Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Information Technologies

Master's Thesis

Digital Transformation of the Small and Medium Enterprises, historical development, and trends

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Faculty of Economics and Management

DIPLOMA THESIS ASSIGNMENT

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Thesis title

Digital transformation of the Small and Medium Enteprises, historical development and trends

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Objectives of thesis

The thesis is thematically focused on the digital transformation of the small and medium enterprises in specific countries of Europe with a high development of the digital technologies, its historical development, and trends.

The main objective is to summarize the strategies used to restructure the SMEs with a digital approach in specific European countries, identify the challenges of the implementation and construct the dev sandbox of the small or medium enterprise with a help of the digital technologies using the Enterprise architecture approach as an enablement for effective digital transformation.

The partial objectives are:
- Define the status of the digital trends for the SMEs
- Investigate the influence of the digital transformation by comparison of digital/non-digital SMEs
- Propose the solutions/workarounds to the current challenges for the non-digital SMEs
- Construct a template for the digital transformation in specific SME scenario

Methodology

The thesis is based on the study of theoretical and practical information available in the scholar and professional literature of application the Enterprise architecture in order to go through digital transformation process of SMEs effectively. Resulting from the literature, research questions will be formulated and addressed in the practical part of the thesis. The analysis of digital transformation will be prepared in SMEs case study by using TOGAF approach and ArchiMate notation language. The findings will be interpreted, summarized and used for formulating recommendations for SMEs.

The proposed extent of the thesis

70 – 80 pages

Keywords

Digital transformation, Small and medium enterprise, information system, information technology, enterprise architecture

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Recommended information sources

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Declaration

I declare that I have worked on my master's thesis titled "Digital Transformation of the Small and Medium Enterprises, historical development, and trends" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the master's thesis, I declare that the thesis does not break any copyrights.

In Prague on 30.03.2024 _____

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Digital Transformation of the Small and Medium Enterprises, historical development, and trends

Abstract

The digital transformation is one of the key points to survive in the current environment for the small or medium enterprises (SME). The research investigates how the digital transformation changed so far according to the most developed countries in the digital sphere. The focus will be kept on the strategies used to restructure the traditional business with influence of the digital technologies. Another point to mention is the challenges that SMEs face during the implementation process. As a result, the research will represent the sample on how the SMEs changed according to the digital influence and if it's possible to define the proper strategy that will adopt the innovations smooth in the business processes. In the meantime, the research will represent the possible template according on the strategies used to process the digital transformation effectively using ArchiMate notation language by using a TOGAF approach.

Keywords: SME, Digital Transformation, TOGAF, ArchiMate, enterprise architecture, digitalization

Digitální transformace malých a středních podniků, historický vývoj a trendy

Abstrakt

Digitální transformace je jedním z klíčových bodů pro společnosti, aby přežily v současném prostředí, zejména pro malé a střední podniky (SME). Výzkum zkoumá, jak se digitální transformace dosud změnila podle nejrozvinutějších zemí v digitální sféře. Zaměření bude zachováno na strategie používané k restrukturalizaci tradičního podnikání s vlivem digitálních technologií. Dalším bodem, který je třeba zmínit, jsou výzvy, kterým SME čelí během procesu implementace. Výsledkem bude reprezentace vzorku, jak se SME změnily podle digitálního vlivu, a zda je možné definovat vhodnou strategii, která plynule přijme inovace v podnikových procesech. Mezitím výzkum představí možný vzor podle strategií použitých k efektivnímu zpracování digitální transformace pomocí jazyka ArchiMate a s využitím přístupu TOGAF.(*ICT Access and Usage by Businesses*, n.d.)IC(*ICT Access and Usage by Businesses*, n.d.)

Klíčová slova: SME, Digitální transformace, TOGAF, ArchiMate, podniková architektura, digitalizace

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1 Introduction

The small and medium enterprises (SME) is a key power for the countries to boost their economy, as stated on the European commission (EC) articles. SMEs represent 99% of all business in the European Union (EU) (*SME Definition - European Commission*, n.d.). With that said, the SME stands as one of the main objectives to focus on with a sustainability and digital transformation (DT) trends and their opportunities to enhance and evolve the approaches for being competitive and survive in the market.

Digital transformation is included in the policy of the European commission with its target of a climate-neutrality by 2050. Official press-releases have been introduced to public since year 2020 and enforced the strategy with a digital approach to power up people society, and release new possibilities to the businesses by mentioning the best of Europe with its openness, fairness, diverseness, and confidence in trustworthy technologies (European Commission, 2020b). There are multiple definitions of the digital transformation that mentions influence of technologies in the business processes, economic and societal effects and helps to improve, create, and adapt most of the aspects depending on the current and future situations. Since the aim of the thesis focus on the European region, the official definition represented by European commission represents DT as a fusion of advanced technologies with its integration to the physical and digital environments (Verina & Titko, 2019). It's expected and already visible how new technologies forces organizations to adapt new solutions for being competitive and meet customer requirements, boost the usage of advanced technologies to share data and be visible in multiple areas, enhance analytical capabilities for better decision making. The study from 2016 defined that people are willing to adapt their solutions to decrease the costs, increase the number of partners/vendors/suppliers, replace the physical resources into the intellectual/cloud based (Tolboom, 2016). At the year of this thesis, the global tendencies show the efficiency of new powerful tools with a help of artificial intelligence (AI), blockchain, internet of things (IoT), computer vision, machine learning, big data etc.

Adapting all new technologies is a challenge for SMEs. Enterprises faces with various problems and difficulties to incorporate new solutions. Generally, the main bullet points comes to security, priorities, privacy, aggregation of data, work performance by computing machines, resources for information technology (IT) or non-IT staff (Heavin & Power, 2018). However, the SME struggles not only on the general equipment in IT infrastructure, but with financial, and strategical possibilities in deciding the transition to the digital platform and need in it (Pelletier & Cloutier, 2019). With that mentioned, there are multiple factors affects SMEs. They can be separated into two sectors: internal and external, that may affect the DT. The research from 2018 represents that internal factors includes capabilities and resources fit, and changes in business model, while, external consists of external capabilities and resource fit, governmental regulation, and industry related factors (Tarutė et al., 2018). All of them includes IT integration, dedicated teams, value allocation,

collaboration, and industry needs. The governmental regulation is a specific point as an external factor in the EU, due to the goal of the sustainable development, which also requires businesses to adapt digital systems, data workflow, digital security to align with regional strategies.

It becomes more and more essential to research on the digital transformation of SMEs. The economy depends on the SMEs as they play a role in the economic growth for the country (Knight, 2001) and one of the key point for the enterprises is to follow the new tendencies and have a smooth transition from traditional business cycle to the digital (Rupeika-Apoga et al., 2022).

The research will focus on the most highly ranked countries in Europe based on the digital transformation. The results for 2022 presented that the Denmark, Sweden, Switzerland, Netherlands, Finland leads in the top 10 as a most digital countries in the world (*World Digital Competitiveness Ranking – IMD Business School for Management and Leadership Courses*, n.d.).

On another hand, the SMEs doesn't have so much power to implement the digital platforms for their needs and may require third party solutions as large firms. It's the competence of the government and regions to support the SME and boost their productivity to increase the interest of businesses to invest in the country (Stich et al., 2020). As a part of the research, it's important to define how the government implemented updates according to the new innovations and what programs they introduced to help the SME proceed with digital transformation.

The literature part of the thesis goes through the history of the digital transformation with a focus on the Nordic countries and provides the strategies used to adapt digital technologies, explains the enterprise architecture and frameworks for its usage, informs about the archimate notation language. The practical part of the thesis divided into 3 sub parts. 1 part includes the analysis of the current status of digital transformation in the Europe according to the Eurostat database, selection of the industries, validating challenges, and providing soft solutions for the SME. 2nd practical part moves to the adaption of the cloud procurement for the medium enterprises as part of the specific template scenario. 3rd practical part leverages the digital transformation adaption as a possible framework for the SME to proceed with their digital journey. The thesis also includes limitations, gaps due to the wide area of scope for investigation. Discussion, conclusion, and recommendation are the final parts of the thesis that summarizes and overview the research.

2 Objectives and Methodology

2.1 Objectives

The thesis revolves around exploring the digital transformation journey of SMEs within specific technologically advanced European countries. This includes delving into the historical evolution of digital technologies, understanding the current trends in SME digitalization, and ultimately, comprehending how digital transformation strategies impact SMEs. The main objective is to provide a comprehensive understanding of the strategies employed to digitally restructure SMEs. Additionally, it aims to identify the challenges inherent in implementing digital technologies and to develop a practical "development sandbox" model that showcases how digital technologies can be leveraged using Enterprise Architecture principles to facilitate successful digital transformation.

1. Define Digital Trend Status for SMEs

This objective involves conducting an exploration of the digital trends within the SME landscape of the specified European countries. By analyzing statistical factors using the Eurostat database for the period since 2019 till 2023 (e.g., artificial intelligence, IoT) to investigate how digital technologies influenced SME within the European Union area.

2. Investigate Influence of Digital Transformation through Comparison

Compare SMEs that have embraced digital transformation with those that have not. By analyzing their performance metrics, efficiency gains, innovation capacity, and market presence, discern the tangible impact of digitalization. The study is continued after the completion of the first partial part and defining the most influenced industry areas by SME for selection.

3. Propose Solutions/Workarounds for Non-Digital SME Challenges

SMEs often encounter obstacles when transitioning to digital processes, which can range from resource constraints to resistance to change. Task here is to thoroughly analyse these challenges and devise practical solutions or workarounds tailored to the specific needs of non-digital SMEs.

4. Construct Digital Transformation Template for SMEs

Building on the insights gathered from the above objectives, this step involves creating a comprehensive and adaptable template that outlines the process of digital transformation for a specific SME scenario. This template will serve as a practical guide, detailing stages such as assessing the SME's existing infrastructure, setting transformation goals, selecting appropriate digital tools, ensuring change management, and measuring the outcomes.

2.2 Methodology

The foundation of this thesis is established through a comprehensive study of both scholarly and professional literature. This involves an in-depth exploration of existing research and practical insights related to the application of Enterprise Architecture (EA) in facilitating the digital transformation process of SMEs. By syncing theoretical and practical information, build a robust understanding of the principles, methodologies, and best practices of using EA for effective digital transformation.

The methodology involves practical application in the form of case studies conducted on SMEs. To analyze their digital transformation processes, the TOGAF (The Open Group Architecture Framework) approach and the ArchiMate notation language used for visualization.

For the case studies, collect relevant data from the SMEs. Usage of the open database is important to leverage the industries such as Eurostat. Once the data is collected and analyzed, interpret the findings to extract meaningful insights. This step involves identifying patterns, success factors, bottlenecks, and notable outcomes of the digital transformation efforts within the SMEs.

Building on the insights gained from the case studies and the theoretical knowledge acquired during the literature review, formulate actionable recommendations. These recommendations will be tailored to assist SMEs in navigating their digital transformation journeys effectively.

The thesis concludes by summarizing the research journey, highlighting the key findings, and discussing their implications for both academic research and practical applications. This section will underscore the contributions work makes to the understanding of utilizing Enterprise Architecture for driving successful digital transformation in SMEs.

3 Literature Review

Literature review part includes in depths research of the frameworks used for digital transformations, adaptations of strategies and evaluation metrics of DT. Second part consists of introduction to EA and its significance in supporting digital transformation in organizations, with a focus on SMEs, explaining specific EA frameworks that are popular among organization undergoing digital transformation, with a special emphasis on the open group architecture framework (TOGAF), introduction to ArchiMate as a modelling language for EA, explaining its purpose, structure, and how it complements frameworks in documenting and visualizing the architecture, and research on existing case studies of SMEs that have successfully utilized EA frameworks and ArchiMate notation to facilitate DT, highlighting the benefits and challenges encountered during the process. Historical Development and current trends traces the evolution of digital technologies and their adoption by businesses over time, the historical progression of DT in SMEs, defining major milestones, shifts in strategies, and the changing role of new technologies, analyses current trends among SMEs. It includes the adoption of cloud computing, big data analytics, IoT, AI, blockchain technology and its impact on SME operations, customer engagement, and market competition.

3.1 Historical Development and Trends

3.1.1 Digitalization in EU

This part contributes on validating the statistical date from the Eurostat and official documentation by the European Union to validate and define countries with a high score contribution in the digitalization.

In 2022, 70% of businesses across the European Union achieved a basic level of digital intensity. SMEs recorded a 69% achievement in this area, which is approximately 20 percentage points below the EU's 2030 goal. In contrast, 98% of large businesses met this level of digital intensity as presented in the figure 1. When it comes to very high and high levels of digital intensity, large businesses outperformed significantly, with 30% achieving a very high level and 54% a high level. This is in stark contrast to SMEs, of which only 4% reached a very high level and 27% a high level of digital intensity. The majority of SMEs fell into the low (38%) or very low (31%) digital intensity categories.

The distribution of SMEs attaining a basic level of digital intensity varied significantly across countries, from as low as 41% in Greece and 47% in Bulgaria, to as high as 89% in Denmark and 90% in Finland.

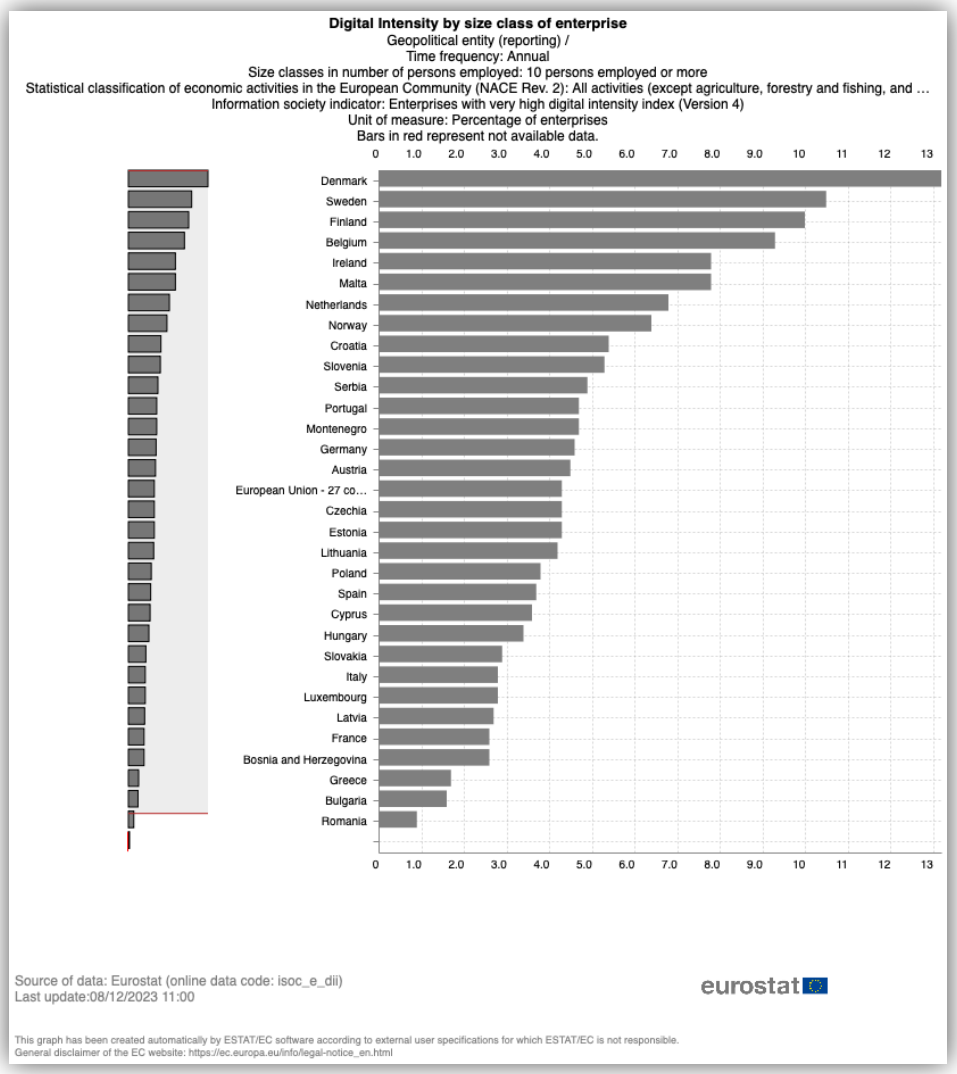


Figure 1 Digital intensity level in business, 2022 (Source: eurostat)

In 2021, 41% of European Union businesses adopted cloud computing services, predominantly to manage their e-mail systems. Cloud computing allows companies to utilize external computing resources over the internet, provided by third parties. This is a considerable benefit for companies, as it eliminates the need for them to invest in developing and maintaining their own IT infrastructure.

Large enterprises are more inclined towards using cloud services than SMEs. Specifically, 72% of large businesses utilized cloud services in 2021, compared to 40% of SMEs. Among those utilizing cloud computing, a significant portion (79%) used it for e-mail hosting. Additionally, 66% employed cloud services for file storage, and 61% used them for office applications, including word processing and spreadsheets. The adoption rate of cloud computing services varies widely across EU

nations, with Finland and Sweden leading at 75% adoption, followed by the Netherlands and Denmark, each with 65% as presented in the figure 2.

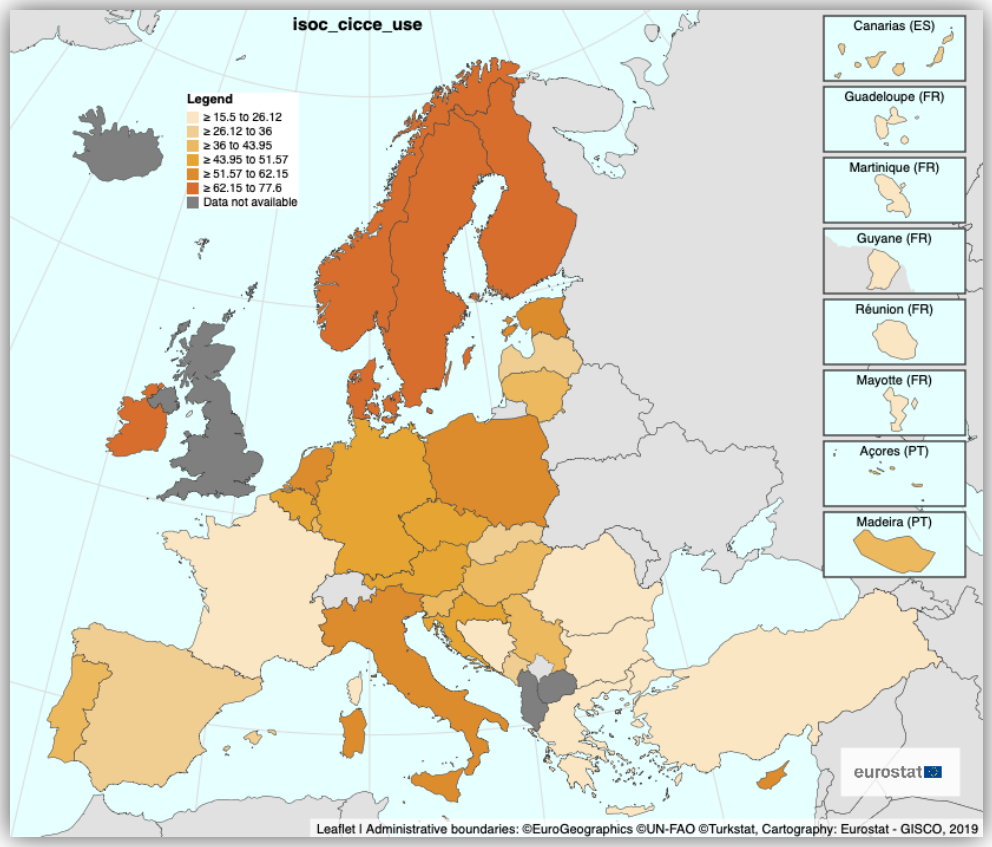


Figure 2 Businesses purchase cloud computing solutions, 2021 (source: eurostat)

As of 2022, 23% of businesses in the European Union indicated they engaged in online sales during the prior year, a rise from 16% in 2012. Around 19% of these businesses utilized websites or apps for their online sales, often referred to as web sales, and a smaller portion (6%) engaged in electronic data interchange (EDI) for their transactions. Specifically, 17% of companies made sales through their own website or app, while 9% participated in e-commerce marketplaces. When considering company size, large enterprises were twice as likely to conduct online sales (44%) compared to SMEs, which stood at 22%. Among EU nations, Ireland boasted the highest proportion of businesses selling online at 42%, followed closely by Sweden and Lithuania, each at 38%. In contrast, Romania and Luxembourg had the lowest participation rates, at 11% and 12% respectively as presented in the figure 3.

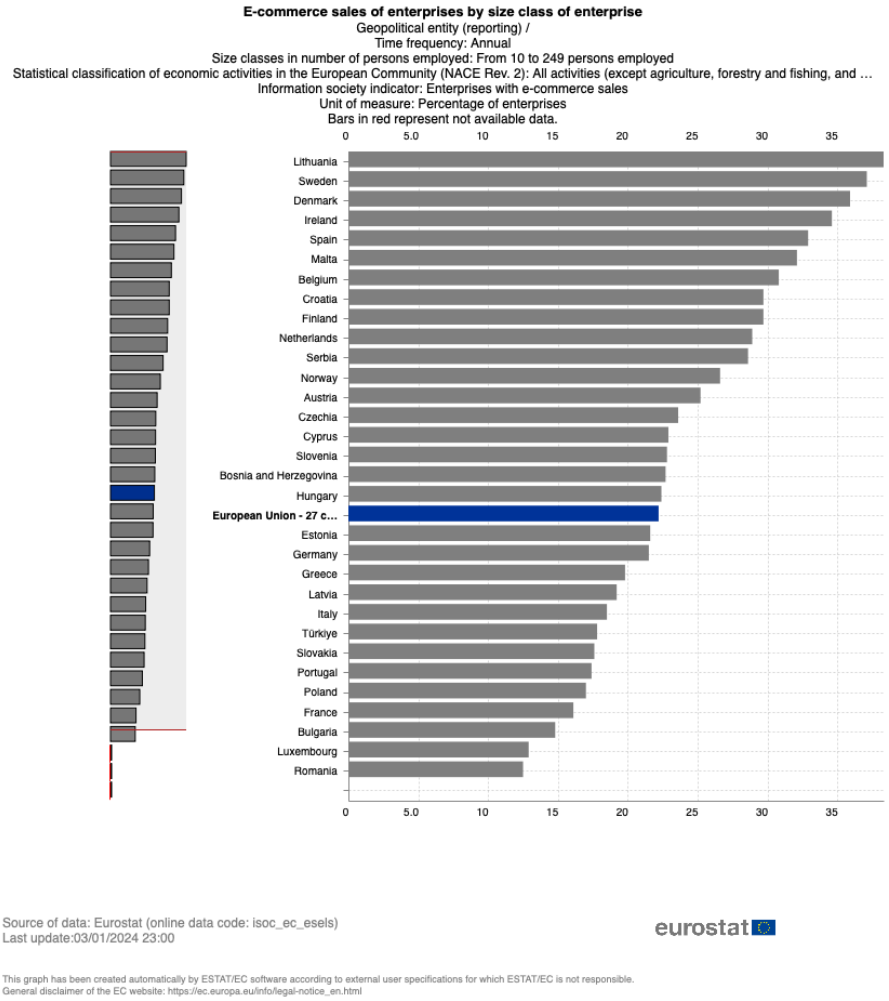


Figure 3 Business and E-sales (source: eurostat)

Based on statistical validation, the data presents high participation of Scandinavian countries including other digital measures among presented in the figure such as ICT security, social media activities, internet of things and online shopping.

3.1.2 Evolution of digital technologies and transformation adoption in EU

The book by (David, 2000) examines the evolving directions in computer technology development and their implications for SMEs. Three emerging trends are highlighted:

- Specialized Information Technologies - a shift towards task-specific devices, like supermarket scanners, which are more suited to certain environments than general-purpose personal computers. These devices support more efficient data acquisition and management in manufacturing and service processes.
- Advanced Personal Computers as Network Servers - the development of client-server data processing systems bridges the gap between personal computers and mainframe

environments. This evolution necessitates rethinking work organization, data ownership, and maintenance within companies.

- Internet Technology Development - opens new possibilities for organization-wide data processing applications and collaborative work environments. Internet standards allow for widespread intra- and inter-company networking, enhancing collective work organization.

Despite these advances, the general-purpose nature of personal computer technology development hasn't led to significant savings in specific computerized tasks due to underutilization and added complexity. In 2000, the author mentioned that the advent of digital "information appliances" might bring about significant enhancements in productivity and structural shifts. Furthermore, the practices of inter-organizational computing and teleworking could notably revolutionize productivity and the organizational structure within the service sector (David, 2000).

More academic papers within range between 2000 and 2005 mentions the impact on the e-commerce adapting business models and practices to remain competitive for SME.

The article "From local networks of SMEs to virtual districts?: Evidence from recent trends in Italy" by (Chiarvesio et al., 2004), investigates the convergence between network technologies and local districts in Italy and its impact on SMEs. The study explores the opportunities and threats for SMEs in terms of sustaining the district model versus adopting information and communication technologies (ICT). The research is based on data from surveys conducted in 2000 and 2003 across 33 industrial districts in Italy, focusing on 1,009 firms within the home furnishings, engineering, and fashion macro-industries. The findings reveal that the adoption of ICT by SMEs contrasts with the predictions of scholars and the behavior patterns of large corporations. Instead of new technologies completely replacing traditional business models, there is a divergence in the paths of ICT diffusion between complex and simple technological solutions. Simple technologies, such as email and websites, achieved high diffusion rates, while complex technologies saw limited implementation (Chiarvesio et al., 2004).

ICT in Italian districts: evolutionary trends (2000–2003)[a]

Technology	Sample average (%)		Home furnishing		Engineering		Fashion	
	2000	2003	2000	2003	2000	2003	2000	2003
E-mail	93.8	99.3	95.1	100.0	96.4	100.0	91.0	98.3
Website	72.8	91.1	77.5	96.5	81.0	93.6	63.7	86.0
Corporate Banking	68.6	76.3	75.4	80.7	65.5	79.5	66.7	71.1
Broadband	14.9	74.1	5.3	66.9	19.4	77.8	14.2	75.9
ISDN	85.9	70.8	87.3	69.7	87.5	72.5	83.9	70.3
ERP	21.2	34.8	14.1	39.3	32.1	48.5	17.5	22.0
Groupware	10.9	22.5	8.5	20.7	16.1	29.8	8.5	18.2
EDI	11.1	15.7	5.6	15.9	13.7	18.2	12.6	14.0
Videoconferencing	7.9	13.4	9.2	15.1	11.3	16.4	4.5	10.2
E-commerce	1.1	10.9	0.7	15.8	1.2	19.3	1.3	19.5

[a] Percentage on valid answers.

Figure 4 ICT in Italian districts (2002-2003) (Source: Wickramansinghe & Sharma, 2005)

In the meantime, (Wickramansinghe & Sharma, 2005) mentions that key factors hindering SMEs are lack of access to technology, insufficient organizational structures, marketing challenges, financial constraints and skill gaps. The study identified technological, organizational, and marketing hurdles as the primary barriers that make it difficult for SMEs to succeed in a knowledge-based economy. The article "Barriers to ICT adoption in SMEs: how to bridge the digital divide?" by (Arendt, 2008), dives into the challenges that micro and small enterprises encounter when adopting information and communication technology across Spain, Portugal, Poland, and compared to California, USA. The study identified financial constraints, lack of technical expertise, and insufficient awareness about ICT benefits as major barriers contributing to the digital divide between SMEs and larger corporations.

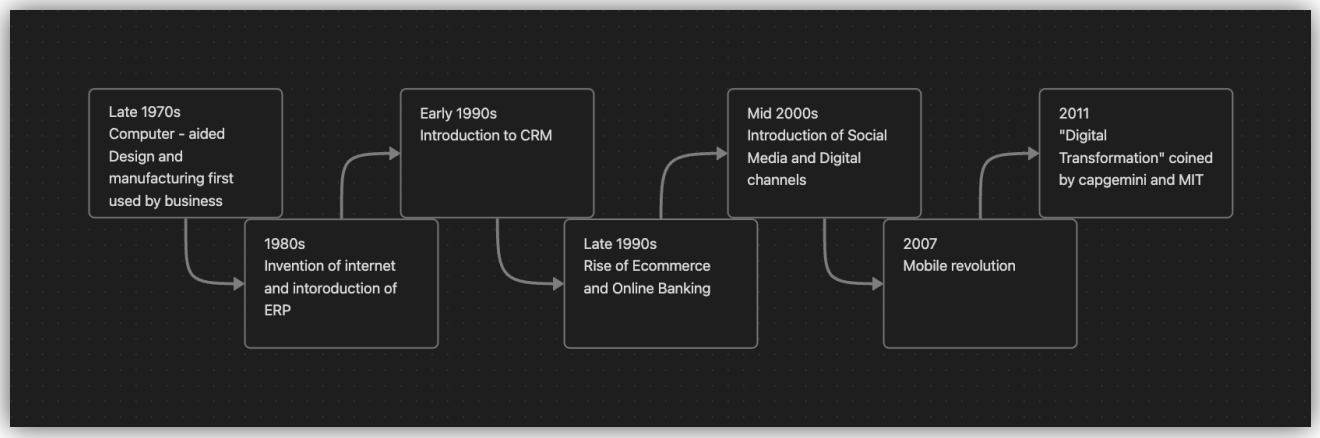


Figure 5 Digital Transformation shift (source: TechEela, 2023)

The digital transformation for the time between 2001 and 2010 mentions the term as e-transformation with a particular guidance and frameworks for its adoption, when the common check of the definition in 2024 refers to the DT itself.

Between 2000 and 2010, scientific paper landscape of digital transformation for SMEs was shaped by early adoption stages, strategic shifts towards a broader digital integration, and key drivers such as technological advancements, competitive pressures, and changing customer expectations.

The paper by (Zhu, 2006) identifies four key innovation characteristics—relative advantage, compatibility, costs, and security concerns—and four contextual factors—technology competence, organization size, competitive pressure, and partner readiness—as crucial determinants of digital technology usage in businesses.

3.1.3 Transformation shifts samples

Coming back to the high innovated counties, the study by (Parmiggiani & Mikalef, 2022) goes into why Norway, along with other Nordic countries, consistently ranks high in digitalization. Factors contributing to this include Norwegians' early adoption of digital technologies, high digital skills, and robust internet and mobile infrastructure. The Norwegian digital transformation journey, marked by both successes and uneven progress, highlights the integration of digital infrastructure into work and private life, influenced by unique social, political, and technical elements. Key examples of this transformation include:

- Altinn - A public platform facilitating digital communication between citizens, companies, and public administrations, evolving from a government portal to a comprehensive service platform thanks to standardized login solutions and cross-silo integration enabled by Norway's trust-based system.
- BankID - a collaborative effort by Norwegian banks, resulting in a standardized electronic identification and authentication system, underlining the cooperative nature of Norway's digital transformation across public and private sectors.
- Diskos – a national data portal for petroleum data, exemplifying mandated data sharing in the oil and gas industry, which is unusual compared to other countries. This initiative reflects the

Norwegian approach of promoting a data-centric economy and the government's efforts to encourage data sharing across industries.

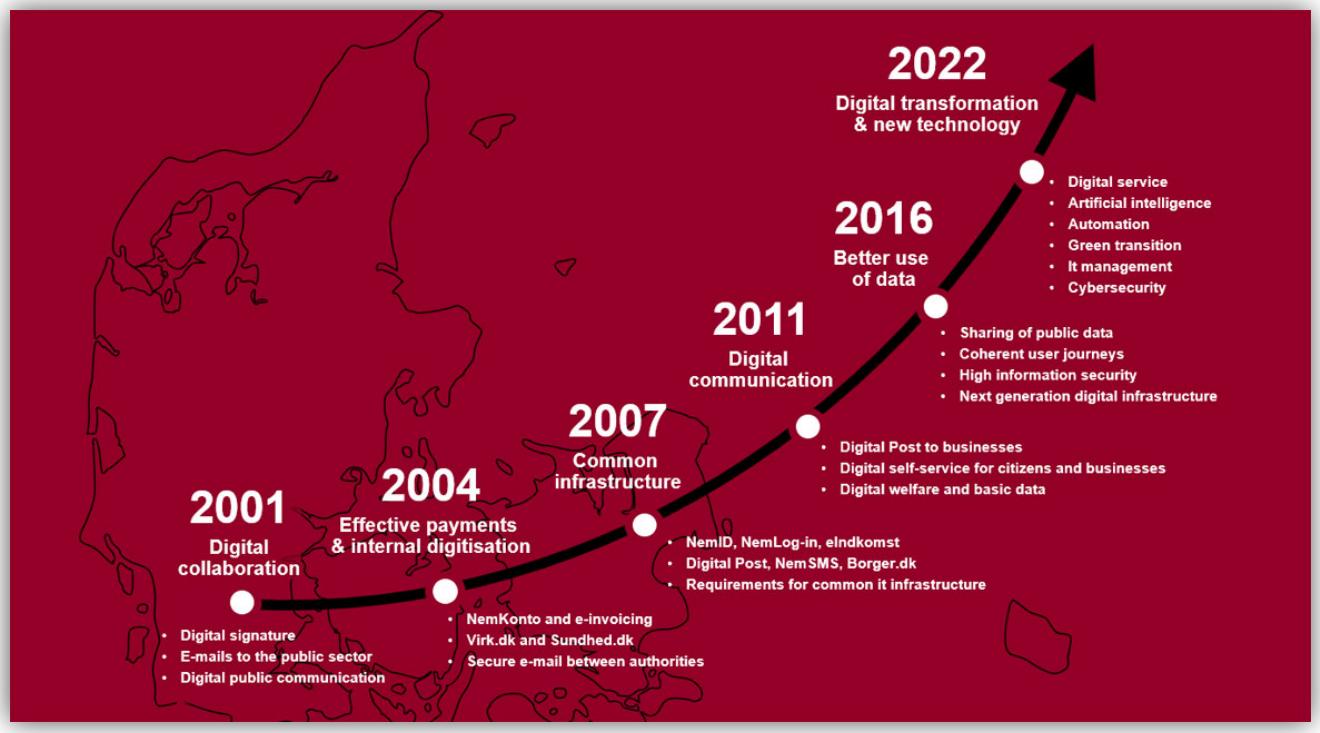


Figure 6 Digital Evolution of Denmark (source: Agency of Digital Government, 2024)

Denmark's digital strategy, spanning over two decades, has positioned the country as a leader in digital government. Initiatives like lifelong learning through digital means, digital administration for efficient public service, and enhancing democracy and cultural participation through the internet have been foundational. Denmark's digital ID system, NemID, now evolving to MitID, exemplifies this commitment, serving both public and private sectors. The strategy includes digitalizing public services like secure digital mail and a unified bank account system for citizens, emphasizing inclusion, efficiency, and citizen-centricity represented in the figure 6 (*The Danish Digital Journey*, n.d.).

Leveraging future directions across multiple countries, EU members represent the government participation in appliances of the digital technologies to the SME to achieve the goals Digital Transformation Europe 2030. However, multiple reports mention the high quality of digital education and number of people with a digital knowledge for the current digitally developed countries that lead the top positions in the EU.

3.2 Digital Transformation Framework

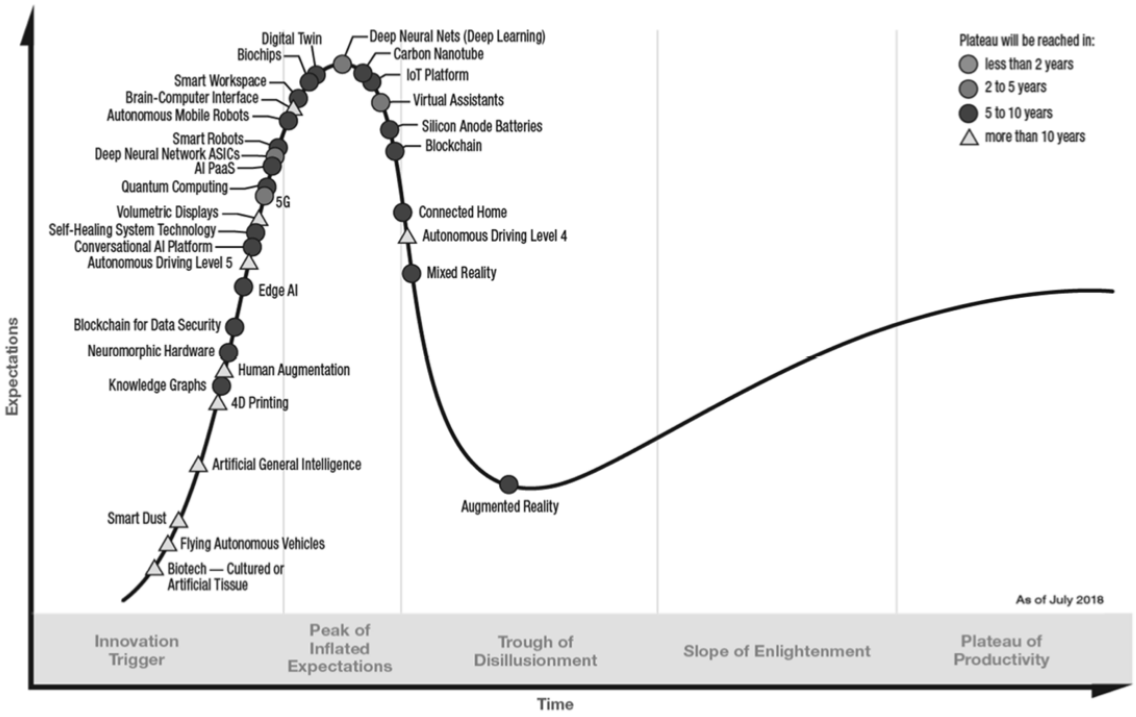


Figure 7 Gartner Hype Cycle for Emerging Technologies (source: Weill & Woerner, 2017)

Hype cycle presented in the figure 7 shows the expected timeframe and expectations for reaching the plateau within 2 years, 2 to 5 years, 5 to 10 years, and more than 10 years. The actual representation shows up innovation triggers and its adoption in the organizations, determining how likely individuals may want to use one of the particular technology and intention of business to evaluate its values and possible risks in it. The figure is presented to outline the features that exist nowadays, and integration of those features requires a comprehensive plan for the enterprises. Digital transformation may have a significant impact but it's crucial to determine the concepts of DT components:

- Digital Technologies – a key to transform business strategies, processes, firm capabilities, products, and services (Bharadwaj et al., 2013)
- Digitization – process to convert physical forms (including sound or voice) into digital format (Khan, 2015)
- Digital Innovation – new digital and physical combination for innovative products (Yoo et al., 2010)
- Digital Artifact – a digital component with a specific functionality as a part of a new product (Nambisan et al., 2017)

- Digital Platform – a technology based framework to support interaction of digital services and create new ways to coordinate ecosystems (Hein et al., 2020)
- Digital Infrastructure – complete pack of components and systems to generate a new combination of socio-technical environment (Schade & Schuhmacher, 2022)

All those components were described in the researches that specifies what will be used in the transformation process, but finally the digital transformation itself describes and encompasses the integration of digital technology into all areas of a business, fundamentally changing how it operates and delivers value to customers (Verina & Titko, 2019), in the meantime the strategy for the digital transformation is a key factor for the financial performance (Teng et al., 2022). Traditional business models are giving way to flexible, instantly adaptable ones that respond in real-time to consumer behavior and are knowledge driven. For SMEs, conducting cost-benefit analyses of digital technologies and understanding their potential is crucial (Ulas, 2019).

3.2.1 Frameworks and models

During the research, there were found several frameworks and models that have been developed to guide digital transformation through the process of DT. These frameworks offer structured approaches for integrating digital technologies into business processes, culture, and customer experience, like: TAM (Technology acceptance model), DQ (McKinsey's Digital Quotient), The Digital Maturity Model, TOGAF (The Open Group Architecture Framework), Gartner's Digital Business Transformation frameworks etc. Described models can be a choice for the SMEs, but it depends on various factors including the organization's specific challenges, industry, digital maturity level, and transformation goals. Below is the brief explanation of the frameworks mentioned for DT:

- Technology acceptance model (TAM) – developed by Davis (1989) to explain how users come to accept and use a technology. It suggests that perceived usefulness and perceived ease of use determine an individual's intention to use a system (Thompson, 2019).
- McKinsey's Digital Quotient (DQ) – assesses an organization digital maturity across four dimensions: strategy, culture, organization, and capabilities. It provides strength and weaknesses of an organization in the digital area (*Raising Your Digital Quotient | McKinsey*, n.d.)

- Digital Maturity Model – developed by MIT Center for Digital Business and Deloitte, this model helps organizations to understand their level of digital maturity across different areas such customer experience, operational processes, and business model innovation (Eva, 2022).
- The Open Group Architecture Framework (TOGAF) - While primarily an enterprise architecture framework, TOGAF provides a comprehensive approach to design, planning, implementation, and governance of an enterprise information technology architecture, including digital transformation aspects (*TOGAF | Www.Opengroup.Org*, n.d.)
- Gartner's Digital Business Transformation - focuses on the digital business transformation journey, emphasizing the importance of technology, business models, and customer engagement in driving digital success (*Digital Transformation - Strategic Guide to IT Transformation*, n.d.)

3.2.2 Adoption Strategies

Adopting digital technologies in SMEs involves more than just implementing technologies. It requires a holistic approach that includes strategic planning, cultural change, and leadership commitment.

Multiple resources studied on factors influencing the DT and combined on the SME interest for its adaptation. They can be divided into cloud computing, servitization, social media, e-Commerce, Blockchain adoption, digital platforms, radio frequency identification (RFID) technology, Industry 4.0 technologies, "Smart Manufacturing", "Portals", accounting information systems (Bin et al., 2021) (Ulas, 2019). All of them differs and depends on the scope of the business activities. At the next part, the in-depth review of adoption strategies will be provided for cloud computing, digital servitization.

3.2.2.1 Cloud Computing

Cloud computing (CC) is the delivery of computing services such as servers, storage, databases, networking, software, analytics, intelligence over the internet to offer faster innovation, flexible resources, and economies of scale (Lewis, 2010).

Whenever talking about the CC, lowered cost of entry is one of the best option for small enterprises (Chong et al., 2014). Cloud computing reduces the need for significant upfront hardware

investments and the ongoing maintenance and upgrades. Users have three options in selecting the CC:

- Software-as-a-Service (SaaS) – business specific focus (ex: Google Apps, Microsoft Apps, Customer Relationship Management (CRM) tools).
- Infrastructure-as-a-Service (IaaS) – provides cloud based computational infrastructure (ex: Amazon Elastic search, IBM computing on demand).
- Platform-as-a-Service (PaaS) – third party platforms allow businesses to leverage resources of that platform to create and host applications (ex: Microsoft Azure, Google App Engine).

Another factor driving CC apart from the cost efficiency is flexibility and security. Flexibility is a key component in adoption factors (Shetty & Panda, 2021) that mentions survey about the need of flexibility and scalability of IT with 64% of positive respondents (Sultan, 2011). Security is a second factor of CC for SME selection. JianHua mentions risks of cloud computing dividing and leverage them across three types of CC as risks may be confronted by customers, service providers, and governments (Che et al., 2011). It's crucial for SME to realize the risks and their impact on payment security and informational sensitive data exchange.

Validation case for Phillips represents 3 existing cloud adoption frameworks: goal oriented engineering approach, cloud adoption toolkit, and cloud adoption strategy (Utomo, 2014).

First framework (Goal Oriented engineering approach) provided by Zardani and Bahsoon in 2011 involves the steps in the engineering phase for cloud adoption. Each of the field mentioned in the figure 8 represent the step for achieving the goal. Next bullet points are short description of phases provided by (Zardari & Bahsoon, 2011):

1. "Specify Goals" - Requirements for choosing cloud providers are grouped into strategic (long-term business objectives), high-level (core requirements), and operational goals (specific technical needs). Goals have an acceptance range and must be prioritized from critical to desirable.

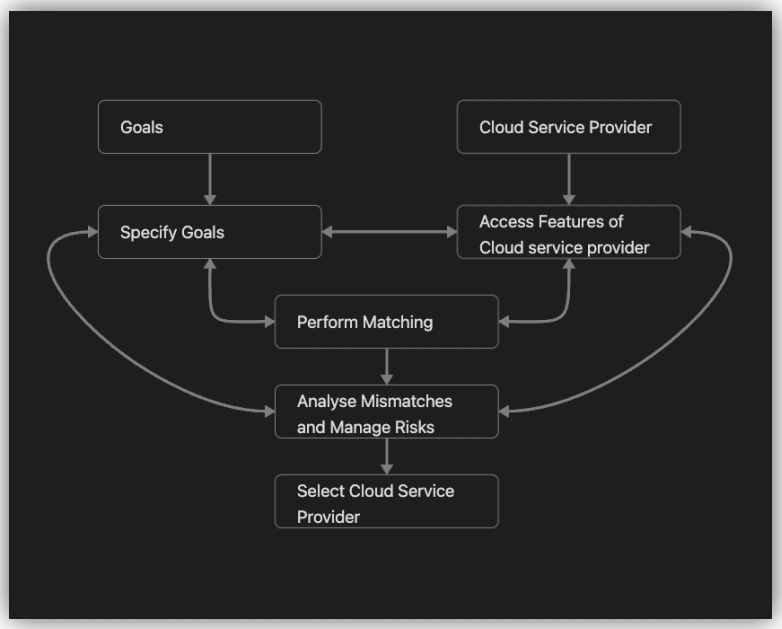


Figure 8 Steps for cloud adoption (Source: Zardani 2011, own work)

2. “Cloud Service Provider” - The search for a cloud provider starts with broad goals to avoid early limitations. It focuses on critical criteria like cost, reputation, and collaboration potential. Demonstrations and a confidence rating system assess provider suitability. A trial period may follow selection to confirm the provider meets the university's requirements.
3. “Perform Matching” - This stage evaluates cloud providers by assigning satisfaction scores to operational goals, allowing for comparison and decision-making. Satisfaction is determined by analyzing if a cloud meets needs within an acceptable range, using sources like CloudHarmony or trial periods. For example, a goal might be deemed met if response times are under 12 seconds.
4. “Analyse Mismatches and Manage Risks” - Risk management in cloud provider selection addresses mismatches and goal conflicts through identifying, analyzing, and mitigating risks, using strategies like adjusting goals or negotiating features based on the evaluation team's experience.
5. “Cloud Service Provider” - This phase aims to select a satisfactory cloud that meets stakeholder goals within budget constraints, evaluating based on value, cost, and risk, rather than seeking an optimal solution that maximizes goals regardless of cost.

There are other frameworks provided by authors can be seen in the figures below. They represent a different approach in delivering the cloud solutions into the business enterprises.

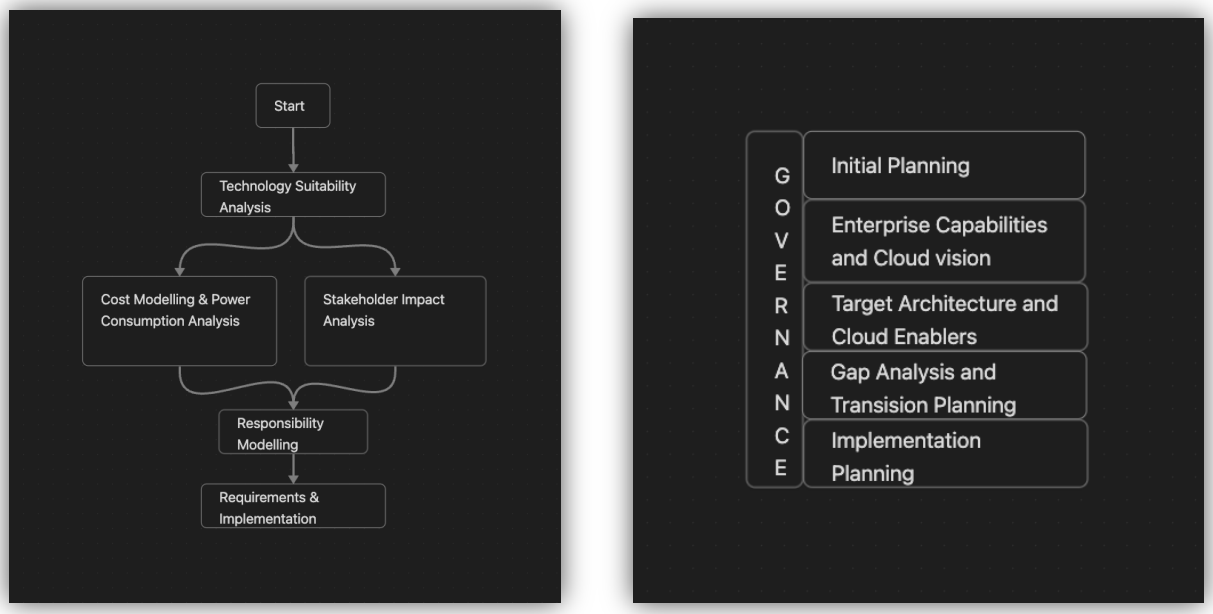


Figure 9 Cloud Adoption Toolkit (source: Khajeh-Hosseini et al., 2010, own work) and Life Cycle of enterprise cloud adoption strategy (source: Isom & Holley, 2012, own work)

3.2.2.2 Digital Servitization

The unified term of digital servitization (DS) was presented by (Favoretto et al., 2022) and determines it as a shift from a product-centric to a service-centric business approach, facilitated by digital technologies. This transformative process allows a company to overhaul its business operations, capabilities, and offerings, thereby enhancing customer value and boosting both its tangible and intangible performance metrics. Mainly the manufacturing SMEs will take the DS as a dominant point that will lead the progress in the 4th industrial revolution (Zheng et al., 2018). Below are the figures representing the six-phase journey for DS supporting the BMI and SMEs and multi-stage journey roadmap for DS journey of SME.

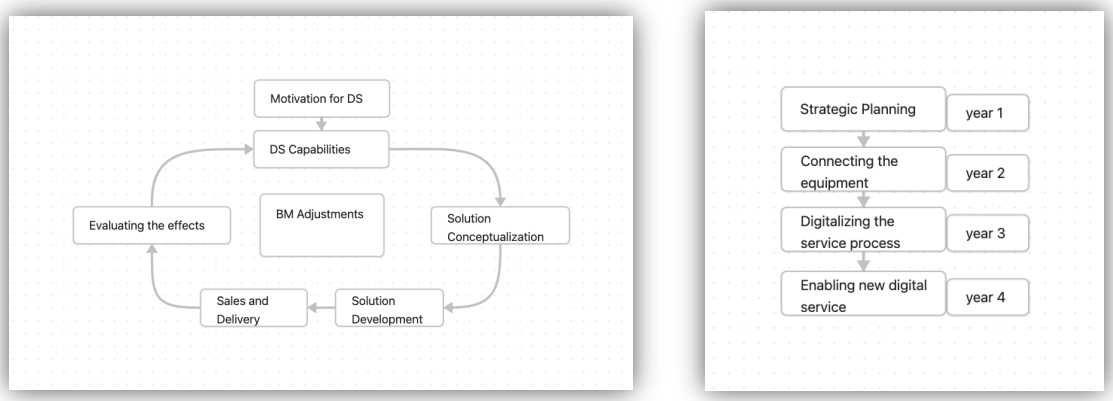


Figure 10 Six-phase journey supportimg BMI in SMEs (source: Lamperti et al., 2024) and multi stage roadmap for DS Jorney (source: Rapaccini et al., 2023)

Six-phase journey provided by Lamperti defines market sensing that recognize the need for DS to market disruptions, pushing company towards exploring new market for economic benefits. DS capabilities assessment involves internal capabilities to handle DS challenges and for strategic partners. Solution conceptualization develops a concept for digital service, potentially with strategic partners, minimizing risks and establishing a customer relationship. Solution development translates customer needs into service and product features. Sales and delivery involves actual sales and delivery of the digital solutions, marking the creation of value through co-creation of services. Evaluating the effects phase assesses the impact of DS on the company's ecosystem.

Another shorter version of multistage roadmap provided in the figure 10 represents the research done by Rapaccini in 2023 (the next description is according to research article | explanation provided). The roadmap defines the years with the related stage process needed during that time. The journey begins with ALPHA's (Rapaccini mentions SME as ALPHA) managing director recognizing the opportunity to leverage tax savings for investing in connected equipment and Industry 4.0 technologies. Lacking the necessary resources and skills, ALPHA partners with BETA (renamed as Technology Partner in the research) to embark on the DS project. This partnership is facilitated by an external consultant and formalized after a digital innovation workshop. BETA's proposal includes a digital platform that offers scalability and a pay-as-you-go model, allowing ALPHA to test and scale pilot projects without major initial investment. Key team members across ALPHA's departments are engaged to support the DS project, using tools like the BM canvas to envision the transition to digitally enabled advanced services. Connecting Products stage involves modifying ALPHA's equipment to connect with the ALPHA4YOU platform (developed branded version of the customer digital platform), a task undertaken with BETA's guidance and an external software company's help.

The focus is on ensuring the products meet connectivity standards without significantly impacting ALPHA's operations. The hiring of a young manager to oversee the DS project marks a strategic move to bridge skill gaps and foster a digital-oriented culture within ALPHA. BETA provides crucial technical training and strategic advice during this phase. Digitalizing the Service Delivery Process with ALPHA4YOU operational, ALPHA initiates a campaign to promote its connected machines and digital services. The DS manager and company director explore the benefits of real-time data, leading to the development of digitally enabled maintenance packages and extended warranties for new equipment buyers. This phase emphasizes evaluating the efficiency and effectiveness of the digitized service process, setting service pricing, and navigating the promotion of these new offerings to ALPHA's customer base and dealer network. Developing and Activating New Digital Product-Service Offerings final stage focuses on expanding ALPHA's digital service offerings, including e-commerce for consumables and spare parts, and advanced services like process optimization and productivity management.

3.2.2.3 Other influencing factors

Accounting Information Systems (AIS) achieve better financial and economic outcomes compared to those not fully embracing AIS, highlighting the positive impact of AIS on firm performance. Specifically, comprehensive AIS use is linked to higher profitability, whereas limited use results in financial losses. This underscores the importance of aligning AIS investment with organizational culture and long-term strategy to maximize benefits. However, no significant link was found between AIS use and productivity (Grande et al., 2011). Comparing the studies from 2011 and 2019, research from (Siyanbola et al., 2019) represents impact of accounting information systems on the performance of SMEs. It confirms that robust accounting practices significantly boost SME performance, highlighting the relationship between effective accounting and business success. Utilizing accounting information and adopting specific accounting modes are all positively linked to improved SME outcomes, echoing findings from various researchers. However, the challenge of high costs associated with advanced AIS suggests that SMEs might benefit from sharing resources to overcome financial barriers. Overall, the research underscores the critical role of AIS in enhancing decision-making and operational efficiency in SMEs, recommending that SME management prioritize solid accounting practices and consider collaborative approaches to access sophisticated systems affordably.

Additionally, research of e-commerce impact on SME by (Sedighi, A. & Sirang, B, 2018) highlights the critical role of SMEs in the growing e-commerce landscape and the need to facilitate their entry into e-commerce to tap into global markets. E-commerce can significantly reduce both operational and non-operational costs for SMEs by enhancing speed, accuracy, and communication, while also lowering marketing and advertising expenses. The use of e-commerce positively impacts firms' internal operations and customer relations enabling firms to transcend geographical boundaries and alter business structures. Understanding customer attitudes towards e-services is crucial for tailoring offerings to meet customer needs, making knowledge management a key component of customer relationship management and e-commerce success. In a competitive global market, continuous innovation and product differentiation are essential for gaining a competitive edge, underscoring the importance of innovation in response to global market pressures.

It’s only a partial explanation of influencing factors adopting the digital solutions to the SME but the systematic review construct the assess for digital transformation for SMEs according to (Bin et al., 2021) and classified into multiple approaches, such as 3-dimensional approach, six-dimensional, social exchange approach and even more. Researchers frequently use the "technology-environment-organization" framework to evaluate metrics like intent, readiness, opportunities, and obstacles associated with the digital transformation of SMEs. Nonetheless, emerging models for analyzing SMEs' digital transformation are also being developed (Bin et al., 2021).

3.3 Enterprise Architecture

S. Kotusev describes the Enterprise architecture as a description to improve the business and IT alignment from an integrated business and IT perspective (Kotusev, 2017b). The author defines that there are several types of the enterprise architecture management: traditional, MIT, DYI that compares approaches and answers the questions about the EA definitions, basis, artifacts, roles, structures etc. (Kotusev, 2017a). While there is the strict recommendation on the traditional approach on the enterprise architecture management and was recommended by many authors, it has many obstacles from the real world and won’t fit most of the business processes (Kotusev, 2017a). EA is a strategic planning framework that aligns an organization's business strategy with its IT and is crucial for organizations, including SMEs, as it offers a holistic view of an entity's structure, processes, information, and technology (Jonkers et al., 2006). This alignment is particularly important during digital transformation, as it ensures that IT investments and digital initiatives support the overarching business goals, enabling agility, innovation, and competitive advantage.

3.3.1 EA framework

Multiple frameworks provided over years representing the best practices on delivering the solutions into the business processes. Another article by (Kotusev, 2016) reveals that methodologies ranging from BSP to TOGAF for EA are fundamentally flawed, challenging the effectiveness of EA frameworks. The problem lies not with EA itself but with these frameworks, as successful EA practices often diverge from these models, as evidenced in previous reports and studies by others. Even so, going into the frameworks, some of them are mentioned in the part 3.2.1 about the digital transformation frameworks and models, but there exist more like: Zachman framework that organizes architectural artifacts in a matrix format, federal enterprise architecture framework developed by US, architectural frameworks for service-oriented architecture, business process framework etc. Those frameworks offer various perspectives, methodologies, and tools for addressing complexities of designing and implementing enterprise architecture.

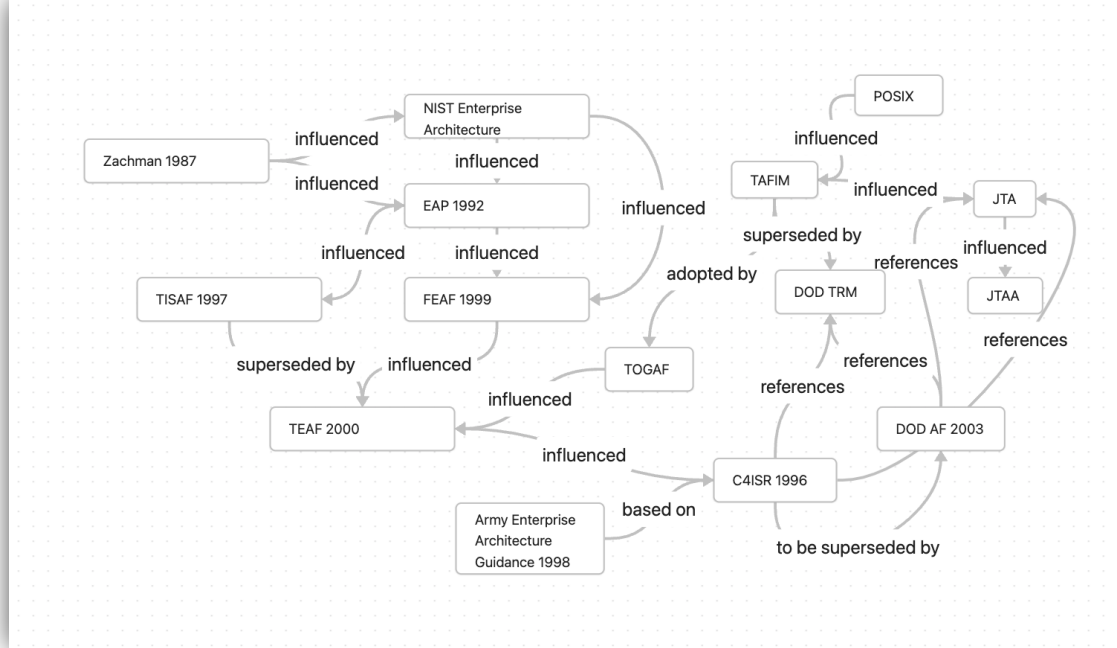


Figure 11 EA architecture evolution (source: Schekkerman, 2004)

Focusing on TOGAF, it is one of the most widely used framework for EA. The TOGAF standards offer methodologies and tools to aid in the adoption, creation, utilization, and upkeep of an Enterprise Architecture. It relies on a cyclical process model, underpinned by established best practices and a collection of reusable architectural resources (*TOGAF® Standard — Introduction - Core Concepts*, n.d.). The TOGAF Architecture Development Method (ADM) offers repeatable approach for creating architectures. It encompasses setting up an architectural framework, generating

architectural content, managing transitions, and overseeing the implementation of architectures. These tasks are executed in a repetitive cycle of ongoing architectural design and implementation, enabling organizations to methodically transform their enterprises according to business objectives and opportunities, as depicted in Figure 12.

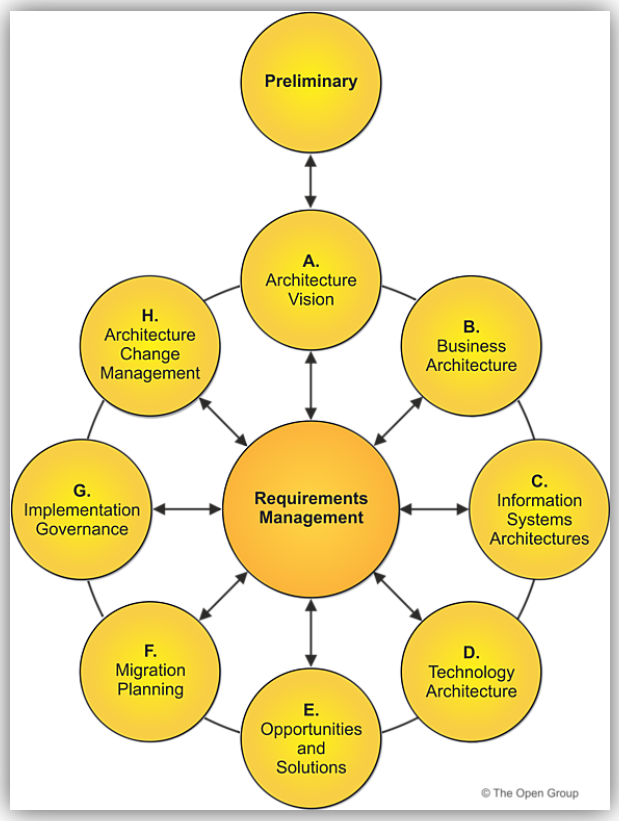


Figure 12 Architecture development cycle (source: The Open Group)

Phases according to official documentation defined as:

- The Preliminary Phase covers the setup and initiation tasks necessary to establish an Architecture Capability, including tailoring the TOGAF framework to specific needs and outlining the Architecture Principles.
- Phase A, Architecture Vision, marks the beginning of the architecture development cycle, focusing on defining the project's scope, identifying stakeholders, formulating the Architecture Vision, and securing approval to move forward with development.
- Phase B, Business Architecture, involves crafting a Business Architecture that aligns with the previously agreed-upon Architecture Vision.
- Phase C, Information Systems Architectures, revolves around creating Information Systems Architectures that support the agreed Architecture Vision.

- Phase D, Technology Architecture, focuses on developing a Technology Architecture to back the agreed Architecture Vision.
- Phase E, Opportunities & Solutions, engages in preliminary implementation planning and identifies delivery mechanisms for the defined architecture.
- Phase F, Migration Planning, tackles the transition from Baseline to Target Architectures by completing a detailed Implementation and Migration Plan.
- Phase G, Implementation Governance, ensures architectural supervision over the implementation process.
- Phase H, Architecture Change Management, sets up protocols for accommodating changes to the established architecture.
- Requirements Management, persisting across all ADM phases, manages the architecture requirements process.

(*TOGAF® Standard — Introduction - Core Concepts*, n.d.): The ADM facilitates its activities through a structured service delivery model, categorized into services that cater to specific organizational needs, regardless of the operation model. These services leverage ADM activities to meet particular requirements. The services are split into customer-centric and architect-centric categories, addressing external and internal focuses respectively:

- Enterprise Support Services - Offered to C-level management to aid in strategic decision-making through enterprise analysis, aiming for better decisions and reduced risk.
- Design Support Services - Aimed at program-level decision-makers, providing Minimum Viable Architectures (MVAs), compliance guidance, and reports to enhance design decisions and ensure program success.
- Development Support Services - Directed at project-level decision-makers, offering MVAs and compliance support to improve product decisions and achieve successful outcomes.
- Requirements Elicitation and Understanding Services - For product managers, focusing on understanding stakeholder concerns and requirements to provide a balanced solution.
- Architecture Planning Services -For architecture team leaders, offering planning services to ensure well-executed architecture projects.

- Enterprise Architecture Practice Development Support Services - Targeted at organizational decision-makers in architecture, focusing on developing and enhancing Enterprise Architecture practices and capabilities.

These categories collectively support informed decisions, compliant designs, and the development of effective architecture practices, facilitating organization-wide change and improvement.

3.3.1.1 TOGAF and SMEs

Unlikely for SMEs, the survey from 2013 highlighted caution against skipping entire stages for cost reduction, suggesting instead a broad approach to modifying phases based on their importance. This insight is crucial for guiding SMEs on which aspects of TOGAF to focus on, although customization should still consider each company's unique characteristics and goals. Further research is encouraged to build on these preliminary findings (Alm & Wißotzki, 2013). Another research from 2015 mentions that TOGAF as overly complex and costly for SMEs. IT complexity was further driven by laws, regulations, and various business process outsourcing (BPO) initiatives, leading to increased IT heterogeneity based on the survey respondents (Timm et al., 2015). Later on, research articles since 2020 presents that the EA frameworks justify efficiency for the enterprise activities and less mentions on the costs for the integration due to alternatives of the digital solutions.

3.3.2 Archimate notation

ArchiMate is a standardized notation developed by The Open Group, designed explicitly for creating clear and comprehensive architectural diagrams. It complements EA frameworks by offering a visual modelling language that represents the architecture across three domains: business, application, and technology (*Archi – Open Source ArchiMate Modelling*, n.d.). Lately on, (Lukáš & Ulman, 2020) mentions that ArchiMate modelling can be used to express and analyse models as a contradiction for language barriers among multiple stakeholders.

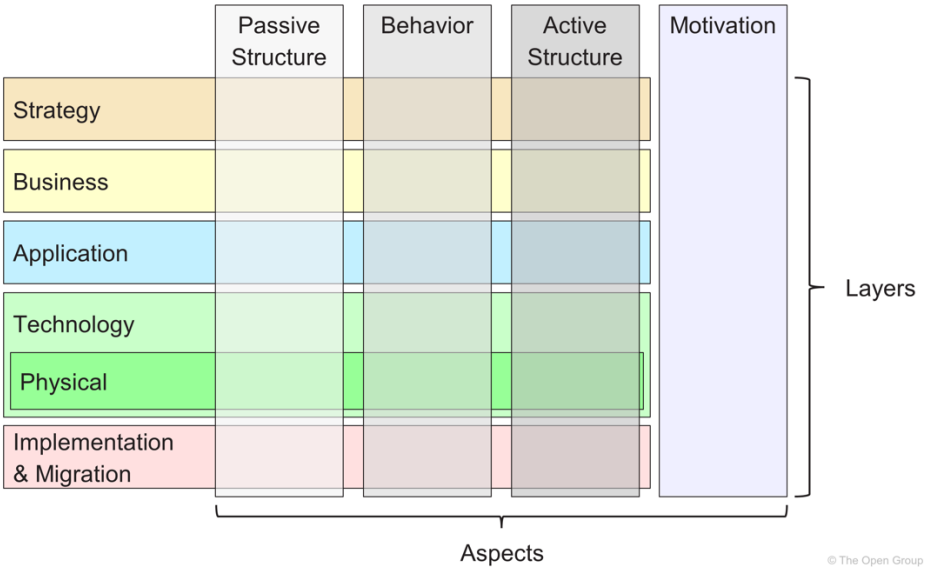


Figure 13 ArchiMate framework (source: Open Group)

Archimate full framework provides number of layers and aspects according to the core elements in the figure 13. So, the motivation elements are designed to represent the underlying reasons for the core elements in an Enterprise Architecture. Thus, there should be a way to connect these motivation elements with the core elements.

Strategy elements are utilized to depict the strategic orientation and decisions of an enterprise, particularly their influence on its architecture. They represent the enterprise's approach to generating value for stakeholders, identifying necessary capabilities and resources, and detailing the organization and application of these capabilities and resources to fulfill its objectives. While strategy elements focus on the enterprise's strategic planning, Business Layer elements concentrate on modeling the enterprise's operational structure (*Strategy Layer: ArchiMate® 3.2 Specification*, n.d.).

Business Layer elements model the operational structure of an enterprise without depending on technology, contrasting with strategy elements, which outline the enterprise's strategic orientation and decisions (*Business Layer: ArchiMate® 3.2 Specification*, n.d.).

Application Layer elements are generally employed to represent the Application Architecture, which outlines the configuration, behavior, and interplay of the enterprise's applications (*Application Layer: ArchiMate® 3.2 Specification*, n.d.).

Technology Layer elements are primarily utilized to depict the Technology Architecture of an enterprise, detailing the composition and functionality of the enterprise's technology infrastructure. Physical elements enhance the Technology Layer by representing aspects of the physical world, comprising only active and passive structural components without defined physical behaviors. These physical technology elements can integrate with other technology elements (like devices) within the same node, enabling the modeling of combined operational and information technology systems (*Technology Layer: ArchiMate® 3.2 Specification*, n.d.).

The implementation and migration elements facilitate the execution and transition of architectures. They are used for mapping out implementation programs and projects, aiding in program, portfolio, and project management, as well as assisting in migration planning (*Implementation and Migration Layer: ArchiMate® 3.2 Specification*, n.d.).

While TOGAF provides the methodology for developing enterprise architectures, ArchiMate offers the tools for their visualization. This synergy enhances communication and understanding among stakeholders involved in the digital transformation process.

3.3.3 Utilization in SMEs

It was already mentioned that SMEs struggles with the adoption of EA due to its complexity and cost, but in opposite, there are enhancement in the efficiency and adaptability to the new challenges. However, there are various case samples and official guidances of integrating the digital solutions to SME using the EA. Different articles from 2020 states the case studies providing the implementation of the IoT, BlockChain solutions, enhancement in the security and adapting the digital commerce in more efficient way.

As an example, The European DIGITAL SME Alliance provided a full guidance on Industrial IoT with a focus on security mentioning a motivation for its adaption, relevance to SMEs, security organizational and operational aspects. The guidance mentions use cases with successful adoption of IoT technologies. One of the case mentions the more effective data collection capability for the manufacturing small enterprise and the ability to communicate across factory and enterprise boundaries. Second case mentions the reduction of costs due to implementation of software program

with a report from the IoT to represent the subsequent analysis to highlight the aspects that need to be improved (Dhaher, 2021).

Representing the strategies applied for the digital transformation in SME that were valued in the EU, the next phase of practical part will represent the investigation into the current trends and challenges according to the official reports and managing the template for digital transformation of SME.

4 Practical Part

4.1 Statistical research and analysis

Figures below are statistics representation of SME by sector with employment between 10 and 250 and turnover less than 50 million euro that was maintained and retrieved from eurostat.

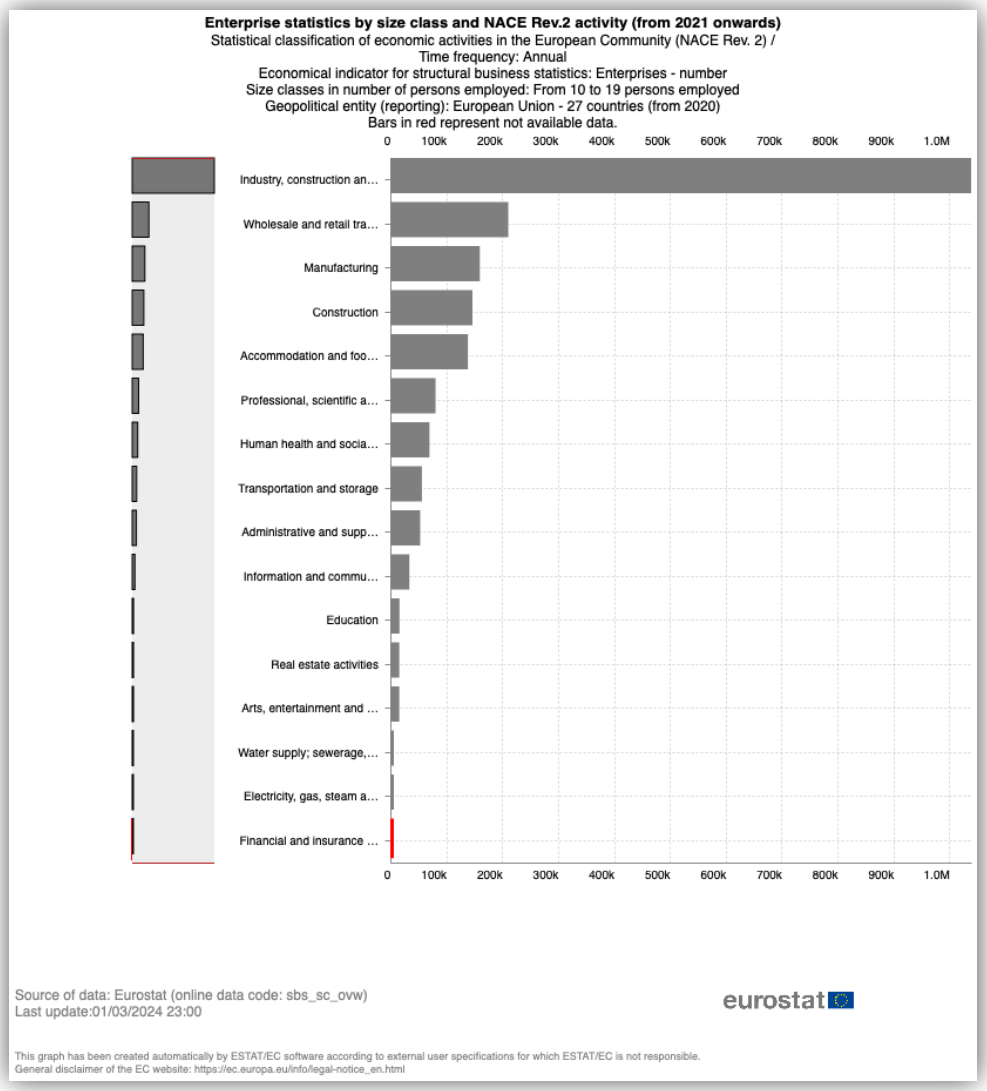


Figure 14 Number of enterprises in the field sectors for the employment between 10 and 19 for years 2021, 2022 (source: eurostat)

The figures 14, 15, 16 represents that the number of the enterprises in small and medium enterprises with the employment between 10 and 249 significantly focus on the industry, construction and market services (excepting public administration and defence; compulsory social security; activities of membership organizations) with total cover of more than 1,7 million of

businesses. Second area is positioned for wholesale and retail industry, while the manufacturing area is participated more in the medium enterprises.

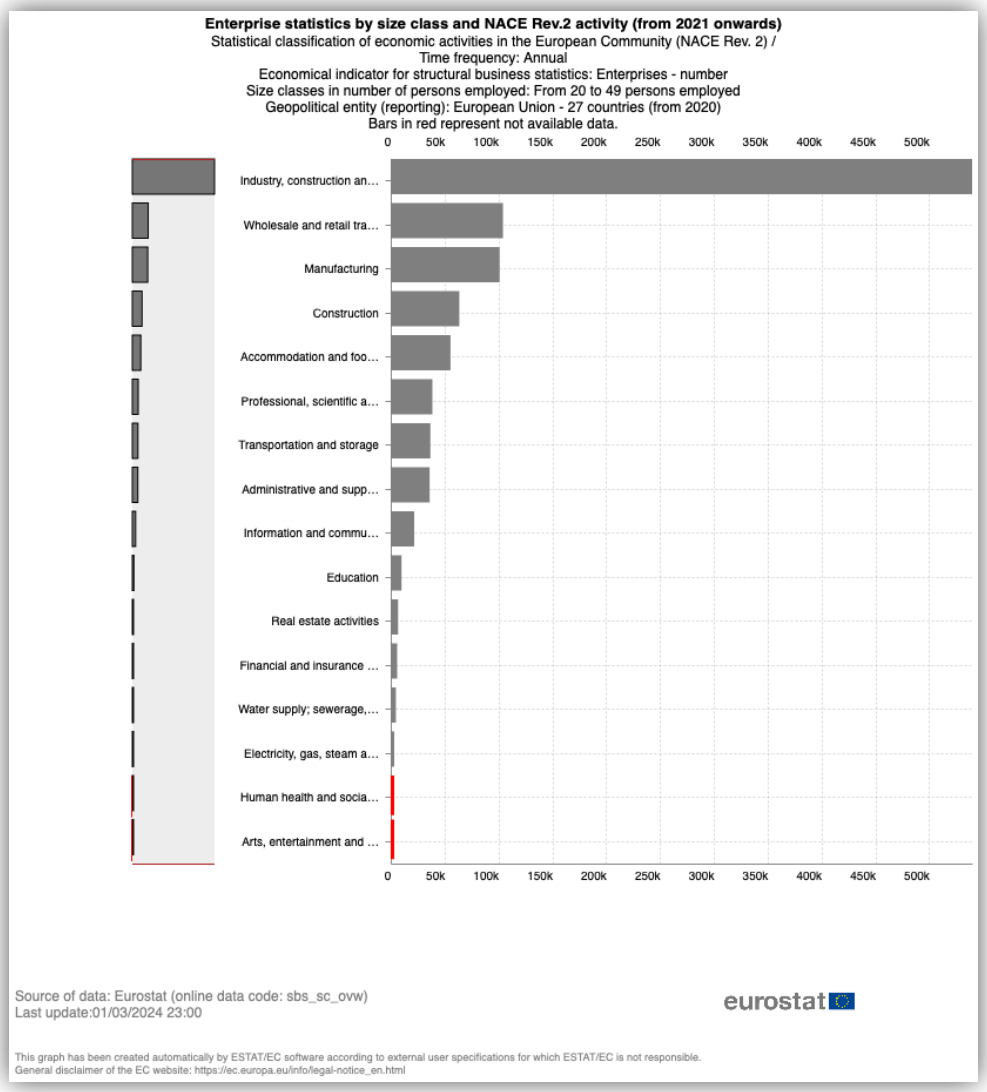


Figure 15 Number of enterprises in the field sectors for the employment between 20 and 49 for years 2021, 2022 (source: eurostat)

The focus will take place on the challenges and possible solutions of the 3 fields in the Schengen area: Industry construction, wholesale and retail industry, and manufacturing. Next part of statistical research presented in the figure 17 defines the digital ICT usage in enterprises with a limitation to SME to validate the best performed countries. Remaining measures for the countries validation can be seen in the appendix part.

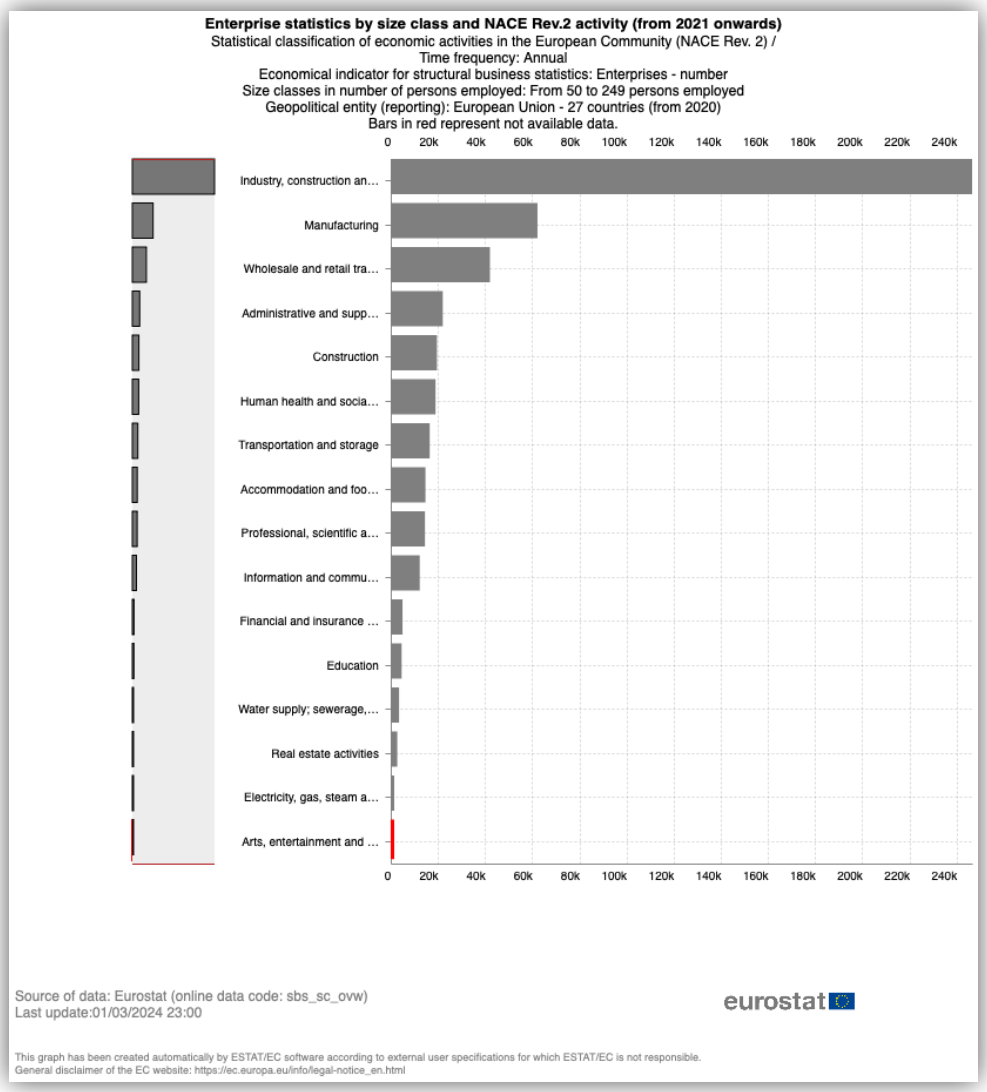


Figure 16 Number of enterprises in the field sectors for the employment between 50 and 249 for years 2021, 2022 (source: eurostat)

In the meantime, validating the mentioned field sectors, the top countries mentioned in the number of enterprises varies in position between 10 and 20 that leads to the low participation in the mentioned areas in the figures from 14 to 16. However, their digital participation is more valuable for the investigation check. Final combination of the statistical investigation refers to the combination of the field sectors (manufacturing, retail, and construction) by digital service offers from the Eurostat.

Validating all factors through the database, the highest developed countries in digital solutions lay on the Scandinavian regions as among all factor indicators represent them in the top 5 level.

Indicators used to validate countries with SME participation in the Eurostat (manufacturing, retail and construction areas):

- Enterprises Using “ERP”, “CRM”, “BI”.
- Enterprises Using electronic invoices for automated process (blot: Italy leads the position).
- Purchase of cloud computing services used over internet.
- Analyse big data internally from any data source or externally (blot: France leads in construction area; Netherlands leads in manufacturing area)
- 3D printing and robotics
- Internet of things (blot: Slovenia leads in wholesale and retail trade)

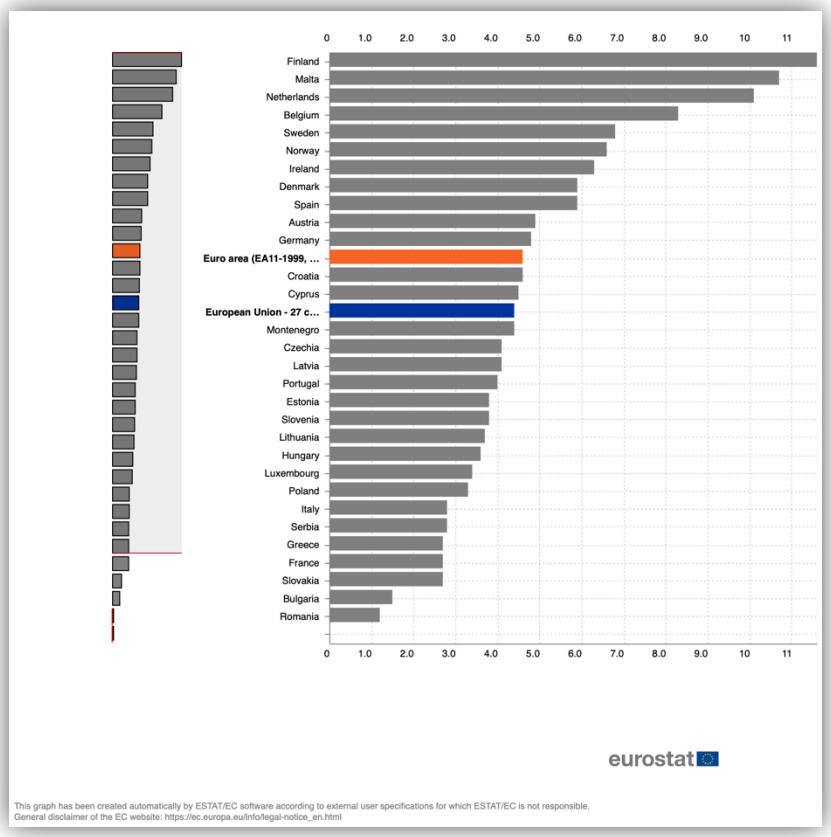


Figure 17 Digital Intensity by size class of enterprise for year 2023 (source: eurostat)

The blots mentioned in the indictor bullet points doesn’t contribute to the real percentage as amount of enterprises is significantly higher in other countries apart from Scandinavian area.

The integration of Artificial Intelligence is not leading in the Nordic countries representing only Denmark in the top 3 position for the manufacturing and wholesale/retail economic activities.

4.1.1 Impact of digital transformation in the multiple sectors

4.1.1.1 Industrial sector

The reports by (Etminan et al., 2019) and (ECSO, 2021) provides an overview of the adoption and maturity of digital technologies in the EU construction sector, revealing diverse levels of maturity and adoption across EU Member States, technologies, and different construction process stages. Despite this variability, the sector shows clear signs of progress in integrating digital technologies.

Data acquisition technologies such as sensors show the highest level of market maturity, though their integration in existing structures could be enhanced. 3D scanning usage is on the rise, whereas the Internet of Things has not yet achieved broad adoption but is rapidly evolving (ECSO, 2021).

In terms of automating construction processes, there is a notable increase in drone usage, especially with advancements in sensor technology. Robots and 3D printing, however, are still in the development stage and are used for specific, limited tasks. The relatively low market readiness of automation technologies also reflects the construction and maintenance phases' limited engagement with digitalization (ECSO, 2021).

4.1.1.2 Manufacturing sector

The report for a policy perspectives by (European Institute of Innovation & Technology, 2021) discusses the current status and future prospects of digital transformation, particularly in the context of automation, digitization, and the adoption of AI and robotics within the European industry. Despite considerable discourse on the potential socio-economic impacts of these technologies, empirical evidence on their economic effects remains rare, mainly because widespread adoption is still on the horizon. Gartner's Hype Cycle predicts significant adoption in industry and services within the next decade, yet challenges such as technology readiness and the need for substantial investment persist. The automotive sector globally has the most significant presence of industrial robots, while other sectors like rubber, plastic, and transport equipment manufacturing in Europe also utilize them extensively. However, industries like textiles are less engaged. Germany, Sweden, Italy, Spain, and France lead in the EU for the number of industrial robots per manufacturing employee (European Institute of Innovation & Technology, 2021).

4.1.1.3 Wholesale and retail sector

Digitalization is transforming the retail and wholesale sectors, with an emphasis on enhancing digital sales channels. The report by (McKinsey & Company & EuroCommerce Retail & Wholesale, 2022) mentions a big review in the transformation of the EU retail and wholesale sectors that is described next. E-commerce in the EU is projected to account for 30% of total sales by 2030, potentially generating over €1 trillion in additional online sales. Although digitalization has already altered the retail landscape, its pace is expected to accelerate, with the European Commission setting digital targets for SMEs and companies to enhance their digital intensity and use of technology by 2030. Automation can address labor shortages by automating repetitive tasks, while advanced analytics and AI offer competitive advantages against data-driven players. However, attracting and retaining digital talent remains a challenge. IT modernization is crucial for enabling omnichannel experiences and integrating digital and physical sales channels effectively (McKinsey & Company & Euro Commerce Retail & Wholesale, 2022).

4.1.1.4 Challenges

4.1.1.4.1 Industrial sector

The study in (ECSO, 2021) found that high costs of equipment and software, a shortage of skilled workers, and insufficient awareness and understanding of digital technologies are the primary obstacles to the accelerated and widespread digitalization of the European construction sector. However, these challenges vary significantly by member states, technologies, and stakeholders. For example, equipment costs are a significant barrier to adopting 3D printing and robotics but less so for sensor technology. Meanwhile, the shortage of skilled personnel especially impacts the integration of Artificial Intelligence and Virtual and Augmented Reality technologies, while affecting sensor usage to a lesser degree.

4.1.1.4.2 Manufacturing sector

The document by (Abdallah et al., 2021) outlines four primary hurdles to digital transformation in the manufacturing sector:

Skills Shortage: It highlights a critical gap in the digital competencies required for transformation, pointing to a lack of a workforce adept in handling the intricacies of modern technologies.

Technology Adoption: It points out the challenges in adopting and integrating new digital tools and technologies into current operations. The difficulty extends beyond mere adoption to the seamless incorporation of these innovations into existing workflows.

Management of Change: It underscores the necessity for effective change management approaches to guide the organizational changes brought about by digital transformation. This includes overcoming resistance to change and facilitating a smooth transition to new digital methodologies.

Innovation Efforts: It stresses the need to cultivate an innovative organizational culture that propels digital transformation forward. This means promoting creative thinking and practices to make the most out of digital technologies.

4.1.1.4.3 Wholesale and retail sector

Lately, the report by (McKinsey & Company & EuroCommerce Retail & Wholesale, 2022) mentions the challenge towards digitalization among many senior leaders, rooted in a cost-driven mindset, poses a significant barrier to leveraging digital transformation for long-term value creation. This viewpoint treats digitalization as an expense rather than an opportunity, with decisions on digital transformation often considered in isolation rather than as interconnected components of an essential whole. Short-term profit concerns deter these leaders from developing and implementing a long-term strategic vision necessary for digital growth.

This cost-centric approach is frequently accompanied by challenges related to scale. The considerable investments required for digitalization, in addition to the expenses associated with daily operations and maintaining physical stores, represent a significant burden. This burden is particularly daunting for smaller entities, with the returns on digital investments potentially taking years to realize. About one-third of those who deprioritized digitalization investments cited the high initial costs as the primary barrier (McKinsey & Company & EuroCommerce Retail & Wholesale, 2022).

Furthermore, the retail and wholesale sectors face a shortage of skilled professionals necessary for driving digital transformation. This is exacerbated by increasing competition across industries for data scientists, engineers, and other technical experts. Complicated regulations, such as local tax obligations, also hinder companies' ability to expand their cross-border e-commerce activities. Additionally, the threat of data breaches remains a substantial concern, discouraging many from fully embracing digitalization and exploiting the potential of data (McKinsey & Company & EuroCommerce Retail & Wholesale, 2022).

4.1.1.5 Possible solutions

At the EU level, developing a regulatory framework similar to what is proposed for establishing a Single Market for Data is crucial for improving data quality and management, while also taking issues related to intellectual property rights, cybersecurity, and data ownership. The European Union has a significant role in promoting digital technology awareness, particularly among construction SMEs who might not fully appreciate the advantages of such technologies (Etminan et al., 2019). It's vital for these SMEs to understand available financing opportunities, with application processes adapted to their specific needs and resources. Moreover, the EU is encouraged to boost financial aid for businesses, particularly SMEs, to facilitate their investment in digital technologies. The recent Multiannual Financial Framework emphasizes digital transformation, incorporating programs like Horizon Europe, with a budget of EUR 95.5 billion, and Digital Europe, with EUR 7.5 billion, aimed at supporting digital infrastructure investments, the application of digital technologies, and research and innovation (ECSO, 2021).

To expedite digital transformation, collaboration between public and private sectors is key, focusing on financing, education, awareness, and harmonization of regulations and accounting principles (Abdallah et al., 2021). By establishing learning programs, stakeholders can underline the importance of digitalization, encouraging companies, including SMEs, to embrace digital platforms and solutions. These initiatives can also support businesses in establishing an online presence (McKinsey & Company & EuroCommerce Retail & Wholesale, 2022).

4.2 Digital Transformation Case Study

The case study focusses on the cloud procurement solution for medium enterprises SAP Ariba solutions as part of the practical part during the internship as technology consultant in the company SAP in 2023. Case study divided into two 2 parts: PESTLE of DT for SME, and SWOT analysis of SAP Ariba to ME and TOGAF framework using Archimate notation language for delivering the e-procurement solution as part of replacement the traditional processes.

4.2.1 PESTLE analysis

PESTLE analysis is a strategic framework used to understand the external macro-environmental factors that might impact an organization, a project, or a new business venture. It helps in identifying how various external factors – categorized into Political, Economic, Social, Technological, Legal, and Environmental aspects – could influence decision-making, strategic planning, and the future success of the entity under consideration (PESTLE ANALYSIS, 2011).

4.2.1.1 Political

Funding and Financial Instruments:

- Horizon Europe - this is the EU's key funding program for research and innovation, with a budget of around €95.5 billion for 2021-2027. It includes support for digital technologies and the digital transformation of industries, including SMEs. Horizon Europe focuses on promoting technological advancements, innovation, and the development of digital skills (European Commission, 2024c).
- Digital Europe Programme - with a budget of €7.5 billion for 2021-2027, this program aims to accelerate the economic recovery and drive the digital transformation of Europe. It supports the deployment of digital technologies by businesses, especially SMEs, and enhances Europe's capacities in areas like high-performance computing, artificial intelligence, cybersecurity, and advanced digital skills (European Commission, 2024d).
- COSME Programme - while COSME (Programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises) primarily focuses on improving SMEs' access to finance and markets, it also includes elements that support digital transformation, such as fostering digital entrepreneurship and enabling SMEs to access new digital markets (European Commission, 2024b).

Support Networks and Initiatives:

- Digital Innovation Hubs (DIHs) - part of the Digital Europe Programme, DIHs are one-stop shops that help companies to become more competitive with regard to their business/production processes, products, or services using digital technologies (European Commission, 2023).
- Enterprise Europe Network (EEN) - the EEN provides support, advice, and services for SMEs, including how to access finance, find international partners, and innovate. It also offers specific services aimed at helping businesses undergo digital transformations, such as access to technology providers and innovation support services (European Commission, 2024a).

Digital Single Market:

- The EU also works on creating a Digital Single Market, aiming to remove barriers to online activities for individuals and businesses throughout Europe. This includes regulatory support and initiatives to enhance cross-border e-commerce, digital privacy (GDPR), and cybersecurity, creating a more secure and integrated market for digital services that benefit SMEs (European Commission, 2020a).

4.2.1.2 Economical

Based on a cost/benefit analysis, the study by (Toktaş-Palut et al., 2014) mentions that adopting an e-procurement system is economically beneficial for the company. This outcome provides a strong business case for the transition from traditional purchasing methods to e-procurement, emphasizing the strategic value of e-procurement in enhancing competitiveness and operational efficiency. The economic aspect of e-procurement for SMEs encompasses a broad range of factors that can significantly influence their efficiency, competitiveness, and bottom line. E-procurement, which involves the use of electronic methods in the procurement processes of goods and services, offers SMEs opportunities to streamline operations, reduce costs, and enhance strategic sourcing.

E-procurement systems automate many steps in the procurement process, reducing the time and labor associated with manual processes. This automation leads to lower transaction costs. By reducing costs and improving operational efficiency, SMEs can offer their products or services at

more competitive prices. Automation accelerates the entire procurement cycle, from requisition to payment, enhancing operational efficiency. Digital procurement solutions provide centralized data management, improving the accuracy of records and facilitating easier access to procurement data (SAP, 2024c).

4.2.1.3 Social

The move towards e-procurement offers an enhancement in digital literacy and skills among employees. SMEs are required to invest in training and development to equip their staff with the necessary competencies for effectively navigating and managing e-procurement systems. Moreover, the transition from traditional procurement methods to e-procurement can encounter resistance to change from employees accustomed to existing processes. Managing this change through effective communication, training, and involvement in the transition process is crucial for fostering a culture that embraces digital transformation. E-procurement also introduces new roles and responsibilities, necessitating a reevaluation of the organizational structure and roles within the SME (Toktaş-Palut et al., 2014).

E-procurement platforms facilitate improved communication and collaboration with suppliers and clients through integrated tools and real-time data exchange. This enhanced interaction can strengthen relationships, improve transparency, and enable more strategic partnerships. Additionally, e-procurement allows SMEs to access a broader network of suppliers, including international vendors, thereby increasing competition and potentially leading to better terms and quality of products and services. The transparency afforded by e-procurement systems enables SMEs to align their procurement practices with Corporate Social Responsibility (CSR) objectives, such as ethical sourcing and environmental sustainability, thereby improving their social image and appeal to socially conscious consumers and partners (SAP, 2024a).

4.2.1.4 Technology

Cloud-based e-procurement solutions have become increasingly popular among SMEs due to their lower upfront costs, reduced need for in-house IT infrastructure, and ease of access from any location. These solutions offer the flexibility needed by SMEs to adapt quickly to market changes and business growth. Additionally, the use of analytics and reporting tools within e-procurement

platforms enables SMEs to gain insights into spending patterns, identify cost-saving opportunities, and make data-driven decisions (Sánchez-Rodríguez et al., 2019).

Security is another technology aspect of e-procurement. As these systems handle sensitive financial and corporate data, ensuring the confidentiality, integrity, and availability of this information is essential. SMEs must consider e-procurement solutions that provide robust security features, including encryption, access controls, and regular security updates to protect against cyber threats. Furthermore, the adoption of emerging technologies such as artificial intelligence, machine learning, and blockchain in e-procurement processes can offer SMEs advanced capabilities for automating routine tasks, enhancing decision-making, and increasing transparency and trust in transactions (SAP, 2024b).

4.2.1.5 Legal

At the heart of legal considerations for e-procurement is the necessity to comply with national and international laws related to electronic transactions, data protection, and privacy. Laws such as the General Data Protection Regulation in the European Union set guidelines for the handling and protection of personal data. SMEs engaged in e-procurement must ensure that their systems and processes are designed to protect personal data and uphold the privacy rights of individuals, necessitating robust data security measures and compliance mechanisms (intersoft consulting, 2018).

Contract law is another crucial area, as e-procurement involves entering into and managing contracts electronically. SMEs must ensure that electronic contracts are legally binding and enforceable in their respective jurisdictions. This includes understanding and complying with requirements around electronic signatures, contract formation, and digital record-keeping to ensure that electronic procurement contracts are valid and enforceable (European Commission, 2019).

4.2.1.6 Environmental

Firstly, digital technologies significantly reduce the need for paper-based processes, cutting down on paper consumption and waste. Traditional procurement methods often involve extensive paperwork, from purchase orders to invoices and contracts. By digitizing these processes, e-

procurement systems help SMEs minimize their environmental footprint related to paper use, contributing to forest conservation and waste reduction (European Commission, 2022).

Moreover, digital technology enhances operational efficiency and reduces energy consumption. Digital systems streamline procurement processes, making them more efficient and less resource-intensive. For instance, e-procurement platforms can automate order processing and inventory management, reducing the need for physical storage space and the associated energy costs for lighting, heating, and cooling. This efficiency extends to logistics and supply chain management, where e-procurement can facilitate more efficient order batching and delivery scheduling, reducing carbon emissions associated with transportation (EIT Digital, 2022).

4.2.2 SWOT of SAP Ariba for SME

SWOT is a strategic analysis framework used to evaluate the internal and external factors influencing the success of a project, product, organization, or individual. It stands for Strengths, Weaknesses, Opportunities, and Threats. Strengths and weaknesses are internal factors, highlighting what an entity excels at or lacks within its operations or structure. Opportunities and threats are external elements, identifying potential favorable conditions and challenges in the environment that could affect outcomes. This analysis aids in strategic planning by mapping out where an entity currently stands and guiding decision-making for future directions or improvements (Will Kenton, 2023).

For SAP Ariba, as a cloud-based procurement and supply chain management solution, provides several advantages for SME including a comprehensive set of features covering procurement processes, seamless integration with other systems, access to a global supplier network, and the scalability and flexibility of a cloud service. However, its adoption by SMEs is not without challenges. The platform's complexity and the breadth of its functionalities can be overwhelming for SMEs with limited IT resources. Additionally, the cost associated with implementing and maintaining SAP Ariba may deter budget-conscious SMEs. The need for substantial training to fully leverage the platform adds another layer of investment in terms of time and money, and some SMEs might find the customization options insufficient for their unique business needs.

Opportunities for SMEs utilizing SAP Ariba include the potential for digital transformation of procurement processes, which can lead to increased efficiency, cost reduction, and improved compliance. The platform's global supplier network can facilitate expansion into new markets. SAP Ariba's analytical tools enable data-driven sourcing decisions, improving negotiation capabilities and supplier relationships. Furthermore, its features supporting sustainability and compliance can help SMEs meet regulatory requirements and adopt sustainable procurement practices.

However, SMEs face threats from market competition, including other procurement solutions that might be more tailored to SME needs or offer competitive pricing. Rapid technological advancements in procurement software necessitate continuous updates, potentially incurring additional costs. Relying on a cloud-based solution exposes SMEs to cybersecurity risks, emphasizing the need for robust security measures. Finally, economic uncertainties can impact SMEs' capacity to invest in and maintain advanced software solutions like SAP Ariba.

4.2.3 Phases

Based on TOGAF approach, this chapter will represent stages for the implementation of direct/indirect procurement solution: preliminary, architecture, business, system information, technology architecture, requirement management, and opportunities/solutions.

4.2.3.1 Preliminary phase

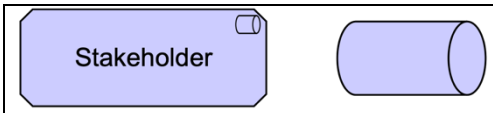
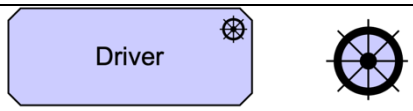
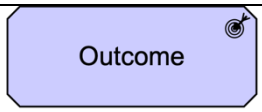
Involvement for internal/external stakeholders:

- Management and Executives: they benefit from the strategic advantages that e-procurement offers, such as cost reductions, better spend visibility, and enhanced decision-making capabilities based on data analytics. Integration supports strategic planning and resource allocation.
- Procurement Team - directly involved in the adoption and day-to-day operation of e-procurement systems, this team benefits from streamlined workflows, reduced administrative burden, and improved supplier relationships. E-procurement can automate routine tasks, allowing the team to focus on strategic sourcing and supplier management.
- Finance and Accounting Departments - these departments benefit from improved accuracy in financial reporting, easier invoice processing, and enhanced budget control. E-procurement systems facilitate real-time tracking of expenditures and integrate with financial software for seamless financial management.

- IT Department - involved in the selection, implementation, and maintenance of e-procurement systems, the IT department plays a crucial role in ensuring the system's security and integration with existing IT infrastructure. They benefit from the adoption of technology that can streamline IT processes and reduce the need for manual IT support.
- Operational Teams - teams across various departments benefit from efficient procurement processes that ensure timely availability of goods and services, directly impacting operational efficiency and productivity.
- Suppliers and Vendors - they are involved in the e-procurement process through online bidding, order management, and fulfillment. Suppliers benefit from more transparent and efficient communication.

The figure 18 represents the motivation layer with described stakeholder and specified goals:

Table 1 Motivation elements (source: The Open Group, 2024)

	A stakeholder embodies the position of an individual, team, or organization (or their respective categories) with vested interests in the outcomes of the architecture.
	A driver is an external or internal factor that compels an organization to establish its objectives and undertake the necessary changes to fulfill them.
	An assessment is the outcome of evaluating the current situation of the enterprise in relation to a specific driver.
	A goal is a broad declaration of purpose, direction, or the intended ultimate achievement for an organization and its stakeholders.

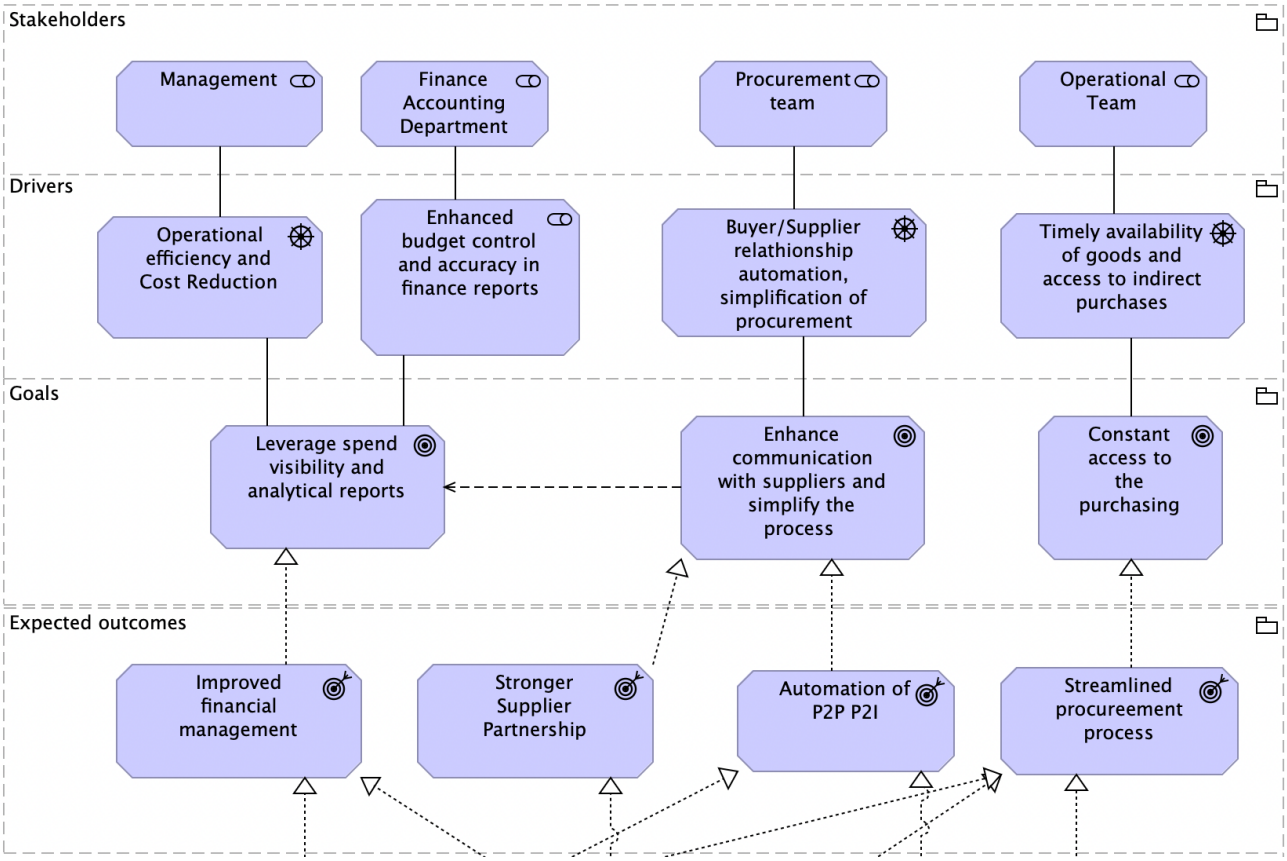


Figure 18 Motivation layer (source: own work)

4.2.3.2 Strategy layer

Strategy layers represents the course of action, business capabilities and resources including the adaptation and implementation of the SAP Ariba, developing and distributing user guidelines across the enterprise, training and change management for course of action. Business capabilities includes provided solution withing a cloud software such as data analytics and reporting, e-procurement management and supplier relationship management. Resources consist of IT department, user guidelines and training materials, SAP Ariba solutions as seen in the figure 19.

Table 2 Strategy elements (source: The Open Group, 2024)

Resource	A resource is an asset that is owned or managed by an individual or organization.
Capability	A capability signifies the skill or capacity that an active structural component, like an organization, individual, or system, holds.
Course of Action	A course of action is a strategy or plan involving the arrangement of certain capabilities and resources of the enterprise, executed to accomplish a goal.

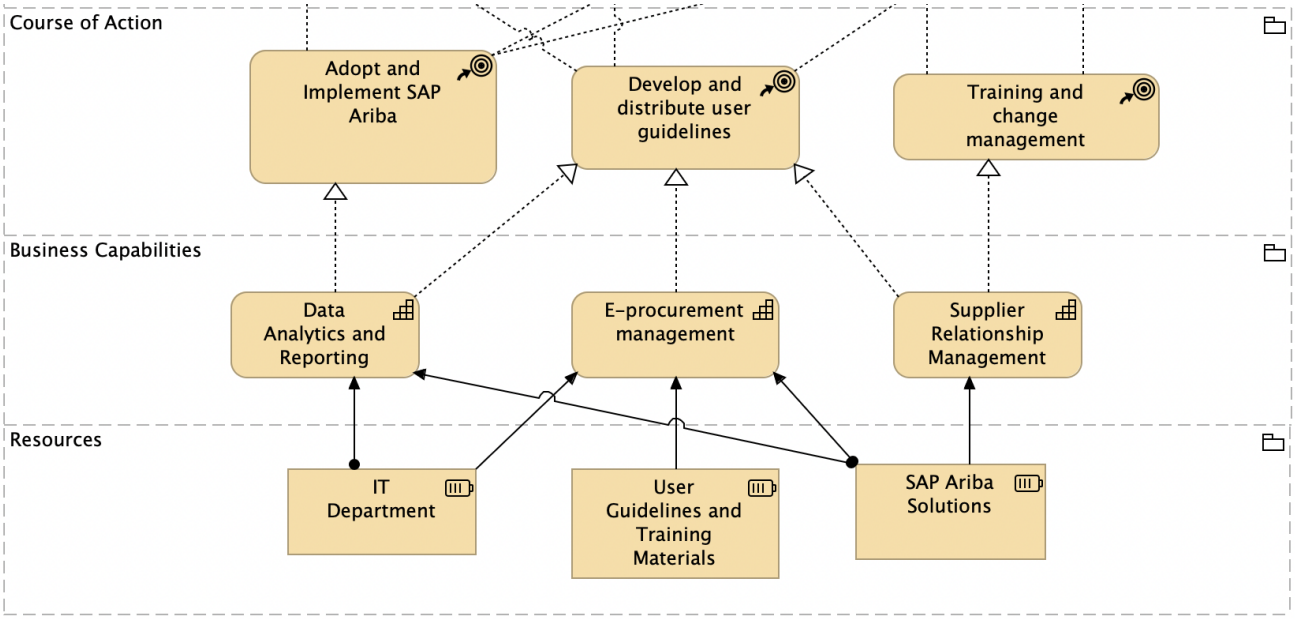


Figure 19 Strategy layer (source: own work)

4.2.3.3 Business layer

Procurement scenes can be seen in the figure below that represents the definition of the need, defining the requirement, identifying and agreeing with suppliers, procure2pay and procure2invoice processes (simfoni, 2024).

The interaction of the e-procurement process management multiple flows including sourcing, purchasing, invoicing, and reporting.

The process begins with digital sourcing activities where procurement officers use the e-procurement system to identify potential suppliers, issue requests for information (RFIs) or requests for proposals (RFPs) and evaluate bids. This is facilitated by the sourcing service within the e-procurement system, often starting with a notification or alert to registered suppliers.

After selecting a supplier, the procurement officers generate electronic purchase orders (POs) within the system. These POs are automatically routed to the designated suppliers via the e-procurement platform, where suppliers can acknowledge receipt and confirm order details through their supplier portal.

Once goods or services are delivered, suppliers submit electronic invoices through the e-procurement system. The invoices are automatically matched against POs and goods receipt notes for verification. The finance team is then alerted to process the payment if everything aligns correctly.

Throughout the process, procurement officers may generate reports to review the efficiency, cost-effectiveness, and compliance of procurement activities. The e-procurement system's analytics and reporting service provides templates and tools to create custom reports, offering insights that inform strategic procurement decisions.

Figure 20 Procurement steps (source: simfoni 2024)

Table 4 Business layer (source: The Open Group, 2024)

Business Actor	A business actor is a business entity that possesses the ability to effect on behaviors.
Business Process	A business process is a series of business activities that leads to a specific outcome, such as a defined collection of products or business services.
Business Event	A business event represents a business state change
Business Service	Denotes specifically outlined behavior that a business role, business actor, or business collaboration presents to its surrounding environment.
Application Component	An application component is a modular and replaceable encapsulation of application functionality, structured according to the implementation architecture.

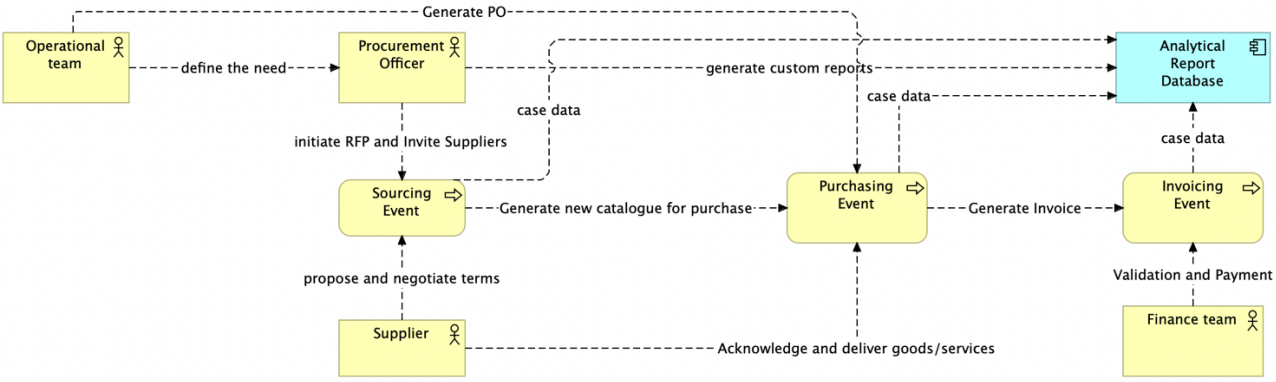


Figure 21 Business layer - cooperation view (source: own work)

In SAP Ariba Sourcing, an event progresses from its draft version of the document based on the needs to the point where contracts are awarded to participants. Each phase of the event process is marked by a specific status, which dictates the permissible actions at that stage. The event process is depicted in the figure 22 below:

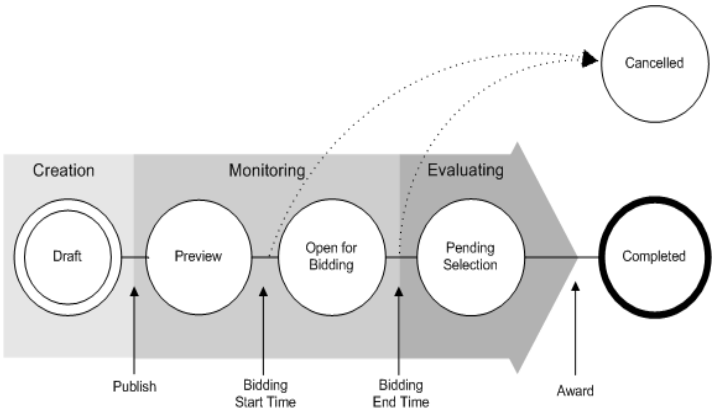


Figure 22 Sourcing event (source: SAP 2024)

Allocation of suppliers may be integrated within the Ariba Business Network system or external invitation to preferred suppliers who are not registered in the system.

The retrieval of all data will be stored in the cloud database and generate a new catalog provided from the supplier that allows to proceed with purchasing. The purchasing and invoicing transactional flow is intended for being integrated with the ERP system for maintaining the accounting and taxation data, that refers the need in importing the valid details from the external systems. The challenge on the integration depends on the allocation of the ERP system if it's on-site or cloud based. On-site ERP solution requires a manual import/export maintenance of the master and transactional data, while the cloud-based software may support the application programming interface (API) or asynchronous data flow. If automation is important, the need in the ERP cloud solution is a priority before the integration of the cloud procurement.

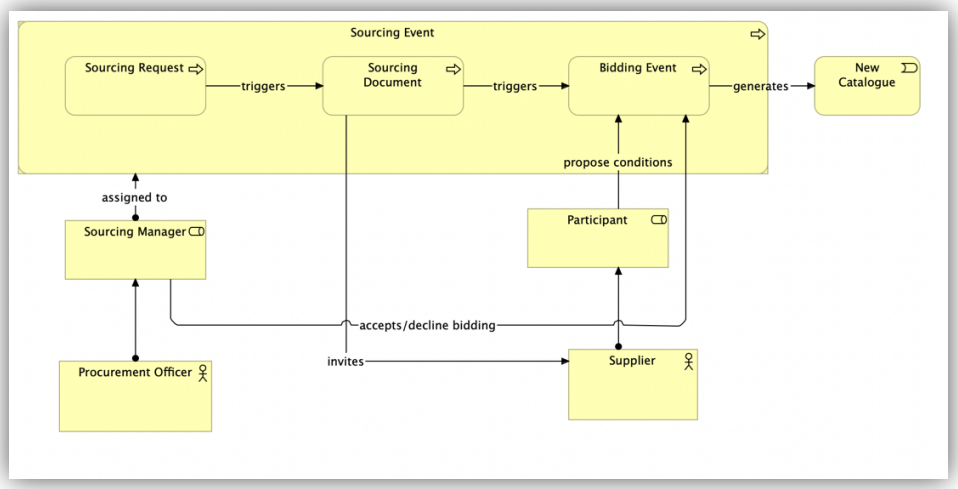


Figure 23 Sourcing Event process (source: own work)

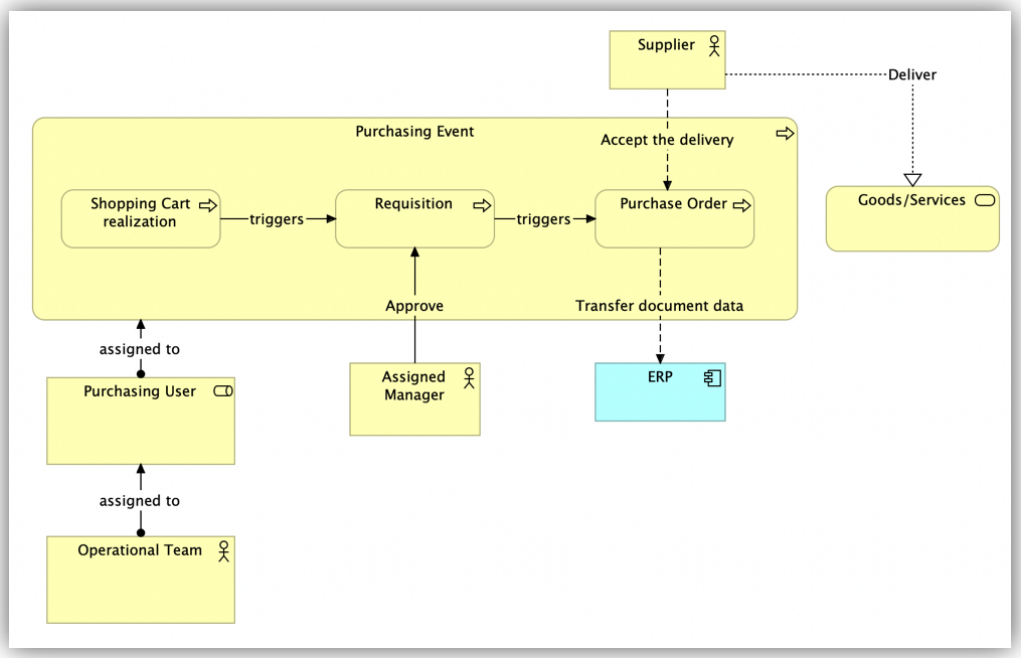


Figure 24 Purchasing Event Process (source: own work)

Purchasing event involves the operational team, management, and suppliers to proceed with the complete flow. That represents the purchasing user action when user selects the appropriate item for the need. It generates a first version of requisition that has to be checked and validated from the management side assigned to the cost center and approve/disapprove the requisition based on the condition. Figure 24 presents the positive case, where the flow is accepted from both supplier and management side to further proceed with delivery of goods or services.

Invoices general process can be created through various methods: directly in an external ERP system and uploaded to SAP Ariba, by suppliers on the SAP Business Network, manually within your site, or automatically for certain procurement transactions. Once submitted, an approvable invoice document is generated. Approval of this document leads to the creation of an invoice reconciliation (IR) document a payment request document for payment initiation. The final steps including approval and payment scheduling based on specific site configuration and ERP integration. The figure below represent the action from the delivering the invoice by supplier to the SAP Ariba.

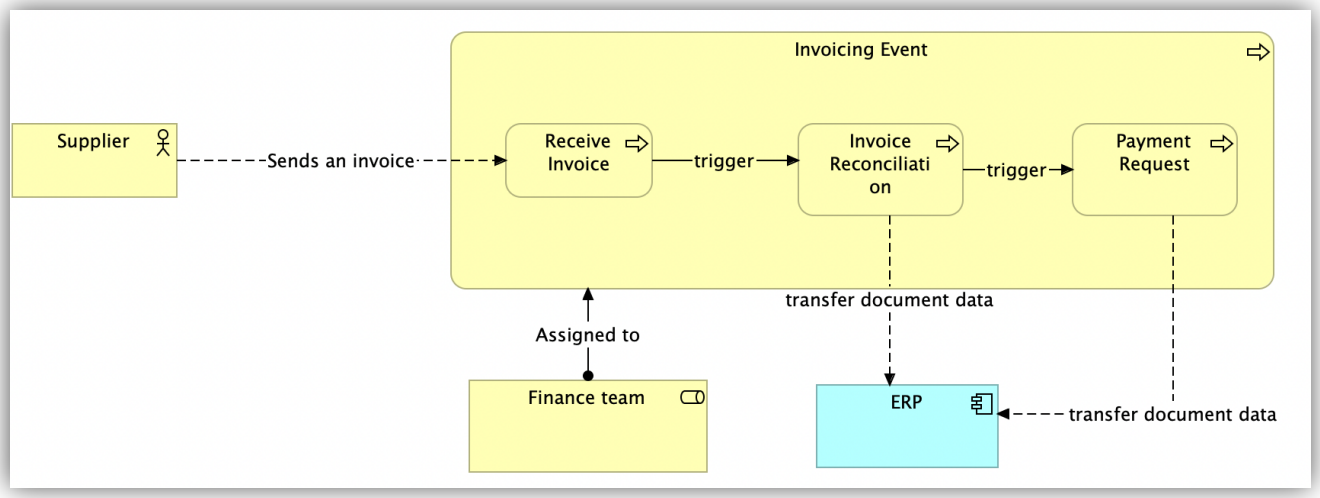


Figure 25 Invoice layer (source: own work)

Full view relation including the technology layer can be seen in the figure 26. It includes three application components that serves the sourcing, purchasing, invoicing events. Maintenance of the transactional data send through the systems to the main application with is SAP Ariba Sourcing and later can be maintained in the analytical report database that will contain both master/transactional data.

Table 3 Technology components (source: The Open Group, 2024)

Technology Function	Denotes an assortment of technological functions that can be executed by an internal active component within the technology infrastructure.
Communication Network	Denotes a framework of structures that link devices or system software to facilitate the transmission, routing, and receiving of data.

Device	Denotes a tangible IT asset where system software and artifacts can be stored or deployed for running.
Facility	Denotes a physical structure or environment

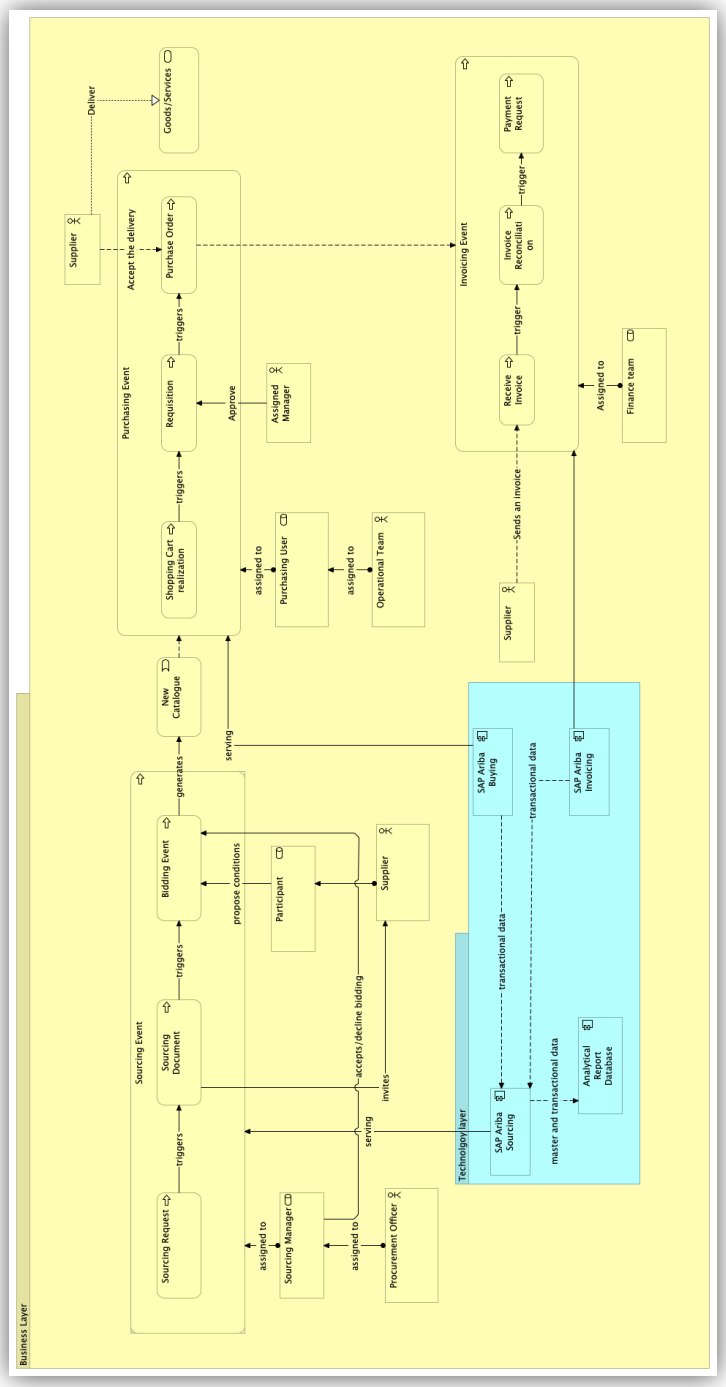


Figure 26 Business and technology layer (source: own work)

4.2.3.4 Technology layer

Next part of the development lays on the technology layer that includes several options for the application usage (smartphone, laptop). All departments of the enterprise need an access for providing the cloud solutions to the users. The figure 27 presents monolith cloud software connected to multiple departments using the wireless network. The figure doesn't represent the communication of the digital procurement with other services but provided overall picture on how people participate in the usage of software.

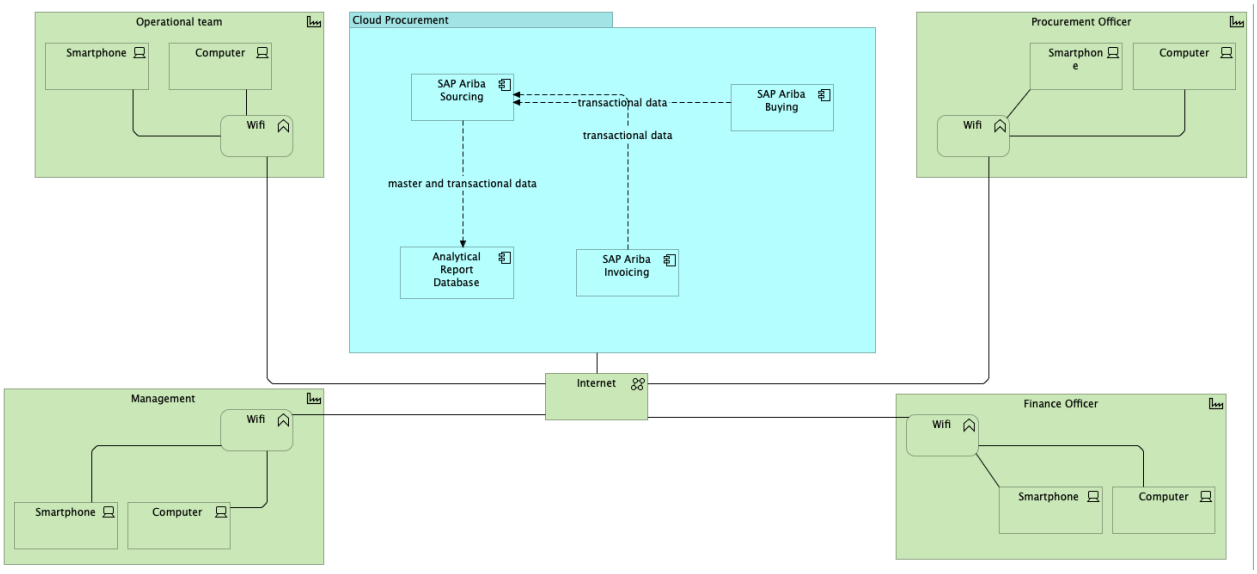


Figure 27 Technology communication layout (source: own work)

4.2.3.5 Use Case Interaction

Interaction layout according to the layers (sample):

At the strategic level, the enterprise leadership work together to set a clear vision for the adoption of the e-procurement system. They are driven by the strategic goals of enhancing operational efficiency. To this end, they identify the need e-procurement management capability, which will be facilitated by implementing SAP Ariba.

They earmark resources, including a budget for the system acquisition, the IT infrastructure required to support it, and funds for training employees on the new system. The courses of action involve a detailed selection process for the e-procurement system that meets their requirements,

negotiating the purchase with SAP Ariba, and planning for a phased rollout that includes training and change management to ensure high adoption.

At the business layer, the focus is on the day-to-day operationalization of the strategy. The Procurement Manager initiates the procurement process by logging into SAP Ariba to create a new sourcing event for office supplies. They define the specifications and requirements within the system and send out the RFP to suppliers.

Procurement Officers then evaluate the received proposals using the system's built-in analytics tools, which help them compare offers and select the most cost-effective option. After the supplier is selected, the operational department generates a purchase order through SAP Ariba, which is electronically sent to the supplier.

As goods are received and services rendered, suppliers upload their invoices directly into SAP Ariba, which automatically matches them against the PO and delivery receipts. The finance team reviews and approves the payment within the system, and the financial transaction is completed.

The management and finance team, using the analytics capabilities of SAP Ariba, pull data on procurement activities to produce reports that offer insights into spending patterns, supplier performance, and the efficiency of the procurement cycle. These insights help in identifying areas for further cost savings and process optimization.

The technology layer underpins the entire e-procurement process. The SAP Ariba system is hosted on cloud servers provided and maintained by SAP, ensuring high availability and scalability. The company’s workstations are configured to access SAP Ariba through web-based interface, ensuring that all procurement activities can be carried out online.

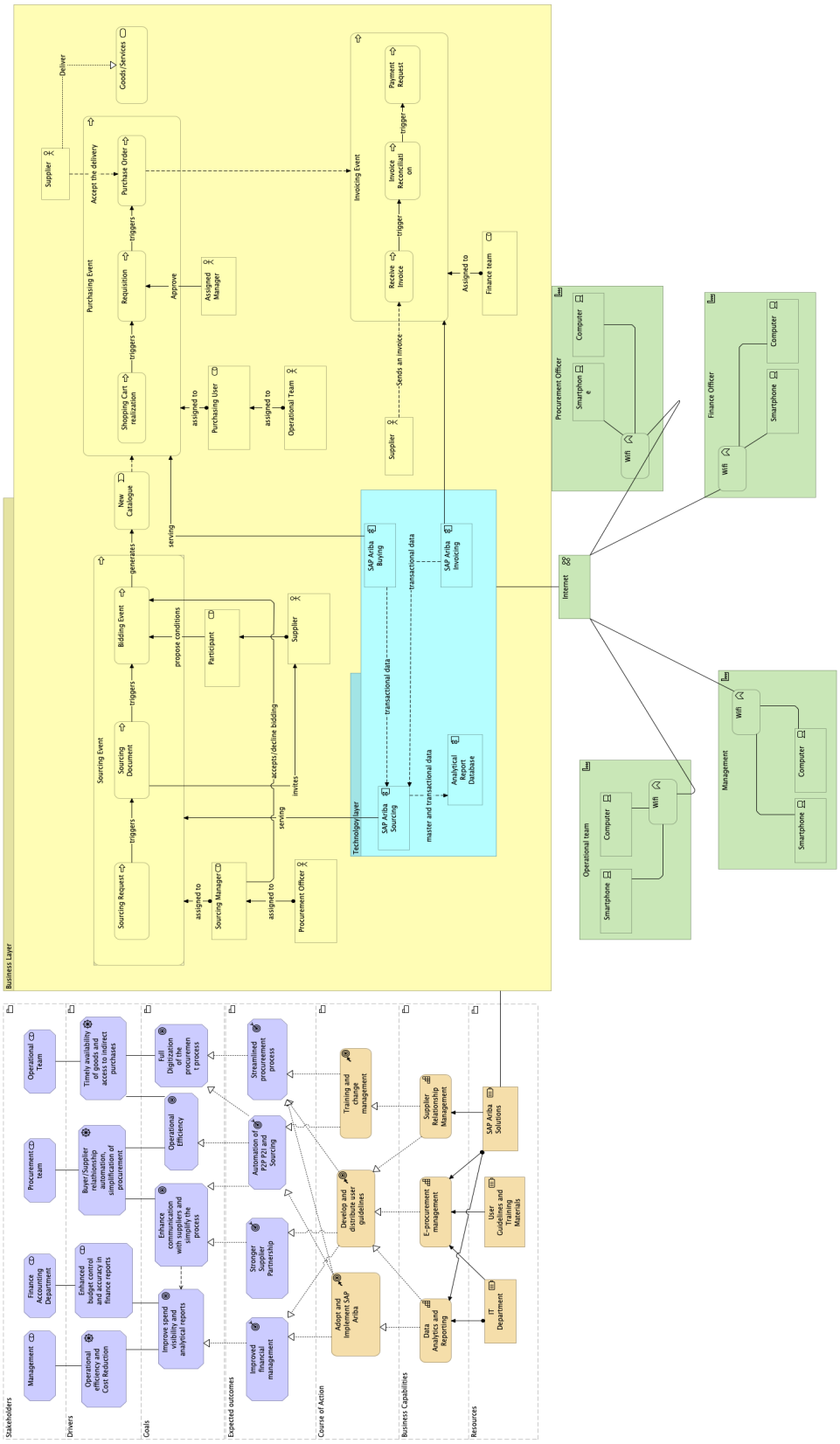


Figure 28 Combination of layers (source: own work)

4.3 EA for SMEs | Challenges & Solutions

EA is judged (Kotusev, 2016). Even so, the main cause represented for the research is misunderstanding in the nature of appliance the EA into the enterprise by providing an example of FEA by United States. Federal Enterprise Architecture has received budget from the taxpayers and didn't provide its efficiency, and key point to mention is that the project was on governmental level. The main problems mentioned for the SME in their digital transformation journey are costs and human adaptability to the new solutions. Appliance of the full enterprise architecture that will lead to the proper digital transformation may require a lot of efforts by the main representatives of the enterprise. However, some parts of the framework may be useful. It depends on what is the business motivation. In case of understanding basic principles of the EA each SME can construct their own DT framework that may play a crucial role for strategy deployment in the market. Each business wish to increase revenue and decrease costs. Business needs to understand what the main strategy will be to apply one or another technology, define its efficiency and investigate how the enterprise may survive without a specific solution. One of the questions that came up is if the framework may be generic and applicable for all enterprises. Then asking that question, we can leverage one framework for SME to validate the necessity of the technology appliance and cycle the process of that framework based on the enterprise view.

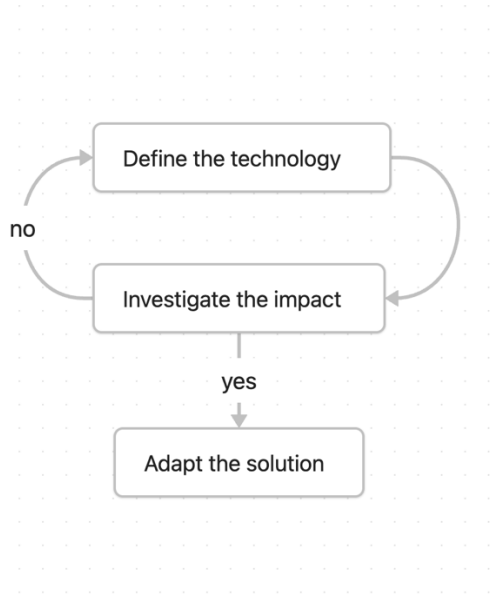


Figure 29 Technology Review (source: own work)

The principle for the technology review in the figure 29 is very common, but common solutions may simplify the future enterprise architecture planning:

1. Define new technology: Research on the technology, define all benefits that new solution provides, gather samples, and use cases on applicability of the new solution into the business process. Validate alternatives in the market.
2. Pros/Cons investigation: Compare all features and costs associated with the new feature for a decision making. There are always risks in adapting new technology as it may not be effective as it's expected from the initial point of view. It's important to structure strong case for the solution adaptability.

Next business action is divided into two parts: 1) Technology Deployment; 2) Employee Preparation:

The technology deployment layout would consist of the process to adapt a new technology for SME that would contain the definition of requirements for deployment, leveraging responsibilities, transition plan, implementation. Such template is presented in the previous case of the adapting the SAP Ariba for Medium enterprises.

Employee preparation is a separate business action layout that require primitive steps: gather documentation, educate responsible persons, distribute handbooks & guidelines, and optionally certify users if needed. Later on, employee preparation layout consists of external factor that may boost adaptability of the people to the new technologies.

Mainly the strategy target can be defined for 3 points: technology adaption, employee acknowledge process, digital transformation strategy. Those strategy targets may boost the adaption to the evolving technologies what can be a main motive for better outcome of the enterprise. On another hand, adaption to the evolving technologies, may goal different aspects that may play beneficial role for the company. Digitalization of the enterprise and ESG principles for transparency and sustainability that are one of the targets for the European Union. The full structure, including external factors and requirements can be seen in the figure 30.

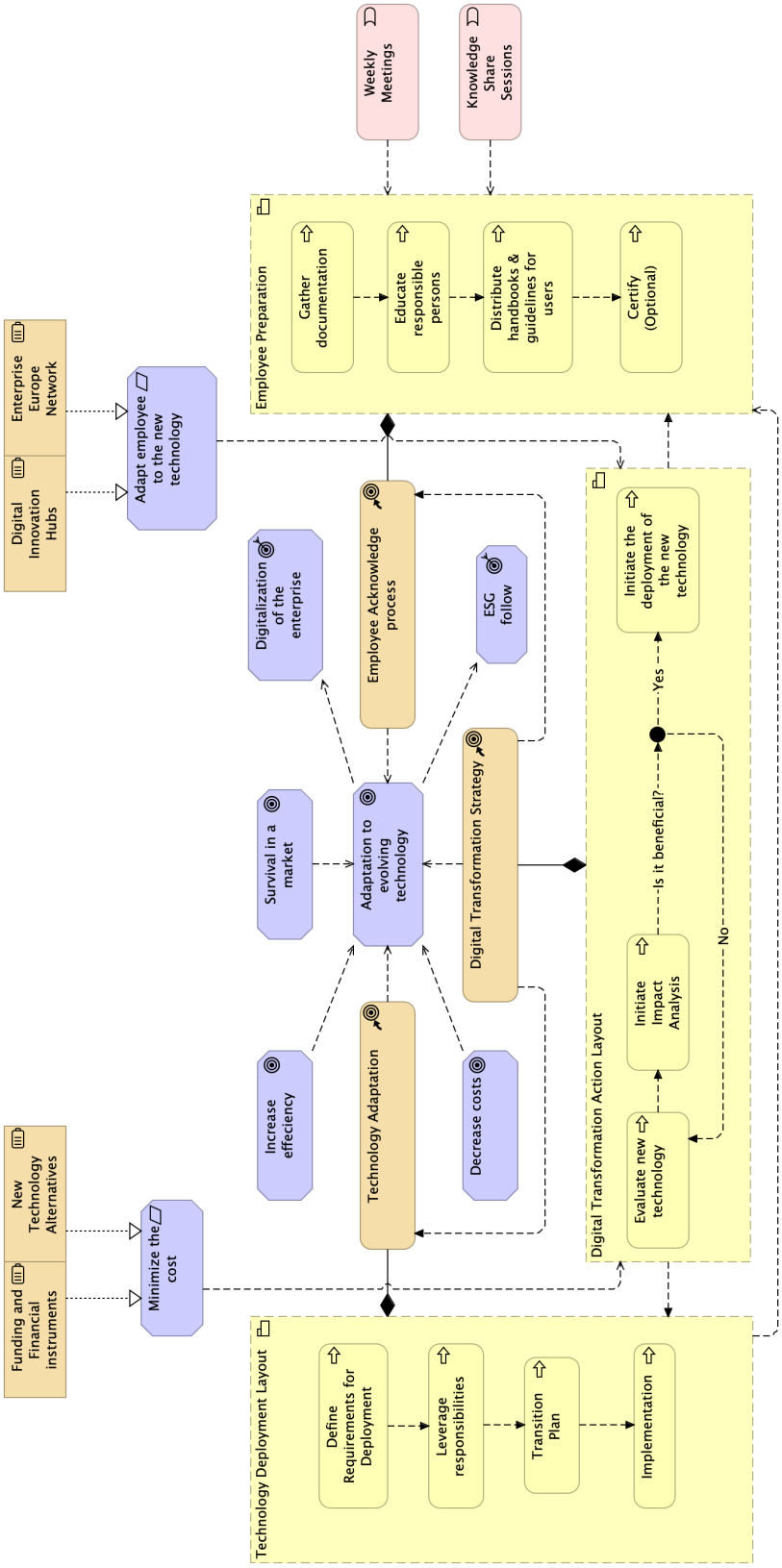


Figure 30 Digital Adaption for SME (source: own work)

The figure 30 presented the outcome of the scientific research into the framework for technology adaptability by small or medium enterprises. The provided framework is useful for the European level as it includes the external factors that may affect the requirements “Minimize the cost”, and “Adapt Employee to the New Technology”. The key points mentioned are “costs” and “adaptability”. Business owner may proceed with various solutions on applying new solutions to the enterprise (such as outsource) and it’s very dependent on the enterprise business processes.

Based on the motivations presented, new questions may appear if the technology is beneficial or not. Would the company survive till the new cheaper alternative appear in the market? Even so the EA may be used in the various ways to represent the strategy that can be useful for the enterprises. One thing that individual needs to operate with is a correct understanding of the processes for the enterprise architecture activity. Motivation and Strategy layers are useful to document the plans of the enterprise for the future grow. Business layer includes the action processes within one or another department and may lead to the better knowledge share within the company. Application and Technology layer may be useful for the companies that operates with IT staff. Even without IT, it may have a significant impact in the human adaptability to the technology understanding by providing the correct process of the application actions.

4.4 Limitation

The provided framework for the digital transformation lays on the medium enterprises with a high average revenue due to the cost of monolith cloud infrastructure provided by the company SAP. The enterprises with unstable income have to look for other solutions to deploy digital procurement system. While having the solution as SAP Ariba, it provides variety of instruments and tools that helps to make the document exchange efficient and transparent. Even so, the provided case doesn’t include all technology capabilities that the consultant needs to deploy for a smooth business process. That includes additional customization in the validation conditions that may vary between countries legislation and includes the check of the taxations. Second point that was already mentioned is the integration of the ERP system within the procurement flow for accounting activities. Initial phase of the ERP integration lays on the identifying the position of ERP for the enterprise (on-site or cloud based). Delivering all accounting data from one platform to another is time consuming and may leverage additional stages in the deploying the cloud procurement. While on-site ERP generates complexities, the enterprise has to think about implementing the cloud ERP solution first.

Another part that is not included in the Archimate notation is the deploying of the guidelines and training. This phase may be separated according to the management decision but overall picture of the possible solutions for each department has to be distributed. The guidelines should align with the proper usage of the system to avoid possible issues that will include more work on the IT department.

Saying about IT department, the main necessity for the employees in that area is to provide a secured connection and prioritize the action of not sharing sensitive or confidential data of people in the company, define and inform users about possible repairs and future fixes deployments that causes delays or unavailability of the system.

5 Discussion

- The practical part includes the integration of the digital procurement SAP Ariba as a replacement to the manual operations for the enterprises. Adopting the cloud-based solution is one of possible ways for digital transformation. However, the implementation lays on the scenario where the medium enterprise has decided on increasing the efficiency of the operations and doesn't contribute to the costs and enterprise performance. Unfortunately, even when the monolith cloud procurement provides a smooth operation, increase transparency and efficiency, the main problem defined in the literature part is costs of the digital solutions. The SAP itself is a large corporation that provides multiple solutions for large enterprises. The news by the company provides successful cases of adopting their solutions to the middle enterprises too, but the number of employers in the defined SAP customers is greater than it's specified by the European Union. The integration of artificial intelligence may cut the costs required for maintaining and servicing the digital software, but main question is if the SAP itself will boost their participation in the SME area and provide more flexible solutions for possible customers with adopting to the current digital single market provided by EU.
- The trend on the market shows the representation of the Nordic countries leading in their digital intensity, but it's not same for the total amount of small and medium enterprises in the selected areas (construction, wholesale & retail, manufacturing). Even so, the history represents that adaptation of the digital solutions was boosted by the governmental activity and moreover with digital education on that level. Initiatives of policy updates by government and high education development in the digital sector is the goal for the people adaptability to the current trends. However, the technology evolves and not only the people should adapt but governments too. Currently, multiple policies (including fundings and digital hubs) in the Schengen area provided to boost the SME in their digital participation, but it needs some time to define if they have significant effect and validate if the result covers its costs.
- Digital Transformation and the enterprise framework for SME is one of the challenges. Does small or medium enterprises need the comprehensive plan for digital solutions if the increasing usability of the systems allows to proceed with a seamless integration of digital solutions. It's still a problem for the enterprises for adapting their process in the digital way. For large enterprises different frameworks like TOGAF seems to be beneficial, while SME struggles with proper adoption of them. In the meantime, frameworks are judged by multiple

authors for its unavailability for fulfilling the unique business cases. The question is if the framework needs to be developed in the way for fulfilling the business requirement or business itself needs to define how they can use opportunities of the one or another framework to achieve the goals. It comes again with enterprise adaptability to understand how likely the enterprise architecture is suitable for filling their goals. Variety of the digital transformation templates allows SME to define which path to go, but still reminds about its real need.

- High cost of the digital transformation is a barrier. It was mentioned multiple times during the research and provides the view that over two decades, it's still a problem. But, whenever the enterprise adopted solutions that are in the market for over 10-15 years, current trends are completely different. Is it matter of time to decrease the costs on the digital solutions by providing better alternatives in the market? If yes, then how many years the SME should await for the capable proposals by the IT companies to follow the current trends?
- Ending this part comes with a question about the adaptability of the people on the new digital transformation processes. New technologies evolve and will continue to do so. Whenever new technology will lead for a replacement of employees, last ones should look for same position in another company that didn't adapt new technology yet or requalify themselves into the new area. Selecting IT as an alternative may become more and more complex and will require a narrow learning program that requires a comprehensive background in the IT area. How likely people are willing to go into the new IT area due to its increasing technology requirements?

6 Conclusion and Recommendation

The main objective of the thesis lays on providing strategies used to restructure small and medium enterprises with a digital approach for the countries in the Schengen area with a focus on the highly developed countries in the digital area. The research showed up Scandinavian countries (with a blots on specific areas leaded by other countries) as leaders in the digital intensity. However, their historical background went through multiple flows including the governmental interventions and adaptability of the education system to the new digital opportunities. Multiple strategies were provided as part of digital transformation for the literature review. The main complexity of the thesis is a wide area even with a focus on the developed countries, it can't cover all of the strategies due to variety of sectors that SMEs participate.

During the investigation of the literature part, the practical part covers the analyze on the current trends and check the possible challenges. Coming back to the wide area of the SME participation, challenges and possible solutions were defined for the manufacturing, construction, wholesale & retail industries due to the high amount of the SMEs in those areas.

As part of the practical part, specific scenario was conducted on the digitalization the procurement process using the Archimate with a help of TOGAF approach. As a main cloud computing solution SAP Ariba was chosen for the middle enterprises. The selected scenario provides a solution for increasing efficiency and transparency of the data but doesn't cover the main problem – costs, that is specified in the limitation section of the second part of practical phase. Even so, new framework provided for the digital not transformation but adaptability of the enterprise to the technologies. The framework may be useful for a common strategic planning and may be enhanced based on the unique business goals of the enterprise.

When the EA is judged for its appliance, it still can be useful in a various way as specified in the third practical part (as a primitive digital transformation strategy to apply the SAP Ariba to ME or Digital Adaptability Course). Even if the company doesn't follow the proper way of the EA using TOGAF method, Archimate may be useful for representing the layouts for the business strategy.

As part of historical trends, costs and human adaptability are main causes of the lack in the digital technologies for the enterprises. It's still remains, while old technologies already adapted, new ones are complicated and may be costly.

1) Does SME need to invest in the new technology if better alternative may appear in the future? Can SME survive during that period?
    a) SME should invest on the technology that may play a crucial role in their business goals. The main problem is to define what technology may be useful for the business processes and what are the prerequisites:
    b) The SME should always look into the new benefits that may be received from the external factors (including policies & interventions provided on the country or union level).

c) Business actors may use EA as a process in different level (from defining the motivation to specifying the condition for the application action) and preparation of the transition plan is always beneficial for the companies.

2) Human Adaptability is one of the main problems, that reminds about everything as a service. That can leverage all business processes within the company that may be supported by the third parties and the company may focus on the business priorities. However, it's very dependent on the financial position of the company and on-going priorities for the company. One deployed strategy by the third party may be useful only for some period of time, while the trained employee in the internal department may use all of the skills for EA preparation and may have deeper vision on the business processes within the company.
3) Does SME need an EA if digital technology can be "easy-to-go" adapted?
   a) Each enterprise may need a proper plan for the solution to be smoothly adapted. EA would be beneficial to process the strategy for the digital transformation and it doesn't require to limit the appliance of enterprise architecture only to one technology but to the overall digital switch framework.
   b) Layers representation and defined approach by the TOGAF may be helpful to realize the proper plan.

SME, DT, EA are main components of the thesis. As part of the partial objectives, status of the DT was described in the first half of the practical part. Influence of DT, challenges, and possible solutions were described at second practical part with a limitation to 3 sectors. Templates were constructed for the cloud procurement solution to the Medium Enterprise, and digital transformation adaption for SME in the third practical part. The thesis focuses on the wide area of the SME and DT and doesn't have a deep inside investigation of a specific sector that may mislead to the unique behaviors of one or another sector. However, the thesis provides wide overview of the history of DT, current trends, templates that may be useful for future use.

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7 List of pictures, tables, graphs, and abbreviations

7.1 List of pictures

7.2 List of tables

7.3 List of abbreviations

AI artificial intelligence
ADM Architecture Development Model
AIS Accounting Information System
API Application Programming Interface
BI Business Intelligence
BPO Business Process Outsourcing
BSP Business System Planning
CC Cloud Computing
CRM Customer Relationship Management
CSR Corporate Social Responsibility
DS Digital Servitization
DT Digital Transformation
DYA Dynamic Architecture
EA enterprise architecture
EC European Commission
EDI Electronic Data Interchange
EEN Enterprise Europe Network
ERP Entity Resource Planning
EU European Union
GDPR General Data Protection Regulation
ICT Information and Communication Technology
IoT internet of things
IR Invoice Reconciliation
IT information technology
PO Purchase Order
RFID Radio Frequency Identification
RFP Request for Proposal
SME small-medium enterprises
TAM Technology Acceptance Model
US United States

Appendix

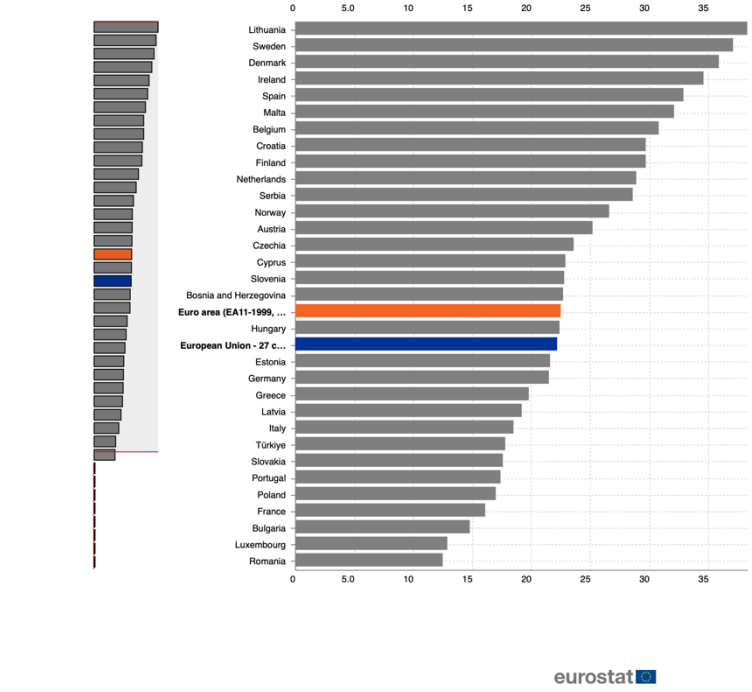

Figure 31 E-commerce sales of SME in 2023 (source: eurostat)

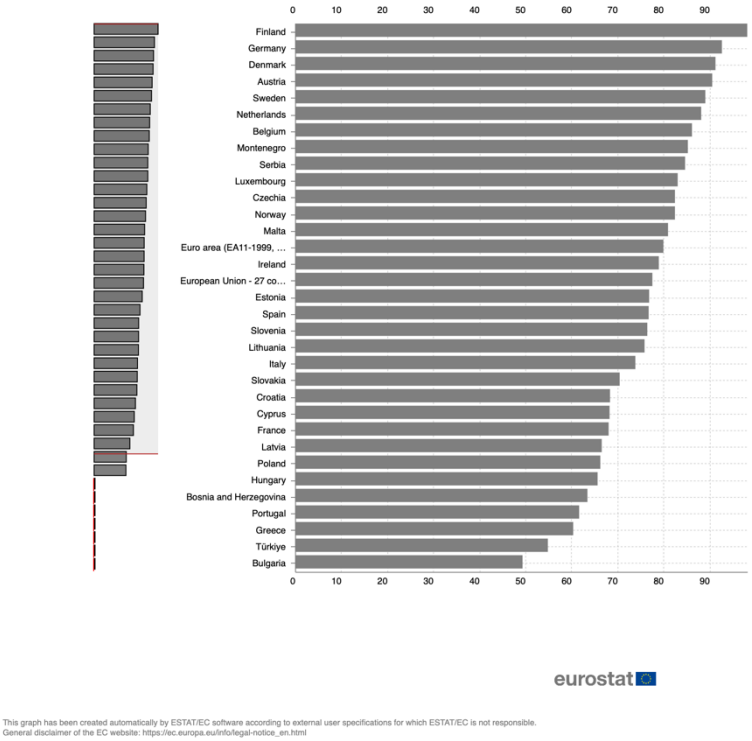

Figure 32 Websites and functionalities for SME in 2023 (source: eurostat)

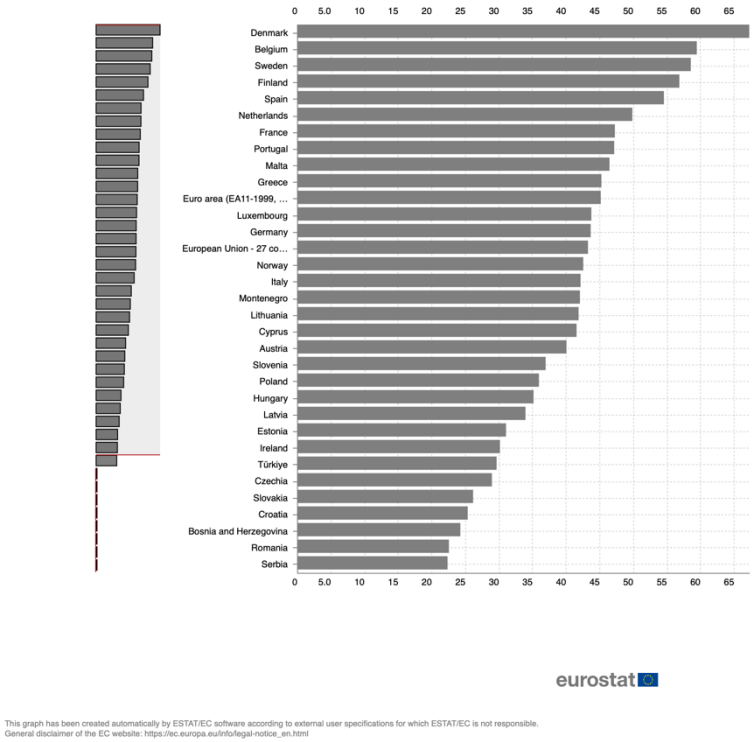

Figure 33 Integration of internal processes for SME in 2023 (source: eurostat)

Table 4 Technology components (source: The Open Group, 2024)

Technology Function	Denotes an assortment of technological functions that can be executed by an internal active component within the technology infrastructure.
Communication Network	Denotes a framework of structures that link devices or system software to facilitate the transmission, routing, and receiving of data.
Device	Denotes a tangible IT asset where system software and artifacts can be stored or deployed for running.
Facility	Denotes a physical structure or environment