless integration and compatibility among these components is essential, and doing so under time constraints may lead to integration issues and operational disruptions.

Prior to the pandemic, there was a **clear technological gap between industrial (and non-industrial) SMEs and large firms in Greece**. Even during the pandemic, the latter are consistently investing in highly specialized technologies [26]. Before Covid-19, just 9% of SMEs had digitized their supply chains (big enterprises: 29%), 15% used customer management systems (large enterprises: 40%), and 13% used analytics tools to harness their data (large enterprises: 20%). In the EU, major firms lead the way in implementing Industry 4.0 efforts, with 54% successfully integrating digital technologies into their operations, compared to only 17% of SMEs [26].

Table 6: Comparison of Greek and European SMEs' digital technology integration [28]

| | Greece | | | EU |
|--|-------------|-------------|-------------|-------------|
| | DESI 2020 | DESI 2021 | DESI 2022 | DESI 2022 |
| 3a1 SMEs with at least a basic level of digital intensity % SMEs | NA | NA | 39% 2021 | 55% 2021 |
| 3b1 Electronic information sharing % enterprises | 38% 2019 | 38% 2019 | 35% 2021 | 38% 2021 |
| 3b2 Social media % enterprises | 19% 2019 | 19% 2019 | 29% 2021 | 29% 2021 |
| 3b3 Big data % enterprises | 13% 2018 | 13% 2020 | 13% 2020 | 14% 2020 |
| 3b4 Cloud % enterprises | NA | NA | 17% 2021 | 34% 2021 |
| 3b5 AI % enterprises | NA | NA | 4% 2021 | 8% 2021 |

All of the above can also be confirmed by analyzing the assessment survey results and specifically the smart operations¹ section.

¹ Smart Operations include information sharing, analytic capabilities, cloud usage, IT security and autonomous processes.

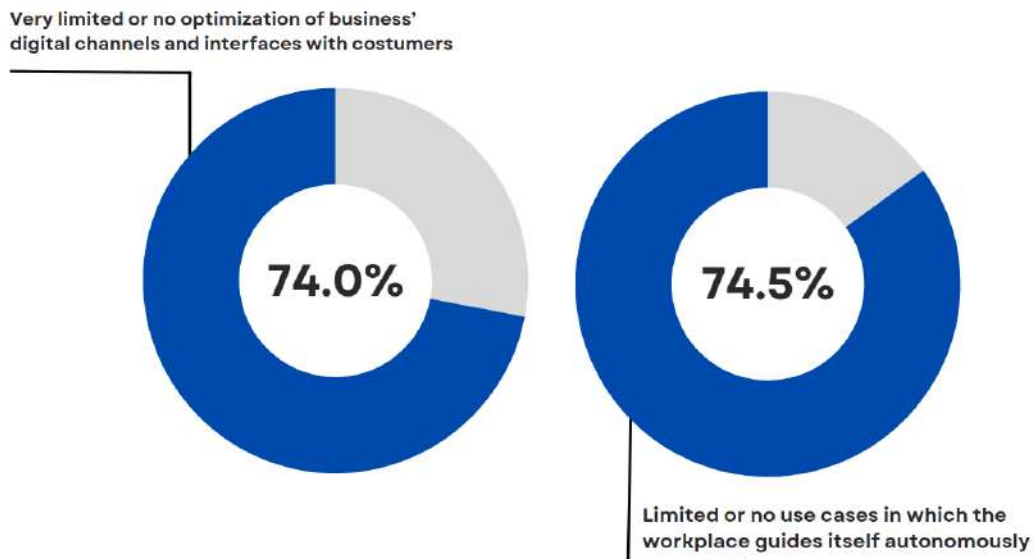


Figure 11: 74% of surveyed SMEs have no production processes that respond automatically in real time; 74.5% have limited or no use cases in which the workplace guides itself autonomously in the production process

Finally, when it comes to regularly updating their IT infrastructure to keep up with technological developments (i.e. regular or demand oriented adaptation of software and hardware such as mobile infrastructure, applications for broadband networks, cloud solutions, mobile end devices, powerful analytics applications), 47% of surveyed enterprises agree with that statement.

2. Customers' Level of Readiness

Customers' readiness can be a significant obstacle for businesses when adopting Industry 4.0 technologies for several reasons:

- **Lack of Understanding and Digital Divide:** Many customers may not fully understand what I4.0 technologies entail. They might be unfamiliar with concepts like IoT (Internet of Things), AI (Artificial Intelligence), and data analytics, **making it challenging for businesses to convince them of the benefits**. In addition, not all customers have equal access to technology. There is a digital divide based on factors like age, income, and geographic location. Customers who **lack access to the necessary digital infrastructure** or who are not comfortable with technology may not be ready to engage with I4.0 solutions.

This identified weakness can also be confirmed by analyzing the overall digital maturity of the country. **Greece ranks 25th of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). On Human capital, Greece ranks 22nd of 27 EU countries, scoring below the EU average.** Equipping people with digital skills is a fundamental goal of Greece's digital transformation strategy. To that end, a strategy for digital skills was jointly developed by the Ministry of Digital Governance, the Ministry of Education and Religious Affairs and the Ministry of Labour and Social Affairs. The strategy sets out three targets: (i) to enhance digital knowledge; (ii) to consolidate the National Academy of Digital Competences; and (iii) to strengthen the Greek National Coalition for digital skills [27]

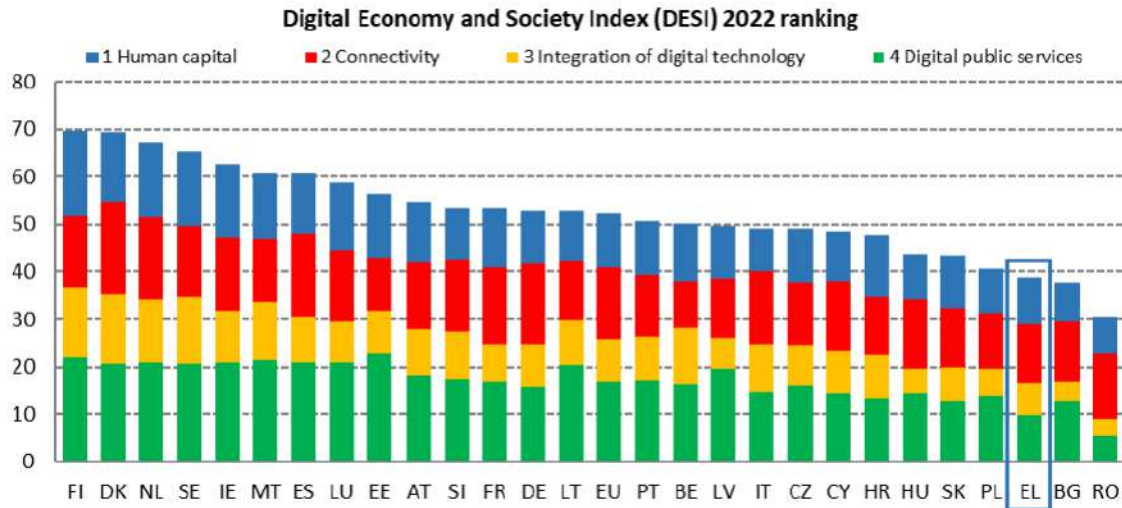


Figure 12: Digital Economy and Society Index (DESI) 2022 Ranking: Greece [28]

- Resistance to Change:** People often resist change, especially if it disrupts their established habits or processes. I4.0 technologies can bring significant changes in how products and services are delivered, and customers might be resistant to adopting new ways of interacting with a business.

The above has been proved to act as a **barrier when it comes to integrating and optimizing businesses’ digital channels and interfaces with the costumers.**

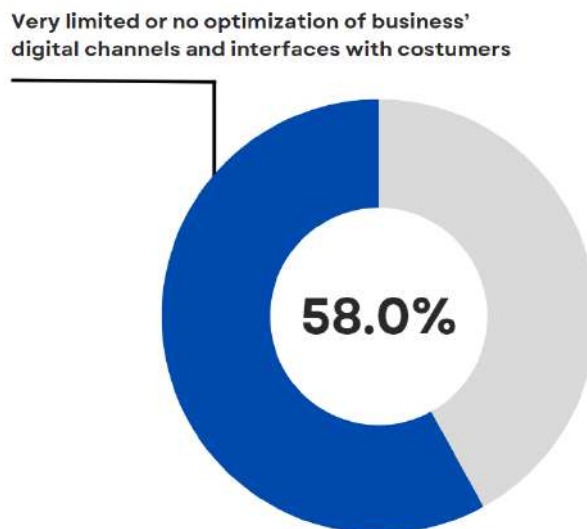


Figure 13: 58% of surveyed companies conduct very limited or no optimization of business’ digital channels and interfaces with costumers

- Security Concerns:** I4.0 technologies involve the collection and processing of large amounts of data. Customers may be concerned about the security of their personal information or data breaches, leading them to hesitate in adopting such technologies.

The above concern is highlighted in the assessment survey when enterprises were asked whether they follow appropriate standards and regulations when it comes to IT Security.

The majority of companies (49%) is not fully complying and cannot adequately tackle customers' security concerns.

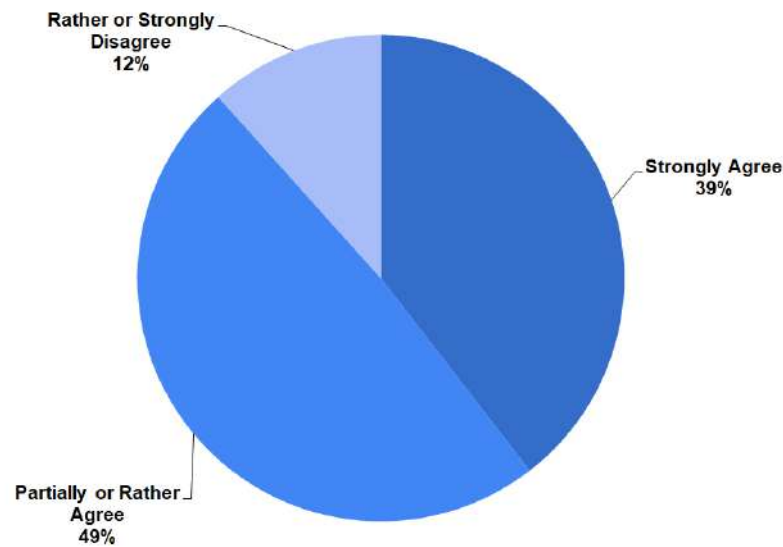


Figure 14: 49% rather and/or partially follow appropriate standards and regulations; 39% fully follow appropriate standards and regulations; 12% do not follow appropriate standards and regulations at all;

- **Cost Considerations:** Some I4.0 technologies can lead to higher costs initially, which might be passed on to customers. Customers who are cost-sensitive may be reluctant to embrace these technologies if they perceive them as leading to higher prices.

3. Limited Funds

A major obstacle regarding the integration of Industry 4.0 technologies to SMEs' production processes is the limited access to funds and the inability for further investments.

In July 2021, the Ministry of Digital Governance announced the Digital Transformation Bible for the period 2020-2025, which constitutes the national strategy for the broader digital transformation of the economy, focusing to a particularly large extent on the digital transition of the public sector. The Bible includes an extensive portfolio of approximately 450 digital transition projects, with an estimated budget of €7 billion. **Of these, only approximately 20 projects concern actions to strengthen businesses in the context of Industry 4.0** [26].

This inability of businesses in terms of securing resources exclusively dedicated to Industry 4.0, is also reflected in the results of this research where the majority of companies (60%) have not fully allocated sufficient budget for Industry 4.0 investments.

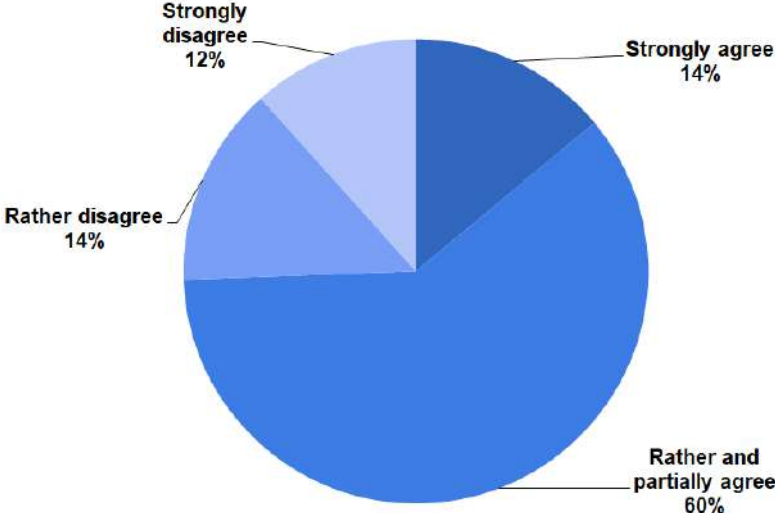


Figure 15: 60% of companies have not fully allocated sufficient budget for I4.0 investments; Only 14% have successfully allocated sufficient budget for I4.0 investments

It is also of interest, that firms have financed their Industry 4.0 strategy and investments mainly using their own funds (34%) while 23% of surveyed firms allocated no funds to I4.0 investments.

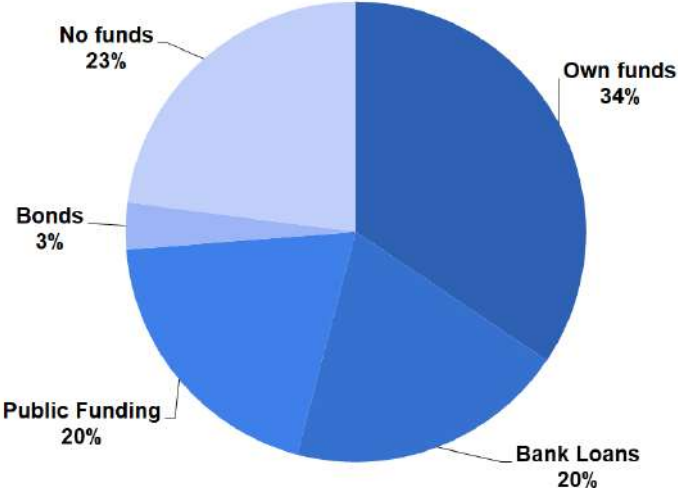


Figure16: Source of Industry 4.0 budget of surveyed companies (last 3 years)

The securing and allocation of I4.0 funds seems to remain a weakness for the surveyed firms in the near future as well (next 5 years), since the majority of the companies reported that they will try to pursue public funds (31%), but at the same time 26% of the companies are still planning to invest their own funds while 20% will not allocate funds towards their Industry 4.0 strategy at all.

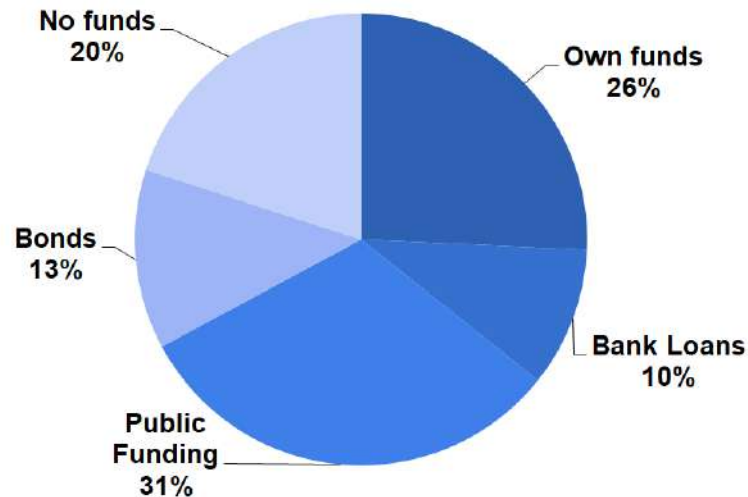


Figure 17: Source of Industry 4.0 budget of surveyed companies (next 5 years)

As a result of the inability to secure resources, Greek businesses make limited investments in digital systems, with the amortized value of fixed ICT occupying 5.3% of GDP. **Examples of digital transformation are limited to a few large groups without extension to other industries.** Thus, the majority of Greek businesses often focus on systems with outdated capabilities.

4. Lack of skilled workers

The Greek Industry 4.0 already faces **shortages of human resources to maintain and increase its production, its exports, and overall added value**, as there is not a sufficient supply in several specialties that organized and modern businesses, especially in industry, demand. In order for the Greek industry to keep up with the revolutionary technological developments of the digital transformation and the 4th Industrial Revolution, the existing knowledge, know-how, material and human capital must be rapidly improved [29].

The problem of attracting suitable personnel is more acutely faced by the most extroverted and large productive enterprises, because they are exposed to international competitive markets, and therefore have higher requirements for modern qualifications and skills. Shortages of workers with knowledge of cutting-edge technologies are growing rapidly, despite a significant number of new graduates in relevant fields. Indicatively, in the medium-long term these needs may exceed 10,000 additional workers, with 80% of the new Industry 4.0 professions we will need in 2030 not existing today. These figures show the extent of the needs arising for the industry and related sectors in qualified personnel.

The above weakness of Greece's internal business environment is also highlighted by the surveyed firms (Figure 18).

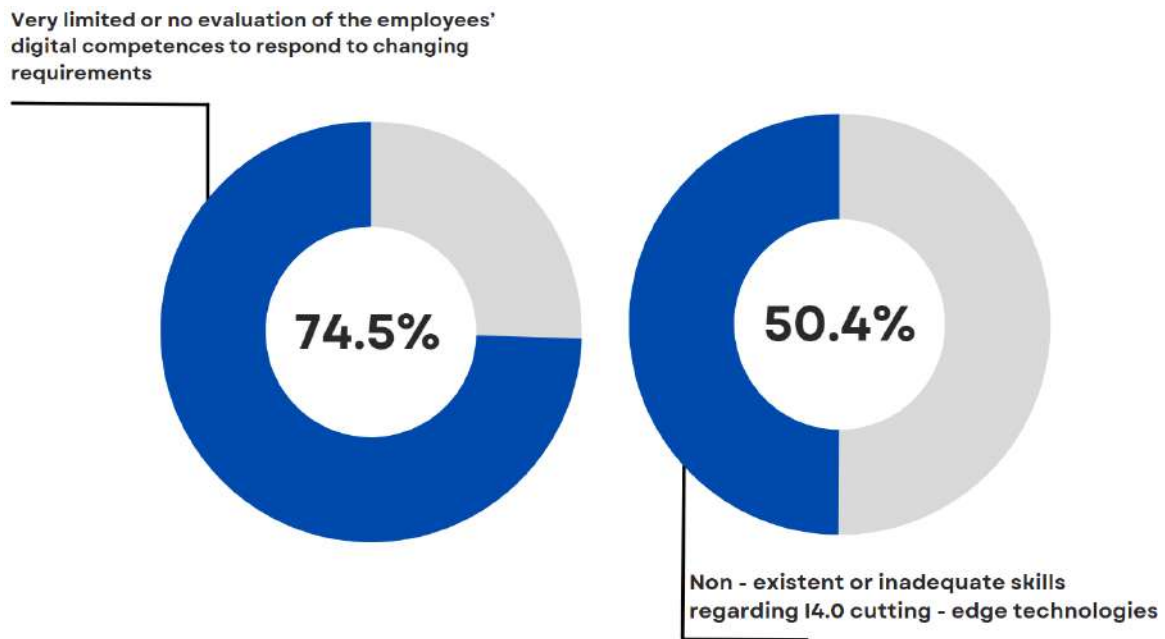


Figure 18: 74.5% of the surveyed companies conduct very limited or no evaluation of the employees' digital competences; 50.4% of the surveyed companies argue that their employees have non – existent or inadequate skills regarding I4.0 technologies (IT Infrastructure, Automation Technology, Data Security/ Communications Security, Development or application of assistance systems, Collaboration software, Non- technical skills such as systems thinking and process understanding);

In conclusion, Greece's pursuit of Industry 4.0 is marked by a **complex landscape of strengths and weaknesses**. While the country is **making progress in adopting advanced technologies and recognizes their significance in enhancing economic sectors**, there are substantial challenges to overcome. The weaknesses identified, including limited time for implementation, the absence of clear strategies, inadequate integration of digital technologies in SMEs, low digital maturity, customer resistance, and financial constraints, collectively underscore the need for a concerted effort to bridge these gaps.

Addressing these weaknesses is crucial for Greece to not only catch up with the rest of the EU but also thrive in the Fourth Industrial Revolution, ensuring long-term competitiveness and sustainable growth.

4.1.2 Bulgaria

A SWOT analysis of SMEs by sectors in the cross-border region between Greece and Bulgaria was prepared, which were further elaborated to carry out the current exercise.

Table 7. Strengths, weaknesses, opportunities and threats of the entrepreneurial ecosystem in the cross-border region for the successful implementation of Industry 4.0

| STRENGTHS | WEAKNESSES |
|--|---|
| <ol style="list-style-type: none"> 1. Positive attitude and understanding of the benefits and advantages of Industry 4.0 by the enterprises 2. Relatively high share of the processing industry in the CBC region 3. Relatively high level of use of digital technologies by enterprises 4. Availability of local ICT specialists who may be involved in the technological transition 5. Relatively high level of penetration of management systems in enterprises | <ol style="list-style-type: none"> 1. Unsatisfactory level of automation in a large part of enterprises (low labor productivity) 2. Lack of sufficient free financial resources to make investments in the transition to Industry 4.0 3. Lack of sufficient technical know-how among the personnel in the enterprises for rapid transition to Industry 4.0 4. Unfavorable educational level of employed persons 5. Lack of technically oriented R&D organizations in the cross-border region to support the technological transition |
| OPPORTUNITIES | THREATS |
| <ol style="list-style-type: none"> 1. Further development of the public digital infrastructure in Bulgaria 2. Use of external funding for the modernization of enterprises from the European Structural and Investment Funds and from the Recovery and Resilience Plan 3. Development of national policies to promote the transition to Industry 4.0 4. Establishment of enhanced collaborations with research organizations 5. Building partnerships, including international (cross-border) and participation in clusters | <ol style="list-style-type: none"> 1. Increasing cyber security risks in the enterprises 2. Deterioration of the business environment in Bulgaria (post Covid-19 effects, the war in Ukraine, high inflation, etc.) 3. Deterioration of the state of the educational infrastructure providing qualified personnel on the labour market 4. Knowledge and technology leakage (in the form of intellectual property and human capital) 5. Deterioration of physical infrastructure (e.g. roads) in the CBC region |

These factors were put into a matrix to carry out the strategic orientation round.

Table 8. Strategic orientation matrix

| | | Opportunities (external environment) | | | | | Threats (external environment) | | | | | TOTAL |
|--------------------------------------|--|--|--|---|--|----------------------------------|---------------------------------------|--|--|-------------------------------------|------------------------------|-------|
| | | O1 Further development of the public digital | O2 External funding for the modernization of | O3 Development of national policies for the transition to | O4 Enhanced cooperation with R&D organizations | O5 Establishment of partnerships | T1 Cybersecurity risks in enterprises | T2 Deterioration of the business environment | T3 Deterioration of educational infrastructure | T4 Knowledge and technology leakage | T5 Deterioration of physical | |
| Strengths (internal environment) | S1 Positive attitude and understanding of the benefits and advantages of Industry 4.0 | 8 | 48 | 8 | 56 | 40 | 32 | 8 | 16 | 16 | 8 | 240 |
| | S2 Relatively high share of manufacturing industry | 8 | 56 | 32 | 8 | 16 | 16 | 8 | 8 | 8 | 4 | 164 |
| | S3 Relatively high level of application of digital technologies by enterprises | 40 | 32 | 32 | 32 | 24 | 48 | 16 | 24 | 8 | 16 | 272 |
| | S4 Availability of local ICT specialists who may be involved in the technological transition | 40 | 32 | 18 | 24 | 24 | 56 | 16 | 16 | 24 | 8 | 258 |
| | S5 Relatively high level of introduction of management systems in businesses | 32 | 24 | 32 | 24 | 24 | 48 | 16 | 16 | 48 | 24 | 288 |
| Weaknesses (internal environment) | W1 Unsatisfactory level of automation | 40 | 4 | 24 | 16 | 24 | 40 | 24 | 24 | 16 | 32 | 244 |
| | W2 Lack of sufficient free financial resources to make investments in the transition to Industry 4.0 | 8 | 32 | 16 | 16 | 8 | 16 | 32 | 32 | 24 | 32 | 216 |
| | W3 Lack of sufficient technical | 8 | 32 | 16 | 24 | 24 | 16 | 8 | 4 | 24 | 8 | 164 |

| | | | | | | | | | | | | |
|--------------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| | know-how amongst the personnel in enterprises | | | | | | | | | | | |
| | W4 Unfavorable educational level of the employed persons | 8 | 32 | 8 | 24 | 24 | 16 | 8 | 4 | 8 | 8 | 140 |
| | W5 Lack of technology-oriented R&D organizations in the cross-border region | 24 | 8 | 32 | 64 | 48 | 16 | 48 | 64 | 4 | 16 | 324 |
| TOTAL | | 216 | 300 | 218 | 288 | 256 | 304 | 184 | 208 | 180 | 156 | 2 310 |

4.1.2.1 Strengths (advantages).

Analysis of the results shows the following:

The **strengths** that have the greatest positive impact on the entrepreneurial ecosystem in the cross-border region for the successful implementation of the principles of Industry 4.0 are the following:

- The relatively high level of use of management systems in business
- The relatively high level of application of digital technologies by enterprises, especially in medium and high-tech industries and in companies that provide high-tech services

4.1.2.2 *Weaknesses (disadvantages)*

The most significant **weaknesses** of the entrepreneurial ecosystem that make the transition to Industry 4.0 difficult are:

- Absence of technically oriented scientific research organizations and universities in the cross-border region to assist in increasing the innovativeness of enterprises through the commercialization of industrial property rights to increase their competitiveness
- The unsatisfactory level of automation in a large part of the enterprises, especially those that fall into the sector of low-knowledge-intensive services or low-tech industries.

4.2 Analysis of external business environment

4.2.1 Greece

4.2.1.1 Business opportunities

The diverse landscape of business opportunities presented by National Programs and Initiatives, as well as EU Programs and Initiatives is presented below. Detailed information about each program and initiative can be found in DEL3.2.

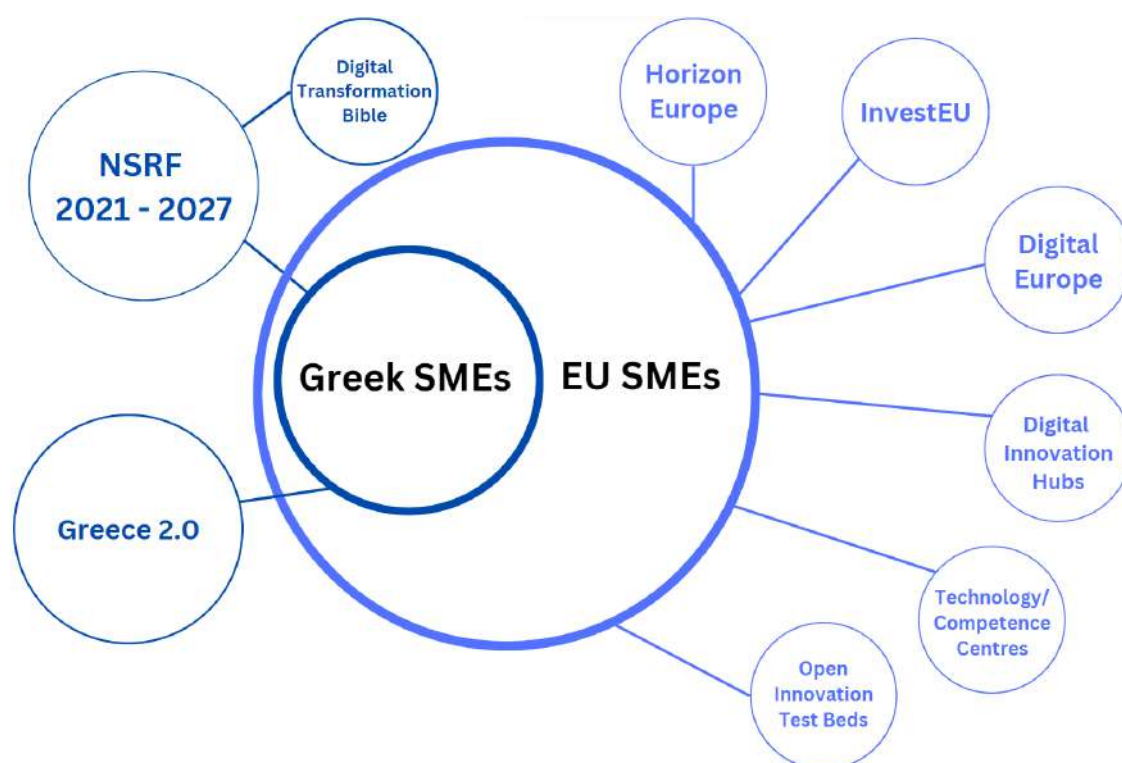


Figure 18: Business Opportunities for Greek and EU SMEs

4.2.1.2 Business risks

The transition to Industry 4.0 (I4.0) presents numerous opportunities for SMEs, but it also comes with its fair share of business risks and challenges. Some of the key risks that SMEs may face include:

1. **Job losses**, industry 4.0 will replace low skilled and low wage jobs by computers and digitization thus increasing the social tensions and pessimistic ideas against industry 4.0 [27].

Industry 4.0, characterized by the integration of digital technologies and automation in manufacturing and various industries, has the potential to impact a wide range of professions to varying degrees. **The extent to which automation can replace jobs depends on the specific tasks and responsibilities within each profession, but it primarily poses a risk to unskilled workers, manual workers, small professionals, operators of industrial plants, machinery, and equipment, and non-manual low-skilled professions.**

These professions constitute a significant and growing proportion of the country's total workforce (Graph 15) [28]:

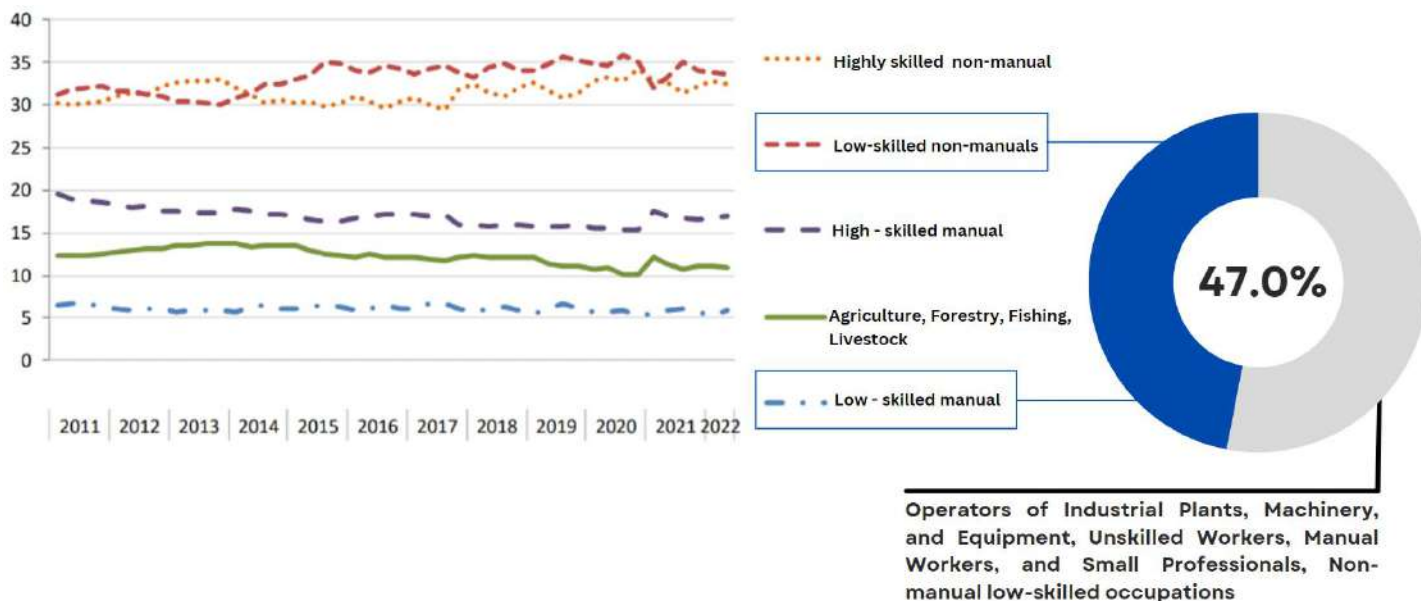


Figure 19: Unskilled workers, manual workers, small professionals, operators of industrial plants, machinery, and equipment, and non-manual low-skilled professions constitute 47% of total workforce [28]

2. Data and Information Security

In theory, the greatest risk when employing Industry 4.0 approaches is the cyber-security risk of IT products. Machine and user network connections will provide fodder for those looking to circumvent security settings in order to leak commercial data and acquire technology and know-how. Cyber attacks should be regarded seriously since any user with access to a terminal, regardless of location, can operate systems remotely. **This will result in higher application expenses and larger investment in security to ensure that valuable data is not lost, thus it is understood that in any situation, security is critical** [29].

In December 2020, **Greece published the National Cybersecurity Strategy (2020-2025)**, an umbrella strategy covering all important and critical sectors that includes a series of actions under the flagship activity program. The Russian invasion of Ukraine has precipitated quick strategic actions and restrictive measures, well ahead of schedule. Examples include (a) the development of a framework to promote excellence in cybersecurity; (b) the increase of the readiness - alerting level of critical infrastructure and take all related measures, such as daily security alerts; (c) the design of a Monitoring Centre for the Critical Infrastructures - Security Operations Center – SOC; (d) the full operation of the protection system regarding governmental web sites. The Hellenic Telecommunications and Post Commission also took appropriate measures, in cooperation with the providers, to ensure the suspension of retransmission of two Russian channels abiding by the EU guidelines.

3. Global competition

Greek SMEs face competition from other EU countries that **have advanced further in their I4.0 adoption, potentially affecting their market share and competitiveness**. When Greece is compared to the rest of Europe, it is discovered that **we underperform in both digital maturity**

(horizontal axis) and industrial size (vertical axis). Several digitization initiatives have been implemented in the recent two years, which have improved the country's image [26].

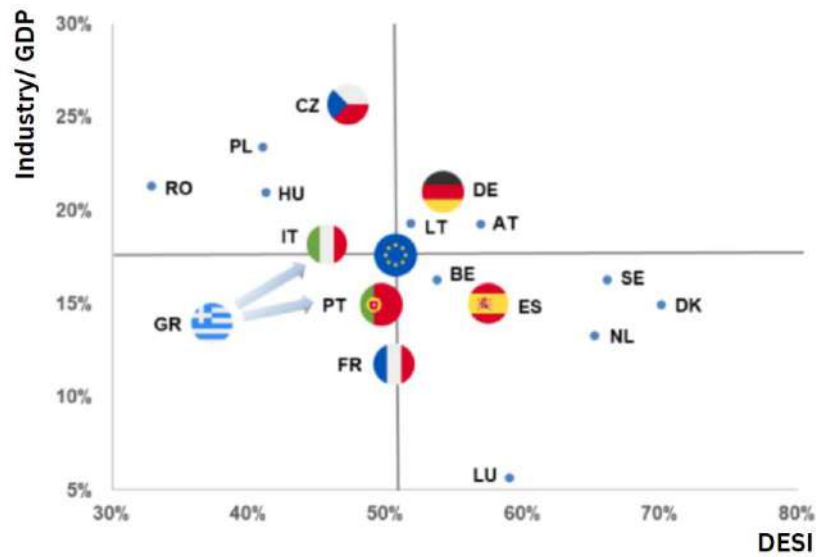


Figure 20: Greece compared to EU countries' digital maturity and industrial size

It is becoming clear that the 4th industrial revolution creates new conditions of international competition and requires **adaptation with a coordinated strategy**.

4.2.2 Bulgaria

4.2.2.1 *Business opportunities*

The opportunities provided by the external environment that may support the transition of the business to Industry 4.0 are the following:

- Available external financing for the modernization of enterprises – various procedures, financed by the European Structural and Investment Funds, the Recovery and Resilience Plan, etc.
- Strengthening of cooperation with scientific and research organizations external to the region, which can support the introduction of technological solutions in enterprises for a smooth transition to a new level of technology.

4.2.2.2 *Business risks*

The main **threats** that may complicate the transition and for which measures should be taken to limit their negative impact, should they materialize, are the following:

- Cyber security risks in enterprises – solutions are needed to ensure adequate protection
- Deterioration of educational infrastructure in the cross-border region, especially in the secondary education system – for this purpose, measures should be taken for the wide introduction of dual education, prioritization of training in vocational high schools and the wide introduction of STEM education in general education schools.

4.3 Assessment of SMEs readiness & adaptability for the changing technology landscape

Based on all of the above, there follows the **SWOT** analysis of Greek SMEs' readiness regarding Industry 4.0 adoption:

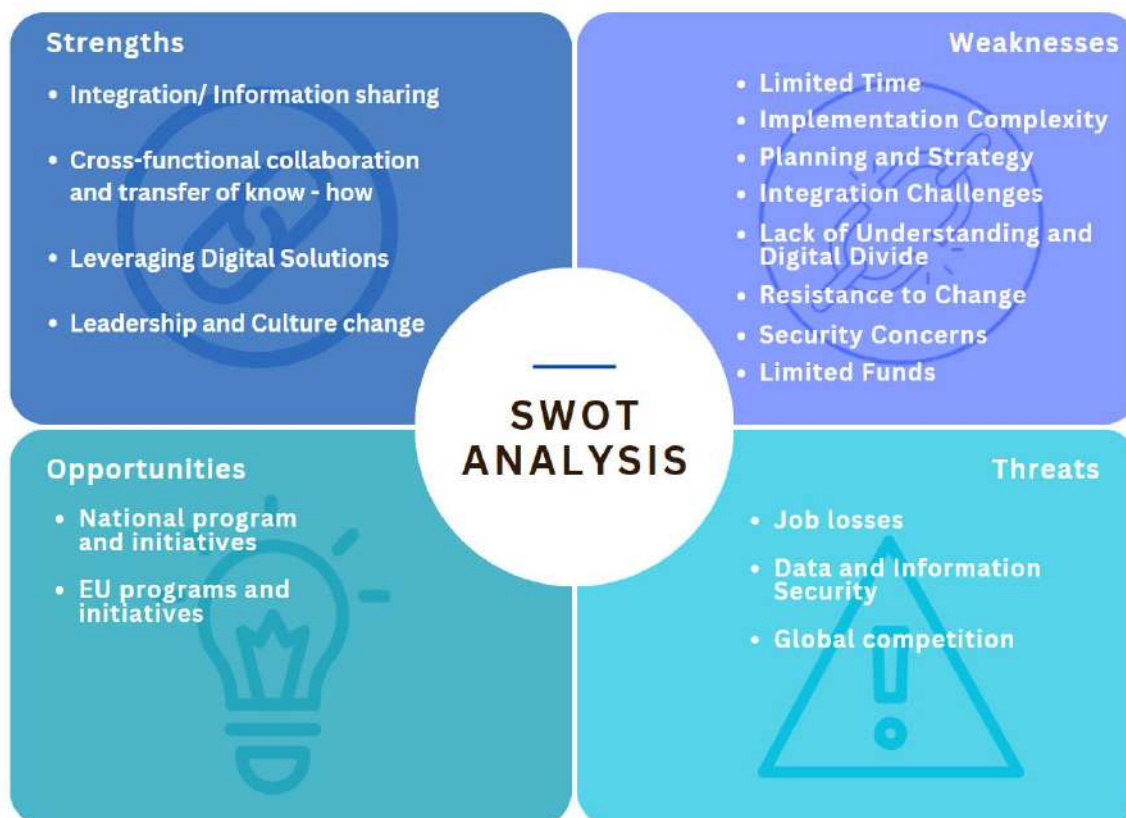


Figure 21: SWOT Analysis of Greek SMEs' adaption to Industry 4.0

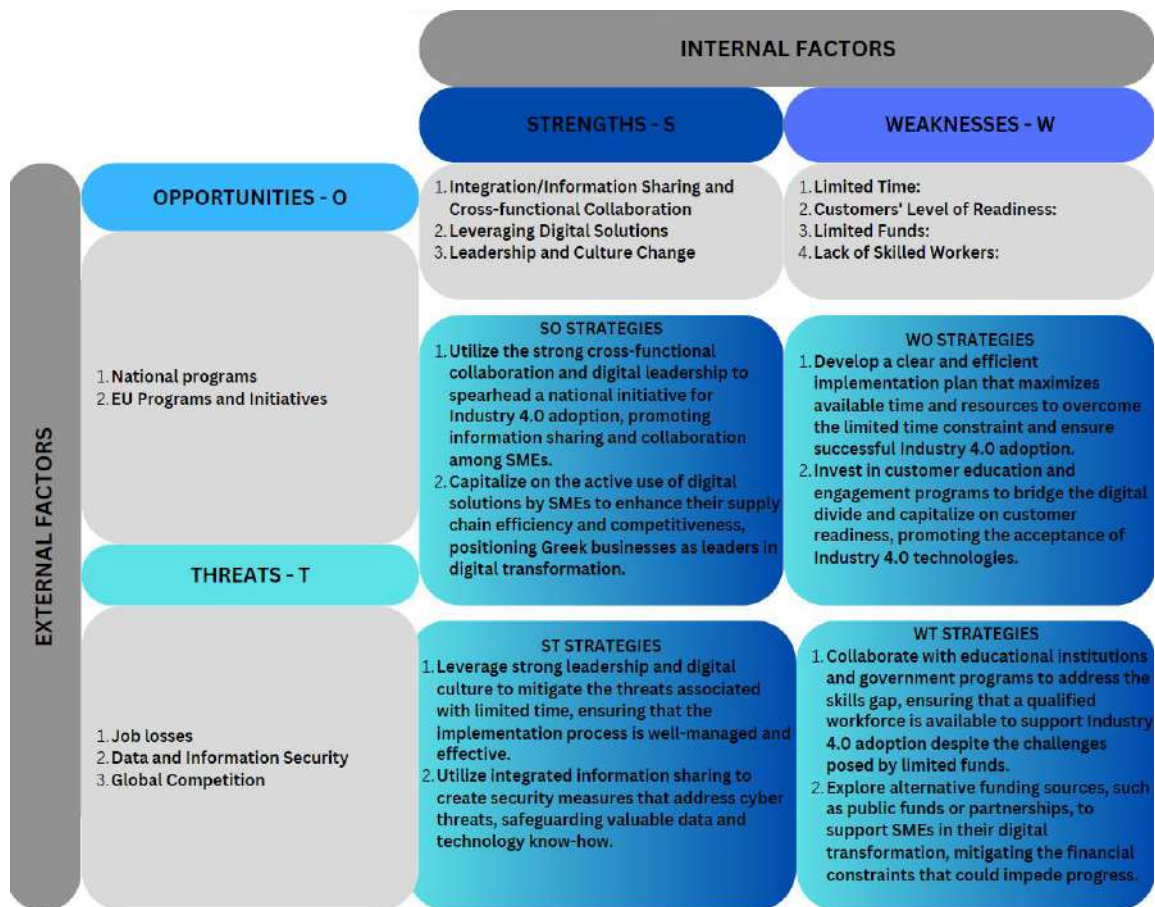
Assessing the readiness of Greek SMEs to adapt to Industry 4.0 (I4.0) based on the provided SWOT analysis reveals a **mixed landscape**. On the strengths side, Greek SMEs appear to have a good foundation in terms of integration, information sharing, and cross-functional collaboration. This is a positive sign as I4.0 heavily relies on seamless communication and data sharing between various functions and departments. Furthermore, their willingness to leverage digital solutions and embrace leadership and culture change indicates an openness to adopt new technologies and adapt to the changing business landscape. **These strengths suggest that Greek SMEs have a solid foundation to build upon when it comes to I4.0 adoption.**

However, there are notable weaknesses and challenges that Greek SMEs need to address in order to fully embrace I4.0. Limited time and resources, as well as implementation complexity, are significant hurdles. Greek SMEs may struggle to allocate the necessary funds and time required for the transformation. Additionally, planning and strategy seem to be lacking, which is crucial for a successful I4.0 transition. Integration challenges and a potential digital divide could also hinder progress, especially if certain sectors or regions lag behind in adopting digital technologies. Resistance to change, both from within the organization and among customers, is another obstacle. Greek SMEs will need to invest in change management and education to overcome this resistance. Finally, security concerns, both in terms of data and information security, could pose a significant threat if not adequately addressed. **In light of these weaknesses and challenges, Greek SMEs**

should actively seek opportunities in EU and national programs and initiatives that can provide funding, resources, and support for their I4.0 journey while also addressing the threat of job losses and global competition through upskilling and innovation.

Overall, Greek SMEs have the potential to adapt to I4.0, but they must address their weaknesses and capitalize on opportunities to stay competitive in a rapidly changing digital landscape.

To facilitate that process, a **TOWS Matrix** is developed in order to help identify strategies by matching external threats and opportunities with internal weaknesses and strengths.



5 CONCLUSIONS

Within the dynamic realm of modern business, the journey of SMEs often hinges on their ability to adapt and innovate. This report, centered on the Greece-Bulgaria Cross-Border Cooperation (CBC) Area, recognizes the critical importance of strategic recommendations to empower SMEs for success. As the report unfolds, it becomes evident that the economic landscapes of both countries hold unique opportunities and challenges. In response, a set of carefully crafted recommendations emerges, each designed to address specific facets of SME growth and resilience.

The recommendations presented here draw upon the rich tapestry of findings and insights garnered from our analysis of SME readiness and adaptability. They are more than mere directives; they represent a blueprint for fostering collaboration, embracing technological evolution, and enhancing competitiveness. By implementing these recommendations, stakeholders, policymakers, and SMEs can collectively chart a course toward sustained prosperity in the CBC Area, underlining the importance of agility and innovation in the face of a constantly shifting business environment.

Cross-border collaboration among SMEs is paramount for leveraging the strengths of both Greece and Bulgaria while mitigating weaknesses. Encouraging SMEs to form strategic alliances, partnerships, and industry clusters can lead to economies of scale, increased market reach, and shared knowledge. Additionally, fostering networking events, trade fairs, and business associations can facilitate knowledge exchange and collaboration. Policymakers should incentivize and support such initiatives, ensuring that SMEs are well-connected and can tap into the broader regional and international markets.

In the rapidly evolving technological landscape, investment in technology infrastructure and digitalization is crucial. Governments and industry associations should provide financial incentives, grants, or low-interest loans to encourage SMEs to modernize their operations. Specialized training and consultancy services can be made available to guide SMEs in adopting Industry 4.0 technologies. Furthermore, creating technology clusters or innovation hubs that SMEs can access can foster a culture of innovation and collaboration. Encouraging technology partnerships with research institutions and larger enterprises can also accelerate technology adoption among SMEs, ensuring they remain competitive and adaptable in an increasingly digital world.

In summary, these recommendations aim to empower SMEs in the CBC Area to harness their potential for growth while effectively navigating the challenges posed by the changing technology landscape. Collaboration and investment in technology will be instrumental in positioning these SMEs for long-term success, enabling them to thrive in the modern business environment.

6 APPENDIX A: QUESTIONNAIRE

6.1 Industry 4.0 Survey

*The purpose of survey is a maturity assessment of your company's readiness for Industry 4.0. The survey has 5 parts: (i) **Smart Products and Services**, (ii) **Smart Production**, (iii) **Smart Operation**, (iv) **Business Strategy, Organization and Processes**, and (v) **Employees and Competences**. Each part corresponds to one of the core Industry 4.0 dimensions. In each part, you will be asked a series of multiple choice questions with clear instructions about how many options should be selected. If question is beyond your knowledge, please select "No answer" option. It should take approximately **20-30 minutes** to complete the survey.*



Ethics and Security

In accordance with the core principles of the General Data Protection Regulation (GDPR) and the fundamental rights of participants in the **4th Industrial Revolution** project, the survey will be anonymous. The study results will be used for project research purposes only. Following the foregoing information and keeping in mind that data privacy techniques will be employed, please read, and cycle through each statement.

My **rights**, the **purpose** of the study, and the **research activities** were explained to me in the information above:

- Yes
- No

In my capacity as a **voluntary participant**, I agree to allow the consortium members to use my information for 4th Industrial Revolution project research purposes:

- Yes
- No

6.2 Company General Information

General Information about Company

Company name: _

Current position of the responder (from the management perspective) *:

Choose one of the following answers:

- Top management (CEO, director, etc.)
- Middle management (head of department, etc.)
- Lower management (project manager, team leader, etc.)
- Employees without management tasks (skilled workers, shop floor management, etc.)

Field of activity*:

Choose one of the following answers:

- Accounting/Controlling
- Human Resources
- Marketing/Sales
- Production
- Production scheduling
- Purchasing/Procurement
- IT
- Other

Company location (Country)*:

Choose one of the following answers:

- Greece
- Bulgaria

Industry type*:

Choose one of the following answers:

Deliverable 3.1

- Electronic
- Manufacturing
- Automation
- Logistic and Transport
- Textile Industry
- Petrol
- Agriculture
- Construction
- Food; drink; tobacco
- Mining
- Utilities (water; gas; electricity)
- Finance and insurance
- Other: _

Number of employees (including contracted, part-time, temporary)² *:

Choose one of the following answers:

- Micro SME (<10)
- Small SME (10-49)
- Medium-sized SME (50-249)

Annual turnover*:

Choose one of the following answers:

- Micro SME (<EUR 2 million)
- Small SME (<EUR 10 million)
- Medium-sized SME (<50 million)

Age of the Company (in years)*:

Choose one of the following answers:

- < 10
- 10 - 20

² <https://www.ggb.gr/sites/default/files/basic-page-files/SME%20Annual%20Report%20-%202021.pdf>

- Having the platform on which the services or cloud applications run
- None of the functionalities are supported.

Q1.2 Is the product/service capable of performing any steps in the data analysis process*?

Multiple choice possible:

- Descriptive – Capture products' condition, environment, and operation
- Diagnostic – Examine the causes of reduced product performance or failure
- Predictive – Detect patterns that signal impending events
- Prescriptive – Identify measures to improve outcomes or correct problems
- None of the steps are supported.

Q1.3 "It is possible to track your products/services throughout their life-cycle."*

Please choose one of the following answers that best corresponds to the above statement for your organisation: (linear scale)

- 1 Strongly agree
- 2 Rather agree
- 3 Partially agree
- 4 Rather disagree
- 5 Strongly disagree

Q1.4 "As part of its ongoing product and service portfolio improvement efforts, your company systematically analyses digitally collected production and usage data."*

Please choose one of the following answers that best corresponds to the above statement for your organisation: (linear scale)

- 1 Strongly agree
- 2 Rather agree
- 3 Partially agree
- 4 Rather disagree
- 5 Strongly disagree

6.4 Part 2: Smart Production

PART 2: SMART PRODUCTION

Smart or intelligent production is the term used for the growing networking of the entire production chain in Industry 4.0. Information and communication technology is playing an

increasingly significant role in facilitating more efficient and flexible production methods. This drives the networking of machines, services, and people throughout the production process. A key element of **Smart Production** is digital modeling, combined with smart data collection, storage, and processing. A company's progress in Smart Production is measured using the following criteria: *Equipment Infrastructure, IT Systems, Digital Modelling, and Data Usage.*

6.4.1 Equipment Infrastructure/IT Systems

SMART PRODUCTION Part 2-a: Equipment Infrastructure/IT Systems



Q2.1 "You update regularly your IT infrastructure to keep up with technological developments."*

Example: Regular or demand oriented adaptation of software and hardware such as mobile infrastructure (5G), applications for broadband networks, cloud solutions, mobile end devices, powerful analytics applications.

Please choose one of the following answers that best corresponds to the above statement for your organisation: (linear scale)

- 1 Strongly agree
- 2 Rather agree
- 3 Partially agree
- 4 Rather disagree
- 5 Strongly disagree

Q2.2 How do you evaluate your equipment infrastructure based on these functionalities? *
(multiple choice grid)

| | 1- Yes, completely | 2- Yes, to some extent | 3- No, not available |
|---|--------------------|------------------------|----------------------|
| Machines/systems can be controlled through IT | | | |
| M2M: machine-to-machine communication | | | |
| Interoperability: | | | |

| | | | |
|--|--|--|--|
| integration and collaboration with other machines/systems possible | | | |
|--|--|--|--|

6.4.2 Digital model/Data Usage

SMART PRODUCTION Part 2-b: Digital model/Data Usage

Q2.3 "You have already started collecting machine and production process data." *

Example: By digitizing the production process and building a digital model, data can be collected.

Please choose one of the following answers that best corresponds to the above statement for your organisation: (linear scale)

- 1 Strongly agree
- 2 Rather agree
- 3 Partially agree
- 4 Rather disagree
- 5 Strongly disagree

Q2.4 "You are using digital technologies to improve cross-functional collaboration and knowledge transfer within the company." *

Please choose one of the following answers that best corresponds to the above statement for your organisation: (linear scale)

- 1 Strongly agree
- 2 Rather agree
- 3 Partially agree
- 4 Rather disagree
- 5 Strongly disagree

Q2.5 Which of the following information systems do you use? Is there an interface between the system and the leading system? *

| | In use | | Interface to leading system | |
|-------------------------------------|--------|----|-----------------------------|----|
| | Yes | No | Yes | No |
| MES- Manufacturing Execution System | | | | |
| ERP-Enterprise Resource Planning | | | | |

| | | | | |
|-----------------------------------|--|--|--|--|
| PLM – Product Data Management | | | | |
| PPS – Production Planning System | | | | |
| PDA – Production Data Acquisition | | | | |
| MDC – Machine Data Collection | | | | |
| CAD -Computer-aided design | | | | |
| SCM – Supply Chain Management | | | | |

6.5 Part 3: Smart Operation

PART 3: SMART OPERATION

Smart operations use connectivity and automation to improve insights and predictability through advanced analytics, so operations are carried out as autonomously as possible. By doing so, employees can perform other types of tasks that require a greater degree of human capabilities, thus fostering innovation and creativity. Smart operations have several important characteristics, which include information sharing, analytic capabilities, cloud usage, IT security, and autonomous processes.

6.5.1 Vertical and Horizontal Integration/Information sharing

SMART OPERATION Part 3-a: Vertical and Horizontal Integration/Information sharing

Q3.1 Where have you integrated cross-departmental information sharing into your system? Please distinguish between internal and external information sharing*. (Multi choice grid) [not mandatory]

| | Yes, internally between departments | Not internally | Yes, externally with customers/suppliers | Not externally |
|--------------------------|-------------------------------------|----------------|--|----------------|
| Research and Development | | | | |
| Production/Manufacturing | | | | |
| Purchasing | | | | |
| Logistics | | | | |
| Sales | | | | |
| Finance/Accounting | | | | |
| Service | | | | |
| IT | | | | |

Q3.2 "Your company is using a digital software solution to manage suppliers."*

Deliverable 3.1

Please choose one of the following answers that best corresponds to the above statement for your organisation: *(linear scale)*

- 1 Strongly agree
- 2 Rather agree
- 3 Partially agree
- 4 Rather disagree
- 5 Strongly disagree

Q3.3 "You optimize your business' digital channels and interfaces with your customers."*

Please choose one of the following answers that best corresponds to the above statement for your organisation: *(linear scale)*

- 1 Strongly agree
- 2 Rather agree
- 3 Partially agree
- 4 Rather disagree
- 5 Strongly disagree

6.5.2 Distributed Control/Autonomous processes

SMART OPERATION – Part 3b: Distributed Control/Autonomous processes



Q3.4 "Your company has production process that respond autonomously/automatically in real time to changes in production conditions." *

Please choose one of the following answers that best corresponds to the above statement for your organisation: *(linear scale)*

- 1 Strongly agree

- 2 Rather agree
- 3 Partially agree
- 4 Rather disagree
- 5 Strongly disagree

Q3.5 "Your company already has use cases in which the workplace guides itself autonomously through production." *

The vision of Industry 4.0 is a workplace that guides itself autonomously through production.

Please choose one of the following answers that best corresponds to the above statement for your organisation: (linear scale)

- 1 Strongly agree
- 2 Rather agree
- 3 Partially agree
- 4 Rather disagree
- 5 Strongly disagree

6.5.3 IT Security

SMART OPERATION – Part 3c: IT Security

Q3.6 "Your company follows appropriate standards and regulations when it comes to IT Security." *

Please choose one of the following answers that best corresponds to the above statement for your organisation: (linear scale)

- 1 Strongly agree
- 2 Rather agree
- 3 Partially agree
- 4 Rather disagree
- 5 Strongly disagree

6.6 Part 4: Business Strategy, Organization and Processes

PART 4: BUSINESS STRATEGY, ORGANIZATION AND PROCESSES

The concept of Industry 4.0 goes beyond simply improving existing products or processes with digital technologies - it introduces the possibility of completely new business models. Because of this, its implementation is extremely important from a **strategic standpoint**. As part of our analysis, we examine the current openness towards Industry 4.0 and its cultural interaction based on the following

characteristics: **corporate culture, leadership, organization, business processes** and **investment strategy**.

6.6.1 Corporate Culture

BUSINESS STRATEGY, ORGANIZATION AND PROCESSES Part 4a: Corporate Culture

Q4.1 How would you describe the implementation status of your Industry 4.0 strategy?*

Multiple choice

- 1 Strategy implemented
- 2 Strategy in implementation
- 3 Strategy formulated
- 4 Strategy in development
- 5 No existing strategy.

Q4.2 Do you use measurable goals or indicators to track the implementation status of your Industry 4.0 strategy? *

Example: Existence of a documented and communicated overview with measurable targets for next three years such as digitization road map

- 1 Yes, we have a system of measurable goals or indicators that we consider appropriate
- 2 No, our approach is not yet that clearly defined

6.6.2 Leadership

BUSINESS STRATEGY, ORGANIZATION AND PROCESSES Part 4b: Leadership

Q4.3 "The top management actively drives the digital transformation in your company" *

Example: Initialization of digitalization projects, provision of resources to achieve objectives, etc.

Please choose one of the following answers that best corresponds to the above statement for your organisation: (linear scale)

- 1 Strongly agree
- 2 Rather agree
- 3 Partially agree
- 4 Rather disagree
- 5 Strongly disagree

Q4.4 "The middle management actively supports the change processes that are necessary for the success of digital transformation" *

Example: Personal involvement in digitization projects, definition of digitization goals at employee level

Please choose one of the following answers that best corresponds to the above statement for your organisation: (*linear scale*)

- 1 Strongly agree
- 2 Rather agree
- 3 Partially agree
- 4 Rather disagree
- 5 Strongly disagree

6.6.3 Organization

BUSINESS STRATEGY, ORGANIZATION AND PROCESSES *Part 4c: Organization*

4.5 Which are the three main expected benefits of Industry 4.0 for your organization?*

Note: Please select up to three answers

- Improved decision making
- Better quality of product/services
- Increased revenues
- Decreased operational cost
- Increased productivity
- Faster go-to-market
- Creation of new business models
- Personalization of products/services.

4.6 What are the three main obstacles that your organization is facing in adopting Industry 4.0?*

Note: Please select up to three answers

- The labour market lacks skilled workers
- The process of securing funds for further investment is complicated
- Time is limited
- Insufficient technical knowhow
- Equipment or software that is not sufficient
- The organization lacks the appropriate culture to handle change
- Suppliers' level of readiness

- Customers' level of readiness.

6.6.4 Business Processes

BUSINESS STRATEGY, ORGANIZATION AND PROCESSES Part 4d: Business Processes

4.7 "You use digital business models for continuous planning, design, and monitoring of your business processes."*

Please choose one of the following answers that best corresponds to the above statement for your organisation: (linear scale)

- 1 Strongly agree
- 2 Rather agree
- 3 Partially agree
- 4 Rather disagree
- 5 Strongly disagree

6.6.5 Investment strategy

BUSINESS STRATEGY, ORGANIZATION AND PROCESSES Part 4e: Investment Strategy

4.8 "You allocate sufficient budget for investments in Industry 4.0" *

Please choose one of the following answers that best corresponds to the above statement for your organisation: (linear scale)

- 1 Strongly agree
- 2 Rather agree
- 3 Partially agree
- 4 Rather disagree
- 5 Strongly disagree

Q4.9 How often do you conduct a cost/benefit analysis for Industry 4.0 investment?*

Multiple choice possible:

- No measurable Industry 4.0 investment yet
- No ongoing review of cost/benefit analysis for Industry 4.0 investment yet
- Annual cost/benefit analysis of Industry 4.0 investment
- Quarterly cost/benefit analysis of Industry 4.0 investment
- I am not aware of.

Q4.10 What type of short-term financing methods did/will you pursue to finance your Industry 4.0 strategy in the past 3 years/over the next 5 years? *

| | Past 3 years | Next 5 years |
|----------------|--------------|--------------|
| Own funds | | |
| Bank Loans | | |
| Public Funding | | |
| Leasing | | |
| Bonds | | |
| No funds | | |

6.7 Part 5: Employees and Competences

Part 5: Digital Skills and Human Capital (Employees)

Employees who help organizations achieve digital transformation are profoundly affected by the change in digital workplaces. They need to acquire new skills and qualifications because of changes in their direct working environment. Consequently, companies need to ensure their employees are appropriately trained and educated so they can handle these changes effectively. The company determines employees' readiness by assessing their skills in various areas and their efforts to acquire new skills.

Q5.1 How do you assess the skills of your employees when it comes to the future requirements under Industry 4.0?*

| | Not relevant | Non-existent | Existent but inadequate | Adequate |
|---|--------------|--------------|-------------------------|----------|
| IT Infrastructure | | | | |
| Automation Technology | | | | |
| Data Analytics | | | | |
| Data Security/Communications Security | | | | |
| Development or application of assistance systems | | | | |
| Collaboration software | | | | |
| Non-technical skills such as systems thinking and process understanding | | | | |

Q5.2 Does your company regularly evaluate the employees' digital competences to respond to changing requirements through digitalization? *

Please choose one of the following answers:

- 1 Strongly agree
- 2 Rather agree
- 3 Partially agree
- 4 Rather disagree

5 Strongly disagree

6 No answer

Q5.3 What skills will your employees need in five years to meet the demands of Industry 4.0?*

Multiple choice possible:

Expertise in new technologies

Soft skills

Problem solving skills

Business management skills

No further skills necessary

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