Norwegian University
of Life Sciences

Master's Thesis 2022 30 ECTS
School of Economics and Business

Unlocking growth within SMEs through digital transformation

A study of digital maturity and its effect on profitability amongst SMEs in the Greater Oslo region.

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PREFACE

This research marks the finalization and end of our two-year long Master of Science in Business and Administration at the Norwegian University of Life Sciences (NMBU), with a specialization in Business Analytics. It is not a secret that a master's degree from 2020 to 2022 in a global pandemic has been very challenging for our university days in many ways. Writing this thesis has been a challenging process, testing us on all our acquired knowledge within different fields and topics, but has at the same time been rewarding and a valuable experience.

There are quite a few people we would like to express our gratitude to. They have accompanied us along this journey and deserve credit for their involvement. Firstly, we would like to sincerely express our deepest gratitude to our supervisors Joachim Scholderer, who has motivated and inspired us with an interesting topic to study. Nonetheless, the constructive criticism and valuable advice for thesis development throughout our whole writing period. Secondly, we would like to extend a big thank you to all our informants who found time to contribute to this study, despite hectic and challenging business schedules. We greatly appreciate your interest and the time you have offered to participate in this research. The thesis would not have been possible without your help.

Lastly, we are grateful to our close family, friends, acquittances and colleagues for supporting us throughout a challenging time, through their genuine curiosity and interest in our work. We appreciate your support, love, and faith in us.

ABSTRACT

Small and medium-sized enterprises (SMEs) classify as the very backbone of Norwegian business and industry. According to SSB, there were a total of nearly 630 000 active enterprises operating in Norway in 2022 (SSB, 2022). This constitutes more than 99% of all companies in the country. The SMB-market also account for half of the value creation in the country. On the other side, we see that these companies have a great need for a digital competence boost which is an important driver for innovation and competitiveness. Their path to becoming more digital, in context with lack of economic capital, fewer employees and minimal resources, is an interesting topic in itself. It has previously been proven through research that digitization in large companies is profitable. Unfortunately, there is little research on the same topic regarding the SME market.

The purpose of this master's thesis is to shed light on whether there is any significant correlation between digitalization and financially profitable for small and medium-sized companies. This is done through qualitative interviews with 30 top leaders from companies in the greater Oslo, who participated in the study. The main aim is to evaluate their digital and technological implementations made in the time period 2014-2019, which is the period the study is based on. Furthermore, these implementations are sorted based on the functions marketing, logistics, organization / management, and production, based on the conceptual product that has been developed by the authors. This conceptual product quantifies the company's digital maturity by quantifying it through a digital index. The economic profitability ratio Return on Sales (RoS), which denotes the relationship between operating profit and turnover, are the parameter used to measure whether the implementations are profitable or not.

The result of the study shows that digitization does not necessarily have a significant connection with profitability. This means that implementation that is introduced does not show any improvement in the financial results even five years after the digital implementation has been introduced. On the other hand, implementations in the organizational / management function are an exception. The findings from the study show that a digital implementation leads to financial profitability 3 years after it is implemented. This thesis explains favorable digital implementations for SMEs, and why some are insufficient in achieving their desired goals where the effect has been negative.

SAMMENDRAG

Små og mellomstore bedrifter (SMB) klassifiseres som selve ryggraden til norsk næringsliv. Ifølge SSB er det i 2022 til sammen nærmere 630 000 aktive virksomheter i Norge (SSB, 2022). Dette utgjør mer enn 99% av alle bedriftene i landet. Disse står også for nærmere halvparten av verdiskapningen i landet. Allikevel ser vi at disse virksomhetene har et stort behov for et digitalt kompetanseløft som er en viktig driver for innovasjon og konkurransekraft i Norge. Dette sett i sammenheng med lite ressursintensitet og mangelen på økonomisk- og humankapital. Det har tidligere blitt bevist gjennom forskning at digitalisering i store virksomheter er lønnsomt. Dessverre er det lite forskning rundt same tematikk som gjelder samme tematikk i SMB-markedet.

Hensikten med oppgaven er å belyse om det er noe signifikant sammenheng mellom digitalisering og økonomisk lønnsomt for små og mellomstore selskap. Dette blir gjort gjennom kvalitative intervju med 30 toppledere fra selskap i Oslo og Viken som deltok på studiet. Disse forteller om deres digitale og teknologiske implementeringer gjort i tidsperioden 2014-2019, som er den perioden studien baserer seg på. Videre blir disse implementeringene sortert basert på funksjonene markedsføring, logistikk, organisasjon/ledelse og produksjon, basert på det konseptuelle produktet som har blitt utviklet av forfatterne. Dette konseptuelle produktet kvantifiserer bedriftens digitale modenhet med en gjennom å tallfeste en digital indeks. Dette ses på i sammenheng med det økonomiske lønnsomhetsfunksjonen driftsmarginen, som betegner forholdet mellom driftsresultat og omsetning.

Resultatet av studiet viser at digitalisering av de samtlige funksjonene ikke har en signifikant sammenheng med lønnsomhet. Dette betyr at implementering som blir innført ikke viser noen bedring i de økonomiske resultatene selv fem år etter at den digitale implementeringen har blitt innført. Derimot så er implementeringer i organisasjons/ledelse funksjonen et unntak. Funnene fra studiet viser at en digital implementering fører til økonomisk lønnsomhet 3 år etter at den er iverksatt.

Denne oppgaven gir implikasjoner på hva som er gunstige implementeringer. Det redegjøres også for hvorfor implementeringene bedriftene har gjennomført ikke har klart å nå sitt ønskede formål.

TABLE OF CONTENTS:

LIST OF FIGURES:

LIST OF TABLES:

1 Introduction

1.1 Background and objectives

Back in the 1700s, production and manufacturing of products such as weapons, clothing, shelter, and food was done by hand. These processes were time-consuming and prosecuted in small warehouses using simple tools and equipment. As advancements were made in machinery and warehouse processes, the industry experienced a significant change. Small warehouses grew bigger with their capacity to produce on a larger scale and for commercial purposes. Such changes, or transitions, from a handicraft economy to a manufacturing industry utilizing machines and new technologies is referred to as the Industrial Revolution (Simone, 2022). The Industrial Revolution, although a phenomenon first introduced in the 1780s, have been an ongoing change through the years as new technologies and products process are introduced to the society.

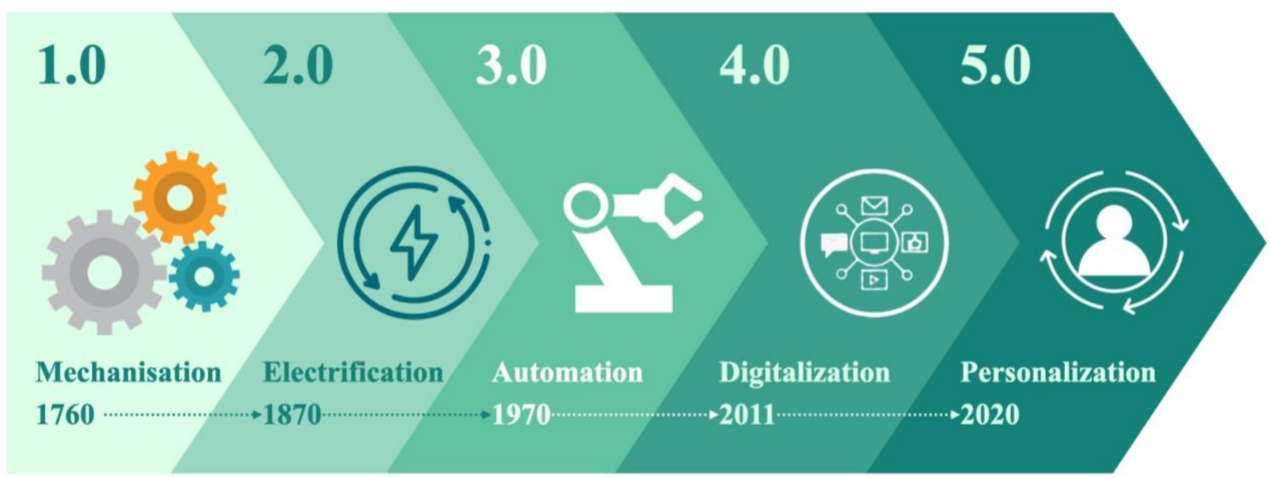

Figure 1: A visualization of the Industrial Revolutions 1.0 to 5.0 over time.

The industrial revolution began in the 18th century, covering the period between 1760 to 1840. The time period was characterized by major transitions in existing economies of different continents. The revolution caused handicrafts and agriculture-based economies to shift towards factory systems, large-scale industries and mechanized manufacturing. New industries were developed, featuring modern power sources, machines, and new strategies of organizing different departments in industries came to existence. Although the transitions spread worldwide by the start of the 20^{th} Century, the changes did not occur in one single move. Gradually, the transitions introduced enhanced, modern and more innovative stages of economies. These can be divided into five industrial revolutions.

Industry 1.0 is a term used for the first industrial revolution that began in England in the 18^{th} Century (Simone, 2022). The main characteristic of this era was mechanization of production and vast usage of steam power. Mechanization was introduced in the production process, leading to faster processes and relatively large-scale production. While steam power was already known prior to the revolution, it had not yet been used in industrial processes. Its introduction to the industry was, however, considered the biggest breakthrough ever made in this era. Despite steam power leading to the production of higher volumes primarily, it also led to significant raise in human productivity due to provision of adequate power for machines.

The second Industrial Revolution, Industry 2.0, featured a more streamlined mass production process (Simone, 2022). Another notable aspect was the improvement in the industry culture. Although management programs had been introduced during industry 1.0, more techniques and programs were put in place to improve the quality and of output and ensure better management of production. Lean manufacturing principles, allocation of resources, just-in-time manufacturing strategies and a better division of labor are a few examples of these techniques. In terms of technological development, the major aspect of this era was the use of electrical energy and steel in production industries. The telegraph was shortly after introduced and railroad networks were developed. These networks facilitate a faster transportation system and allow for faster communication and transfer of information.

Industry 3.0 is commonly referred to as the ‘Digital Revolution’ or the ‘First Computer Era’. It began partially through automation, which refers to a technological process achieved by using simple computers and Programmable Logic Controllers. With the introduction of Information Technology (IT) and electronics, manufacturing processes required less human intervention in production. Further advances in the automation process followed with the use of renewable energy as well as the development of connectivity and internet access. During the late 20^{th} Century, great advancements followed in the electronics industry causing a greater accuracy in production, increased speeds, better competency, and even replacement of human labor in some manufacturing processes. The incorporation of electronic machines, however, led to a demand for software systems to control the electronic hardware. This fueled the software development market, which ensured that management process could be carried out. Inventory management, tracking of products, enterprise resource planning and scheduling of product flows are a few examples of activities requiring management software systems.

Industry 4.0 is often considered to be a development of the third industrial revolution, while characterized by the use of communication and smart information technologies in various industries. It has led to efficient networking of systems, also known as “cyber-physical production systems”. As a result, smart factories have emerged where all production is almost done by completely automated production systems, although people and components communicate. With the significant increase in the use of digital devices and machines in production industries, provision of service histories and equipment documentations provide ease to maintenance professionals. In short, crucial information is now provided in a timelier manner and available in the right places at the right times. Another important aspect of Industry 4.0 is the increased awareness surrounding sustainability and environmental issues.

A key aspect of technologies within Industry 4.0, are Cyber-Physical Systems (CPS). These analyze, guide and share intelligent actions, making devices smarter with less human intervention needed. Smart machines have become a phenomenon providing monitor systems that detect failures in manufacturing processes, allowing industries to be prepared for any drastic changes that could result in high downtimes and losses.

Industry 5.0 has been defined in various ways, but is currently conceptualized to leverage the unique creativity of human experts to collaborate with powerful, smart and accurate machinery (Maddikunta et al., 2022). Formerly, the technological advancements have resulted in less human intervention in production processes. However, with the advancements in Industry 5.0, it is expected that human’s intervention is re-introduced to the industries. It is expected that high speed and accurate machines, and critical, cognitive thinking of humans are to be merged. A key factor to this is the mass personalization wherein customers can prefer personalized and customized products according to their taste and needs. The collaboration between humans and machines is expected to increase manufacturing efficiency and create versatility, while enabling responsibility for interaction and constant monitoring activities.

Compared to Industry 4.0, Industry 5.0 creates a market for more skilled jobs since intellectual professionals are required to work with machines. With a focus on mass customization, this industrial revolution is primarily designed to enhance customer satisfaction. One way of doing such is by assigning repetitive and monotonous tasks to the robots/machines and the tasks which need critical thinking to the humans. Furthermore, it proved more green solutions compared to the existing industrial transformations, neither of which focuses on protecting the natural environment. By using predictive analytics and operating intelligence to create models that aim at making more accurate and less unstable decisions, meaning that production with be automated with real-time data in collaboration with highly equipped specialists.

Small and Medium-sized Enterprises (SME) are defined as businesses that maintain revenues, assets or a number of employees below a certain threshold (Liberto, 2020). The World Trade Organization defines SMEs as firms employing between 10 to 250 employees, while micro firms are referred to firms that hire up to 10 employees (World Trade Organization, 2021). The Confederation of Norwegian Enterprise (NHO) defines SMEs as firms with less than 100 employees (NHO, 2020a). Small enterprises are regarded as firms with 1-20 employees, medium-sized ones as firms with 21-100 employees, and any firm with more than 100 employees is regarded as larger.

SMEs, in any given national economy, are likely to outnumber large companies by a larger margin and hire a larger number of employees (Fischer & Reuber, 2000). Excluding companies without any employees, Norway is home to approximately 200,000 companies and according to NHO, SMEs stand for 99% of all these (NHO, 2020b). Of the enterprises within the private business sector, 47% are SMEs. By purchasing from subcontractors, other services, rent premises and paying taxes, these companies generate larger ripples even with a few numbers of employees. This creates incomes for larger and other companies, the municipalities, and the State, which create an overall knock-on effect. Altogether, the SMEs of Norway stand for 47% of the workforce and 44% of the value creation in the country, which accounts to a kroner-sum of 700 billion (NHO, 2018).

1.2 Objectives of research

According to McKinsey and Company, sluggish productivity is one of the biggest threats to economic growth in both developed and developing countries (Alibaz et al., 2020). It results in lower income growth, increase inequality and challenges regarding loan repayments as a domino effect of lower incomes, posing as an overall threat to citizens' well-being. In a study conducted by McKinsey Global Institute (MGI) in 2018, it was found that productivity growth has stalled in recent years. The study was conducted with data from seven Organization for Economic Co-Operation and Development (OECD) countries and the results showed a drop in average productivity growth of 2.4% between 2000-2004 and 0.4% between 2010-2014.

Given the drop in productivity and knock-off effects of SMEs on the national economy, improving the productivity of SMEs is a worthwhile endeavor. These companies can spur growth by integrating proven practices and technologies, which is increasingly important due to the technological gap SMEs have to close in comparison to larger companies (Alibaz et al., 2020). This can result in a more rapid growth rate for SMEs than larger firms. Additionally, start-ups have become an increasingly important source of innovation, as they are unhindered by legacy systems and outdated strategies. These companies are able to rethink established practices and cut through traditional industry boundaries through innovation and creating new markets.

The global interest in how organizations can improve through digitalization and business analytics is reflected in academic literature and in numerous reports. Despite this, there exists no roadmap towards digital and analytics excellence. The overall aim of the research reported here is to identify any correlation between digitalization and profitability in Norwegian SMEs and to identify how digital technologies affect growth in SMEs.

At present, most research on the subject is limited to small-scale case studies, which primarily focus on specific industries or larger organizations. This can limit the generalizability and strategic value of the findings. The intention of this research is to provide a broader basis, allowing comprehensive cross-industry benchmark assessments and suggestions on how to promote growth within SMEs. The research will therefore address these overall objectives:

- Assess the degree to which Norwegian SMEs have adopted digitalization as a strategic orientation,

- Identify main challenges Norwegian SMEs face on their path to digital and analytics maturity,

- Develop recommendations on how Norwegian SMEs can proceed to achieve digital and analytics maturity for growth and performance excellence.

1.3 Overview

The thesis consists of seven chapters. Following this introduction, the second chapter presents the theoretical foundations of our research and reviews existing empirical models and evidence. The third chapter presents our research question and an overview of relevant studies regarding the topic. The existing studies presented here will be used to explore our proposed framework for assessing digitalization within a firm. The fourth chapter visualizes and explains our methodological approach to the assessments and analysis of gathered data, while the fifth chapter presents the generated results. Chapter 6 and 7 integrate and discuss the findings, present conclusions and recommendations, and make suggestions for future research in the area.

1.4 Limitations

The data collected for the research report is limited to a geographical area due to limit time and a wide scope and large number of potential respondents. Viken and Oslo have, therefore, become the main focus of this report and all respondents reside and operate within this geographical area. By doing so, it is assumed that the findings are far less vulnerable to activity deviations based on location in urban, rural or less populated cities. This also creates the requirement that respondents are expected and chosen based on whether or not they are established in Norway.

Since the report is aimed to focus on SMEs, it is beneficial to geographically limit our scope for more accurate findings with the least deviations from other factors. Most models and theoretical frameworks surrounding digital and analytical maturity are tailored for larger firms, as opposed to SMEs. It is, hence, interesting to develop a framework that considers SME, and assesses the scope of the differences between SMEs and larger firms. This does require that all respondents, additionally, fulfill the criteria presented for SMEs in 1.2.

Furthermore, the research report excludes firms established on sole proprietorship. By utilizing Proff.no, we are able to acquire necessary information to conduct the respective analyses presented in the report. However, sole proprietorship creates complications surrounding accurate financial reports, resulting in inaccurate findings. The considered ownership types in this report are, therefore, Limited Liability Company AS).

The past few years, specifically 2019-2022, have been strongly impacted by the COVID-19 pandemic. The pandemic can be described as a global crisis that has caused more and more firms to adopt digital solutions to substitute for physical attendance at offices. Such rapid changes have primarily been caused due to a dire need for a redirection. In this research report, the time frame in which data will be considered, is defined as 2014 to 2019. The main reason for this is to captivate data and conjure results from a rather stable time frame, less affected by external factors forcing changes.

2 Theoretical Framework

2.1 Business Analytics

Business Analytics (BA), at its core, is about leveraging value from analyzing data to create an improvement in measurable business performance (Schniederjans, 2014). There are three forms of analytics used sequentially within business analytics: descriptive, predictive, and prescriptive. *Descriptive* analytics are utilized to identify possible trends in large data sets or databases. The purpose of this is to create a rough picture of what the data generally looks like and what criteria might have potential for identifying trends or future business behaviors. *Predictive* analytics takes this a step further by building predictive models designed to identify and predict future trends based on chosen criteria. *Prescriptive* analytics allocate resources optimally to take advantage of predicted trends or future opportunities.

2.2 Digitalization

The term digitalization is collectively used for several aspects of the widespread phenomenon and can be defined variously based on the contextual usage. Yoo et al. (2010) propose that digitalization is about leveraging digital technology to alter socio-technical structures, where structures refer to anything composed of parts arranged together. These can, i.e., be products, services, user experiences or process. Socio-technical structures are made of both social and technical aspects of structure. Social aspects include human interactions, relationships, and norms, whereas technical structures regard, i.e., technology, task, and routines. Since digitalization enables rapid change in both aspects, Yoo et al. (2010) define digitalization to be beyond the mere technical processes of encoding analog information in a digital format.

In a literature study conducted by researchers Osmundsen, Iden & Bygdstad, former literature regarding digitalization has been analyzed to create a better understanding surrounding the term and its use. The study introduces digitalization as a product of three levels, presented in a conceptual model illustrating the inter-connection between digitalization, digital innovation and digital transformation (Osmundsen et al., 2018)

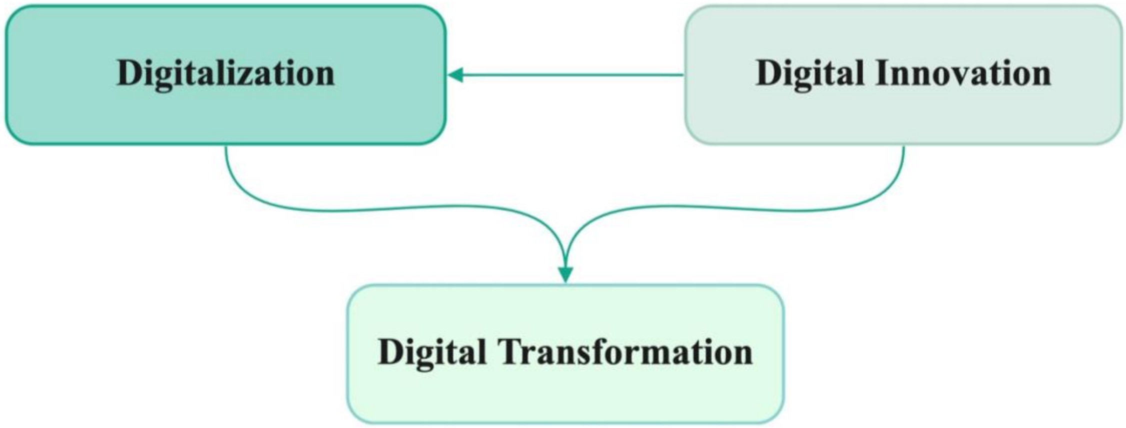

Figure 2: Conceptual model of digital transformation and related concepts.

The concepts illustrated in figure 2 build on digital technology such as electronic tools, systems, devices, and resources that generate, store or process data. This process of converting information, products, and services to a digital format, is also referred to as digitization.

These are products of purely technical processes of data conversion, also referred to as digitization. This process converts information, products, and services to a digital format, meaning numeral values that are possible to store, process and transport. By converting data to such a format, it allows for different digital systems to manipulate the information to create various desired outputs (Dvergsdal, 2021). Digitalization, on the other hand, goes beyond a mere technical process and instead intertwines the material and social aspects of a construct, meaning it is more user-focused which in turn forces businesses to change.

When discussing digital innovation, many researchers refer to Yoo, Henfridsson, and Lyytinen (Yoo et al., 2010). They define the term as a process that is novel or perceived as new that relies on digital technologies. In other terms, its defined as a process and an outcome where digital technology is combined in new ways or in physical components that enable socio-technical changes and creates new value for adopters.

Osmundsen et al. (2018) suggest that the outcome of a digital innovation leads to digitalization through individuals' absorption in the diffusion stage of the digital innovation process. They explain that digitalization and digital innovation can enable major changes in how business is conducted, which naturally leads to digital transformations of organizations or entire industries.

2.3 Maturity Models

The changes following utilization of digital technologies lead businesses into a digital realm, forcing them to leave behind former practices. Maturity models provide a systematic and organized overview over how businesses change their thinking. Martin Fowler suggests that the purpose of these models is to help assess the current effectiveness and to identify the capabilities needed to climb the models' steps (Fowler, 2014). Meaning, the models work as an evaluation tool to support users in improving their performance in their respective fields of business. The main focus in this thesis will be on the digital maturity models of Deloitte and Capgemini, which will provide an overview for understanding and approaching digitalization.

Although the models were introduced decades ago, the digital and analytical maturity models have been criticized for their scope. For one, the models only cover a specific part of their given domains, which results in a fail to grasp the domain as a whole (Rajteric, 2010). Some propose that using several models will provide an accurate assessment of the company's maturity. This is where the second problem arises, given that the various models use different approaches, metrics, and criteria, they are not comparable in nature which requires the user to be attentive. Thirdly, due to specialized terminology, many models have yet to reach a unanimous definition of terms. With no explicit concept of who the models should be used by and how, the models will be understood differently depending on the company, professional field and the background of the individual user (Andersen et al., 2020).

Most maturity models are built on numbering and visualization of different stages of maturity, which can be wildly misleading in complex fields as analytics (Widjaja, 2020). By having no certainty surrounding whether or not higher levels of analytics bring more value, the models can defer from providing decision support. Sequential movement along the models is another instance of how the models can distract from the actual goal. Furthermore, other researchers have challenged the influential position of maturity models by questioning their ability to grasp analytics' contribution to business value (Ali et al., 2018). They specify and explore how users can avoid myopia by using analytics maturity as an approach to achieve business goals, rather than an end itself. With a combination of strategy focused specifically on the company's broader ecosystem and its shareholders with analytics maturity, a company can optimize gains from analytics.

2.3.1 Digital Maturity Models

Nearly every consultancy firm has their own maturity model. An example of a model is Forrester's Digital Maturity Model 4.0 (Gill & VanBoskirk, 2016). The model consists of four dimensions of digital maturity related to cultural, organizational, technical, and insights challenges. Companies can be labeled as either skeptics, adopters, collaborators, or differentiators, based on their final scores. Forrester claims that any digital team should keep their focus on three functions within the company: developing strategy, governing digital strategies across firms, and operational excellence in digital execution.

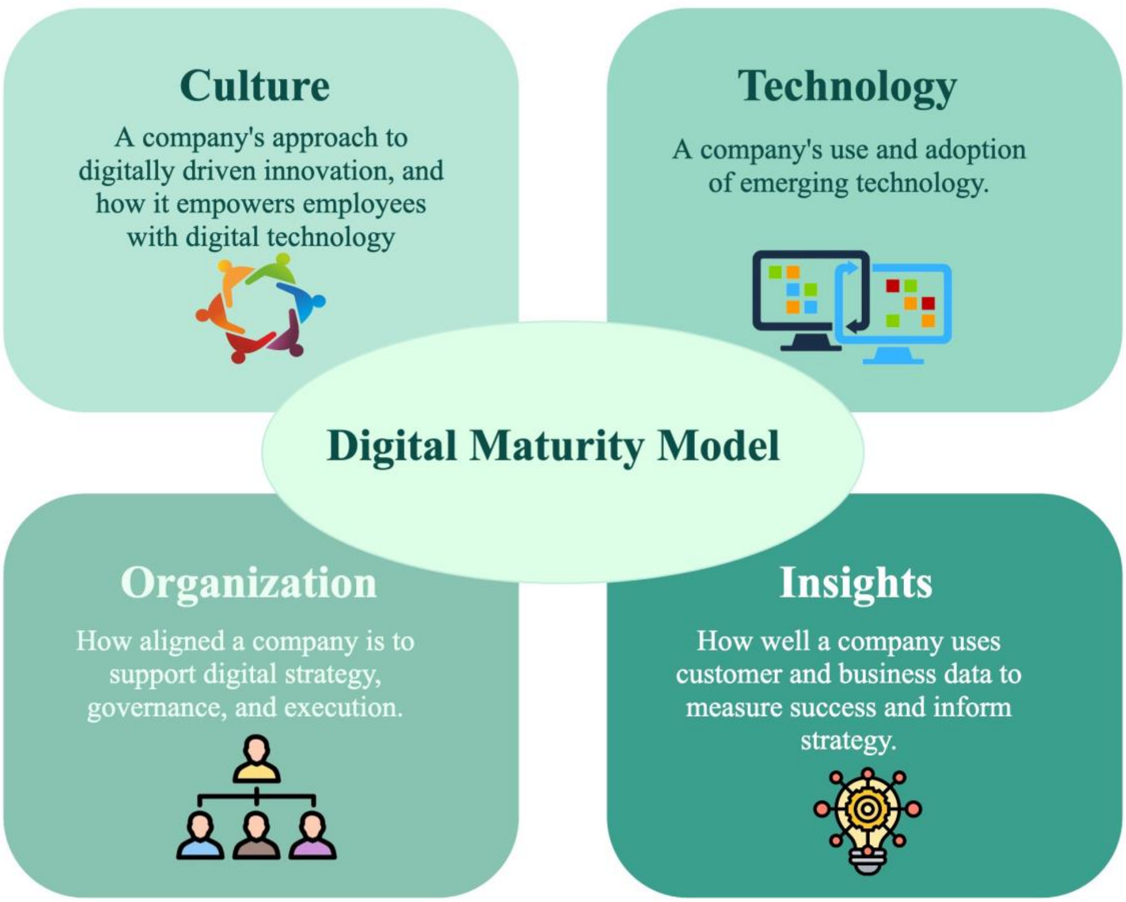

Figure 3: Forrester's Digital Maturity Model 4.0 and its four dimensions.

David Rogers is a second renowned example of a digital maturity model (Rogers, 2016). This model present five domains of strategy that are affected by the digital age and require response of digital transformation. The domains consist of the grouping's customers, competition, value, innovation, and data. The traditional understandings of customers being mass markets is here substituted with an approach that sees it as customers networks, and exploration of concepts of coopetition.

Although there are a vast number of models to choose from, this paper will focus on Deloitte's Digital Maturity Model and Capgemini's Digital Mastery. Deloitte developed their Digital Maturity Model in 2018, where they identified five dimensions that combined give a clear picture of a company's progress with digitalization (Deloitte Digital, 2018). These dimensions include customer, strategy, technology, operations, and organization & culture. The *customer* dimension tackles digital partnerships with customers, where they are able to return to available channels for future needs. *Strategy* looks at digitalization as a competitive advantage, and to what degree it is included in the overall business strategy. The digital strategy is defined within the dimension *technology*, where creation, processing, storage, security, and exchange of data to support this strategy is considered too. Within *operations*, processes and tasks are designed to aid the company's effectiveness by using digital technologies. Lastly, *organizations* and *culture* review how the organizational culture enhances improved maturity. Each of the five dimensions branch into sub-dimensions that sum up to a total of 28 sub-dimensions. The survey is scored based on 179 individual criteria.

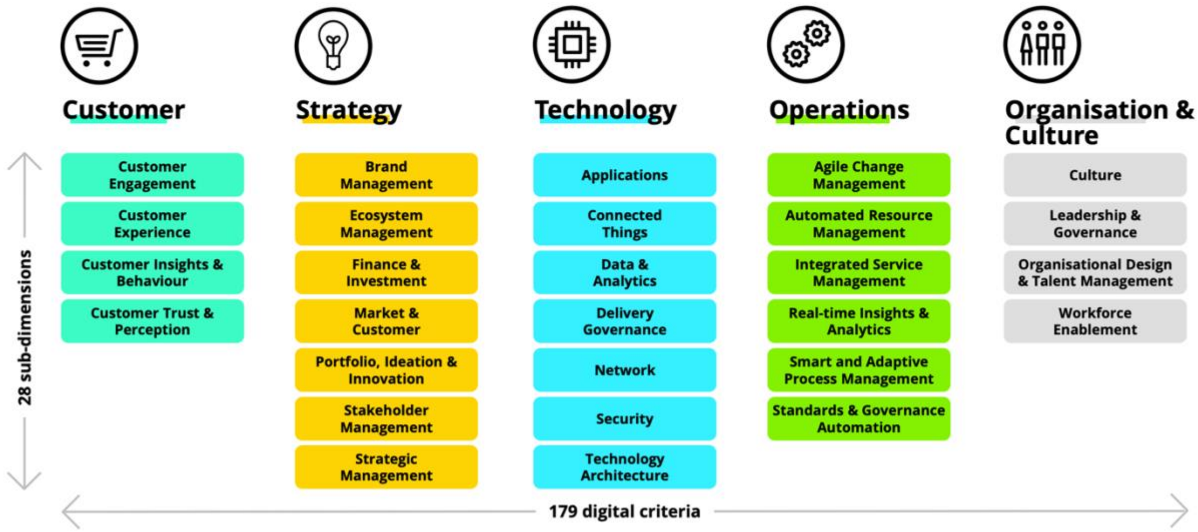

Figure 4 Deloitte Maturity Model (Deloitte Digital, 2018)

Capgemini's model of Digital mastery, on the other hand, tackles digital and leadership capabilities (Buvat et al., 2019). Leadership capability tackles the creation of environments and cultures that facilitate to digital transformations, inclusive of factors such as vision, sense of urgency, data governance, and executive skills. Digital capability refers to changes in customer experiences, daily operations, innovation and more. In other words, leadership capabilities work as prerequisites for digital capability, as it represents more concrete changes at company level.

The model classifies companies into four categories based on their performance in digital and leadership capability. Low performance on these dimensions classifies as *beginners*, which are companies that typically have just started their digital journey. If the company excels in digital capability but performs low in leadership capability, it is classified as *fashionista*. These companies tend to have sophisticated digital functions and usage, but the lack of leadership capability results in unobtained potential. *Conservatives*, thirdly, are companies characterized by a conscious approach on an organizational level but lack use and exploration of the opportunities presented by digitalization. The final classification is called *digital masters*, which are companies that have high digital capability and leadership capability. This enables them to combine strong organizational culture with value-adding digital initiatives.

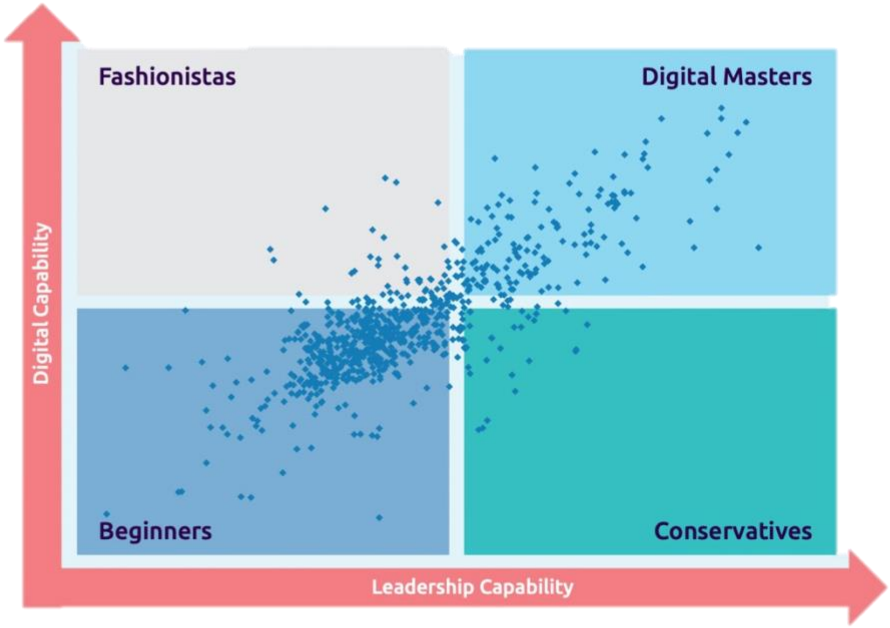

Figure 5: Capgemini Digital Maturity - The four groups of digital mastery (Buvat et al., 2019)

In a survey conducted in 2018, Capgemini illustrates that a minority believes themselves to be digital masters. However, 39% of the respondents believe themselves to have needed digital capabilities, while 35% believe they lack leadership capabilities. The combination of both capabilities was rare in comparison.

Although the models provide valuable insights on digitalization, Deloitte model shows how closely related digitalization is to Business Analytics, whereas Capgemini's model serves as a great tool in exploration of digitalization as strategy. Through analytics, one can thoroughly explore customer understanding and behavior. Capgemini has identified that insights in operations through sensors and data-gathering devices is increasingly beneficial but remains unexploited (Fitzgerald et al., 2013). The report illustrates how digitalization without analytics is a losing proposition, as the latter supports and enables several parts of organizational development.

2.3.2 Analytics Maturity Models

An important part and contributor to digitalization, is analytics. Likewise digital maturity models, there are numerous analytics maturity models. Williams and Thomann's BI maturity model is an early example in which three maturity stages are presented (Williams & Thomann, 2003). The first stage is characterized by companies treating information like before, where are predefined data list was sent from business users to IT, with focus on extraction of wanted data. In stage two, organizations rethink the role of information, tightening the bonds between information requirements and business goals. The focus thus shifts to include *why* the information extracted is necessary. The final stage, three, is recognized by companies searching for a way to use the information, by looking into overall business processes and organizational change required to support new capabilities. Although a simplistic model, the BI Maturity model has changed a lot since it's creating in 2003.

Another widely used analytics maturity models is the TDWI (Transforming Data With Intelligence) Analytics Maturity Model (Król & Zdonek, 2020). TDIW defined data maturity as the evolution of an organization to integrate, manage and leverage all relevant internal and external data sources. As a results, their models consist of five stages of maturity.

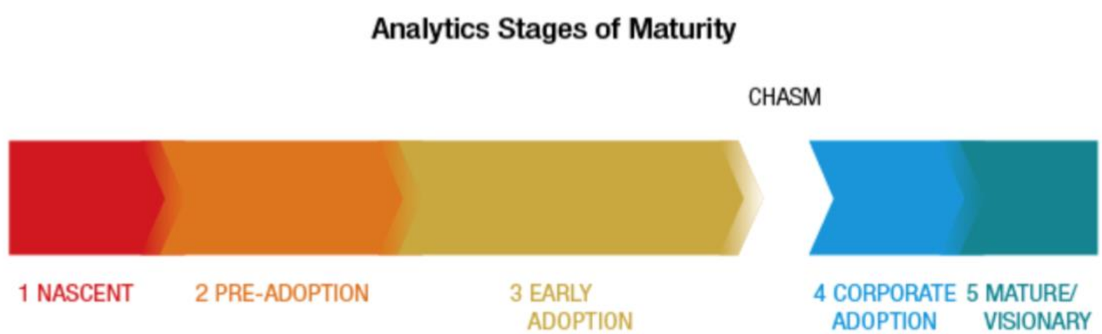

Figure 6: TDWI's big data stages of maturity (Russom et al., 2014)

Within each step, organization, infrastructure, data, management, analytics, and governance are characterized in various ways. The first stage, *nascent*, consists of organizations with low awareness of big data concepts and potential value, and are recognized by pockets of enthusiasts rather than real executive support. Although there will be a presence of data warehouse, there is also a lack of assessment surrounding what data to gather and how to store it. Therefore, data use in this stage mostly revolves around immediate results.

Pre-adoption, stage two, oversees the companies preparing for further expansion through investments in new technology such as data lakes, and have one executive sponsor not on the business side. While realizing that identifying the right business problems are crucial for success, the organizations still experience skepticism company-wide and the mindset generally revolves around experimentation. In terms of infrastructure, the initiatives still relate on individual departments and an enterprise-wide framework for data governance is evolving. Therefore, most data sources, in this stage, are internal and metadata is lacking.

Stage three is said to be the most time-consuming and is recognized as *early adoption*. In this stage, one or two proofs of concept (POCs) will have evolved, with the result of increased interest and support from executives. By establishing a team, the organizations plan further and increase bureaucracy. A unified data architecture or ecosystem is still absent, despite various kinds of big data technologies now being in place, which results in un-obtained potential. Data quality and security becomes increasingly relevant and less is casually disregarded, although there is absence of a company-wide big data management strategy. The analytics of the organizations are project based, and descriptive and predictive analytics are utilized.

As illustrated in Figure 5, there is a gap that organizations have to cross in order to reach stage four of *corporate adoption*. The authors have named this gap of barriers to be *the chasm*. Due to most big data projects being driven by IT, it is crucial that an organization is involved by securing necessary means of funding and providing tangible business outcomes. A unified data architecture becomes increasingly important for a smooth data sharing, alongside data governance. Another important factor is combining employee skills in traditional warehouses and new data lakes technologies, especially since employee working with new technologies tend to be new graduated with a lack of business knowledge.

Once these issues are resolved, companies can enter stage four where end-user are more involved, gain insights and change how they work. Analytics are here embraces as a tool for competitive differentiation, securing stable funding. With a unified architecture for data infrastructure, the organization can use a wide range of technologies, which might include the cloud, with the goal of supporting the analytics. As goes for data management where the aims are to make data sharing a collaborative activity and removing data silos. In this stage, strong data governance policies are in place, keeping the overall executive sponsor involved, and metadata is attributed to a divisional or company level. In most instances, a center of excellence (COE) is also formed, which consists of data scientists who might train other groups in the use of analytics. New data can now quickly be analyzed and integrated into the existing logical infrastructure.

Going further, stage five is characterized as *visionaries*, in which big data programs are effortlessly use and as a budgeted and planned initiative. The importance of analytics as a critical standard for how the organization does business, has been endorsed by the executives and is viewed as a crucial competitive advantage. Collaboration has become a central feature in the company data culture, in which they are searching for new ways to use analytics. By using data lakes, the infrastructure supports smooth integrations of new data sources. Security and backup have become vital aspects and data is now openly shared across the organization. However, this label is relatively hard to reach and is only achieved by a few companies.

Although the analytics maturity models provide great insight, this research paper will focus on digital maturity models as the primary theory. Therefore, analytics and digital maturity models will not be distinguished past what the main model in the paper provides.

2.4 Components of digitalization

To present existing research that is useful for this thesis, this chapter is organized based on some of the components described in the chapter above. Although the research relates to the categories set by the framework of Deloitte's Model for Digital Maturity, the intention is not describing their concrete descriptions of the categories, but to provide more research backed insight to the categories. The model creates a picture of a company's progress towards digitalization; however, it was created based on data from larger firms and corporation.

To develop a framework more fit for the scope of SMEs, we have defined four components of digitalization. Although these are inspired from Deloitte's Maturity Model, the components represent the main functional departments in SMEs. Since digitalization is defined as leveraging of technology, we choose not to look at technology as an exclusively standing component. Thus, the four components used to assess digitalization of SMEs in this research report are marketing, logistics, production, and organization and management.

The existing research providing insights into the different components of this chapter stem from different fields. Despite academic research on business analytics and business intelligence being limited, it has been incorporated as it is connected to digital transformation, data driven organization and similar topics. Digital transformation, digital innovation and digitalization have much in common, big data being one of them (Osmundsen et al., 2018).

2.4.1 Marketing

Some important changes in today's society have been caused by the development and rapid usage of the internet. This communication tool has brough connectivity to consumers while making companies more vulnerable to changes (Varbanova, 2018). The marketing concept has been widely affected by the speed in which connectivity and communication has increased amongst consumers.

There are several definitions of the marketing concept, although the first recognized definition of the marketing concept was presented in 1960s by the American Marketing Association. They define marketing as "the development of economic activities that direct the flow of goods and services from producers to the consumers" (Ringold & Weitz, 2007). The concept of marketing has, since then, evolved greatly from being related to selling goods and products, to identifying the needs and wants of the consumers and satisfying them while maintaining a certain level of profit (Varbanova, 2018). Furthermore, it has transformed into a managerial and social approach that considered need for value creation for consumers, community, and the company. Philip Kotler takes the definition of marketing to the next stage by introduced evolutive and modern marketing, defining the concept in light of its evolution.

Kotler designed the marketing 1.0 concept based on the evolution of the marketing theory and practice in the first half of the 20th Century (Varbanova, 2018). This was based and centered on the idea of products and production being relatively small and designed for large body of clients. A significant concept here was that products were mainly based on functionality, excluding of how customers perceived the products. The main idea was to provide and market something that covered the needed functionalities of consumers.

Marketing 2.0 arrived along with the first steps of the contemporary information age that followed with the development of the communication and information technologies. The challenges for companies and marketing occurred around the fact that consumers were far better informed (Varbanova, 2018). This resulted in the ability to compare and search information surrounding similar products and services. The value of certain items, thus, became what the consumer considered it to be worth. The main difference between marketing 1.0 and 2.0 is the emotional criteria that increased information sharing developed. Instead of solely focusing on the functional criteria around a product or service, companies were forced to create value for consumers.

The third stage of the marketing evolution, Marketing 3.0, was governed by the “value-driven era”. Instead of seeing consumers as simple consumers, the focus shifts to seeing consumers as human beings with feelings (Varbanova, 2018). Companies start developing marketing and communication strategies to determine, create and deliver values not just from an economical, functional or environmental point of view, but also a spiritual and sentimental point of view.

Marketing 4.0, the fourth evolution of marketing was presented in 2017 by Kotler. According to him it related to a marketing approach that combines online and offline interactions between companies and consumers (Varbanova, 2018). However, a significant elevation with this evolution is the incorporation of the machine or artificial intelligence to other ITC technologies to increase productivity, while leveraging human to human connectivity to improve the customer interaction process.

The fifth evolution of marketing, marketing 5.0, is the application of human-mimicking technologies to create, communicate, deliver and enhance value across the customer journey (Kartajaya et al., 2021). One critical theme in this next stage is next tech, which refers to a group of technologies that aim to emulate the capabilities of human marketers. An example of such next tech is Artificial Intelligence (AI) that has been developed over the years to replicate human cognitive abilities. It has especially been developed to learn from unstructured customer data and discover insights that might be beneficial for marketers. AI can therefore be utilized to provide the right offers to the right customers. Although the assistance of AI provides marketers in skipping many steps in the marketing process, human marketers are still a critical element in marketing, since machines cannot be learnt how to build human-level connections.

The rapid development of social media marketing and search engine marketing alongside the exponential growth of e-commerce have introduced marketers to the benefits of digitalization (Kartajaya et al., 2021). However, in marketing, this usually means to migrate customers to digital channels or to spent more on digital media. One way technology can boost marketing practices is by enabling more informed decisions based on big data. Big data helps marketers target customers at a granular and individual level, allowing one-to-one marketing at scale. Secondly, digitalization helps predict outcomes of marketing strategies and tactics. With artificial intelligence-powered analytics, marketers are able to predict the outcome of launching new products or releasing new campaigns before doing it. The predictive models utilized aim to discover patterns from previous marketing endeavors and understands what works. Based on its learning, the models recommend an optimized design for future campaigns.

Digitalization in marketing further provides marketers with the ability to bring contextual digital experiences to the physical world. By tracking the activities of internet users, they can personalize landing pages, relevant ads, and custom-made content. It further enables frontline marketers' capacity to deliver value. Marketers can now focus on building an optimized symbiosis between themselves and digital technologies. AI, for instance, can improve the productivity of customer-facing operations by taking over lower-value tasks and empowering frontline personnel to tailor their approach (Kartajaya et al., 2021). Chatbots, i.e., can handle simple, high-volume conversations with an instant response, making it so frontline marketers can concentrate on delivering highly coveted social interactions only when they need to. Lastly, companies are able to adapt to constantly changing customer preferences by drawing inspiration of market experiments and real-time validation practices of start-ups that rely heavily on technology. This enables companies to build on open-source platforms and leverage co-creation to accelerate go-to-market, although this requires an agile attitude and mindset.

2.4.2 Logistics

Logistics refers to the processes of managing how resources are acquired, stored, and transported to their final destinations (Kenton, 2022). The goal of logistics management is to ensure that the right number of resources or inputs are utilized at the right time. It also includes the duty of delivering it to the appropriate location in proper condition, and to the correct internal or external customer. While being one of the most important business aspects in any organization and especially for the industry, logistics have changes with the rise of the industrial revolutions and the emergence of digitalization.

Logistics 1.0 was introduced and defined by the military in the early 19th century as the planning and movement of troops (Ezzat et al., 2019). It was first introduced as a business in 1964 where it was only concerned with the optimization of three aspects. The first aspect was place, also referred to as location and destinations and regarded creating value to customers by moving goods between locations which would achieve the best value to the customer. Secondly, period and place, also referred to as time value, meant to create value to customers by focusing on time, which reflected in inventory management along with the flow of goods. Lastly, the pattern, or forms of order, regarded value creation through ordering by focusing on the desired form of goods. During industry 1.0, logistics only focused on the optimization of transportation and moving goods (physical distribution) inside of an organization, not the personnel. Hence, logistics 1.0 only satisfied the industrial needs that were created by the customers in the first place.

Logistics 2.0 was introduced during the 1960s, where it recognized the importance of mass production (Ezzat et al., 2019). The mass production that was booming in this era required automation of cargo handling. As a results, companies started considering how to increase the level of optimization for more enhancements within the process of logistics. This led to an increase in the level of engagement between different organizations that work as suppliers for one another. Therefore, Logistics 2.0 concerned itself with the process of coordination between different parties belonging to the same chain. This introduced the fourth P for Process Coordination and Partnerships management.

Industry 3.0 started when the first industrial robot was manufactured in 1968, when the Numerically Controlled (NC) machines were introduced to the industry (Kartajaya et al., 2021). The logistical revolution, Logistics 3.0, rose due to what was known as “Systems of logistics management”. It was now obvious that companies’ activities were dived into “product development” and “operations” or “Supply Chain Management” supported by several activities such as Legal, Finance, Human Resources, Marketing, etc. With this realization, a new “P” was introduced to shift the focus into “Flow Management”. The fifth “P” was called “Pliancy” or “agility”, where the process now considered workflows at administrative levels of each organization, cash flows, service flows, flow of decisions and ideas, and everything creating value to the customer.

Logistics and supply chain within industry 4.0 can be described as collaborative cyber-physical systems. Cyber-Physical Systems (CPS) are defined as systems that link real, physical objects and processes with information processing, virtual, objects and processes via open, partially global and always interconnected information networks (Ezzat et al., 2019). The new scope introduced to logistics was that products were now considered to be highly trackable due to the transparency process of all involved parties, starting from dispatch until the end of the product’s life cycle. CPS monitors process the in real life information and copies it into the virtual world to enable a decentralized decision-making process (Ezzat et al., 2019). To create such a system, companies are required to integrate hardware systems and cloud computing into a centralized data storage unit. This changes the factory and its components into smart products, services and logistics. Thus, CPS and cloud computing enables logistics to be called “Smart logistics”, which is the application of various technologies to improve the efficiency of certain processes such as transportation, warehousing, and storage, impacting the entire supply chain. With these solutions stemming from advances in industry 4.0, Logistics 4.0 increases the level of flexibility of logistics to meet the highly fluctuating market demand. As a results, the customer is brought closer to the company, which in turn improves the optimization opportunities in production. Increasing the cost reduction of storage and production results in achieving improved levels of customer satisfactions.

Logistics 5.0 follow with the evolution of Industry 5.0. As opposed to Logistics 4.0, Logistics 5.0 cares more about innovation and focuses on sustainability, problem solving and value creation, diversity, decentralization, and resilience (Škrijelj & Duzgun, 2021). This evolution is based on three factors; humans work with robots (Cobots), green logistics and quality of life.

The first factor enables collaborative work between machines and humans. The goal of this collaborative work is to bring Artificial Intelligence aligned with Internet of Things and Big Data Analytics technologies, to be imbedded on society's life (Škrijelj & Duzgun, 2021). With Industry 5.0, logistics now aim to return the human factor to production. By having warehouse robots do the heavy lifting in the automated warehouses, the humans can focus on handling significantly more supplies every day, which also results in improved accuracy from robots.

While green logistics aims on minimizing an environmental footprint, quality of life focuses on automatization as means for bettering people's lives. With, for instance, delivery robots and driverless buses, companies can serve consumers faster than normal vehicles, which happen to be more secure for people as well.

2.4.3 Organization and management

Although factories had started to emerge already in the 18th century, most people produced by hand tools or simple machines (Kohnová & Salajová, 2019). During Industry 1.0, new machines were introduced but could mostly only be used by larger companies due to their high fixed costs and knowledge needed for operation. This created the need for higher level of competence, creating the division of labor. Furthermore, inventions and growth of organization led to the need for transformation. Technological advances in manufacturing, distribution and strategy resulted in organizations trying to adapt to innovation. The first managerial functions appeared as managerial coordination and control for safety reasons. These are the characteristics of Organization and Management 1.0.

Organizational changes in Industry 2.0 were based on more expensive technology equipment. The economy allowed businesses to increase production and technological change caused larger businesses to employ thousands of workers (Kohnová & Salajová, 2019). This period was prone to extremes, which led to overcapacity and partial recessions. Markets were now sustained by mergers and acquisitions, which allowed marginal facilities to be closed. Although the era-built societies of wealth, most employees earned pennies and lived in poverty. Job safety was not provided to workers, and low-skilled workers were required to work for long hours at low wages with no pension plans. Unskilled workers were tending to the machines with simple tasks, such as pulling a lever or turning the valve. Skilled worked, on the other hand, received high wages and oversaw the production processes. Organization and Management 2.0 can, thus, be characterized by more qualified skills of senior management, middle and low management.

The third industrial revolution, Industry 3.0, was characterized by a free market spreading in Eastern Europe (Kohnová & Salajová, 2019). This contributed to an emergence of HR, as opposed to the formerly known Personnel function that was based on administration and policy camps. HR was firstly introduced at General Electric as human resource management through information technology. This was a system to acquire, store, manipulate, analyze, retrieve, and distribute information about human resources in organizations. Management 3.0 is, therefore, characterized with this HR system.

Industry 4.0 contributed to the next wave of the HR system, leading to a self-service HR technology environment that required little to no IT investment as a results of cloud-based systems (Kohnová & Salajová, 2019). The demand for highly skilled workers in specialized field have been covered by the usage of platforms such as LinkedIn, providing an online resume for employers, employees and new workers. Additionally, it is noteworthy that organizations have changed into focusing on satisfying employees. For instance, this includes job safety, security and favorable wages. Organization and Management 4.0 is therefore more employee-oriented, focusing on 'the right people for the right job' and satisfying basic employee needs.

While organizations have been heavily affected by natural disasters and unforeseen crisis', agility and innovation has become more important. In a report from Deloitte, Deloitte Global Human Capital Trends 2019, it is pointed out that employee well-being was boosted during and after the Covid-19 pandemic (Vargas, 2021). To ensure the well-being of employees, managers are trained to encourage employees to rediscover their purpose at the workplace. Another change seen in organizations due to the pandemic, is the facilitation of home offices to ensure employee safety. As a result of this, the use of digital communication tools has been boosted and rapidly implemented across industries. Organization and management 5.0 are, therefore, characterized as a highly digitalized organization with great focus on employee well-being.

2.4.4 Production

The industrial revolution has, over time, served to separate a human's work from a machine, allowing the latter to take over most of the jobs that are unsuitable or dangerous for humans. Industry 1.0 was characterized by the introduction of water- and steam-powered machines to aid workers in their tasks (Momentum, 2019). This increased efficiency and capability necessity growth in other areas of the business, shifting the human resource utilization to customers. For instance, textiles and transportation benefited immensely from industrialization and machine use in manufacturing became more widespread with the increased use of coal as an additional fuel source.

Production 2.0 was affected by innovation aided by electricity that now had replaced water and steam. This enables the concentration of power sources to individual machines. One major characteristic with this era of production was the division of labor and mass production via assembly line, as first introduced by Henry Ford in 1913 (Banton, 2020).

The third industrial revolution was referred to as the first computer area. Here, production was surrounded with the invention of devices such as transistors and the integrated circuit chip. The circuit chip made it possible to fully automate machine that aided in the automatization of production (Momentum, 2019), leading to Production 3.0. Due to the possibilities created by the electronic hardware, software systems were developed to make complete use of these new inventions. By replacing integrated manufacturing systems with enterprise-scale planning tools, companies were able to plan, schedule and track product flow. While Production 1.0 and Production 2.0 enabled larger scale production through mechanical aids, Production 3.0 allowed automated systems to perform human tasks using things such as Programmable Logic Controllers.

Production 4.0 connected the internet of things with manufacturing techniques. These allowed systems to share and analyze information, using analysis to guide intelligent actions (Momentum, 2019). This evolution is a natural progression of programs first introduced in Industry 3.0. The manufacturing execution systems, product life cycle management and other far-sighted concepts simply lacked the technology that would make full implementation possible. In industry 4.0, the cyber-physical system was introduced, making it possible to run mechanical devices via algorithms. Furthermore, the interconnectivity increased while cloud computing and cognitive computing was introduced.

When it comes to Production 5.0, it is highly affected by the concept of human re-introduction from Industry 5.0. Whereas Industry 4.0 reduced human labor by replacing it with smart machinery, Industry 5.0 focuses on using technology to complement human work. Thus, Production 5.0 has a more human-centric approach (Heredi-Szabo, 2022). For instance, there is a need for human labor in collaborate with exoskeletons, which are machines that do heavy lifting. Additional to the human-centric approach, sustainability is an important topic where the aim is to reduce energy consumption and controlling the resource usage. Recycled material and new product designs are therefore important to develop to gain efficient recycling.

2.4.5 Strategy and business models

Not only have technological advances forced organizations to tackle digital challenges, but it also enables the emergence of novel business models based on digital platforms. A study conducted by Täuscher and Laudien (2018), revealed six fundamentally distinctive business model types for marketplaces. The models were defined by the strongest source of discrimination within their respective clusters. A cluster is a group of people or 'things' gathered together based on similar characteristics.

The first business model (BM) type they define is 'efficient product transactions. Marketplaces in this cluster consists of physical products. Of the firms, 2/3 facilitate transactions between individuals (customer to customer – C2C) while the other 1/3 facilitates transactions between businesses. Since a majority of marketplaces in this cluster focus on exchanging industrial goods, they often aim at standardizing and commoditizing products to facilitate search and negotiation. An example of companies using this kind of business model is *Finn.no* where customers are able to buy and sell used cars through the digital platform.

The second cluster is primarily consistent of start-ups who build a community around products. A majority of the marketplaces are represented by 100% digital products, while only a minority are physical product exchanges. Firms create value to users by developing an active community of like-minded people. Therefore, Täuscher and Laudien (2018), describe this BM type as ‘digital product community’. This cluster consists mostly of C2C transactions, despite a small number of business-to-customer transactions (B2C). It has the highest share of globally operating marketplaces, given the low geographical boundaries of digital goods. An instance of company with such a business model is *Sellfy* that enables creators of a variety of digital content (i.e., e-books, music, and videos) to commercialize their content via the platform.

The third cluster consists entirely of marketplaces that facilitate the exchange of physical products. While 2/3 of the firms in the cluster focus on B2C transactions, the last 1/3 is surrounding C2C transactions. Majority of the marketplaces in this cluster creates emotional value through the image of the platform. The firms charge individual sellers with either a commission or subscription solution. Sellers provide products for buyers with fixed prices. Most of the firms apply a vertical model to concentrate on one distinctive product category, while start-ups focus more on creating and curating the product listings. Due to this cluster being focused on building a community of people with a shared passion for a certain product, it has been labeled ‘product aficionadas.

Following, cluster 4 compromises marketplaces that match service firms with consumers. The primary value for both businesses and their customers relate to efficiency gains due to offline delivery channels highly affected by scheduling. The firms within this cluster can be subdivided into two groups. The first consists of firms acting like aggregators for services that require appointments, whereas the other group focuses on capacity management. The firms in this cluster are often operating through mobile apps where sellers are charged a commission fee and buyers are operating for free. Given location dependency, most firms focus on one geographic market and one market segment. This BM type is labeled ‘on-demand offline services’ as a result of its time-sensitive nature.

The largest cluster in the study is labelled ‘online services’ and contains 28% of the firms from the research sample. Firms in this cluster offer services that are consumed via a web-based platform, which includes individuals sharing their skills through online language tutoring, teaching classes, or other video-based online courses. In addition, the cluster includes marketplaces for professional freelancers such as divorce attorneys, municipal financial investors, designer, or scientific researchers. These marketplaces focus on one specific market segment, while they offer additional income for sellers and efficient access to services for buyers. Firms in this cluster use a fixed price per service, indicating that they commodify services to a certain extent.

Lastly, the second largest cluster and sixth proposed BM type is ‘peer-to-peer offline services. There are two sub-types of firms in this cluster: individuals sharing their physical resources, and individuals providing their time and skills. Resource sharing firms include private accommodation, office spaces, or cars. A rather infamous example of such a firm is Airbnb. Time- and skill-sharing services comprise activities such as pet sitting, delivery services, or event organization. Most firms in this cluster provide a review system to generate trust between the users. They provide a novel source of income for the supply side and create value to the buyer side through an increase in transaction efficiency, and a positive platform image. A majority of the revenue streams are generated through commission fees, with 60% of the platforms determining a fixed fee. Although most firms generate revenue through the seller side, more of them charge buyers amongst all clusters.

2.5 Digitalization and profitability

Visma Software has, throughout the years, made a report regarding digital maturity within Norwegian companies (Russom et al., 2014). The report illustrates how companies adjust to new opportunities and acknowledge the need for change towards a more digital path. Their findings show a clear connection between profitability and digitalization within Norwegian companies. In addition to this, a study conducted by Statistics Norway (SSB) illustrated that average value creation per hours was 14,7% higher for companies utilizing digital tools (Rybalka, 2008). The finance sector has experienced a productivity growth of 4,5% from 2000 to 2008, which they believe is the result of digitalization. OECD indicate that in international markets, data driven innovation has resulted in a 5-10% higher growth rate than others (OECD, 2017).

Visma’s report, on the other hand, provide two perspectives on how digitalization can contribute to profitability. By analyzing data from Norwegian companies, they propose 13 processes in which the companies can start digitalization (Visma, 2019). Their proposal looks at different aspects with these process that could either save costs or earn revenues for companies when digitalized. From their data, they find that digitizing information-intensive processes can, over time, show significant time savings and allows companies to free resources for core business objectives. For instance, Visma visualizes this by explaining how the process of receiving an invoice could save companies 10 minutes of time per invoice sent and 91 Norwegian Kroner per electronic invoice. Their data shows that 53% of companies still receive invoices as PDFs through emails or printed on paper through mail. The invoiced, thus, have to be manually processes and handled, meaning that companies waste valuable time on punching.

There are similar findings in regard to sending an invoice to a customer. Behind every printed invoice, there are resource intensive manual processes. By sending an invoice electronically, the invoice will be sent through the companies own financial system to the receivers financial system or to the receivers bank of use (Visma, 2019). This results in the customer having control over what is to be paid and at what time. As a company, you save time on ensuring the right information has been communicated to the customer or that the invoice has been delivered. Visma further enlightens that with every electronically sent invoice, a company saves approximately 55,50 Norwegian Kroner as opposed to sending it by email or printed through mail. They conclude that digitalization can, over time, increase profitability within a firm.

3 Research questions

The growing, global interest in how organizations can improve through digitalization is reflected in academic literature and numerous private-sector reports. However, there are few existing empirical studies applicable to small and medium sized enterprises (SME) and the effect digitalization has on their profitability. The overall aim of this study is to assess the current level of digitalization in Norwegian SMEs to identify any correlations between digitalization and profitability.

The first objective is to assess the digitalization degree within SMEs based on the digital components and their evolutions discussed in chapter 2.4. The empirical basis will be a large survey of Norwegian SMEs, conducted through expert interviews with one representative from each firm. Specifically, these research questions have been investigated:

- Are there differences between the enterprises perception of their digitalization focus and their actual degree of digitalization?

- Does their perception of their progress with digitalization reflect in their implementation of digital technologies, through the year 2014 to 2019?

The second objective is to identify whether there is a connection between digitalization and profitability amongst the respondent SMEs. This is addressed in the same survey as for the first objective and the qualitative methodology is explained in depth in chapter 4. The following research questions have been asked to map this:

- Does profitability measured in Return on Sales from 2014 to 2019, indicate a significant increase when digital technologies are implemented?

- What digital technologies facilitate for increase profitability?

The research questions will be investigated by means of retrospective interviews with SMEs in the Greater Oslo region. The interview data will be content analyzed in such a way that each company will be assigned a digital maturity level, separately for each of the four main organizational functions (marketing, logistics, production, organization/management) and six years chosen as the observation window (2014 to 2019). These data will then be analyzed by means of two-way random-effect panel models.

4 Method

The chosen research method for this thesis was a sequential exploratory design. Firstly, qualitative method is utilized for data collection, followed up by a quantitative method. The qualitative approach was appropriate to capture the “what”, “how” and “why” of the interesting and complex situations that required more in-depth explanations (Yin, 2015). On the other hand, the quantitative approach captures the numerical data needed to map interesting effects and patterns in the data. These two methods enhance one another and are, in this thesis, contributing to a method triangulation (Thurmond, 2001).

4.1 Data collection

Several sources of data were used to produce process data for the purpose of the study. This strategic choice was made to enable triangulation between data sources to create a more comprehensive understanding of the context at hand. Some sources were collected through Proff Forvalt and stored in an excel sheet, while other data was captured through retrospective interviews conducted during the process. Each one is regarded as a primary source of data for the study and is described below. Relevant parts of the data will be used to create a holistic picture of the effects laid out by the research questions.

4.1.1 Participating Companies

There was originally planned to capture data from minimum 50 companies. However, this number was reduced to 30 due to the time limit and unforeseen complications with gathering enough informants. The 30 companies that, finally, participated in the study stem from different industries within the Greater Oslo region. There were several criteria identified for choosing relevant informants. These were made to best explain the phenomenon to enlighten the research questions in the best possible way with the most robustness.

The criteria set were that the companies:

- Were established and registered from before 01.01.2014 and to 31.12.2019 or after
- Can be classified according to the criteria and description of SMEs (as defined in 1.1)

- Is operational in the Greater Oslo Region
- Is listed as an AS in Norway (Limited Liability Company)
- Has a yearly revenue from minimum 12 million to 1,000 million Norwegian Kroner
- Are actively operating present day

When these criteria were established and finalized, a segmentation process on Proff Forvalt was utilized to conjure a list of fitting companies. Proff Forvalt is a paid service that provides information on all established firms in Norway. This information includes contact personnel, management personnel, and financial information on firm performance. By utilizing this service, relevant information was extracted to an Excel-sheet, where contact information in the forms of telephone number and email was stored for over 200 companies.

Apart from the recruitment process explained above, the personal network of the recruiters was also utilized to recruit potential companies. This network included family, friends and connections on social media. LinkedIn was, therefore, actively utilized as a secondary source to recruit firms and share posts regarding the research. Unfortunately, there was no significant response to this, and phone calls and email contacting through information provided by Proff Forvalt became the most effective and primary source of recruitment.

Of the companies that were recruited, there was a fairly equal amount of small and medium sized enterprises. Amongst 30 companies, 13 were companies identified as small enterprises, while the other 17 companies were identified as medium-sized companies.

Company type	Quantity
Small-sized Enterprises	13
Medium-sized Enterprises	17

Table 1: The distribution of small and medium enterprises amongst the participating companies.

As illustrated in table 2 below, there is quite a large variation in industries that the participating companies operate in. Industry specification is possible through the segmentation function on

Proff Forvalt; however, this was not utilized to create a generalization of the results across industries.

Company ID	Industry (Proff Forvalt)
1	Wholesale - other, Wholesalers
2	Retail Stores, Retail Stores - Other
3	Technical Consultants, Consultants
4	Hotels and other accommodation
5	Transport, Contractors, Freight and goods transport
6	Timber, lumber and building materials - agency and wholesale, Agencies
7	Transport, forwarding and customs clearance
8	Building and construction suppliers
9	Schools and education, Traffic schools
10	Cars and vehicles, Agencies
11	IT Consultants & Consulting, Consultants
12	Veterinary services
13	Cars and vehicles, Agencies
14	Newspapers, trade magazines and periodicals, Publishers
15	Newspapers, trade magazines and periodicals, Publishers
16	Lawyers and legal services
17	Schools and teaching
18	Schools and education, Traffic schools
19	Building and construction suppliers, Road work and road safety
20	Wholesalers, Machinery and equipment
21	Cars and vehicles, Agencies
22	Wholesalers, Hardware, plumbing and heating equipment and supplies - wholesale
23	Retail, Retail Stores - Other
24	Web design and programming
25	Transport, Freight and goods transport

26	Manufacturers, Food & Beverage - Production, Food & Beverage
27	Business Consulting, Cleaning
28	Building and construction suppliers
29	Web design and programming
30	Restaurants, Restaurants and Cafes

Table 2: A visualization of the included industries in the data base.

After contact was established with the companies, the spokesperson was enlightened about the purpose of the research and inquired about possible timeframes to conduct a 30-min interview. There was further inquired about meeting an employee with the most information and knowledge of the companies IT systems across departments. This, in most cases, meant that the researchers interviewed CEO's, CTO's or a high-level manager responsible for digitalization and transformation.

4.1.2 Interview guide

The interviews conducted were semi-structured, meaning they do not necessarily require a very detailed list of question but an idea of what to ask about before beginning the interview (Johannessen, 2016). However, an interview guide was created to help gather thoughts, develop concrete ideas of what was interesting to explore and to easily analyze the different responses, during and after the interviews. The guide was created with consideration to appropriate language and understandable question for all parties involved. It was also created to avoid questions that covered multiple issues, and to ensure they were comprehensible for the respective informants. With consideration to this, an interview guide was built on existing literature and the research question of this study, available in Appendix A. Some question primarily in the interview guide aimed at getting the participants to explain what they perceived as digitalization, AI and technological implementation. Furthermore, the informants were met with transitional questions that lead into the main questions. The main questions were more specified on the research questions, extracting data regarding implementation in exact years.

During none of the interviews were all questions fully utilized as respondents answered some in advance in correlation to other questions. As the study progressed, some topics proved more fruitful than other, and some questions were never touched upon. In either case, the interview guide proved helpful, ensuring a smooth and focused conversation with all information.

4.1.3 Procedure

All interviews were conducted via video links (MS Teams, Zoom) or telephone. For each company, either the CEO, CTO or someone from the management was selected as the key informant. An important element of the process was that we assured the informants that both they and the company they represented would remain anonymous. Thus, a trust was created between the parties, and we quickly noticed that they felt secure providing the relevant information.

The interviews were only done at one point during the program, with the exception of a small number that required elaboration on information provided on their first interview. The informants were not provided access to the interview guide beforehand but were, firstly, met with a short introduction of the purpose of our study. This was done to ensure the same procedure of data collection across all participants. However, as several informants struggled to provide the exact year of their digital implementations, they were informed in advance about what was required for the interviews. Thereafter, the informants were asked several questions in a semi-structured manner according to the questions provided in the interview guide.

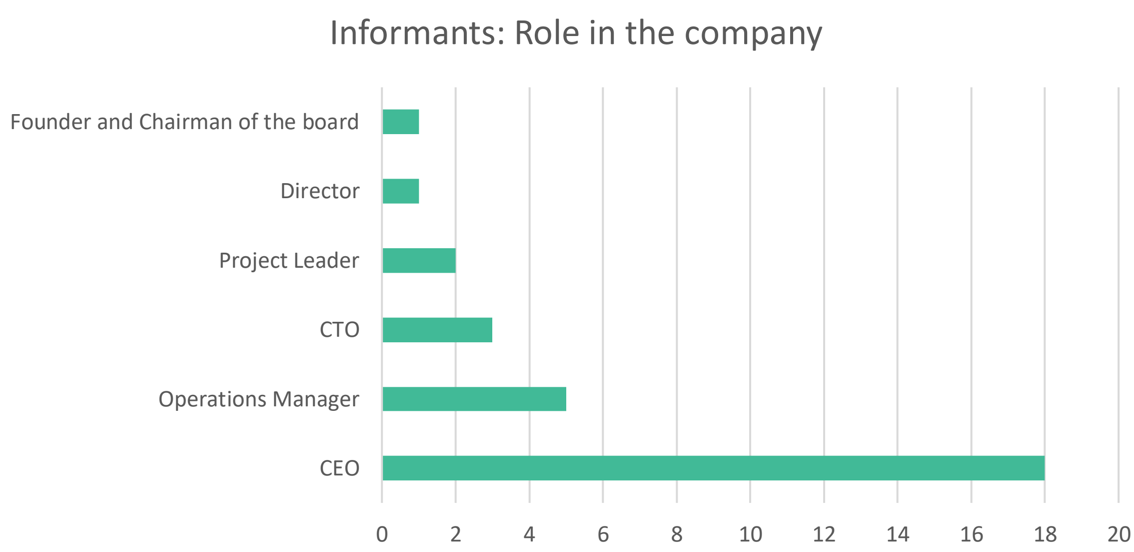

Figure 7: An illustration of the informants' role in their respective companies.

Figure 7 illustrates what position in the company the key informants had. About 60% of the respondents were CEOs. In several cases, these were also the founders of the companies, which means that they had a good insight in the decision-making processes. When there was uncertainty on the informants' end, they were informed that they did not have to answer on the spot but had the opportunity to come back to us with the information through email or another, short phone call. Although the interviews were scheduled to be 30 minutes long, they lasted between 20 min to 40 min.

4.2 Content analysis

The processing of the data material was done through using a research method within content analysis called thematic analysis. This is a highly practical and effective research method that allows the researchers a systematical approach to identify patterns in the interview material. This could be from the collected data in the form of texts, which could be both oral and written. With the intention of creating a better understanding about the purpose and underlying messages about the received content, this method was utilized. Through this method the research can examine the data to identify the occurrence of certain words, phrases, subjects or concepts.

Table 3 illustrates the different phases of the data processing through a thematic analysis. This framework was originally developed for psychology research by Virginia Braun and Victoria Clarke, but can be utilized across sectors. (Braun, Virginia & Clarke, Victoria, 2006.)

Phase	*Description*	*Process*
1	Familiarize with the dataset	Conducting the interviews, creating notes throughout the interview timeframe, and recording to re-analyze for overseen information.
2	Coding	Generating labels (coding) important features of the data to further sort it.
3	Generating initial themes	Evaluating the interview data to find pattern of importance or meaning.
4	Reviewing themes	Assessed the initial themes according to the coded data, to evaluate relevance.
5	Refining, defining, and naming The final model	Detailed analysis of each theme, working out the scope of findings based on each functional section.
6	Writing up	Finalized and contextualized the analysis in relation to existing literature.

Table 3: Phases of the data processing through Thematic Analysis.

Phase 1: Familiarize with dataset

The data material was collected through qualitative method interviews. Here, the key employees within technology or digital transformation were inquired about their decisions within the field. The interviews were recorded, while notes were also taken during the interviews. This created the main foundation of data for the research.

Phase 2: Coding

The interviewed material, in form of transcription and notes, was highlighted into different sections. By assessing the data, it was created an understanding and overview of relevance, and idea of potentially interesting topics. This was, primarily, significant to create an idea of what data connected to which organizational function (marketing, logistics, organization and management, or production).

Phase 3: Generating initial themes

The coded material was further used to identify patterns. After sorting the material based on the digital implementations of each respective firm, it was further sorted into a panel structure, as explained in 4.4. This created ease in mapping Return on Sales for measuring of profitability and plotting of Digital Index' as they as explained in 2.4. The result was an excel sheet providing more than 700 rows of data sorted with columns named; Company ID, Year, Returns on Sales (RoS), Digital Index, and Description of Implementations.

Phase 4: Reviewing themes

With a thorough review, the researchers made sure that the data was as accurate as possible. By looking through the transcripts a second time, new or overseen information was assessed and mapped down accordingly in the panel structure. This process provided useful in re-evaluating Digital Index' across companies, respective year and digital implementations.

Phase 5: Refining, defining, and naming themes

Since thematic analysis was being utilized for quantitating the interviews, the relevant and interesting topics had already been refined and defined. During this process, the inputs for the models were not clearly defined. Despite this, the data analysis continued in SAS, creating the opportunity and insight to what was interesting to investigate in depth. This resulted in a clearly defined dependent variable, Time ID and other cross-sectional IDs. Through this model, all relevant results were provided.

Phase 6: Writing

Lastly, the analysis was contextualized in relation to existing literature. The data was assembled and linked to the relevant research questions and literature, to investigate where there was a clear connection between profitability and digitalization. The models created with SAS were further explained in a way which provides comprehensiveness of the findings.

4.2.1 Degrees of digitalization

The assessment that was made according to what extent the company is digitalized was made by looking at the technological and digital implementations that have been made in various functions in the company. We categorized this as marketing, logistics, organization/management, and production. These are main activities that generally represent the value chain of a company. After conducting the interviews, it was reviewed to what extent the digital implementations are simplifications or replacements of human capital. During the interview, we therefore tried to get a better understanding of why the implementations were made, but also to understand what effect these implementations will have on reorganization internally and organizational structure. The grading is based on the researcher's subjective judgement of the different digital implementations

The degree of digitalization is based on a self-developed conceptual digital index which quantifies the degree of digitization of companies according to Industry 1.0 to Industry 5.0, as explained in chapter 2.4.

Digital index = 1

At this level the companies are highly dependent on the employees and their manual processes. The already implemented systems are outdated and leads to unproductivity for the employees, the customers, and the rest of the stakeholders.

Digital index = 2

At this level the company has gained a better understanding about what resources they have and how they could allocate them to make values for the company and for the customers. A big change from the digital index 1, is the efficiency of production and sustainable routines adopted. The usage of principles of lean manufacturing principles or just-in-time manufacturing principles are introduced. Better communication and information flow are also characteristics for companies falling under this category.

Digital index = 3

This phase is referred to as the 'Digital Revolution', and the technology used in the form of computers. At this phase manual and repetitive processes becomes more automated. The companies can automate processes using logic processors and information technology. However, they are always in need of human interference, although they are automated.

Digital Index = 4

This index looks at further development of what we regard as a starting point in Industry 3.0. The company uses several smart information technologies in various industries. Crucial information is now provided in a timelier manner and available in the right places at the right times. Cyber-physical systems (CPS), cloud computing, and IoT (industrial internet of things) gets introduced at this phase. The technological impacts involve decentralization of information, real-time data collection and Interoperability.

Digital Index = 5

This is currently conceptualized to leverage the unique creativity of human experts to collaborate with powerful, smart and accurate machinery (Maddikunta et al., 2022). Industry 5.0 is complementary the existing "Industry 4.0" approach by specifically putting research and innovation at the service of the transition to a sustainable, human-centric and resilient European industry more in focus (European Commission. Directorate General for Research and Innovation., 2020)

It is expected that high speed and accurate machines, and critical, cognitive thinking of humans are to be merged. A key factor to this is the mass personalization wherein customers can prefer personalized and customized products according to their taste and needs.

	Industry 1.0	**Industry 2.0**	**Industry 3.0**	**Industry 4.0**	**Industry 5.0**
Logistics	Logistics 1.0	Logistics 2.0	Logistics 3.0	Logistics 4.0	Logistics 5.0
Marketing	Marketing 1.0	Marketing 2.0	Marketing 3.0	Marketing 4.0	Marketing 5.0
Organization / Management (OM)	O/M 1.0	O/M 2.0	O/M 3.0	O/M 4.0	O/M 5.0
Production	Production 1.0	Production 2.0	Production 3.0	Production 4.0	Production 5.0
Digital index	1	2	3	4	5

Table 4: Illustration of grading based on the industrial revolutions.

4.2.1 Criteria for rating the participating companies

In this subchapter, real examples from the interviews will be highlighted. Based on various criteria, we rate the information we receive from the qualitative interview regarding implementations that have been introduced. This will be visualized by adding two columns. The first column represents the organizational function. Furthermore, an explanation of a concrete implementation, the effect of the new implementation and how the process previously was is highlighted. The second column represents the digital index. The number that is set is based on the criteria of the conceptual model, and the rating is than given.

In figure 8, an implementation of an accounting system is given as an example, which is considered as part of the organizational function organization / management. The representative from the company explained that they previously had been using excel to store all the financial related material. Hence, this kind of method they would also have invoiced, receipts, binder and etc. This process is highly reliable on the human capital and is highly manually. Hence, the previous processes of what they would previously have, would be rated as Digital Index = 1. However, with the new functionalities and the new effective and digitalized processed. Everything is automated in to one system.

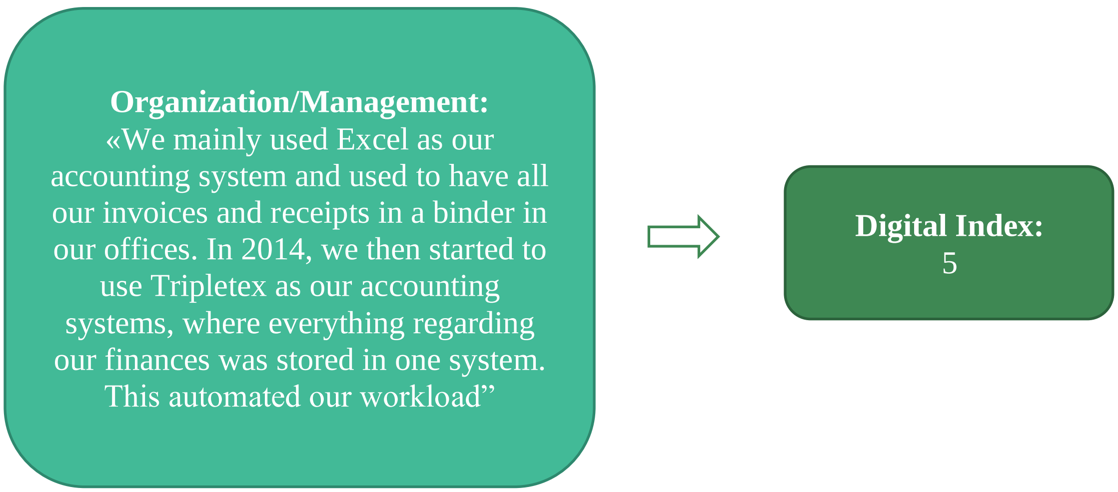

Figure 8: An example of assessment of digitalization degree for Organization and Management.

In the following example the marketing function was heavily down prioritized. The leader that we interviewed believed that marketing did not directly lead to sales. Therefore, he didn’t want to prioritize it. The company he represented had also been in operating in the market for a while and had good connections with the media agencies. That is why they until 2015 only marketed their services once in a while through the newspapers. Digital marketing was then in the company an unknown phrase for them.

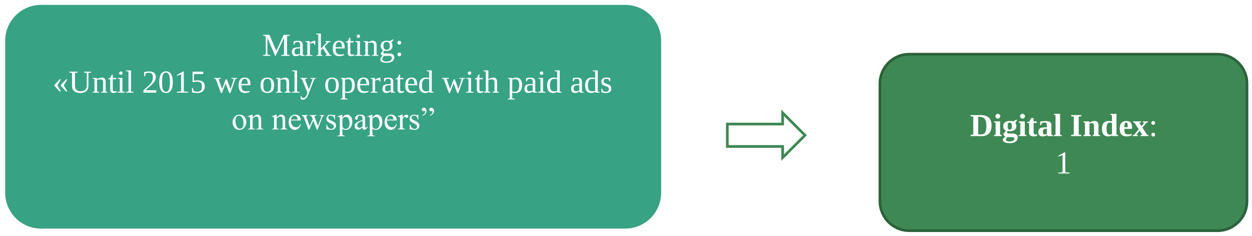

Figure 9: An example of criteria used for assessing degree of digitalization.

4.2.2 Inter-rater reliability

In order to assess the inter-rater reliability of the content analysis procedure, both authors independently rated the current digital maturity of five randomly selected companies, separately for the four organizational functions (marketing, logistics, production, organization/management). The correlation between the values assigned by the two raters was r = 0.85

The measuring for inter-rater reliability is a percent agreement between the raters. We counted the number of ratings in agreement, and then went on counting the total number of observations. We than calculated the total number by the agreement and got the correlation number.

4.3 Financial performance data

Financial performance data for the participating companies were extracted from annual report databases through Proff Forvalt. Proff Forvalt gave us the possibility to go calculate historical financial performance data.

The profitability parameter that was used was, Return on sales (RoS). This is a ratio used to evaluate a company's operational efficiency. This primarily provides us with the insight on how much profit that is produced pr. NOK of sales. The calculation shows how effectively a company is producing its core products and services, but also how the company’s management runs the business. That’s why return on sales is both used as an indicator of efficiency and profitability.

RoS was calculated by dividing operating profit by net sales. This was calculated for each participating company by looking at their financial report and calculating it from 2014 till 2019. This was then added to the panel model as this was the dependent variable.

4.4 Panel modelling

The methodology used for data collection is longitudinal surveys. These are data collected at more than one point in time (Johannessen, 2016). Within longitudinal surveys, there are several subcategories, but we take a closer look at panel studies. A panel study is conducted with a survey of two or more time points with the same participants (Johannessen, 2016).

There are several advantages of using a panel data, and some of the main advantages includes, according to Baltagi (2005) that it allows the researcher to get a better understanding of the "dynamics of adjustment", while it is easier to create and test more advanced models. Panel data also gives us also further information within the data set, more flexibility, less risk of collinearity between variables and more control for individual heterogeneity. It allows us to control the variables that we otherwise could not observe or measure like differences in business practices across companies.

Panel modelling allows us as researchers to study cross section effects along N, where we can examine the variation across the participating companies in the study and time series effects and the variation across the time, T, which is from 2014-2019 in this study.

The data modelling that is created consists of six columns. This includes the Company ID, Year, Function, RoS, Digital Index and a description of the implementations. Figure 10 highlights how the panel data is modeled.

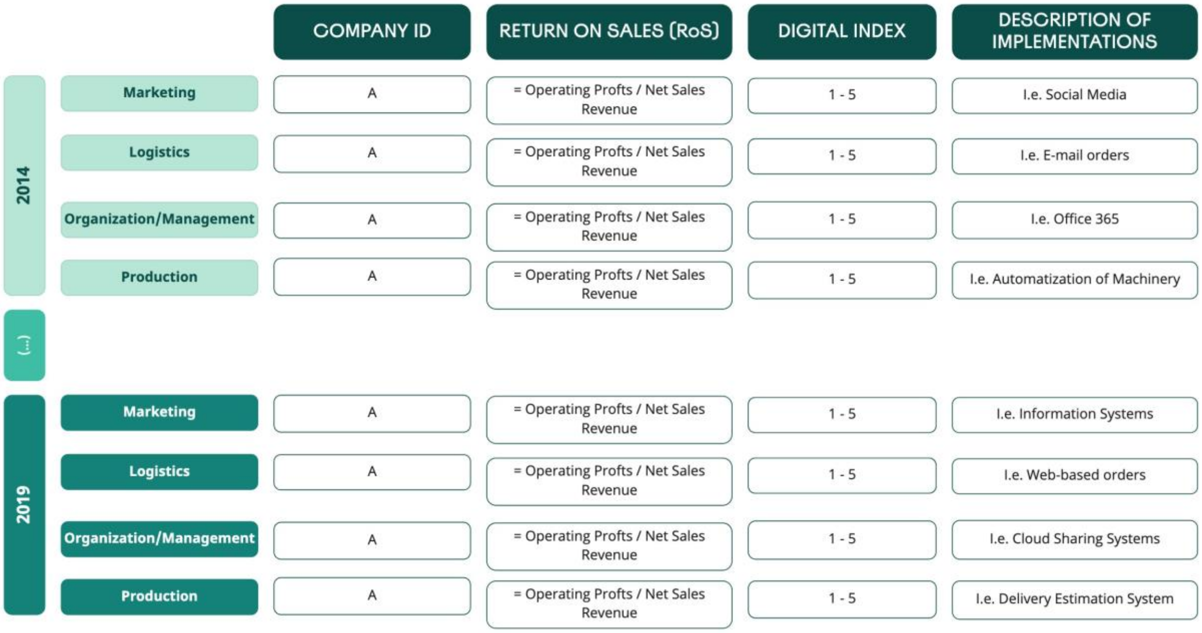

Figure 10: The figure visualizes the panel structure of this study.

4.4.1 The two-way random-effects model

The two-way-random effects model studies how cross section units (N) and time series units (T) affect the error variance. The random effect model is suitable for N which are drawn randomly from a selection. The two-way analysis considers both cross sectional and time series variables, while the one-way analysis includes only one cross sectional variables in the output. There are two available estimators to use for our random-effects model to be able to estimate the model. The two methods are FGLS and GLS. The one that are chosen are dependent on whether the variance structure when variance covariance matrix is defined or not in the estimation. We used the FGLS estimator as used since the variance covariance matrix was not known. The analyzing of the panel data was used using SAS. In SAS programming we went on using PROC PANEL, which is supported by the FGLS estimator.

Terms	The two-way random-effects model
Equation	$u_{it} = v_i + \lambda_t + e_{it}$
Intercept	Constant
Error variance	Varying across cross sectional/time series
Slope	Constant
Estimation	FGLS

Table 5: Explanation of the different aspects of the two-way random-effects (RANTWO) model.

The estimation is done in two steps (SAS, 2017):

1. Obtain the estimates of the variance $\sigma_\nu^2, \sigma_\lambda^2$, and σ_e^2. components. There are five different methods of estimating variance components. The method we have chosen for our panel procedures are Fuller and Battese’s method (Fuller & Battese, 1974)

2. With the variance-component estimates, we than need to transform the data in such a way that estimation can take place using ordinary least squares (OLS)

As a generalized least squares estimation technique for our panel structure we used Fuller and Battese’s error components procedure (Dharmasena et al., 2011) This includes the error of disturbance uit that is a equitation equals to three independent components including cross-section, time periods and random elements.

$$V_{ht} = u_h + v_t + w_{ht}. \qquad (1)$$

h represents the companies and *t* represents the year. This way it is based on the cross-section units and time series units the Fuller-Battese procedure corresponds to the two-way random effects model. The variance of u_{it} according to the model be written as:

$$var(v_{ht}) = \sigma^2 = \sigma_u^2 + \sigma_v^2 + \sigma_w^2. \qquad (2)$$

$\sigma_{2u.}$ is the variance of the cross-sectional units (N=30) while the σ_{2v} is the variance of the time (2014-2019) component and σ_{2w} is the variance of the random component. The variance-covariance matrix of disturbance can further be written as:

$$\sum = \begin{bmatrix} \sigma_u^2 A_T & \sigma_v^2 I_T & \dots & \sigma_v^2 I_T \\ \vdots & \vdots & & \vdots \\ \sigma_v^2 I_T & \sigma_u^2 A_T & \dots & \sigma_v^2 I_T \\ \vdots & \vdots & & \vdots \\ \sigma_v^2 I_T & \sigma_v^2 I_T & \dots & \sigma_u^2 A_T \end{bmatrix} \qquad (3)$$

I_T in the matrix (3) is a matrix 6 x6, that represents the 6 years (2014-2019) the timeframe of our study.

$$A_T = \begin{bmatrix} \sigma^2/\sigma_u^2 & 1 & \dots & 1 \\ \vdots & \vdots & & \vdots \\ 1 & \sigma^2/\sigma_u^2 & \dots & 1 \\ \vdots & \vdots & & \vdots \\ 1 & 1 & \dots & \sigma^2/\sigma_u^2 \end{bmatrix}. \quad (4)$$

PROC PANEL was then used for estimating parameters in the panel data models through SAS programming. The PROC PANEL handled the panel data by using RANTWO and the FGLS method.

4.4.2 Modelling strategy

The collected data was carried out through a qualitative design, before it was further coded and themed through a content analysis, so that the information needed could be quantified through the tool Microsoft Excel in the form of a panel structure. This was then further analyzed and modeled in the analysis and modeling tool SAS. The data was modelled separately for each organizational function (marketing, logistics, production, organization/management). The dependent variable was set to be the profitability ratio RoS, with year as time ID variable and company as cross-sectional ID variable.

In the dataset there are only N = 30 cross-sectional ID levels and T = 6-time ID levels. Due to the size of the dataset, the models must be kept simple.

For each functional area, we will estimate one model with lag_0 to lag_5 predictors included. In addition, in order to assess the robustness of the results, we will estimate six additional models were only a single lag is included in addition to the constant. This means that all of the lags are merged, and this is in the 'Model 6' in the comparison of the Model statistics tables. Just to clarify the meaning of what a lag represents, we will use lag_2 to explain. The meaning of the variable "lag_2" is the economic effects of a digital implementation introduced 2 years prior of present day.

5 Results

This chapter is constructed with the purpose of creating ease in understanding the comprehensiveness of the data set investigated and the interpretations made. Each company's development in digital maturity, based on the conceptual model described in 2.4, was initially visualized in a numerical panel structure scored by information gathered through individual participant interviews. The results found through a multiple regression analysis were then interpreted to guide the search for interesting events and developments. In sections based on the main organizational functions assessed in this research, key parts of evidence and observations for each function are summarized and interpreted. Additionally, some data from the interviews were used to map the companies in Capgemini's model for Digital Maturity.

5.1 Logistics

The first organizational function investigated was Logistics. The goodness-of-fit statistics for the panel models for this function are shown in figure 11, while the parameter estimates are presented in figure 12. The only significant effect noticeable in this analysis was the lag_2 effect in Model 6, which also considers all other lags as predictors. Here, the p-value of the model is below 0.05 which illustrates the significance of the results.

Comparison of Model Statistics								
Statistic	BASELINE RanTwo	MODEL_0 RanTwo	MODEL_1 RanTwo	MODEL_2 RanTwo	MODEL_3 RanTwo	MODEL_4 RanTwo	MODEL_5 RanTwo	MODEL_6 RanTwo
Cross Sections	30	30	30	30	30	30	30	30
Time Series Length	6	6	6	6	6	6	6	6
MSE	0.0288	0.0290	0.0290	0.0287	0.0290	0.0290	0.0290	0.0286
Root MSE	0.1697	0.1702	0.1702	0.1693	0.1702	0.1702	0.1701	0.1691
R-Square	0	0.0000127	0.000233	0.0107	9.322E-7	0.0000855	0.000888	0.0404

Figure 11: Goodness-of-fit statistics for two-way random effect models of the logistics function

Comparison of Model Parameter Estimates									
Variable		BASELINE RanTwo	MODEL_0 RanTwo	MODEL_1 RanTwo	MODEL_2 RanTwo	MODEL_3 RanTwo	MODEL_4 RanTwo	MODEL_5 RanTwo	MODEL_6 RanTwo
Intercept	Estimate	0.035696	0.036336	0.037898	0.047806	0.035784	0.035090	0.034422	0.036195
	Std Err	0.012652	0.018498	0.016676	0.015351	0.014432	0.013604	0.013080	0.018382
	t Value	2.82	1.96	2.27	3.11	2.48	2.58	2.63	1.97
	Pr > |t|	0.0053	0.0510	0.0242	0.0022	0.0141	0.0107	0.0092	0.0505
Digital_Index	Estimate		-0.000304						0.002339
	Std Err		0.006393						0.010659
	t Value		-0.05						0.22
	Pr > |t|		0.9621						0.8266
digital_index_1	Estimate			-0.001326					0.014809
	Std Err			0.006516					0.013978
	t Value			-0.20					1.06
	Pr > |t|			0.8390					0.2909
digital_index_2	Estimate				-0.009603				-0.038019
	Std Err				0.006931				0.014404
	t Value				-1.39				-2.64
	Pr > |t|				0.1676				0.0091
digital_index_3	Estimate					-0.000102			0.019047
	Std Err					0.007885			0.014453
	t Value					-0.01			1.32
	Pr > |t|					0.9897			0.1893
digital_index_4	Estimate						0.001253		-0.000388
	Std Err						0.010155		0.016179
	t Value						0.12		-0.02
	Pr > |t|						0.9020		0.9809
digital_index_5	Estimate							0.005878	0.006909
	Std Err							0.014779	0.018987
	t Value							0.40	0.36
	Pr > |t|							0.6913	0.7164

Figure 12: Parameter estimates for two-way random effect models of the logistics function

It should be noted though that the effect of digitalization within logistics was not strong enough to also reach significance when it was included as the only predictor in the model. Hence, the robustness of this finding is limited. The low R_2 for the models (see Figure 12) points in the same direction. Additionally, the estimate for the effect is negative, meaning that digital implementations done two years prior within logistics will have a negative effect on profitability in present time.

One interpretation of the finding is that automation, digitization, and networking technology require large expenditures for infrastructure, implementation and maintenance costs. Investing in new technologies also comes with a high financial risk given that SMEs don’t have the financial capacity to invest in analysis of which processes will be economically advantageous in the long term and which will not. It should consider that a good number of the participants did not have a physical production product as some focused on providing of services or digital goods. This will be further discussed in chapter 6.

5.2 Marketing

The same panel models were estimated for the marketing function. These did not reveal any significant effects. However, the were two marginally significant effects of lags 2 and 3, both of which had approximately the same absolute coefficient value but with different signs, meaning positive and negative values. It is not clear whether these is a regression artifact (caused by a high correlation of the two lag variables) or a substantial result. Considering the small sample size, this will not be further investigated for its effects.

The goodness-of-fit statistics for the panel models for this function are shown in Figure 13, while the parameter estimates are presented in Figure 14. The highest R-square value in this model is 0.0335, meaning the finding are, once again, not robust.

Comparison of Model Statistics								
Statistic	BASELINE RanTwo	MODEL_0 RanTwo	MODEL_1 RanTwo	MODEL_2 RanTwo	MODEL_3 RanTwo	MODEL_4 RanTwo	MODEL_5 RanTwo	MODEL_6 RanTwo
Cross Sections	30	30	30	30	30	30	30	30
Time Series Length	6	6	6	6	6	6	6	6
MSE	0.0288	0.0288	0.0285	0.0284	0.0289	0.0288	0.0287	0.0281
Root MSE	0.1696	0.1696	0.1689	0.1685	0.1699	0.1697	0.1695	0.1675
R-Square	0	0.003088	0.000786	0.000335	0.001863	2.3557E-6	0.008038	0.0335

Figure 13: Goodness-of-fit statistics for two-way random effect models of the marketing function.

Comparison of Model Parameter Estimates									
Variable		BASELINE RanTwo	MODEL_0 RanTwo	MODEL_1 RanTwo	MODEL_2 RanTwo	MODEL_3 RanTwo	MODEL_4 RanTwo	MODEL_5 RanTwo	MODEL_6 RanTwo
Intercept	Estimate	0.036341	0.053786	0.043216	0.032596	0.042075	0.036184	0.030883	0.050729
	Std Err	0.012947	0.027116	0.024918	0.025039	0.016297	0.015933	0.013425	0.037319
	t Value	2.81	1.98	1.73	1.30	2.58	2.27	2.30	1.36
	Pr > |t|	0.0056	0.0488	0.0846	0.1947	0.0106	0.0243	0.0226	0.1758
Digital_Index	Estimate		-0.005377						-0.014288
	Std Err		0.007241						0.012553
	t Value		-0.74						-1.14
	Pr > |t|		0.4588						0.2566
digital_index_1	Estimate			-0.002567					0.002147
	Std Err			0.006859					0.015770
	t Value			-0.37					0.14
	Pr > |t|			0.7086					0.8919
digital_index_2	Estimate				0.001774				0.026558
	Std Err				0.007261				0.015885
	t Value				0.24				1.67
	Pr > |t|				0.8073				0.0963
digital_index_3	Estimate					-0.003686			-0.026363
	Std Err					0.006395			0.015990
	t Value					-0.58			-1.65
	Pr > |t|					0.5650			0.1010
digital_index_4	Estimate						0.000155		0.003230
	Std Err						0.007593		0.016047
	t Value						0.02		0.20
	Pr > |t|						0.9837		0.8407
digital_index_5	Estimate							0.011697	0.016922
	Std Err							0.009739	0.017037
	t Value							1.20	0.99
	Pr > |t|							0.2314	0.3220

Figure 14: Parameter estimates for two-way random effect models of the marketing function

There could be several reasons as to why digitalization within marketing does not show a significant effect through the results. Marketing is rather capital intensive, according to several of the correspondents. It requires regular investments in new market research and CRM systems, which in turn increased the financial costs of the firms. One of the correspondents inform that marketing was down-prioritized, due to active sales being the main focus of the company. On the other hand, some marketing investments give a positive result due to the accuracy of data analysis. These plausible causes will be further investigated and discussed in chapter 6.

5.3 Organization and Management

When it comes to the panel model results regarding organization and management, we do not see any significant effect on any model apart from model 6 for lag_3. Meaning, digital implementation within organization and management done 3 years prior show a positive effect on profitability, according to the estimate. On the other hand, there are no significant effects of the lags on any of the panel models where it is investigated exclusively.

The goodness-of-fit statistics for the panel models for this function are shown in Figure 16, while the parameter estimates are presented in Figure 17. Figure 17 shows that R-square is very low for all models, thus making the findings less robust.

Comparison of Model Statistics								
Statistic	BASELINE RanTwo	MODEL_0 RanTwo	MODEL_1 RanTwo	MODEL_2 RanTwo	MODEL_3 RanTwo	MODEL_4 RanTwo	MODEL_5 RanTwo	MODEL_6 RanTwo
Cross Sections	30	30	30	30	30	30	30	30
Time Series Length	6	6	6	6	6	6	6	6
MSE	0.0285	0.0286	0.0286	0.0286	0.0283	0.0285	0.0285	0.0282
Root MSE	0.1689	0.1691	0.1691	0.1691	0.1683	0.1689	0.1688	0.1678
R-Square	0	0.003736	0.003636	0.0000332	0.004609	0.001289	0.000265	0.0314

Figure 15: Goodness-of-fit statistics for two-way random effect models of the organization and management function

Comparison of Model Parameter Estimates									
Variable		BASELINE RanTwo	MODEL_0 RanTwo	MODEL_1 RanTwo	MODEL_2 RanTwo	MODEL_3 RanTwo	MODEL_4 RanTwo	MODEL_5 RanTwo	MODEL_6 RanTwo
Intercept	Estimate	0.036199	0.059273	0.050687	0.037240	0.026714	0.039644	0.037157	0.056158
	Std Err	0.012589	0.030925	0.021953	0.019095	0.018195	0.015533	0.015107	0.035015
	t Value	2.88	1.92	2.31	1.95	1.47	2.55	2.46	1.60
	Pr > |t|	0.0045	0.0569	0.0221	0.0527	0.1438	0.0115	0.0149	0.1106
Digital_Index	Estimate		-0.006688						-0.005883
	Std Err		0.008186						0.010665
	t Value		-0.82						-0.55
	Pr > |t|		0.4150						0.5819
digital_index_1	Estimate			-0.005279					-0.006161
	Std Err			0.006550					0.011857
	t Value			-0.81					-0.52
	Pr > |t|			0.4213					0.6040
digital_index_2	Estimate				-0.000494				0.000157
	Std Err				0.006432				0.012202
	t Value				-0.08				0.01
	Pr > |t|				0.9388				0.9897
digital_index_3	Estimate					0.006467			0.024786
	Std Err					0.007123			0.012711
	t Value					0.91			1.95
	Pr > |t|					0.3652			0.0528
digital_index_4	Estimate						-0.003804		-0.019372
	Std Err						0.007936		0.013421
	t Value						-0.48		-1.44
	Pr > |t|						0.6323		0.1507
digital_index_5	Estimate							-0.002537	-0.005017
	Std Err							0.011668	0.015178
	t Value							-0.22	-0.33
	Pr > |t|							0.8282	0.7414

Figure 16: Parameter estimates for two-way random effect models of the organization and management function

A plausible cause for this effect can be how change management is important to ensure a smooth digital transformation. According to how the function has been defined in 2.4.3, this could also be a result of HR hiring the “right people for the right jobs” in terms of skills and knowledge required for high skill jobs. This will be further discussed in chapter 6.

5.4 Production

The panel models for the organizational function production did not, as marketing, reveal any significant effects. There is also no form of regression artifacts present in these panel models. The highest value of R-square is 0.0175, which makes the findings in this analysis less robust.

Comparison of Model Statistics								
Statistic	**BASELINE RanTwo**	**MODEL_0 RanTwo**	**MODEL_1 RanTwo**	**MODEL_2 RanTwo**	**MODEL_3 RanTwo**	**MODEL_4 RanTwo**	**MODEL_5 RanTwo**	**MODEL_6 RanTwo**
Cross Sections	30	30	30	30	30	30	30	30
Time Series Length	6	6	6	6	6	6	6	6
MSE	0.0286	0.0286	0.0286	0.0287	0.0287	0.0287	0.0287	0.0290
Root MSE	0.1690	0.1692	0.1692	0.1694	0.1694	0.1694	0.1694	0.1704
R-Square	0	0.002066	0.001318	0.000175	0.000255	0.000629	0.001067	0.0175

Figure 17: Goodness-of-fit statistics for two-way random effect models of the production function

One explanation as to why digital implementations do not show any effect on profitability is how a lot of services and goods are gradually shifting towards being digital instead of physical. In these cases, where firms provide digital products or services, their marginal costs and marginal revenue will give a neutralized effect. This will be enlightened in chapter 6.

Comparison of Model Parameter Estimates									
Variable		**BASELINE RanTwo**	**MODEL_0 RanTwo**	**MODEL_1 RanTwo**	**MODEL_2 RanTwo**	**MODEL_3 RanTwo**	**MODEL_4 RanTwo**	**MODEL_5 RanTwo**	**MODEL_6 RanTwo**
Intercept	Estimate	0.035152	0.029109	0.031045	0.036406	0.033925	0.036590	0.033941	0.028938
	Std Err	0.012596	0.016188	0.015507	0.014497	0.013881	0.013428	0.012926	0.016178
	t Value	2.79	1.80	2.00	2.51	2.44	2.72	2.63	1.79
	Pr > |t|	0.0058	0.0738	0.0468	0.0129	0.0155	0.0071	0.0094	0.0754
Digital_Index	Estimate		0.003898						0.005314
	Std Err		0.006422						0.012360
	t Value		0.61						0.43
	Pr > |t|		0.5446						0.6678
digital_index_1	Estimate			0.003300					0.009616
	Std Err			0.006809					0.016868
	t Value			0.48					0.57
	Pr > |t|			0.6285					0.5694
digital_index_2	Estimate				-0.001298				-0.020524
	Std Err				0.007362				0.017214
	t Value				-0.18				-1.19
	Pr > |t|				0.8603				0.2348
digital_index_3	Estimate					0.001781			0.015257
	Std Err					0.008362			0.017216
	t Value					0.21			0.89
	Pr > |t|					0.8316			0.3767
digital_index_4	Estimate						-0.003498		-0.018834
	Std Err						0.010451		0.018067
	t Value						-0.33		-1.04
	Pr > |t|						0.7383		0.2987
digital_index_5	Estimate							0.006606	0.016816
	Std Err							0.015152	0.019998
	t Value							0.44	0.84
	Pr > |t|							0.6634	0.4016

Figure 18: Parameter estimates for two-way random effect models of the production function

6 Discussion

The results sections showed some interesting finds in the data analysis. This chapter will discuss and clarify possible causes and reasons for the occurrence of the findings, thereby answering the research questions.

6.1 Logistics

The negative effect proved on profitability when implementing digital tools and AI in logistics, can be explained by several causes. Firstly, automated technology, though highly sought after, poses as a large capital investment. While some firms are well informed about several systems, others have little to no idea about what systems are favorable for them specifically based on their work process requirements. Therefore, some companies may be hesitant to purchase systems that are new, somewhat untested, and expensive. To tackle such challenges, companies with the financial capacity to hire consultants for decision-making, utilize this service.

In this research's case, the companies are SMEs, meaning that they have limited financial capacity due to their size and cannot, in most cases, utilize consulting services. As a result, some firms have experienced implementation of systems that lack important functions or system integration possibilities. These systems are, as mentioned capital intensive, causing an increase in overall costs for the company. Additionally, there are more expenses in question when considering that automation normally requires onboarding. Employees need training to operate new systems to their full potential. A company representative informs that apart from installation and implementation, they have experienced that some systems and machinery require maintenance if it happens to break down. These operation downtimes are costly as well. Therefore, the representative concludes that some investments in automation and digitalization in logistics counteract some of the savings acquired from reducing human staff and optimizing processes.

Another interpretation of the negative effect is the lack of adaptability for some systems. While automation is most often implemented to replace simple, repeatable and time-consuming tasks, changes to layout or inventory require reprogramming of systems. A small number of the participants inform that once they have fully automatized their logistics processes, they experience the inability to integrate existing systems with new technologies without steep costs. Whereas there is the possibility of integrating almost anything, the companies experience difficulty in tackling the recurring costs as technology continues to advance. Nonetheless, machinery that is system specific will require to be changed out to implement the new systems, simply because the machinery no longer is compatible with newer systems.

6.2 Marketing

When it comes to marketing, the results show a regression artifact, meaning that the model has been distorted by extreme measurements and the associated influence of regression towards the mean. This is a result of different perspectives on digitalization within marketing amongst the participants. As previously mentioned, the participating companies were selected across from several industries. In hindsight, a consequence of this has been the occurrence of extreme measurements where some companies are graded on higher levels of digital index', while other are ranking low.

Companies that rank low on digital index in the marketing function are amongst those who either focus less on digitalization within marketing due to prioritization on sales or are operating in narrow niches. The former is applicable a minor number of participants. One participant in particular explains that marketing has not been beneficial for them. This has developed a mindset within the company that marketing does not lead to any increased sales, resulting in a down prioritization of investment in it. The company claims that there were no return on the investments made, therefore favorable to cut costs instead by excluding investments in marketing completely and focusing solely on the already established customer base.

Even if the data base is collected without regards to specific industries, some companies are very niche specific. For this reason, a lot of their sales are dependent on word-of-mouth marketing amongst consumers who look for their particular products. It occurred that one company was one of very few providers of their specific product and service. The informant explained that their industry, in the Greater Oslo region, consisted of no more than three producers, creating monopolistic competition. Since the producers are few and the consumers aware of their brand, products and services, this company focused their capacity on maintaining existing customer relations through simpler CRM systems and more traditional means of marketing.

While the above is the cases for some companies, others invest heavily in new digital technologies and AI systems for marketing. These rank highly on the digital index defined in this research. A majority of the firms experience that they retain more customers when utilizing new digital tools within marketing to their full potential. Several of the informants explain how new and updated CRM systems have provided cost-effectiveness, especially associated to processes. It primarily reduced paperwork, but also creates the possibility of firms storing big amounts of customer data on cloud solutions or systems. These can be processed efficiently through processes utilizing business analytical tools. This way, the companies are able to map what customers are expected to order, preferences and much more, for further product development, and personalized and customized customer experiences. In a lot of cases, the companies add that this increases costs given that retaining customers is one of the major challenges for most businesses. Competition is high in many of the industries and CRM helps companies to not only retain customer but maintain long term customer relationships with its customers. This increases their return on marketing investments in the form of repeated purchases, translating into increased revenues.

However, these companies still experience an increase in costs and investments over time. Amongst these are overhead costs associated with running the CRM application. If the software is proprietary, it is required for the company to pay software developers, system administrators and maintenance people to keep the software running. An addition cost comes from the need to keep backups of customer data, usually to run a personalized CRM application. One company informs that another challenge with investments in marketing for digitalization, is how some systems require system upgrades and security patches to ensure smooth integrity of the system. In instances of downtime, the company usually experiences damaging losses.

6.3 Organization and Management

A plausible cause for the positive effect proven in the function organization and management, can be how change management is important to ensure a smooth digital transformation. According to how the function has been defined in 2.4.3, this could also be a result of HR hiring the "right people for the right jobs" in terms of skills and knowledge required for high skill jobs. Hiring the right-skilled and talented employees play the biggest role in the growth of a business and success in projects. As it appears from the interviews that have been held, there is a great focus on getting the right people into the companies. A CEO, who is also the founder of the company, in one of the largest companies in terms of the number of employees for this study, went so far as to say that "hiring could make or break the company". He explained this by saying that early in the start-up phase, they hired a person who they thought was a perfect fit for an advertised position. To their despair, this employee was supposed to create value and take the company to new heights, was only a burden for the company. The informant also said that the company at that time was about to go bankrupt, due to this incorrect employment. This happened before 2014. Since that incident the company has started to use digital tools, background checks for software, alongside external HR function to hire the right people. These software and digital services have also been used by many companies that have been involved in the study. Although the HR-function is an important function within organization/management, there are many instances where the recruiter utilized traditional recruitment styles, by checking the social media accounts of the one they want to hire, in addition to that they are giving their email, so that the applicants could attach the asked files in there.

Another function within organization/management is the finance function. In Norway it is required by law that all stock-based companies are required to keep accounts. Simplified, this means that they are required to submit annual accounts. There are several unique processes regarding how the participating companies had kept their accounts. From 2014-2016 many of the companies many of the companies did not used cloud-based financial system. This applied especially to smaller companies. They also used the sent out the invoices manually and either got sent the invoices by email or by post, to their private home, and then sent it to their accountant by email. The Accounting Act states that primary documentation must be stored for 5 years, whether this is stored physically or electronically. There were several cases when this was stored in binders and was in the office or in private homes. Although, around 2015 many companies utilized the cloud-based financial systems. With this system, the degree of automations increased drastically. Through these services, a full-fledged invoicing and accounting system with project and timekeeping was made possible to be digital and saved in the cloud.

A digital implementation that made the digital transformation easier within this function was the software from Microsoft that is known today as Microsoft 365 formerly Office 365. This is subscription-based services offered by Microsoft which includes access of Microsoft Office product line of, Word, PowerPoint, Microsoft Office Outlook, Excel, OneDrive, Teams etc. This made it feasible to get the job done and keep in touch with each other, whether they would work remotely or in the workplace. This made it also possible to share documents in the cloud, and collaborate through the Office apps and chat, call, and host meetings and stay in touch with the email and calendar function. However, as it appears from the interviews, most of these products was used, except Teams for most of the companies. As it was only few cases, where the company worked remotely, everyone else didn't see the benefit of using the communication and collaboration platform before after 2020. As this does not include the time span, we are looking at in the study, it would be not discussed going on.

On the other side we understood it as many companies were skeptical of using the digital tools. If we look at the HR function and training of the employees there were adapted different ways to it. For many small companies, the employees had to "jump in it" and learn the job they were going to do. In the rest of the small sized companies and the medium sized companies there were some degrees of training. Most of them were about operational overview and positioning of the company, while some were introductory training about software's and the digital tools that was complex. This was done inhouse by some of the employees. The lack of full-fledged training of systems indicates inefficiency and little purpose. One example of this was told by one of the leaders, who told us that when some of the team members had a project they were working together on, they would use to send each other documents on email with drafts. The other team member would than edit it and send it back for review. Although they did had access to the cloud function and the co-writing tools, they did not utilize the functions and made the work ineffective and expensive for the company. This indicates the low digitalization capability alongside low leadership capabilities that Capgemini has addressed. The framework of our companies will be visualized in their model in chapter 6.7.

There were also different routines when it came to economic routines where several of the companies handed out printed forms that had to be filled out and delivered manually to the person who worked within the finance department. Although many companies adapted the cloud-based accounting systems later, the lack of understanding the functionalities throughout the hierarchy was a problem within the digitalization.

6.4 Production

Although the data analysis for production provided no significant effects of digitalization on profitability, the qualitative data proves that participants experience both an increase and decrease on their profitability considering their implementations. While some participants see great results from utilizing digital tools or means of production, others experience reluctance from employees or management which in turn causes unsuccessful digital transformation.

Many companies amongst the selection experience that the digital tools implemented, for instance Adobe Acrobat for modelling of buildings, improve their operational efficiency. By departing from traditional paper and manual processes by deploying digital tools, participants inform that they are better able to streamline process flow, access helpful analytics, improve decision-making capabilities, avoid costly rework and down, and more. One participant explain briefly how they utilize means of business analytics in their manufacturing processes to ensure quality, increase performance and yield, reduce costs, and optimize supply chains. By utilizing predictive analytics, they can create real-time contextual awareness amongst employees and management. The participant also informs that by utilizing business analytics to improve their process flow, they take use of the large customer databases they store with great expenses. This way they ensure that they optimize their return on investment on several areas in the business. Another participant informs that while most production is automatized, they actively utilize business analytics to ensure process improvement. For this company, this means to find areas in which defects occur more often than not. By doing so, they are able to evaluate what part of the production process needs to improve, whether that is on quality control or change of machinery.

For both the companies, the ultimate goal of utilizing analytics alongside digital implementations for efficient production, is to improve the quality of the end product. A significant advantage these companies experience is the reduction of costs associated with downtimes and equipment failure as they are able to detect where the process is lacking.

Despite the advantages presented, there are companies that experience disadvantages of converting physical production to digital. A publishing company part of the database informant that the biggest challenge with producing digital products is scaling. This is usually caused by market challenges and tough competition against established companies with strong brand presence. The e-book company explains how the emergence and demand for the product boosted the creation of their own website providing the different digital literature in several formats. However, they quickly noticed that scaling was near impossible and made it hard to gain any revenues of the digital product. Instead, it resulted in increased costs.

A few companies experience reluctance from either employees or management, when it comes to implementation of digital tools that can provide more efficiency. While some participants explain this as a fear amongst employees to lose their role or decrease their job security, others explain this as a fear of failure. New technologies not only mean increased efficiency in production, but it also requires development of new digital skills to accelerate change. This requires training of staff, to ensure ability to take advantage of the digital investments made. However, some companies inform that there have been instances that they have failed in creating a good plan for training of employees due to high expectations of their existing capabilities and knowledge. Employees, therefore, tend to feel on pressure to perform well with a tool they have no knowledge of how to fully utilize, resulting in resistance, uncertainty and a failed digital transformation.

On the other hand, some of this resistance is a result of employees being aware of whether or not the tools actually improve efficiency or not. Where managers can assess what tools could provide increased efficiency, they are not always aware of the work tasks of their employees. Some participants inform that the promised benefits of some digital solutions and machinery within production have been implemented with promised benefits. However, employees spend a lot of time interceding. For instance, some systems are meant to automate a majority of the tasks in the productions but prove to still require human operators for simple tasks. Implementations that do not meet up with their promised benefits result in dissatisfied employees that resist or do not open up to future solutions.

6.5 Underlying factors

The interpretations and possible explanations of the results in each main organizational functions have been explained in the sections above. While these create an understanding based on the functionalities of the units, there is reason to believe that there are underlying factors affecting the digital transformation and profitability of the companies implementing digital tools and AI. These are not evident through the quantitative data, although they are observable in the semi-structured interviews.

A majority of the participants inform that they have been in a continuous digitalization process even after the timeframe of the study. Parts of their production process has been fully automatized while other parts still require handcraft or intensive human resource utilization. Mass production for these companies is usually fully automated, although this widely depends on the industry in question. While some have fully automated order production, other companies have fully automated shipping centers. One company within shipment explains how their logistics and production facilities are fully automated to require the least human interactions. With AI systems incorporated in the machinery in 2015, tags similar to RFIDs are scanned on packages ready to ship. From there, machines, data systems and AI provide accurate shipping prices and custom costs according to weight, size and value of the respective packages. As in this company, most employees in the participating companies inform that their employees are well aware of the necessity of efficiency through digital tools and systems.

Despite this awareness, the participants meet on several challenges, amongst them being how time consuming the digitalization process can be. The digital implementation in the firm often times result in digital transformations, both minor and major depending on the number of employees in the companies. Once the implementations have started, the companies inform that the transition is smooth. Even so, there are instances where the transformation progresses slowly or too quickly. For instance, one company informs that their transition from an old CRM-system, Super Office, to a newer one caused confusion and uncertainty amongst the employees. This was caused by the lack of one function that was widely utilized in the old system. The new system had no function to substitute for this which created difficult in former work processes. This has, in extreme cases, caused companies to reverse the digitalization process, which results in cost increase due to investment in systems that unexpectedly fail.

Another underlying challenge that can contribute to understanding the lack of significant effects in the results, is that a few companies experience difficulty with their organizational culture. In simpler terms, a lot of the companies experience the lack of a 'digital mindset', meaning that the employees don't necessarily understand the importance of and opportunities lying within digitalization. The lack of insights and understanding has shown negatively in how much the digital tools are actually utilized. One company explains that, while most employees understand the most of tools like Office 365 and the cloud system, other employees utilize less than 10% of the possibilities for streamlining through the tool. This proves to show that despite the tool being applicable, it is not in all cases optimally utilized according to its lease or product price. However, to solve such an issue surrounding lack of knowledge, most of these companies invest in employee training in the new systems and tools. Despite the effort, this too provides an increased cost in the forms of wages and arrangement of seminars or coursing, resulting in a negative effect on overall profitability.

From another perspective, the effect digital investments have on the profitability was assumed to be reflected through RoS calculations made and included in the panel model. One interesting finding in the interviews was the different preferences companies had when deciding to acquire a software. While some utilized a one-time investment opportunity, meaning they buy the license for using a software to its full price, others preferred the solution "software as a service" (SaaS). The latter can be explained as a rental solution where the applications for a software reside on a remote cloud network accessed through the web or an API. Most companies informing about their usage of SaaS solution mention the main benefit as lowered costs. Due to the service being cloud based, the companies are only required to pay up-front once for installation costs. Thereafter, the costs for the installed systems are based on their usage of the system. The differences in what companies utilize a capital-intensive one-time investment and those who utilize SaaS, will affect the result and its robustness.

6.5 Digital maturity and strategy

By accumulating and comparing all results from the panel models and the interviews, a Capgemini Digital Maturity model has been developed. This has been done to see if the digital maturity of the companies can explain the lack of connection between digitalization and profitability.

The companies score differently on the model, although there is a similar pattern to Capgemini's own model. Most companies are saturated in between all four categories. Even so, a majority seems to be categorized as “beginners” in digitalization. A minority is categorized as “fashionistas" and “conservatives”. A few numbers of the companies were graded as “digital masters”. Companies categorized as digital “beginners” are doing very little with advances digital capabilities, although they have these are available to them in more traditional forms, such as e-mail. For instance, as explained in 6.3 Organization and Management, some companies have the availability of cloud solutions and easier forms of communications, but their employees resist change by continuing to use older forms of communication. In other cases, companies are either unaware of the possibilities of new digital technologies or are starting investments without effective transformation management in place.

The four companies evaluated as digital “fashionistas” have implemented a large number of digital tools. Some of these contribute to creating value, while others pose as accessory in the background. One of these companies explain that some programs end up becoming more utilized than others due to the lack of synergies. This results in companies looking highly digital without a good digital transformation strategy based on actual knowledge on how to proceed. For instance, another company out of the four informs that often times managers push for digital transformation without knowing how the tools can contribute to creating value in the value chain. This poses as a challenge for employees who also have to keep up with the rapid changes.

Approximately three companies were assessed to be digital “conservatives”. These represent an older generation of employees who understand the need for a strong unifying vision and for governance and internal engagement activities to ensure prudent investment management. However, they are also skeptical to the actual values off new trends, something that causes lack of momentum to carry out ambitious programs. This strategic mindset explains why some companies do not focus on new marketing systems, as discussed in 6.2 Marketing.

Companies categorized as “digital masters” are those who express understanding of how to drive value from digital transformation. By combining a strong shared vision for transformation, careful governance and engagement, and sufficient investment in new opportunities. A few of these companies inform that they carefully, yet effectively, evaluate how to digitally transform their businesses through a digital culture. One participant explains that they strive to develop a digital culture and mindset amongst the employees, to create a vision encouraging changes and implementation of new tools. Additionally, the asses what competitive advantages they can draw from implementing digital tools, something that employees are thoroughly informed and trained in.

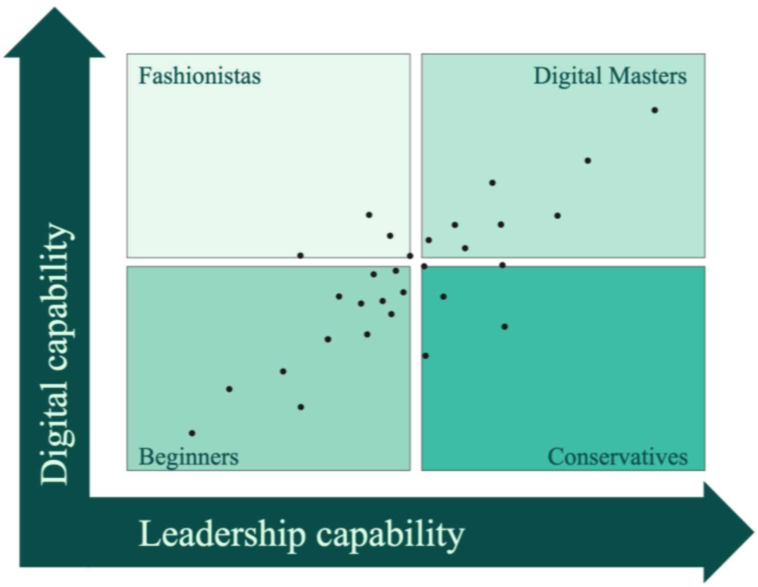

Figure 19: A mapping of the digital maturity of the participating firms, utilizing the Capgemini Maturity Model.

Given that a majority of the participating companies rank as digital “beginners” in the Capgemini Digital Maturity Model, there is reason to believe that the lack of optimal utilization of digital tools is reflected in the data results as insignificant effects.

6.6 Limitations with the research

A new conceptual model was developed to better connect digital implementation to profitability conjunctions. Interestingly, the analysis conducted based on this framework uncovered that there is no clear connection between digitalization and profitability, as measured in RoS, despite participants providing several examples of perceived and experienced increase in profitability.

Although the number of companies that participated in a 30-40 min interview is remarkable due the time limit of the study and most participants being the CEOs in a global pandemic, the results prove no robustness strong enough for generalization. A possibility to make the model more applicable and the results generalized, is to focus on one industry. This can be strengthened by the findings and discussion under 6.2 Marketing and 6.4 Production, where the findings are highly affected by industry specific activities and markets. Therefore, there are reasons to assume that the widely different, operational markets and industries create disruptions in the results.

It is also a limitation that the study looks at RoS based on sales revenue and profit. Revenue can be connected to several aspects of the company. This means that there is not guarantee that an increase or decrease in profitability calculated with these number are a result of digital implementations excluding all other factors. There is, therefore, reason to believe that this limits the robustness and applicability of the model.

Furthermore, the digital index' assigned in rating the companies are based on a subjective approach of the researchers. Although the highest efforts in ensuring objectivity have been utilized, there is still a possibility that a subjective bias has occurred.

6.8 Future Research

In future research within what effect digitalization has on profitability on SMEs in the Greater Oslo region, it will be interesting to investigate in depth on how different industries differ from one another in their digital journeys. In Visma's report, Digital Index 2019, they present different factors that contribute to a company's profitability. It would be interesting to look at differences amongst industry-specific activities and how changes in these, in terms of digital implementations, affect profitability. Another interesting topic is to investigate further with specification to robotizing, AI and machine learning. For instance, how much of an effect do the digital systems actually result in through how efficient the processes become through the implementations. The focus of this research has primarily been on how profitability changes due to different actions, although investigating to what degree has not been an easy task to define. It will, further, be appropriate and interesting to investigate how the degree of digitalization and profitability in industry-specific companies has developed in the more stable times after the COVID-19 pandemic, and if the findings in this research are similar to new findings.

7 Conclusion

This thesis has explored the state of digitalization and its effect on profitability among 30 SMEs in the Greater Oslo region. By developing a conceptual model based on existing literature and assessment models for digital and business analytical maturity, the degree of digitalization amongst the SMEs was assessed through interviews. The data was mapped into the conceptual model, presenting four main organizational functions, where the digital index was explained as industrial changes according to Industry 1.0 to Industry 5.0. While there have not been proven significant effects on profitability based on the conceptual model developed in this research, there seem to be more company- and industry-specific differences in digitalization across the participating companies.

In summary, the findings emphasize that there is no direct correlation between digitalization and profitability. The empirical data collected through interviews, on the other hand, give light to underlying factors that create disruptions in the panel models. It is evident that more factors than digital implementation alone effect the profitability of a firm. This illustrates that, while there is an overarching trend of digitalization amongst many companies, this phenomenon is made up of multiple composite parts and streams that effect the internal organization and performance as it is presented through profitability. May firms explain different challenges within each of the four, main organization functions utilized for the conceptual model.

Consequently, the analysis emphasis the different digital mindsets of the participating companies and their perception of their own degree of digitalization. Their assessed strategy creates a deeper understanding of why some firms experience an increase or decrease in their overall profitability and efficiency. A major challenge for a larger number of the firms proves to be an overestimation of their digital capabilities in relation to the leadership capabilities. This, in often cases, result in lack of optimalization of digital tools and technologies initially implemented to contribute to efficiency and increase profitability. Meaning, most companies implement tools with the expectation that employees will fully utilize them, but the management fails to implement the digital implementation for full optimization.

As the relevance and impact of digitalization show no sign of slowing down, there are numerous aspects surrounding the topic to explore further. While there are several case studies surrounding the effect of digitalization, we hope the research inspires future students in illuminating the bigger and complex picture of digitalization. Looking into the challenges of fully utilizing digital implementation in some industries in depth is one alternative, as well as other segments than SMEs. Another is to compare larger sets of industries, identifying patterns and differences in their digital transformations and strategies. As concluded, there is no straight correlation between digitalization and profitability. Exploring how profitability can be increase through digitalization alone, with financial data excluding expenses and revenues resulted by other factors, will hopefully provide the answers to an unresolved issue.

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Appendix A – Interview guide

Interview guide

About the project:

- Who are the researchers?
- What are they looking for?
- What is the purpose of this research?

Introductory questions:

- How digitized do you perceive your company today?
- What do you think when you hear the words digitalization and artificial intelligence?

Transitional questions:

- How far have you come with digitalization?
- Have you implemented AI (Artificial Intelligence) systems?

Main questions:

- What digital solutions has the company introduced?
    - Which of these have been implemented in marketing? Logistics? Organization and Management? Production?
    - What exact years were these implemented?
- What factors are important to you when implementing digital solutions?
- How have things changed after the mentioned digital implementations were done?
- Have your employees given any feedback on what their thoughts are around the changes?

Follow up questions:

- Has the company experienced any increase or decrease in their profitability after implementation?
- What could be the reason for such an increase/decrease in the company's perspective?
- Has the company faced any challenges surrounding the implementations?
- Has there been any resistance from employees?

Closing questions and statements:

- Is there any information that you can think of that you wish to add?
- Are there any questions on your end to us?
- Would the company like to have a finalized research report sent to them?

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