Barriers to Adopting AI Technology in SMEs

A Multiple-Case Study on Perceived Barriers Discouraging Nordic Small and Medium-sized Enterprises to Adopt Artificial Intelligence-Based Solutions

Master's Thesis

by

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Abstract

The focus of this thesis is Artificial Intelligence (AI) technology adoption constraints in small and medium-sized enterprises (SMEs). Today, only 5% of SMEs in Europe have engaged in the use of AI technology. Compared to larger organizations, SMEs are vastly underrepresented and face the risk of losing their competitiveness. The issue was addressed by exploring the following research question: "*Why are some SMEs hesitant with adopting AI technology?*"

Previous literature and research on AI application in business, technology adoption in SMEs, and Digital Transformation in SMEs was reviewed which led to ten concepts that potentially affect the outcome of an AI adoption decision process: *AI Value Perception, AI Black Box, Data Ecosystem Requirements, Strategy and Resources, Digital Transformation Capabilities, Organization Readiness, Management Support, AI Talent, Risk Perception, AI Technology Accessibility*. The concepts were used in combination with the Technology-Organization-Environment (TOE) framework as a research lens. As the next step, four objectives related to the research question were set with the main one being: "*Explain what factors come into play, discouraging SMEs from engaging in AI-investments*".

Subsequently, the following research methods were applied as they were relevant for this study: *an exploratory and pragmatic approach*, both *abductive and inductive reasoning*, *multiple-case study research design*, *qualitative data collection strategy, and qualitative data analysis through coding, theming and categorizing*. The data was collected using *non-standardized semi-structured, open-ended interviews* from eight representatives of four Nordic SMEs. The interviewed representatives were executives, senior employees or decision-makers that would be involved in a technology adoption decision. The interviews were recorded and transcribed using the Otter.ai tool and analyzed using software NVivo 12, Microsoft Word, and Microsoft Excel in three phases. The analysis process led to the result of 65 themes representing perceived barriers preventing SMEs to engage in applying AI technology.

A hypothesis of the 20 most significant barriers hindering SMEs to adopt AI technology was constructed (see chapters 6.6 and 6.7). These found barriers were (1) *Lack of AI competence*, (2) *Dependency on external help*, (3) *Lack of IT competence or knowledge*, (4) *No or little prior AI experience*, (5) *AI or technology scepticism*, (6) *Change resistance*, (7) *Unclear benefits of an AI initiative*, (8) *Competing priorities*, (9) *Employee age*, (10) *Firefighting*, (11) *Lack of AI understanding*, (12) *Resources constraints*, (13) *Lack of clear business case and strategy*, (14) *Insufficient employee training*, (15) *Financial constraints*, (16) *Incompatibility of an AI solution with an organization's legacy IT systems or processes*, (17) *Not following AI trends*, (18) *Price of an AI solution*, (19) *Risk of losing reputation and damaging customer relationships*, (20) *Tasks or processes that are challenging to streamline*.

This preliminary study contributes to identifying perceived barriers to engage with AI technology that specifically apply to SMEs and invites researchers to further study this field as it is not sufficiently researched.

Acknowledgments

We would like to express our gratitude to our supervisor Louise Harder Fischer who guided us through the research process. Thank you for your major insight, knowledge, support, and contribution to interesting discussions which helped us to overcome difficult stages of this thesis. It was a pleasant experience to have Louise as our thesis supervisor.

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–Axel Aarstad and Michal Saidl

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Topic Overview

Artificial Intelligence (AI) is considered to be the biggest commercial opportunity in today's fast-changing economy, estimated to increase global GDP growth by 15.7 trillion USD by 2030 (Rao & Verweij, 2017). Today, AI gets a lot of attention from the media and general public, supporting a willingness to invest which contributes to stimulating the AI-field into being an attractive area for research and practical application (Corea, 2017).

Even though there is a tremendous expectancy to the potential of AI today, it has yet to reshape most businesses (Bergstein, 2019). There is a huge interest to deploy AI technology, although only 20.6% of European organizations have actually adopted the use of AI technology (Delponte, 2018). The adoption rate is especially low among small and medium-sized enterprises (SMEs) as only 5% of them have adopted the technology (Delponte, 2018).

SMEs are underrepresented among AI adopters in Europe, and there exists little to no formal exploration into understanding the challenges with AI adoption from an SME perspective, though it is expected to affect most industries in Europe. "*No sector or business is in any way immune to the impact of AI. The big question is how to secure the talent, technology and access to data to make the most of this opportunity*" (Rao & Verweij, 2017). In an inevitable future dominated by AI-fueled organizations, the question that should be addressed is how an organization starts with such an initiative.

Planning to be "fast followers", waiting for the technology to mature and for expertise in AI to become more widely available might be a bad adoption strategy, a situation that is fair to assume that many SMEs are planning to position themselves in (Mahidar & Davenport, 2018). The risk of being a slow adopter is falling behind the competition that has done the necessary preparations to be more capable of quick up-scaling of AI-solutions, outperforming other organizations at a lower cost and thus making slow adopters not be able to catch up.

As SMEs currently represent the group of slow adopters, this research is pressing the importance for SMEs to initiate measures to build an understanding about what is required to successfully adopt the use of AI as a technology, if they are to maintain their future competitiveness. This report is considered important to get started with the preparation to adopt the technology, by attuning on how AI works and knowing where one's blind spots and pitfalls are.

In order to address the real risk of SMEs becoming outperformed in this context, authors of this study see it as important to investigate what the complications and barriers are that cause SMEs to avoid initiating AI projects, and believe that the low adoption rate among SMEs can be addressed by providing SMEs by creating an overview of potential issues, so that SMEs can more quickly address them and initiate measures to overcome these.

This thesis is a preliminary multiple-case study on engagement barriers to adopting AI technology with focus on Nordic SMEs. From a management viewpoint, the content should be read with a self-reflective perspective to see whether some of these barriers are recognized to exist in an organization's context as companies have different circumstances they begin with. For the academical reader, the thesis aims to report how the perception of AI adoption barriers from an SME viewpoint was researched, by conducting a relevant review of the literature within the academic field of technology adoption and qualitative exploration of four case companies.

1.2 Motivation and Problem Definition

The following subchapters consist of background information underlining three key reasons why the topic of AI technology adoption engagement barriers is relevant today and why it needs to be addressed. Collectively, the listed reasons explain the motivation for the conducted research.

1.2.1 SMEs Falling Behind Larger Organizations

According to Østergaard et al. (2019), leading AI users are starting to break away from the remainder. While many organizations struggle with scaling AI and to capture the value, AI-leading organizations such as Google, Amazon, Tencent and Alibaba in the front are succeeding with hard tasks to scale AI projects and generate insights into a valuable outcome. The mentioned organizations are offering a large amount of AI-related services to their customers, consequentially concentrating the real power of AI into the hands of a few large players (Corea, 2017).

It may be difficult to mimic the AI business models of the mentioned tech giants and to use AI as a business model, but smaller businesses are positioned to consider using AI as a differentiator in their respective competitive environments and draw inspiration from how the tech giants support and manage AI initiatives (Østergaard et al., 2019).

There are several noticeable traits among large organizations that have experienced more success with AI that can function as indicators to what they do differently. Successful breakaway companies typically have unique characteristics in the sense that they better support AI practices, such as (as per Østergaard et al., 2019):

- they spend more on IT budgets compared to other less successful organizations in terms of AI– typically more than 25% of their IT budget goes to AI and analytics,
- they are more likely to apply analytics over several more use cases (typically 3+ use cases) across their business units and functional areas,
- they have well defined AI and analytics roles and career paths for their employees,
- they are more likely to align executive leadership on AI and analytics vision and strategy.

There are also similar results that can be seen in the Spiceworks (2018) report on AI adoption, where it was found that there are significant differences in the adoption rate depending on an organization's size. While about 30% of organizations with 1000 or more employees expressed that they have adopted AI technology, the adoption rate in organizations with 100 or fewer employees was merely 4%. The report suggests that the cause of the adoption gap is that larger organizations increase their IT budgets at a larger rate compared to smaller-sized organizations, making them more quickly jump on the latest tech trends. AI development projects are often dependent on heavy funding, therefore organizations with smaller IT budgets tend to sacrifice long term AI research and development (R&D) for simpler short-term business applications, an issue argued to also be stemming from a lack of high technical knowledge required to understand AI (Corea, 2017). This puts SMEs today in a disadvantageous position compared to more resourceful competitors.

For an SME that is operating in a sector that is preparing for the adoption of AI, it is recommended to move quickly if you want to capitalize on the opportunities, to make sure that you do not lose out to more resource-strong, fast-moving, and more cost-efficient competitors. (Rao & Verweij, 2017). As SMEs have less access to resources than larger organizations, it is important to begin early with considering AI adoption if they are not to fall behind.

1.2.2 AI Trend and Economic Impact

Organizations should not ignore the potential impact that AI technology will have on society due to that there will likely not be another "AI-Winter", a term used to describe the cycle of investments and excitements that are historically followed by disillusionment and withdrawal of funding (Lovelock, Tan, Hare, Woodward, & Priestley, 2018). The world has experienced two "AI winters" in the 1970s and 1980s, where expectations for what AI could do was not met, thus leading to a fallback in investment and interest. Forecasts from Lovelock et al. (2018), Møller, Czaika, Bax, & Nijhon (2019), and Østergaard et al. (2019) all conclude that this is not the case today, nor in the years to come. In the 10-year period from 2008 until 2018, it is estimated that 10.5 billion USD in total has been invested in AI-related activities in Europe, steadily increasing every year (Møller et al., 2019). When looking at forecasts of business value growth resulting from AI, it is predicted that AI augmentation has the potential to "*create value in the Nordics of about USD 11-17 billion annually (roughly USD 750-1,200 billion globally)*" (Østergaard et al., 2019). Lovelock et al. (2018) report that in 2021, "*AI augmentation will generate $2.9 trillion in business value and recover 6.2 billion hours of worker productivity*". These reports paint a picture of how AI is a phenomenon too important to ignore for businesses today.

The future economic impact presented is argued to be driven by three main factors, according to Rao & Verweij (2017). The most significant driver mentioned will be increased productivity due to automating processes of routine tasks, followed by enhancing employees' capabilities and freeing up more time for higher value-adding work. The third factor is that AI front-runners will have the advantage of offering superior customer insight and personalization, meaning products and services enhanced through AI.

"AI-fueled organizations", organizations that capitalize on the drivers of AI, is the latest trend in a series of tech-driven transformations that have delivered massive leaps in productivity (Deloitte Insights, 2019). AI initiatives are often expected to result in adopting solutions to provide insights that naturally lead to greater productivity, increased efficiency and lower operational costs, but it might only be the stepping stone for AI's future potential. Deloitte Insights (2019) argues that the mentioned benefits might be the "low-hanging" fruit that AI technology can offer. AI can offer more "mass personalization" of products and services, intelligence and knowledge surpassing human insight and offer enhanced regulatory compliance. These visions are fueling a push for organizations to aim to adopt larger AI systems, attracting huge investment sums into AI-research.

1.2.3 Current Lack of AI Knowledge, Support and Competence

Navigating in the AI landscape is not an easy task if your organization is not built to capture and use digital data, partly due to the lack of formal knowledge on the topic. Through the literature review process presented in chapter 3, there was found a lack of empirical research on the concerns of SMEs and their struggles with AI adoption and how SMEs could increasingly reap benefits from AI along with larger organizations. In general, most of the empirical work on the topic of AI adoption has been done by large consulting and audit companies, investigating barriers for more resourceful organizations.

Recently, the issue has gained the attention in the EU; the EU Parliament recognizes the potential threat that SMEs are currently in an unfavorable position by stressing "*the importance of targeted measures to ensure that SMEs and start-ups are able to adopt and benefit from AI technologies*" (European Parliament, 2019).

The European Parliament calls for actions to target underlying key issues in Europe of having a shortage of ICT expertise, estimated to be 750.000 job vacancies by 2020 and the lack of an ecosystem with relevant stakeholders that is open to meeting the needs of SMEs in an AI environment, such as mitigation of risks, security, safety, and governance. The European Digital SME alliance also expressed the concern of SMEs

falling behind, stating that "*only a thriving digital industry with strong small and medium sized companies can help Europe regain its digital sovereignty and take full advantage of the digital revolution*". (European Digital SME Alliance, 2019).

As SMEs are less financially attractive employers, they are losing the competition over the most talented ICT graduates to multinational companies (European Digital SME Alliance, 2019). The concern of lack of access to professionals with IT expertise is also highlighted in the 2018 Global AI Report from the MIT Technology Review. The report states that "*this is particularly true for small and midsize enterprises that need to compete with deeper-pocketed organizations for sparse talent*". (MIT Technology Review Insights, 2018).

As the issue is also becoming formally recognized and due to lack of accessible academic knowledge, it was found as important to map barriers that could be causing the low adoption rate and hesitant behavior towards AI adoption among SMEs.

1.3 Research Overview

1.3.1 Research Question and Objectives

The purpose of the thesis is to identify main factors that SMEs consider as barriers when assessing whether they should venture into the adoption of AI. To better understand the adoption of AI technology from an SME's perspective, the research aimed to answer the following **research question**:

Why are some SMEs hesitant with adopting AI technology?

The research question is accompanied with the following **research objectives:**

1. *Explain what factors come into play, discouraging SMEs from engaging in AI investments.*
2. *Show similarities and differences with the perception of AI adoption among selected SME case company examples.*
3. *Establish an AI technology adoption framework that would support SMEs' managers in addressing challenges that arise from projects that require some degree of AI technology.*
4. *Contribute to progress the research field of AI adoption in SMEs, which was found to be barely explored.*

The term "AI adoption" in this research should be understood as engaging in the application and implementation of AI solutions that fall within the disciplines under the umbrella term "AI" covered in chapter 2.1.

In the context of this research, the adoption decision was not considered as a "one-time evaluation" on whether to invest in AI technology, but it was defined as a decision to engage in AI investment once the level of barriers is perceived to be low enough by SMEs.

In this research, barriers are negative contextual factors with AI adoption that can be understood to discourage adoption actions. These barriers are perceived to challenge and complicate a potentially successful outcome from an AI investment.

1.3.2 Research Scope

The thesis contains several boundaries in order to maintain a clear and consistent focus. The scope of barriers is investigated and analyzed through the academic perspective of technology adoption, looking at the pre-engagement stage of the adoption process. It is fair to assume that the decision to invest in new technology among independent SMEs would be influenced and made by a few selected representatives, typically C-level managers in an organization. Therefore, the scope of analysis revolves around exploring hesitant behavior and perception among decision-makers.

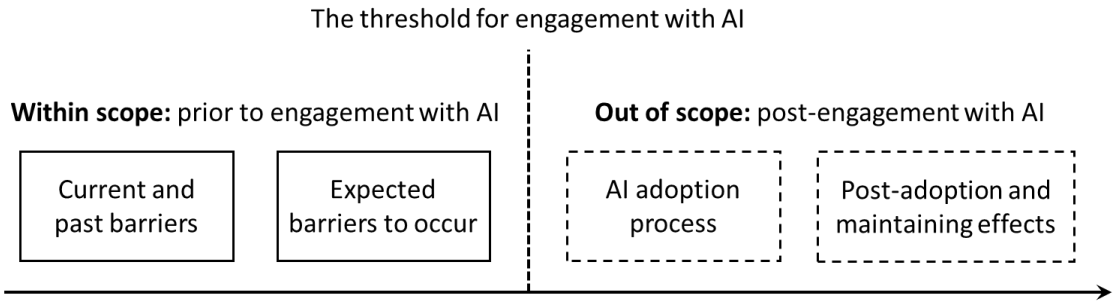


Figure 1 – Research scope.

The focus of the thesis is on barriers that transpire when representatives from an SME evaluate AI technology for their own respective organization. The barriers in focus derive from representatives' perception of current and past barriers, the current state of an SME, and factors expected to surface as barriers if the SME were to engage in applying, implementing and maintaining effects of an AI-based solution, i.e., the post-engagement stage (see Figure 1). The goal of the illustrated scope is to point out the factors that make an SME less willing to step over the threshold to take actions towards adopting AI.

The subject of this research is the AI adoption decision process perceived by representatives of SMEs, not the AI technology itself. The research aims to fill a gap knowledge by investigating AI from an SME organizational perspective. It should be mentioned that SMEs that are using AI technology to a significant extent are not in the scope. This thesis does not target any specific industry as it focuses on SMEs as a segment.

1.4 Paper Roadmap

The thesis is structured in a traditional "logico-deductive" reporting style, as seen in Figure 2 below (Saunders, Lewis, & Thornhill, 2009). The reporting structure was chosen as it helps to present a clear argument and logical reading path. The deductive "step-by-step" style of reporting deviates from the conducted inductive research logic.

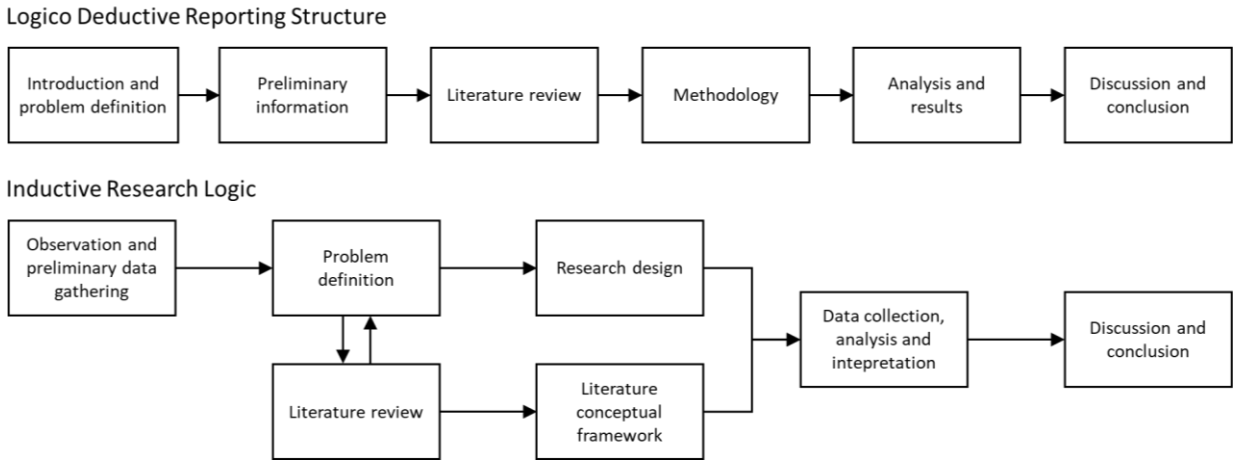


Figure 2 – Logico-deductive reporting style and inductive research logic.

To start off, chapter 2 introduces preliminary information to provide context and relevant prerequisites for the report. First, AI is introduced with a technical breakdown of the phenomenon and underlying technologies. Then the chapter describes the definition and characteristics of SMEs in the EU. Last, the chapter introduces established technology adoption theories and models, including the Technology-Organization-Environment adoption decision framework used as a research lens for this thesis.

Chapter 3 presents a literature review on research of AI application in business, technology adoption in SMEs and Digital Transformation in SMEs. The literature is presented in a conceptual framework based on the TOE model, containing 10 main concepts derived from the reviewing process. The chapter concludes with identified research gaps and explaining the action taken to address these.

Chapter 4 contains a description of the chosen research methodology, that includes the research design, logic, and methods that have been cautiously chosen and applied to provide a valid approach to this research.

Chapter 5 is dedicated to describing the analysis process that led to revealing patterns and constructing findings from the collected data.

Chapter 6 presents the results of the study.

Chapter 7 is dedicated to discussing the interpretation of the findings, implications for SMEs and their practice and the future directions where new research proposals are introduced.

Chapter 8 is a concluding chapter with reflections on the research contributions and final remarks.

2 Preliminary and Theoretical Underpinnings

2.1 Artificial Intelligence

2.1.1 Origin of AI

Artificial Intelligence as a new separate research field in science and engineering was founded after World War II in 1956 at a conference at Dartmouth College in Hanover (New Hampshire, USA) by John McCarthy. The term Artificial Intelligence was not used until then despite previous milestones and achievements since the 1930s which are considered to also contributed to the development of this field (Gentsch, 2018; Russel & Norvig, 2010).

As Gentsch (2018) and Russel & Norvig (2010) discuss, the name Artificial Intelligence derives from humanity's fascination with intelligence and attempts to understand what it is, how to measure it or how we humans think, i.e., how can we perceive, understand, predict and manipulate the world around us. Human intelligence can be described as "*a general mental ability that, among others, covers recognizing rules and reasons, abstract thinking, learning from experience, developing complex ideas, planning and solving problems*" (Klug, as cited in Gentsch, 2018).

2.1.2 AI Definitions

McCarthy (as cited in Ertel, 2017) defined AI as an effort to develop intelligent machines. Elaine Rich (as cited in Gentsch, 2018) later described AI as "*the study of how to make computers do things at which, at the moment, people are better*". Russel & Norvig (2010) developed a matrix presenting an overview of some different AI definitions, organized by following dimensions: (1) thought processes (thinking) and reasoning and (2) behavior (acting), (3) human performance (prone to errors) and (4) rational performance (ideal). AI definitions of Bellman, Winston, Kurzweil, Poole and Nilsson (as in Russel & Norvig, 2010) show differences among the four perspectives: Bellman thinks of AI as "*automation of activities that we associate with human thinking*" (thinking humanly), Winston ponders about AI as "*computations that make it possible to perceive, reason, and act*" (thinking rationally), Kurzweil talks about AI as "*the art of creating machines that perform functions that require intelligence when performed by people*" (acting humanly), and Poole and Nilsson mention intelligent agents and intelligent behavior in artifacts, respectively (acting rationally).

2.1.3 AI Perspectives and Trends

To act as a human, a machine would need to have abilities to (1) successfully communicate, (2) store what it knows or hears, (3) use stored information to answer questions and draw new conclusions, (4) adapt to new circumstances and to detect and extrapolate patterns, (5) perceive objects and (6) manipulate objects and move about. These abilities are simulated by six disciplines that compose most of AI: natural language processing (NLP), knowledge representation, automated reasoning, machine learning (ML), computer vision (image analysis) and robotics (object manipulation), respectively. Those competence areas are the foundation of modern AI methods (Russel & Norvig, 2010; Wodecki, 2019).

To "think" as a human, the cognitive modeling approach is used to imitate the human brain's cognitive abilities (to recognize an image, to understand the meaning of a sentence, etc.). Cognitive science is a combination of computer models from AI and methods from psychology to create testable theories of the human mind (Russel & Norvig, 2010).

The perspective of acting rationally leads to another trend of the AI field. The idea of rational intelligent agents began with the dream of creating systems without being burdened by "human" irrationality (Wodecki, 2019).

It is about AI computer agents (something that acts) that can do much more than a single computer program: "*operate autonomously, perceive their environment, persist over a prolonged time period, adapt to change, and create and pursue goals.*" A rational agent acts in order to achieve the best outcome or the best expected outcome (Russel & Norvig, 2010). The most common examples of intelligent agents are bots that act as parts of search engines or recommendation systems, or intelligent chatbots operating in customer service (Gentsch, 2018).

These perspectives clearly show the ambiguity of the broad term of Artificial Intelligence. As Davenport (2018) points out, while some use the general term AI, others prefer to distinguish among cognitive technologies, machine learning and other highly statistical approaches, and robotic process automation (RPA). Those can be considered separate fields of automation due to that machine learning can often have closer to traditional analytics and RPA has not been very intelligent so far. Some, who consider machine learning artificially intelligent, even prefer to use machine learning as a general term over AI. Davenport is one of those who considers "cognitive technologies" a significant term given that he is not afraid to confuse it with the general term "AI" in his management-focused book *The AI Advantage*. On the other hand, for example, Ertel (2017) has deduced (in his general-AI book *Introduction to Artificial Intelligence*) from Elaine Rich's definition of AI (do things at which people are better) that the central subfield of AI is machine learning due to the fact that it imitates the human adaptability through learning.

Artificial intelligence and its terminology are complex topics but in its pragmatic view, this research does differentiate among the above-mentioned terms and uses the unified general definition "AI".

2.1.4 Narrow AI, General AI, and Super AI

Another important distinction within AI definitions is between Artificial Narrow Intelligence (ANI, also called Narrow AI or weak AI), Artificial General Intelligence (AGI, also called General AI or strong AI) and Artificial Super Intelligence (ASI, also called Super AI or Singularity). The competences of machines and intelligent systems that have been constructed for many years and are in use today have already surpassed human capabilities. Nevertheless, these systems can only do thousands of specific narrow tasks (e.g., online internet searches), thus they fall into the category of Narrow AI (Burgess, 2018; Gentsch, 2018; Wodecki, 2019).

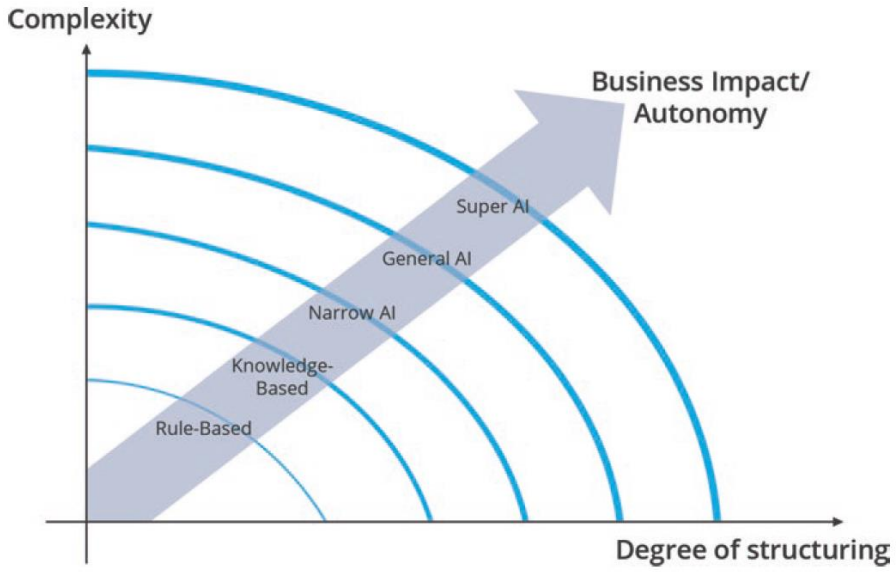


Figure 3 – The higher the level of AI, the greater business impact (Gentsch, 2018).

What has not been accomplished yet is General AI (human-level intelligence), to build intelligent systems independent of functions and sectors, universal algorithms for learning and acting in any environment, and Super AI (singularity, superhuman intelligence), the dream of building systems that would outperform human intelligence in all tasks and such systems could independently replicate and dynamically develop itself. These types of intelligence simply do not exist yet, they are only theoretical and while AGI is subject of intensive research, it is not clear whether it is possible to reach the level of ASI. Singularity would "*allow us to transcend these limitations of our biological bodies and brain"* and to "*fully understand human thinking and will vastly extend and expand its reach."* (Kurzweil, as cited in Russel & Norvig, 2010) If it can ever be achieved, ethical implications must be considered, as there are concerns whether it would be "Friendly AI" within our control or not (Burgess, 2018; Gentsch, 2018; Russel & Norvig, 2010; Wodecki, 2019).

2.1.5 AI Technologies, Capabilities and Applications

Table 1 presents an overview of seven key AI technologies (as per Davenport, 2018). Each technology and its applications are further described in the paragraphs below the table.

Table 1 – Seven key AI technologies (Davenport, 2018).

Technology	Brief Description	Example Applications
Statistical machine learning (ML)	Automates the process of training and fitting models to data	Highly granular marketing analyses on big data
Neural networks (NN)	Uses artificial "neurons" to weight inputs and relate them to outputs	Identifying credit fraud, weather prediction
Deep learning (DL)	Neural networks with many layers of variables or features	Image and voice recognition, extracting meaning from text
Natural language processing (NLP)	Analyzes and "understands" human speech and text	Speech recognition, chatbots, intelligent agents
Rule-based expert systems	A set of logical rules derived from human experts	Insurance underwriting, credit approval
Physical robots (Robotics)	Automates a physical activity	Factory and warehouse tasks
Robotic process automation (RPA)	Automates structured digital tasks and interfaces with systems	Credit card replacement, validating online credentials

Statistical Machine Learning

ML is one of the most common forms of AI and it is a technique to automatically train statistics-based models with data and to then apply them to new data. It may employ more than a hundred of possible algorithms. Machine learning can be categorized by the degree of complexity and by how the models learn and function. The more sophisticated form of ML is the neural network, while the most complex form involves "deep learning", i.e., deep neural network models. Supervised learning models learn from a labeled dataset and are then used to classify or predict new data with the highest possible accuracy, unsupervised learning models cluster, segment, or detect patterns in unlabeled data without prior training and are usually more difficult to develop, and finally, reinforcement learning models are trained to make specific decisions with a defined goal where the ML system is exposed to an environment, gets a positive or negative reward as a feedback (trial and error) from each action, and learns from past experience to make accurate decisions (Burgess, 2018; Davenport, 2018; Gentsch, 2018; Wodecki, 2019).

Neural Networks

A neural network is a technology that has been used for categorization applications, e.g., to reveal fraudulent transactions and to support decisions about granting credit in the financial industry. It is an architecture where "neurons", i.e., variables or features, are connected to each other with various weights and associate inputs with outputs (Burgess, 2018; Davenport, 2018).

Deep Learning

Deep learning is a subset of machine learning. It is a more complex structure of neural networks, a neural networks model made of multiple layers (levels) of connected variables or features (neurons), where the first layer is called an input layer, the last layer is called an output layer, and all the layers in between are called "hidden layers". There can be thousands of features involved and each layer in the structure extracts an increasing level of complexity. Deep learning enables computers to do tasks that are intuitively easy for humans and due to its high efficiency, deep neural networks are becoming more popular in use for text and image recognition, making investment decisions or classification of diseases (Burgess, 2018; Davenport, 2018; Gentsch, 2018; Wodecki, 2019).

Natural Language Processing

NLP is an ability of computers to extract meanings from written or spoken text, to analyze text, to translate text to a different language, or to even generate text (natural language generation) that is readable, grammatically correct and stylistically natural. The two basic approaches to natural language processing are statistical NLP and semantic NLP. Statistical NLP is based on machine learning, requires a large dataset (language "corpus") and seems to improve its capabilities faster, while semantic NLP can be moderately effective if words, syntax and concept relationships are trained and a proper "knowledge graph" is developed, but it is time-consuming and there is no big technical breakthrough in that area (Burgess, 2018; Davenport, 2018; Gentsch, 2018; Wodecki, 2019).

Expert Systems

Knowledge- and rule-based expert systems are dependent on the input of knowledge (variables), originally originating from experts, that is accompanied by rules (if-then) and linked to a derivation system. That enables the system to derive conclusions from the knowledge in order to solve challenges or provide results to users. Expert systems have been widely used since the 1980s, e.g., in insurance underwriting, logistics planning, air traffic, or medical diagnostics. They can become very complex and their models can be very difficult to define if they comprise of a large number of features, rules and even rules conflicting with each other. Today, modern systems are rarely called expert systems and they no longer need to store manually structured knowledge in databases as the knowledge can be captured and processed using natural language processing and machine learning methods in real-time (Burgess, 2018; Davenport, 2018; Gentsch, 2018).

Robotics

Industrial robots capable of doing specific mechanical tasks are well known and have been around for many years but in recent years, the combination of technologies such as machine learning, rule-based systems, sensors, and computer vision has led to a new generation of physical robots that have become more intelligent and collaborative with humans, their models can be more easily trained, and they can adapt flexibly to various tasks. The improvements in AI are now also becoming incorporated into physical robots. Due to these advancements, machines such as autonomous vacuum cleaners and driverless vehicles are becoming a reality (Burgess, 2018; Davenport, 2018; Gentsch, 2018).

Robotic Process Automation

RPA does not involve physical robots. It is a technology that can replace transactional, rules-based actions, such as access company systems, access internet through a web browser, read e-mails, extract data, make

calculations, create documents and reports, revise files, and other digital routine tasks that a human would normally do through the user interface of a computer. RPA is inexpensive compared to other AI technologies and in some cases relatively easy to configure and implement, as it relies on a combination of workflow, business rules and integration of the "presentation layer", i.e., the user interface, of information systems. RPA technology is often considered as not very smart, but it is slowly becoming more complex and intelligent as it is increasingly combined with other existing AI technologies (Burgess, 2018; Davenport, 2018; Gentsch, 2018).

To summarize AI technologies through the lens of business capabilities, AI can support the following three important business activities (as per Davenport, 2018): (1) automating structured and repetitive work processes using robotics or RPA, (2) gaining insight through analysis of structured data using machine learning, and (3) engaging with customers and employees using natural language processing intelligent agents (chatbots) and machine learning.

2.2 Small and Medium-Sized Enterprises

This chapter presents the unit of analysis for the conducted research. The term "SME" that is used within the EU is presented and the chapter introduces innovation characteristics that are found to be common among organizations that can be segmented into the SME category.

2.2.1 European Union's SME Definition

In this research, the SME definition proposed by the EU commission was used, originally created to determine which companies are eligible for governmental support through grants and loans (European Commission, 2015). The EU's SME definition takes staff headcount, annual turnover, and annual balance sheet total into account when assessing what category an enterprise fit within (European Commission, 2015). The category of SME can apply when an organization consists of fewer than 250 employees, have an annual turnover not exceeding 50 million euro or an annual balance sheet that does not in total exceed 43 million euro. An enterprise may choose between the turnover or balance sheet as a measurement tool. Table 2 below displays enterprise categories based on the mentioned requirements (European Commission, 2003).

Table 2 – EU's enterprise categories (European Commission, 2003).

Enterprise category	Criteria
Micro	Headcount less than 10 employees, an annual turnover of less than 2 million euro, an annual balance sheet total of less than 2 million euro.
Small	Headcount less than 50 employees, an annual turnover of less than 10 million euro, an annual balance sheet total of less than 10 million euro.
Medium	Headcount less than 250 employees, an annual turnover of less than 50 million euro or an annual balance sheet total of less than 43 million euro.

For the definition, the concept of control in an important aspect in addition to size and capital. The purpose of this is to determine what the enterprises, that fit the conditions in Table 2, potentially have access to additional external resources that make them exceed the financial ceilings mentioned. The EU's SME definition distinguishes between three different categories of enterprises, based on the type of relationship that an enterprise could have with another. Autonomous enterprises have either none or minority partnerships (>25% ownership), an SME can be considered to part of a partner enterprise when holdings with other enterprises are significant (between 25% and 50%). Last an enterprise can be categorized as a linked enterprise if holdings exceed the 50% threshold. If an SME can be categorized to be a partner or part of a linked enterprise, then the

related enterprise should be partly or fully considered when calculating the total amount turnover or balance sheet (European Commission, 2015).

2.2.2 SMEs' Innovation Characteristics

SMEs often fail to feature in surveys of R&D and other formal indicators of innovative activity as their innovation processes often involve more tacit rather than formalized knowledge (Tidd & Bessant, 2009). Even though SMEs' innovation processes can also be hard to generalize upon, there are characteristics that are frequently mentioned in this context.

Compared to large enterprises, SMEs are confronted with a unique set of barriers that could lead to low innovation performance. SMEs often experience market failures that make the competition scene more challenging due to lack of access to finance, inability to invest in innovation or the ability to comply with environmental regulations. (European Commission, 2015). Additionally SMEs have more manpower bottlenecks in terms of few or inadequately qualified personnel, and they do not have other products, "cash cows" to compensate for a period of lack of return on investment (ROI) that comes with innovation (Pullen, De Weerd-Nederhof, Groen, Song, & Fisscher, 2009). SMEs often face struggles with overcoming structural barriers concerning the lack of management and technical skills, rigidities in the labor markets and limited knowledge about opportunities for expansion (European Commission, 2015).

Managing innovation in SME's possess a range of advantages and disadvantages compared to larger enterprises (Tidd & Bessant, 2009). These factors are presented in Table 3 below. The list is not representative for every SME but factors that typically describe their innovation capabilities.

Table 3 – Advantages and disadvantages for small firm innovators (Tidd & Bessant, 2009).

Advantages	**Disadvantages**
Speed of decision making	Lack of formal systems for management control, e.g., of project times and costs
Informal culture	Lack of access to key resources, especially finance
High quality communications – everyone knows what is going on	Lack of key skills and experience
Shared and clear vision	Lack of long-term strategy and direction
Flexibility, agility	Lack of structure and succession planning
Entrepreneurial spirit and risk taking	Poor risk management
Energy, enthusiasm, passion for innovation	Lack of application to detail, lack of systems
Good at networking internally and externally	Lack of access to resources

In relation to digital transformation activities, SMEs are often not aware of innovation potentials, struggle to understand what to digitalize and which technology should be utilized (Barann, Hermann, Cordes, & Chasin, 2019).

SMEs may have more freedom than larger enterprises to search for new external knowledge and information in an active and flexible manner (Massimo, Laursen, Magnusson, & Rossi-lamastra, 2012). If SMEs do not have too strong capabilities in a specific field, they could experience higher levels of flexibility and space for maneuvering and facilitating radical innovation activities. This might give SMEs an opportunity to quickly test emerging technology once they find some use for it.

2.3 Technology Adoption Theories and Models

Technology adoption is defined as "*the stage at which a technology is mentally accepted by an individual or an organization*" (Kelsey & St.Amant, 2008). In this subchapter, different technology adoption theories and frameworks that were considered for this research path are presented. Though only one framework was used, the listed frameworks inspired the research. Lastly, the chapter introduces the TOE-framework that was chosen as a lens to interpret the findings of the literature review and to guide the data analysis and interpretation of results in the conducted research.

2.3.1 Established Theories on Technology Adoption

The Technology Acceptance Model (TAM) was originally developed by Fred D. Davis (1985) aimed to improve the understanding of user acceptance processes to support the design and adoption of information systems (IS). The model (see Figure 4) proposes that an individual user's overall attitude towards using a system is a determinant of whether or not he or she actually uses the system (Davis, 1985). The attitude towards using a system is in the model presented as a function of two constructs, perceived usefulness and perceived ease of use (Davis, 1989). Perceived usefulness is defined as "*the degree to which a person believes that using a particular system would enhance his or her job performance*" and Perceived ease of use is defined as "*the degree to which a person believes that using a particular system would free the effort*" (Davis, 1989). The model focuses on how the design features directly influence (arrows) individual perceived usefulness and perceived ease of use, and through these constructs indirectly affects the attitude towards using the system. A challenge with the model is that it excludes external and structural factors that are in place prior to when TAM process applies. For this research, using the framework would limit the perception of adoption barriers to individual acceptance of a technology and undermine the importance of an SME's context.

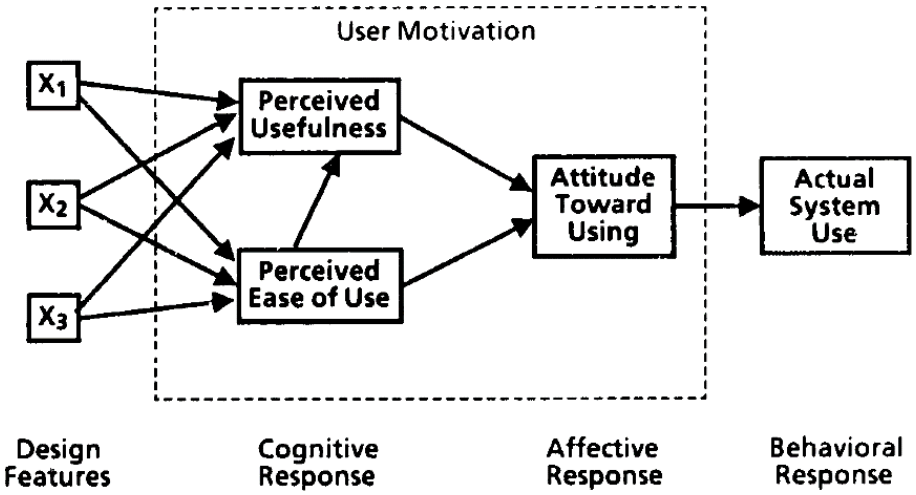


Figure 4 – Technology Acceptance Model (Davis, 1985).

The Unified Theory of Acceptance and Use of Technology (UTAUT) is an adoption model (see Figure 5) that is built upon constructs from the TAM model, apart from other usage behavior theories, and introduces four core determinants of intention and usage: (1) performance expectancy, (2) effort expectancy, (3) social influence, and (4) facilitating conditions; and four moderators of key relationships: (1) gender, (2) age, (3) experience, and (4) voluntariness (Venkatesh, Morris, Davis, & Davis, 2003). The model aims to assess the likelihood of success for new technology introductions and helps understand drivers of acceptance, aimed at populations of individual users that are less inclined to adopt new systems.

The authors of the proposed framework argue that the constructs are meant to be independent of any theoretical perspective. The UTAUT framework covers a larger spectrum than the technological acceptance by including social influence (external pressure) and facilitating conditions (organizational and technological infrastructure) into the framework, as can be seen in the model. However, the model was not chosen as it puts the perspective of the user and not the adoption decision maker in focus. The decision maker might have a different perspective when assessing AI technology, so it is believed that it does not cover organizational goals and circumstances that should be taken into consideration.

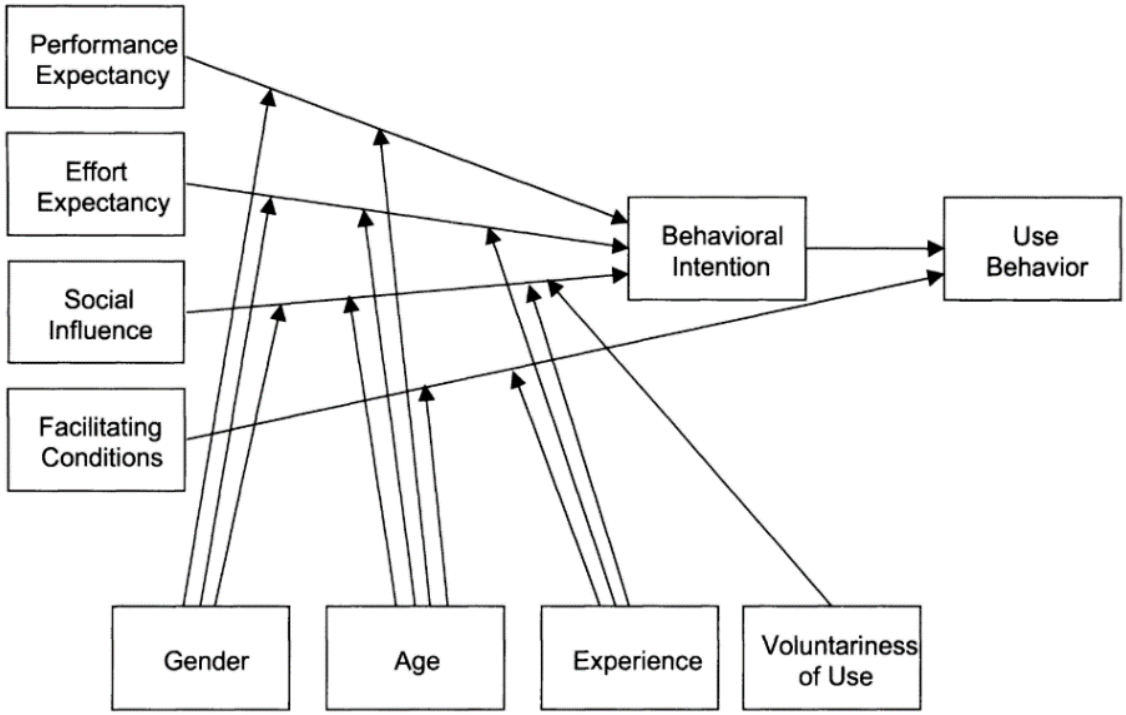


Figure 5 – The Unified Theory of Acceptance and Use of Technology model.
(Venkatesh et al., 2003)

The third theoretical field considered was the Diffusion of Innovations (DOI) which focuses on the adoption rate of innovations (Rogers, 1995). Rogers explains that the adoption rate of innovations is the relative speed of which an innovation is adopted by members of a social system, such as groups, organizations or society. The theory finds that relative advantage, compatibility, complexity, trialability and observability are attributes of an innovation that determine the adoption rate (Rogers, 1995). The variables determining the adoption rate of innovations can be seen in the framework in Figure 6 below, focusing on what type of innovation decision it is, communication channels diffusing the innovation, the social system in which the innovation is diffusing and change agent's promotion efforts in diffusing the innovation. Typically, the DOI in relation to marketing and centered on communication channels is used to guide measures aiming to speed up the adoption rate. Though the intention of DOI theory is not within the scope of this research, Rogers covers important variables that can be understood as potential barriers. The variables can be used to understand why AI technology spreads slower among SMEs compared to larger enterprises, but it is not the focus of this research.

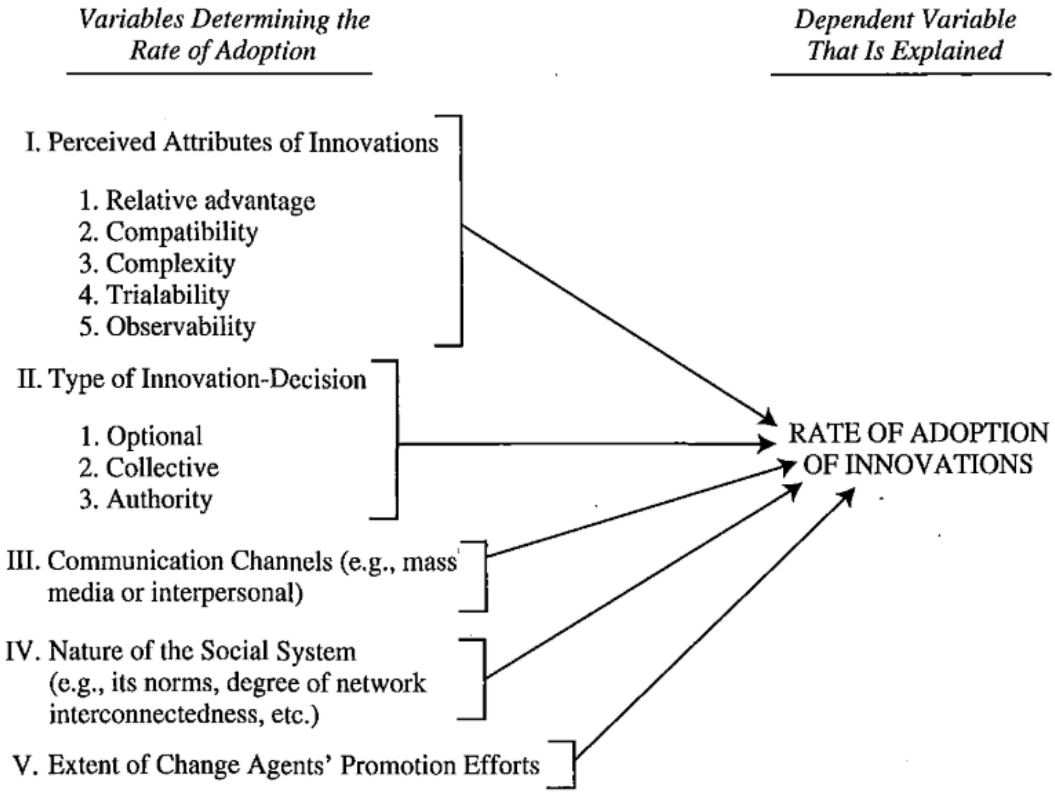


Figure 6 – Variables determining the rate of adoption of innovations (Rogers, 1995).

2.3.2 Technology-Organization-Environment Framework

The scope of the research problem area derives from an organizational theoretical perspective. To analyze technology adoption at an institutional level, two theoretical foundations are commonly used: the DOI theory and the Technology-Organization-Environment (TOE) framework (Chong, Ooi, Lin, & Raman, 2009). The latter was chosen as it was found more fitting for this research context as it focuses on understanding what affects an adoption decision.

The TOE framework (see Figure 7) represents a segment of the innovation process, focusing on how the firm context influences the adoption decision and implementation of innovations. Therefore, the framework was considered useful to identify factors acting as barriers for SMEs (Baker, 2011). Originally, introduced by DePietro, Wiarda, and Fleischer (1990), the three technological, organizational and environmental contexts make up the main elements of the framework seen below. The three elements present "*both constraints and opportunities for technological innovation*".

Note that Jeff Baker is referred to extensively below as he is the biggest contributor to organizing TOE framework-related research.

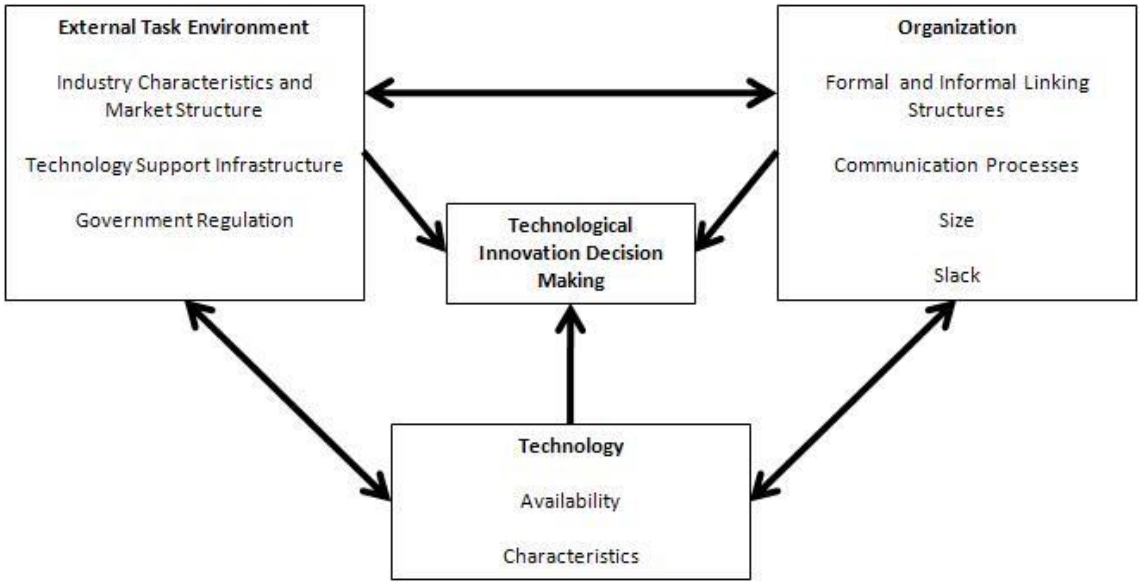


Figure 7 – The Technology-Organization-Environment framework (Baker, 2011).

The technological context of the framework includes internal and external technology that is perceived to be relevant to the firm, both technologies currently in use and technology available in the marketplace (Baker, 2011). Technology consists of solutions, equipment and processes. Baker found several studies with technological contexts, focusing on factors and characteristics such as complexity, compatibility, perceived benefits and technological competence required.

The organizational context considers resources and characteristics of a firm, employees, intra-firm communication, degree of centralization and formalization, managerial structure, human resources, organization size and the lack of resources (Baker, 2011; DePietro et al., 1990). In Bakers review, top management support, strategic planning, perceived financial cost, presence of technical competence and innovation champions, organizational readiness and information intensity where among factors highlighted in TOE research.

Last, the environmental context covers the structure of the industry, risk assessment, external pressure, and the presence or absence of technology providers and the regulatory environment (Baker, 2011).

Researchers using the TOE framework seem to agree that the three main contexts do influence adoption, but they have assumed that for each specific technology or context that is being studied, there is a unique set of measures or factors (Baker, 2011). Therefore, it cannot be simply assumed that all the factors found in other studies focusing on adoption of technology in a TOE context are applicable for the adoption of AI technology.

The TOE framework has previously been used in inductive research setting investigating the adoption of Business Intelligence Systems adoption determinants in SMEs (Puklavec, Tiago, & Popovic, 2014). The framework has also been used to determine the relationship between commonly accepted TOE factors and the adoption of virtual-world technology (Yoon & George, 2013). Ramdani, Chevers, & Williams (2013) concluded that factors within the TOE context were found to affect the adoption of enterprise applications (EA) and that the framework was a useful approach for studying decision making factors in SMEs.

As exemplified, the TOE framework has been commonly used to identify factors affecting adoption. Therefore, the authors of this study were confident that the framework could be applied for the purpose of this study.

3 Literature Review

The literature review presented in the following chapter represents the most significant knowledge that was contributed to make better sense of the chosen problem formulation. Conducting a review enables one to develop a sufficiently clear, strong argument and transparency for the research (Wallace & Wray, 2011). The chapter structure follows a logical trail. First, the literature review strategy is explained, followed by a presentation of the reviewed literature in a concept-centric approach. The concepts are then put in context through the TOE framework resulting in a conceptual framework and the summary of the implications it has for the research.

3.1 Literature Review Strategy

3.1.1 Review Method

The literature review describes and classifies what has been produced concerning the problem area, usually by mapping and not by theorizing (Rowe, 2014). The literature review falls under Rowe's first dimension of literature review typologies, where one is aiming at "*understanding* (of) *a new phenomenon or problem through related concept(s) that have been proposed in former research*". (Rowe, 2014). A narrative, concept-centric style was chosen to make sense of the content found and understood from the literature (Webster & Watson, 2002). The structure of the review is based on commonalities among the authors' findings, categorized into higher-level concepts that present technological, organizational and environmental dimensions (Rowe, 2014). The concepts contribute to concretizing the research problem area.

The search strategy was guided by two principles chosen prior to the literature search process:

1. Finding literature that is directly or indirectly related to what is known or not known about AI adoption challenges in SMEs.
2. Make sense of what the focus areas are in the literature related to AI adoption in SMEs.

The literature findings and argumentation were analyzed through the perspective of whether the problems in focus could also represent barriers for adopting AI and whether they were relevant findings in relation to SME characteristics. The limitations and lack of information that were found are listed and emphasized in the summary of this chapter.

3.1.2 Scope and Literature Findings

Application of AI in SMEs was found to be frequently discussed by AI expert practitioners, but not a popular research focus area, making the review process a bit challenging. By searching for academic publications and combining "AI" with "SMEs" in CBS library (with connected databases), ACM library, ScienceDirect and Google Scholar, only 1 peer reviewed publication was found to directly address "AI adoption in SMEs" (Jabło & Pólkowski, 2017). Due to the lack of research on AI application in SMEs, the literature search strategy scope was expanded to related topic areas in order to find literature connected to components of the research question.

Since combining "AI", "Application", "SMEs" and "challenges" did not prove any significant results, one or two of the search words were replaced with related words. The three main search phrases and combinations used are presented in the table below. Note that different search word combinations were used in order to identify critical findings. First, the search phrase "AI application in business" was chosen as a more general search phrase to identify empirical and expert knowledge concerning complications and challenges related to the searched phrase. Second, the search phrase "Technology adoption in SMEs" was chosen as it is a higher-level search phrase with the same focus, not specifically addressing AI adoption. Finally, the search phrase

"Digital Transformation in SMEs" was chosen due to its unique focus on the novelty of using digital technology to solve traditional problems, argued to be the case for AI adoption by inexperienced SMEs. The review process was stopped when the findings did not present any new relevant dimensions or results (Webster & Watson, 2002).

The literature was filtered based on the publication year (from 2009 to 2019), whether it was a relevant book, a peer-reviewed article, or a report published by a leading technology consulting company, and whether it focused on either SMEs or a context that links findings to any organizational size. Publications with findings on potential general IT adoption challenges found through investigating specific technological areas, such as Enterprise Resource Planning or Cloud solutions, were excluded in order to maintain a relevant literature sample.

The search resulted in identifying 30 relevant publications (see Table 4 below), where 16 are journals, 7 are books and 7 are published reports. The relevancy of the publications was evaluated by grading the papers from 1 to 5 (1 least relevant, 5 most relevant), where grade 5 papers are considered as the most important publications for the research. Papers reviewed and ranked between 3-5 were considered relevant and chosen for the literature.

Table 4 – Identified literature for the literature review.

(+…) = added to specify search / = alternative words used Databases: CBS library, ScienceDirect, ACM library, Google Scholar				
Search Phrase	**Other search word combinations used**	**Publications found relevant from search word**	**Publication type**	**Level of Relevance (1-5)**
AI Application in business	use/Application/ Adoption of AI/ML/Artificial Intelligence in business/ organizations/ enterprises	(Earley, 2016) (Jeude & Smith, 2018) (Bughin et al., 2017) (Davenport, 2018) (Akerkar, 2018) (Corea, 2017) (Danner, 2019) (Walczak, 2017) (Paschek, Luminosu, & Draghici, 2017) (Jarrahi, 2018) (Frank, Roehrig, & Pring, 2017) (Ng, 2019) (Burgess, 2018) ***Total: 13***	Journal, Practice Report, Practice Report, Research Book, Practice Book, Practice Book, Practice Book, Practice Journal, Research Journal, Research Journal, Research Book, Practice Report, Practice Book, Practice	4 4 4 4 4 4 4 3 3 3 3 3 3
Technology adoption in SMEs	ICT/Technology/IT/AI adoption/application (+ challenges, barriers, issues) in SMEs/organizations/small and medium enterprises	(Ghobakhloo, Hong, Sabouri, & Zulkifli, 2012) (Dyerson & Spinelli, 2011) (McKinsey & Company, 2018a) (Molinillo & Japutra, 2017) (Wymer & Regan, 2011) (Cragg, Caldeira, & Ward, 2011) (Yoon & George, 2013) (Grant, Edgar, Sukumar, & Meyer, 2014) (Johnson, 2010) (Massimo et al., 2012) (Tidd & Bessant, 2009) ***Total: 11***	Journal, Research Journal, Research Report, Research Journal, Research Journal, Research Journal, Research Journal, Research Journal, Research Journal, Research Journal, Research Book, Practice	5 5 5 4 4 4 3 3 3 3 3
Digital Trans-formation in SMEs	(+AI, Artificial intelligence) Digital transformation in SMEs/organizations	(Warner & Wäger, 2019) (Cartelli, 2010) (Loonam, Eaves, Kumar, & Parry, 2018) (McKinsey Digital, 2016) (McKinsey & Company, 2018b) (Kane, Palmer, Phillips, Kiron, & Buckley, 2015) ***Total: 6***	Journal, Research Journal, Research Journal, Research Report, Practice Report, Research Report, Research	5 4 4 3 3 3

3.2 Concepts Derived from the Literature Review

The concepts function as a subjective understanding of the patterns in the literature relevant for the research scope of this study (Webster & Watson, 2002). The concepts are factors from the literature that might potentially affect the outcome of an SME AI adoption decision process.

3.2.1 AI Value Perception

Memo: The value and benefits perceived from adopting the technology for a clear and defined business use case.

Keyword listing: clear business case, return on investment (ROI), perceived value

From the literature search, a vast number of authors was found discussing the importance of value perception of the technology to be adopted. Therefore, "AI Value Perception" has been broken down into three distinct views.

3.2.1.1 Clear use case

The research from Cragg, Caldeira, & Ward (2011) and Ghobakhloo, Hong, Sabouri, & Zulkifli (2012) suggest that managers and organizations can improve the possibility of IS adoption success by improving one's ability to recognize business opportunities and by defining a clear use case and the need for the given technology. Simply investing in state-of-the-art technology most likely will not produce any value unless these investments are backed up with a clear understanding of how, and crucially, why it is being deployed (Dyerson & Spinelli, 2011).

AI initiatives should first start with defining and recognizing the problem one is planning to solve (Akerkar, 2018). To determine where automation for the purpose of insight can be applied, an organization should question whether the task at hand allows for repetition, high volume, a pattern, and low cost resulting of mistakes (Akerkar, 2018). In addition to this, Frank, Roehrig, & Pring (2017) argue that AI value should come from targeting tasks that employees at a great scale do every day.

Walczak (2017) presents two ways AI may be integrated or used in the domain of business leadership. First, AI applications can be used as a source for expert knowledge for better decision-making capabilities. Through the use of AI, leaders have been able to push down decision-making to others, but still ensuring that an expert quality solution to a business problem will be reached. AI applications can additionally be used as an intelligent support decision system to address other managerial tasks such as financial management, human resources management, customer management and building heuristics for strategic planning. AI knowledge-based systems consist of solving use cases in the context of supporting rapid human decision-making, identifying relevant information and solving sub-problems.

3.2.1.2 Return on Investment

AI projects at a large scale can take 2-3 years to start generating ROI, thus smaller projects (6-12 months perspective) could help with making the effect of AI more visible in an organization. In this way, organizations can foster a sense of success in relation to AI initiatives (Ng, 2019).

Corea (2017) compares the AI sector to have similarities to the biopharma industry in the way that R&D is a long and expensive process with a long investment cycle, low probability for enormous returns and a concentration of funding toward specific phases of development. Corea proposes a matrix of four ML project types based on the level of short-term monetization (high vs low) together with research defensibility or level

of product development required (high or low). For organizations that are using narrow AI, building enablers for analysis and focusing on value extraction from data offers the biggest potential to monetize their project in the short term, also due to the low requirement of defensibility (being model-as-a-service, "MaaS"). Academic spin-offs are considered to be the long bet, which is dependent on solid research that makes them unique but valuable in the long-term prospect. As SMEs usually do not have much capacity for long-term investments, MaaS or data-as-a-service (DaaS), collecting and generating new datasets, ML projects are considered a more natural choice.

Jarrahi's (2018) premise is that most benefits of AI are likely to materialize only in long-term partnership with unique human abilities. Achieving business value from AI application takes patience rather than relying on short-term ROI financial impacts. This might be a huge barrier for SMEs as they tend to prioritize short-term wins from resource investments. Organizations that have adopted AI often use AI to address the easiest parts of a given problem (Davenport, 2018). Since AI is not capable of common sense yet, solutions fall short in some respects. AI solutions can automate tasks but not entire jobs, making AI initiatives often perceived to not offer high levels of economic benefit, thus discouraging potential adopters.

3.2.1.3 How AI creates business value

Understanding what AI technology can do for an organization and how it produces value is a fundamental aspect of understanding value perception. Jeude & Smith (2018) argue that AI's core value proposition is that it is the answer to the "too-much-data-to-ignore conundrum" that organizations are and will increasingly experience. The problem-solving ability of AI is more useful for supporting analytical rather than intuitive decision-making (Jarrahi, 2018). In the case where an SME has a need for analyzing more data than the employees can handle, AI technology can produce value in the form of insight from analysis.

Akerkar (2018) presents a division of analytics into three layers, ordered from least to most complex: descriptive (reporting on past), predictive (understanding the future) and prescriptive (identifying new opportunities) analytics. These distinctions are important in order to understand what type of outcome from an AI solution an organization is aiming to achieve (Akerkar, 2018). SMEs that work with this type of problem formulations should consider using ML.

There are three challenges that "plague decision making in organizations: uncertainty, complexity and equivocality" (Jarrahi, 2018). AI can reduce the complexity and uncertainty of a problem by identifying causal relationships and asserting the appropriate cause of action. Equivocality occurs in an organization' decision-making due to conflicting interests of stakeholders, customers and policy makers. This often transforms the decision-making process from an objective process into a subjective process that attempts to fulfill the conflicting needs and objectives of multiple parties. The application of AI, though, should be targeted on solving well-structured problems, supporting business operations where the level of ambiguity is low and enhancing a clear understanding of what a correct answer or output could be.

3.2.2 AI Black Box

Memo: The technology having internal workings hidden or not readily understood.

Keyword listing: Black Box, Observability, Complexity, Transparency, Trust, Personalization

AI is perceived by many people as a digital mystery. Many often accept the digital world as mysterious because they value the convenience of it (Jeude & Smith, 2018). Though, in order to utilize the technology for specific use cases, some level of understanding of how AI and ML produce insights might be necessary. As AI is a

concept that many struggle to grasp, there is a risk that AI will move toward the verge of structural failure as a result of users not understanding how AI systems operate.

Molinillo & Japutra (2017) found that the innovation characteristics of limited technological observability and perceived technological complexity are barriers that are commonly referred to in technology adoption research. Working to achieve transparency, trust and personalization could provide the counterbalance AI needs for making AI initiatives succeed (Jeude & Smith, 2018).

Transparency refers to understanding "how" and "why" a decision was made. Knowing the backstory of a decision provides the emotional and intellectual foundation that we need to make sense of the world, where "*AI systems, however, are black boxes*" (Jeude & Smith, 2018). This is a huge problem for AI's perceived value. To battle this, the authors suggest "*moving from black box to open air thinking*", meaning clear descriptions of the logic used for a decision made by an AI solution. Davenport (2018) also recommends allowing as much transparency in ML models as possible and to avoid using "black-box" AI technologies that cannot be interpreted or explained.

For us to trust AI, it must fit within the universe of reliability, where trust is derived through context and connection rather than through confidence in the suggestion itself (Jeude & Smith, 2018). Bughin et al. (2017) underline the importance of building trust in AI insights by investing in making employees understand how data-driven AI produces insights. Another way of increasing trust in AI systems is to try to fully disclose as much as possible about the system and how it will be used (Davenport, 2018).

Creating a feeling of personalization capitalizes on what Jeude & Smith (2018) define as "Code Halos", describing the massive swirl of data generated by every individual's or organization's digital behavior. To produce a feeling of technological personalization, AI needs some degree of contextual awareness. AI does not understand a wider context, but it still must make decisions that fit the users' needs and current contextual setting.

3.2.3 Data Ecosystem requirements

Memo: The requirements from the methods and system used for creating, capturing, storing, structuring data together with the availability of the data in order to enable generating insights from AI technology.

Keywords: Data driven AI, Data structure, Data quality

AI and ML methods being adopted are not always compatible with an organization's current data ecosystem, which might act as a entry barrier for SMEs. Sanjay Srivastava, the chief digital officer of Genpact, stated in relation to working with launching AI projects for companies that "*10% of the work is AI… 90% of the work is actually data extraction, cleansing, normalizing, wrangling.*" (Bergstein, 2019).

Bughin et al. (2017) emphasize that successful AI adoption lies in having fundamental well-functioning data-ecosystem. Data silos need to be broken down, the required level of data aggregation is needed, pre-analysis needs to be conducted and high-value data should be identified. It is not always understood that data-driven AI solutions require some information architecture and high-quality data sources (Earley, 2016). Factors such as completeness, relevancy and bias of input data will affect the output value and overall quality of an AI or ML system (Jeude & Smith, 2018)

A common mistake in considering data sources, even for unsupervised learning, is concluding that no data-structure is required (Earley, 2016). Data for ML and pattern-identification algorithms does require attribute

definitions, normalization and cleansing for it to be successfully applied. There are exceptions but only when the ontologies are self-contained in the AI tool (Earley, 2016).

An organization should holistically and systematically plan for how you best "fuel" the AI engine with data. Before engaging with AI technology, organizations should develop an enterprise ontology that represents "*all the knowledge that any AI system they deploy would process, analyze, leverage, or require*" (Earley, 2016). Organizations should evaluate and decide on what data should be used in relation to what type of insights one is aiming for, what actions one wants to take based on the data, and what the system should learn from its actions and insight (Jeude & Smith, 2018).

Paschek's, Luminosu's, & Draghici's (2017) case research found that 45% of the compiled data from the investigated companies was not currently being used or controlled efficiently, proposing that there are huge opportunities for utilizing AI, ML and DL. A mature analytics system is an underpinning factor for the success of AI and ML. AI is often a more natural evolutionary step for analytics-aware organizations that deal with big data, data discovery and tasks such as data preparation, wrangling and integration (Akerkar, 2018).

3.2.4 Strategy and Resources

Memo: Strategic objectives and the resource constraints that typically characterize SMEs.

Note: Resources and talent are distinguished in order to emphasize different factors found to be critical for AI adoption.

Keywords: Prioritizing, resource constraints, size, strategic objectives, firefighting

Lacking a clear strategy for AI is the most common barrier organizations face when adopting AI (McKinsey & Company, 2018a). Some businesses tend to adopt new IT purely for the reason to keep up with other SMEs (Ghobakhloo et al., 2012). Under such circumstances, a lack of a clear plan and purpose for the adoption of AI will likely lead to project failure and managers desiring to implement AI will need to make this a strategic goal for the organization (Walczak, 2017). One activity that will ensure maximum value from any AI initiative is to create an automation strategy that aligns with existing business strategy goals (Burgess, 2018).

In relation to innovation, Tidd & Bessant (2009) argue that disadvantages that commonly occur in SMEs are the lack of a having a long-term strategy and direction, and the lack of access to key resources, especially finances. As a result of this, long-term IT projects tend to not be prioritized by SMEs (Wymer & Regan, 2011). Danner (2019) argues that the aspect of the ongoing "firefighting" in organizations, where most of the employees' time is dedicated to fighting the latest fire, causes SMEs to not spend enough time on long-term planning and improvement. AI investments result in a short-term penalty of disruption in order to gain the long-term benefit, and many companies have zero tolerance for any kind of penalty and usually tend to avoid these types of initiatives. Too many competing priorities are also perceived to contribute as a barrier, impeding an organization to take advantage of digital trends (Kane et al., 2015).

Business size definable by turnover and the number of employees restrains the number of strategic options an organization has for AI adoption and is perceived to be one of the most important factors of IT adoption success (Ghobakhloo et al., 2012). Most organizations that fail with AI adoption fail due to limited approaches, such as department-level solutions, standalone tools and insufficient funding. (Earley, 2016). Automation-related strategic goals should be ambitious in terms of cost reduction or efficiency (Frank et al., 2017). Setting more dramatic results from the application of AI forces employees to rethink how a company traditionally plans and implements efficiency measures. In this way, it will become clear that the traditional cocktail of reorganization, outsourcing, and enterprise software will not be sufficient for AI adoption (Frank et al., 2017). Andrew Ng

(2019) argues that organizations might find it challenging to develop a thoughtful AI strategy until it had some basic experience with AI. This is quite contradictory to Frank et al.'s (2017) recommendations, where they argue that you should start with planning and building a bold strategy first. Ng argues that building up a momentum gradually is more effective for successfully adopting AI in an organization.

Yoon & George (2013) found that perception of environmental characteristics produces the strongest influence on an organization's decision to adopt a technology. The perception can be divided into pressure from competitors adopting a given technology and normative pressures from customers, suppliers and industries.

3.2.5 Digital Transformation Capabilities

Memo: Perception of an organization's capabilities to identify, act upon, and successfully implement AI in an organization.

Keywords: technology utilization, actions and capabilities for digital transformation, process model for building capabilities

Digital transformation (DT) can be defined as "*an organizational transformation that integrates digital technologies and business processes*", in other words the ability to see through a technology adoption (Liu, Chen, & Chou, 2011). An AI adoption process for an organization can be considered a DT if the organization does not have any prior experience using AI and aims to implement it in into their core business processes. After an organization has found a potential use for AI, an organization should work backwards to determine what capabilities are necessary to successfully deliver these objectives (Burgess, 2018). Having inadequate capabilities could act as barriers for AI adoption. Organizations with experience from previous successful transformations are more likely than others to continue with adopting more sophisticated technologies such as AI and ML (McKinsey & Company, 2018a). DT capabilities are usually not obtained for a single purpose or one technology alone but utilized as methods and processes to connect traditional and digital parts of the business.

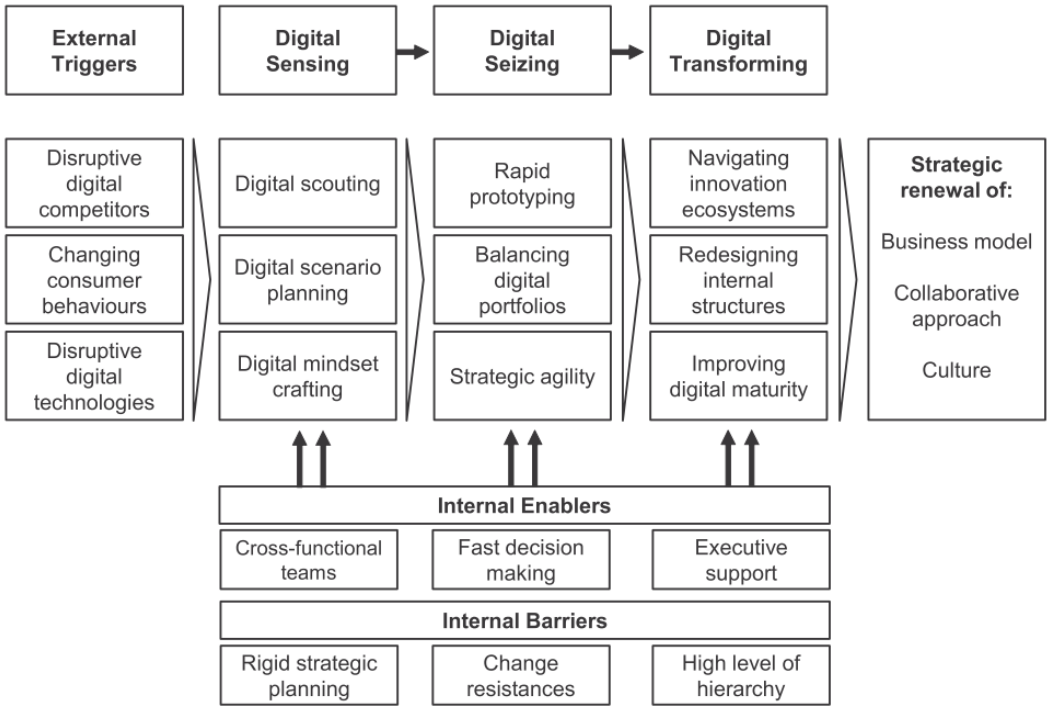


Figure 8 – Dynamic capabilities for Digital Transformation: a process model (Warner & Wäger, 2019).

Warner & Wäger (2019) show similarities to McKinsey & Company (2018a) by also perceiving DT capabilities as a set of skills or actions. Warner and Wäger provide a valuable perspective on what type of dynamic capabilities (DC) are required to achieve a successful digital transformation process. DCs are perceived in their study as "*innovation based and provide the capacity to create, extend, and modify a firm's resource base*". The process model displayed in Figure 8 shows important clusters of DCs under the capabilities of sensing, seizing and digital transforming that were found important to achieve successful technology adoption.

3.2.6 Organization Readiness for Change

Memo: Barriers that come from prerequisites such as culture, IT infrastructure and aversion to technology. The concept focuses on whether there will be internal or structural resistance preventing adoption success.

Keywords: Reluctance to change, culture, ICT maturity, compatibility with legacy systems

Johnson (2010) found in his research on SME e-business innovation that the organizational readiness for change was considered a main barrier for technology adoption. Johnson conceptualized an organization's readiness by highlighting issues with change and culture, ICT infrastructure, aversion to technology and implementation problems as underlying factors. The term does not have a unified description; Yoon & George (2013) set organizational readiness more in connection to technological readiness, focusing more on whether an organization has the right technical competence, IT resources and the existence of an IT department. Dyerson & Spinelli (2011) built a conceptual framework for capabilities of Information and communications technology (ICT) adoption readiness, relating "ICT readiness" to the dimension of "strategic vision of ICT" and "ICT maturity". They refer to readiness as the "*extent to which the SME in focus demonstrates pre-conditions for the organization* (that) *are able to design innovative strategies and behaviors that fully exploit ICT potential*". The authors argue that organizations' ICT readiness should be determined by evaluating the

level of ICT maturity by looking at the richness of IS elements, homogeneity and coherence of operative systems and a presence of open or proprietary architectures, and evaluating the level of strategic vision of ICT by looking at senior management commitment, an organizational figure (an employee) who is able to translate business needs into ICT investment choices and the firm's capability of managing ICT processes (implementation ability).

A successful approach to AI utilization involves assessing your high-level organization readiness for deploying AI at scale. The 3 M model, consisting of assessing your machinery (AI computing power and talent to use it), material (separating signals from noise in available data) and model (enables machinery and material to seamlessly connect) was recommended (Jeude & Smith, 2018).

Loonam, Eaves, Kumar, & Parry (2018) found that management needs to be aware of legacy business processes and organizational structures when adopting digital technologies. Seitz (2016) states that the hardest part of a successful DT is the cultural piece. Shifting technology, finding competency and setting the right strategy is all challenging but doable, however, the cultural transformation in businesses is more complex and has very deep legacy due to cultural roots.

For AI initiatives to gain momentum and acceptance in an organization, the first project should be meaningful enough for employees to gain familiarity with AI technology and convince others in the company to invest in further AI projects (Ng, 2019). Technology adoption projects should also include a plan for how to maintain and build an understanding early on. A potential barrier for adoption with integrating new technology is the possibility of not believing that an organization is ready and able to maintaining the benefits achieved from the implementation once the experimental period has elapsed (Cartelli, 2010).

3.2.7 Management Support

Memo: Management engagement in AI initiatives and barriers that come with the lack of necessary support from leaders.

Keywords: Leadership, competence, brass-wall, support, sense of urgency, encouragement

Senior leaders demonstrating true ownership of and commitment to AI initiatives is considered crucial for achieving adoption success (McKinsey & Company, 2018a). Yoon & George (2013) write that top management support is one of the better predictions for IT innovation adoption by organizations, as it ensures sufficient allocation of organizational resources and that reduces the organizational resistance to adopt IT innovation. Managerial IS skills and technical competency tend to be more heterogeneously distributed amongst SMEs than larger enterprises, as larger enterprises typically have a large IS department (Cragg et al., 2011).

There is a higher probability of adoption if the owners and managers are more knowledgeable about the relevant IT category and the owner-managers have a positive personal attitude toward change (Molinillo & Japutra, 2017). Organizations with managers that do not know what is possible with AI technology may need to educate their stakeholders about the possibilities that these technologies provide (Davenport, 2018).

In relation to the application of AI, Frank et al. (2017) argue that the brass-wall phenomenon is reappearing in digital automation initiatives, addressing the reluctance for change from senior employees and managers. They label this as the "brass-wall phenomenon", considering change efforts often being halted by officers with "brass" on their shoulders, sitting in the middle of a hierarchical pyramid. They state that these types of employees tend to use phrases such as "*yes, automation is good for our customers and investors, but is it good for me?*", "*it's impossible*", "*we've done it this way for 20 years, and it's working fine*", "*nobody can prove*

the ROI today" and "*we should focus our efforts elsewhere*". This is a tough problem to solve, but it must be solved in order to execute AI initiatives.

According to McKinsey & Company (2018a), having the right, digital-savvy leaders with commitment improves the chance of a transformation succeeding. Senior management that fosters a sense of urgency for making transformation changes and encouraging employees to experiment with new ideas might improve the success of a future digital transformation. A major barrier some organizations might experience is the suppression of ideas and questions by management that are perceived as uncomfortable. Questions such as "*Why do we do it in this way?*" and "*Why are we happy with that level of performance?*" are not appreciated in some organizations (Danner, 2019).

3.2.8 AI Talent

Memo: The access to competency, knowledge and people that can enable AI initiatives.

Keywords: AI talent shortage, obtaining AI expertise, external assistance

Most organizations today do not have enough in-house AI talent or competency, and there is a general shortage of AI talent, making it challenging for smaller organizations to recruit or obtain expertise. Therefore, an internal AI training or competency building should in some situations become a part of an AI-application strategy (Ng, 2019).

A fundamental challenge with AI is finding skilled people to implement it efficiently (McKinsey & Company, 2018a). A McKinsey survey with 2135 organizations (489 used for questions related to talent), 42% of organizations that had tried to implement AI stated that a lack of AI talent and appropriate skill sets for AI work was a main organizational barrier (McKinsey & Company, 2018a). Obtaining AI talent was also found to be very challenging, even for the most digitized companies (being attractive employers), 41% stated that this was their biggest barrier for adopting AI. The survey found that for less digitized companies, hiring external talent was the most common approach (45% of respondents) to attempt to close the knowledge gap. If this is not optional, organizations either try to build internal competence (35%) or buy professional services (27%) within the field. Partnering with institutions and acquiring other companies was found to be used as one of the technology acquisition strategies, but it is likely to be an option for larger enterprises.

Corea (2017) argues that AI is the only sector in which the pure team value of an AI company exceeds the business value. Companies that are acquired by larger enterprises are purchased to "*acqui-hire*" the people and pure technological advancements rather than the revenue potential. Acquisition costs are perceived to be lower than the opportunity cost of "*leaving around many brains*", and therefore many companies seem to (over)pay for obtaining a team in fear of missing out on talent.

SMEs suffer from obtaining restricted access to expertise compared to large organizations, hindering the adoption of IT in SMEs (Ghobakhloo et al., 2012). SMEs could fill this knowledge gap through engaging external experts and the use of vendor assistance, though engaging external consultants might not always be a beneficial investment for SMEs if they struggle with making their strategy and objectives understandable for outsiders.

3.2.9 Risk Perception

Memo: Perception of risk associated with implementing AI in business operations.

Keywords: High Risk, Risk averse, security issues, control

High risk perception moderates an organization's adoption of innovative technologies and engagement in new strategic ventures (Johnson, 2010). Johnson states that innovative technologies tend to have liabilities of being "new" and "untested", presenting for many potential adopters a notion that there is too high risk that makes the investment unjustifiable. Deficient IT investment decisions can in great manner affect an organization's profitability or even survival of SMEs due to their financial constraints and that may result in risk-averse behavior (Ghobakhloo et al., 2012).

Kane et al. (2015) conducted a survey finding that 44% of the respondents found the "Willingness to experiment and take risks" as one of the top three abilities that was most lacking in their organization. Digitally mature organizations, where digital has transformed processes, talent engagement and business models, tend to commit to transformative strategies supported by collaborative cultures that are more open to taking risk.

AI adoption does in some degree require outsourcing and giving up some level of control. Having an understanding of what the security-related consequences are for adopting AI is crucial, as uncertainty concerning the security issues is found to be a barrier for IS adoption in SMEs (Wymer & Regan, 2011). In relation to stakeholder perception of adoption of e-business technologies in SMEs, Grant, Edgar, Sukumar, & Meyer (2014) found that different external attacks in terms of exploitation of weaknesses obtained from the adopted technology was considered as the top security risk factor. Damage to reputation due to poor customer satisfaction and fulfilment, ending up with too much dependency on vendors and developers and damage to information assets, were also found to be high-risk factors of SMEs' investments in technology.

3.2.10 AI Technology Accessibility

Memo: How an organization can access AI technology if they cannot develop the AI solution themselves.

Keywords: Tech maturity, suppliers, obtaining AI, technical characteristics, external collaboration

For successful adoption of IT, external assistance is vital for SMEs as they generally suffer from a lack of IT knowledge, skills and training sources (Ghobakhloo et al., 2012). SMEs are likely to not have the in-house capabilities to build AI solutions, and therefore are dependent on some level of external support. Andrew Burgess (2018) provides an overview over three approaches for how organizations can obtain or customize AI with external support. The approaches can be seen below. Note that these can be used in combination as well.

- Obtaining "off-the shelf AI" is perceived to be the simplest approach, since the complex task of designing the system is done by the vendor. Though this method is perceived as the simplest, the organization will have to clean and make available the required data and provide subject matter expertise regarding the organization's own processes. The disadvantage of using a "software-package" is that it is often a result of compromise, where the capabilities are not optimal for specific objectives or required specifications.
- Another optional approach is using an AI platform, provided by large tech companies such as IBM, Google, Microsoft and Amazon, offering ready-made algorithms for organizations with simple and well-defined requirements. Burgess argues that the platform approach makes sense if your organization already has a relationship with one of these tech giants, especially in terms of cloud services and accessible data in this manner.

- Last, bespoke AI applications (customized for an organization) provide the greatest level of flexibility and control. Bespoke AI can provide exactly what an organization needs but it is the most complex and AI-specialist demanding approach. Burgess states that AI development should be used only when absolutely necessary, in cases where large data problems are involved or when creating a completely new product or service that requires a technological competitive advantage. Bespoke development requires access to highly capable data scientists, developers or bring in specialist AI consultancies with these resources.

The IT adoption decision is perceived to be dependent on characteristics of the marketed AI solutions available. Ghobakhloo et al. (2012) found several factors of IT products in the market that affect SME IT adoption of the specific service or technology. Software availability, compatibility, complexity, cost, popularity of the technology, user-friendliness and perceived quality of the software were important determinants of IT adoption in organizations. Currently, partial solutions of AI "*are all that's available*", and many AI solutions solve a relatively isolated problem and are standalone solutions (Davenport, 2018). For an AI solution to be more than a nice-to-have, it might have to be integrated with several existing internal systems and processes.

Due to the potential high technology acquisition cost, managers may have to consider building capabilities in identifying mutually profitable projects with external partners when they are ready for ICT adoption (Dyerson & Spinelli, 2011). By networking outside their boundaries, SMEs can in some cases potentially complement their limited internal R&D with knowledge generated by external actors and obtain access to external assets (Massimo et al., 2012).

3.3 Concept Matrix Summary

A structured summary of the knowledge and findings, which were derived from the concepts, is presented in the concept matrix in Tables 5 and 6. The purpose of this matrix is to highlight where arguments for the concepts were drawn from when challenges for AI adoption were evaluated. The concept matrix is concept-centric, showing which concepts are discussed by the different authors (Webster & Watson, 2002).

To highlight in what context a concept is discussed, another dimension is added to the matrix based on the TOE-framework. Note that AI talent and Risk perception were considered as to be discussed in both an organizational and environmental context. The AI talent concept concerns both the lack of in-house talent and the lack of talent to be obtained, and Risk perception can be perceived both from an organizational perspective and an environmental perspective as the risk is also affected by external actors' behavior.

When dealing with novel technology, there is a degree of unexpected barriers that are hard to identify prior to conducting a data collection. Hence, the concepts do not cover all dimensions of possible barriers but discuss the most present and commonly referred problem areas to be found in literature.

The authors that support the different concepts are ordered chronologically (in Tables 5 and 6) from where they appear in the review above. Some sources are mentioned twice as they support concepts in both in part 1 and part 2 of the matrix.

Table 5 – Concept matrix, part 1.

Concepts → ↓ Citation	**AI Value Perception**	**AI Black Box**	**Data Ecosystem requirements**	**Strategy and Resources**	**Digital Transformation Capabilities**
Context	Technical	Technical	Technical	Organizational	Organizational
(Cragg et al., 2011)	X				
(Ghobakhloo et al., 2012)	X			X	
(Dyerson & Spinelli, 2011)	X				
(Loonam et al., 2018)	X				
(Akerkar, 2018)	X		X		
(Frank et al., 2017)	X			X	
(Walczak, 2017)	X			X	
(Ng, 2019)	X			X	
(Corea, 2017)	X				
(Jarrahi, 2018)	X				
(Davenport, 2018)	X	X			
(Jeude & Smith, 2018)	X	X	X		
(Molinillo & Japutra, 2017)		X			
(Bergstein, 2019)			X		
(Earley, 2016)			X	X	
(Bughin et al., 2017)		X	X		
(Paschek et al., 2017)			X		
(McKinsey & Company, 2018a)				X	
(Burgess, 2018)				X	X
(Tidd & Bessant, 2009)				X	
(Danner, 2019)				X	
(Wymer & Regan, 2011)				X	
(Kane et al., 2015)				X	
(Yoon & George, 2013)				X	
(McKinsey & Company, 2018b)					X
(Warner & Wäger, 2019)					X

Table 6 – Concept matrix, part 2.

Concepts → / ↓ Citation	**Organization Readiness**	**Management Support**	**AI Talent**	**Risk Perception**	**AI technology Accessibility**
Context	Organizational	Organizational	Organizational Environmental	Organizational Environmental	Environmental
(Johnson, 2010)	X			X	
(Dyerson & Spinelli, 2011)	X				X
(Yoon & George, 2013)	X	X			
(Jeude & Smith, 2018)	X				
(Loonam et al., 2018)	X				
(McKinsey Digital, 2016)	X				
(McKinsey & Company, 2018a)	X	X	X		
(Ng, 2019)	X		X		
(Cartelli, 2010)	X				
(Cragg et al., 2011)		X			
(Davenport, 2018)		X			X
(Frank et al., 2017)		X			
(McKinsey & Company, 2018b)		X			
(Danner, 2019)		X			
(Corea, 2017)			X		
(Ghobakhloo et al., 2012)			X	X	X
(Kane et al., 2015)				X	
(Grant et al., 2014)				X	
(Burgess, 2018)					X
(Massimo et al., 2012)					X
(Molinillo & Japutra, 2017)		X			

3.4 Summary of the Literature Review

3.4.1 Literature Conceptual Framework

The literature review aims to build understanding of a previously unstructured problem area, therefore it was seen as beneficial to construct a conceptual framework to synthesize and classify different sets of research pieces within these broad categories together (Rowe, 2014).

The conceptual framework below (Figure 9) sets the concepts in perspective of what type of context they relate to with respect of an adoption decision. The concepts are set in the TOE framework, used in this context to present the diversity of possible factors complicating the decision to adoption AI. Some concepts could, by the reader, be perceived to be overlapping, but this was a choice made due to the importance of highlighting different dimensions that would not be visible if presented in the same context. The framework is based on the perspective of putting the adoption decision made in an SME in focus. The model contributes to defining the problem area of the research and functions as a research lens.

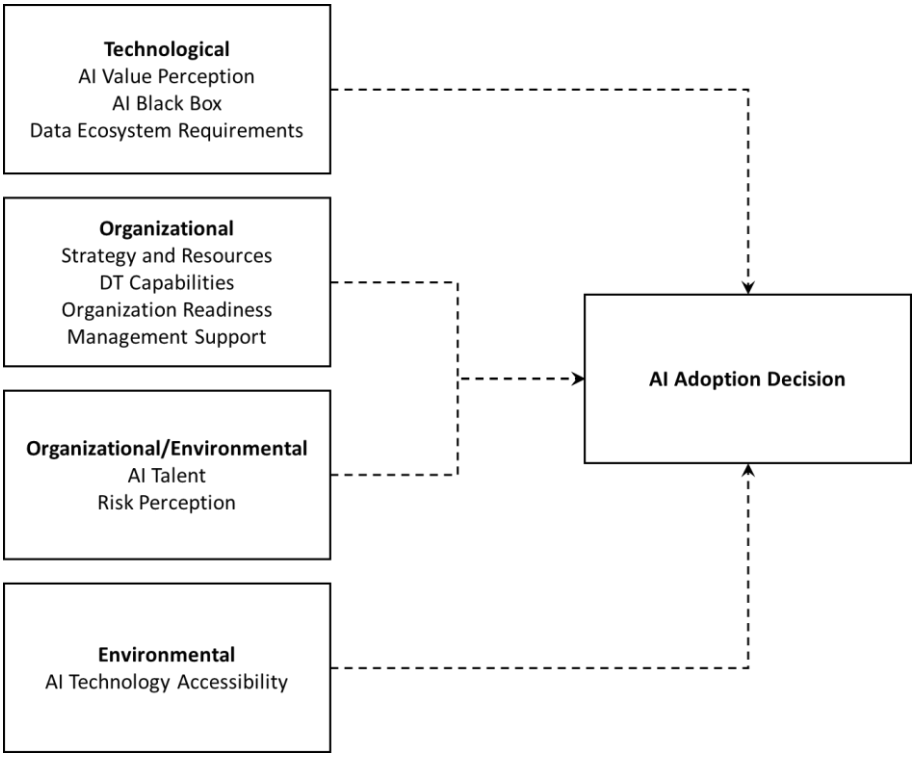


Figure 9 – Literature conceptual framework.

3.4.2 Research Gap

A review constitutes a contribution to knowledge as it shows both what is known and also clarifies where knowledge is lacking (Webster & Watson, 2002). Additionally to that the literature review guides the direction of the research, it also contributes to identifying thematic gaps of knowledge (Rowe, 2014).

Assessing what prevents SMEs with no AI experience from engaging in AI adoption has not been properly researched. The research found to be closest related to this research is McKinsey & Company (2018b) report on foundational barriers for AI adoption, but the author focused on organizations that already "*have piloted or embedded AI in 1 or more functions or business units*". Though the research holds some relation to the AI adoption research topic, McKinsey's report does not focus on determining barriers specifically for SMEs.

The lack of research on the topic introduced limitations to how far the interpretation could extend the assumptions for the concepts found. Therefore, it is important to collect more data exploring the underlying contexts of the adoption decision that the above-presented literature conceptual framework places in focus.

By focusing on the adoption decision, it seemed logical to further investigate the problem area by targeting decision makers in SMEs that would take part such decision. Based on the framework, the contribution of the literature review was found to be fitting to the research area, attempting to understand whether the concepts do hold any relevance to the adoption decision and if there are more important dimensions that are not covered by the proposed concepts.

4 Methodology

This chapter and its subchapters describe the research design, logic and methods that have been cautiously chosen and applied to provide a valid approach of this research.

4.1 Research Design and Logic

4.1.1 Exploratory Study

The purpose of this research is of an exploratory nature. An exploratory study is useful for clarifying what is the nature of the problem, and its principal techniques include literature search and interviewing "experts" in the subject. Both in-depth (unstructured) and semi-structured interviews are suitable for exploratory research (Saunders et al., 2009). Robson (2002) explains that an exploratory enquiry can be helpful to "*find out what is happening",* "*seek new insights*", "*assess phenomena in a new light*" and allows for "*flexible design*". Bryman & Bell (2011) argue that an exploratory stance and qualitative research may be preferable for an unexplored topic, as it usually leads to the generation of a theory and tolerates a relatively unstructured approach to the research process. That suits very well for this research, as it focuses on the unexplored phenomenon of why SMEs struggle to adopt AI technology.

4.1.2 Philosophy of Pragmatism

As this study focuses on a very practical research, the viewpoint of pragmatism was adopted. The pragmatic philosophy includes aspects of both interpretivism and positivism but rejects a forced choice of either of them. It allows to work with variations in epistemology (what constitutes acceptable knowledge), ontology (what assumptions do researchers make about the way in which the world works) and axiology (what roles do values of researchers play in a research) in order to choose the best position to answer the research question, study both objective, observable phenomena and subjective meanings, and use both qualitative and quantitative methods (Saunders et al., 2009).

Pragmatists focus on applications and solutions to problems ("what works") (Patton, as cited in Creswell, 2014) instead of asking questions about reality and the laws of nature (Cherryholmes, as cited in Creswell, 2014). They do not commit to a single philosophy as they do not see the world as an absolute unity. Individual researchers have freedom to choose appropriate methods, techniques and procedures to solve the problem (Creswell, 2014).

Sekaran & Bougie (2016) argue that "*pragmatism describes research as a process where concepts and meanings (theory) are generalizations of our past actions and experiences, and of interactions we have had with our environment.*" The advantage of pragmatism is that it considers different viewpoints on research and the studied subject (different researchers may have different ideas and explanations for what is happening around us), which is useful to solve a (business) problem. Pragmatists derive theory from practice and then apply it back to practice, thus the research is valuable if the findings possess practical relevance. It is also important to state that in pragmatism, results are always tentative and changing over time – they should be viewed as provisional truths.

4.1.3 Abductive Reasoning

In the case of this study, abductive reasoning (Ho, 1994) was applied to identify the research problem, to develop a preliminary conceptual framework from explored topics and other phenomena surrounding the subject under study (through the literature review) in order to build understanding about the field and to further guide the data collection process (through the interview guide), and to generate knowledge through the analysis of the data.

Charles Sanders Peirce developed a ten-sign (evidence) classification system where one sign (an "argument") is associated with deduction, three signs ("dicents", signs capable of being asserted or qualitatively expressed) with induction, and six signs, or sources of evidence, are modes of abduction. These modes are (1) hunch (a guess or an omen), (2) symptom (a possible resemblance), (3) metaphor (a sign that belongs to a new frame of reference), (4) clue (an informal connection between a sign and its object), (5) diagnosis (scenario formed by a set of rules), and (6) explanation (fits the narrative and connects everything together) (Coyne, 2018; Peirce, 1992; Shank & Cunningham, 1996). According to the logical system of Peirce (as stated in Ho, 1994), abduction is a process which can be well applied in exploratory data analysis to look for a pattern in a phenomenon and generate new ideas or hypotheses. "*In the simplest terms, abduction is how we generate hypotheses and is the first (but most neglected) stage in theory building.*" (Hansen, 2017) Abduction, which should be supported by deduction and induction, can be understood as critical thinking by means of a mental process and observation of the world with appropriate categories that arise from internal structures of meanings (Hansen, 2017; Ho, 1994; Reichertz, 2010).

In his Harvard lectures on pragmatism, Charles Sanders Peirce emphasized the relation of pragmatism to abduction and its usefulness to identify and comprehend unclear and difficult ideas. "*If you carefully consider the question of pragmatism you will see that it is nothing else than the question of the logic of abduction.*" (Peirce, 1992)

4.1.4 Inductive Reasoning

This study is further applying the inductive approach as its aim is to develop new practical knowledge (about the phenomenon) that will emerge from the collected data and to relate it to the literature (Saunders et al., 2009). According to Hinkin (2005), the inductive approach is also useful when doing exploratory research, which is the case of this study. The inductive approach allows for a close understanding of the researched problem since it considers context of events and thus the study of a small sample is recommended. It typically uses qualitative research methods, it is flexible, and it permits changes during the research process. In induction, theory generation follows the data, not the other way around as in deduction (Saunders et al., 2009).

The inductive approach is "*a systematic procedure for analysing qualitative data in which the analysis is likely to be guided by specific evaluation objectives*" and can produce reliable and valid findings (Thomas, 2006). Its use is common in qualitative data analysis which consists of procedures such as: conducting multiple readings and interpretations of the raw data; cross-matching of themes identified by different evaluators; decision-making on what is more important and less important in the data; developing a model that consists of identified key themes, categories and processes. The purpose of the general inductive approach is to condense and summarize raw text data, establish clear, transparent and justifiable links between the research objectives and the findings, and to develop a model or a theory about the experiences that are apparent in the data. Thomas (2006) provided a useful guide for the general inductive approach that was applied within this study.

4.1.5 Case Study Research Strategy

The research strategy of a case study was adopted due to its suitability for research projects that ask questions starting with "how" and "why", focus on a current phenomenon within real-life, want to contribute to knowledge of organizational and related phenomena, and it has been a common research method in business as it enables researchers to reveal holistic and meaningful characteristics of real-life events, such as managerial and organizational processes. The case study inquiry considers "*many more variables of interest than data points,* […] *relies on multiple sources of evidence,* […] *benefits from the prior development of theoretical propositions to guide data collection and analysis.*" (Yin, 2009)

Stake (2003) states that the research strategy of a case study is "*defined by interest in individual cases, not by methods of inquiry used*" and further underscores the importance of focusing on understanding of the case rather than generalization beyond, as the ultimate question is: "*What can be learned from the single case?*". Similar to Stake, Flyvbjerg (2006) also acknowledges the significance of "*concrete case knowledge*" over "*the vain search for predictive theories and universals.*" This does not mean that case studies may not lead to generalization, but it rather highlights the key feature of the case study approach – the value that a single holistic case holds within its context. Flyvbjerg further strengthens the relevance of the case study as a research method in the social sciences, as he argues that case studies possess "force of example" and transferability, they allow for in-depth analysis of a single case and they are useful for generating new hypotheses.

For the purpose of this research, the holistic multiple-case study approach was chosen which enables to draw cross-case conclusions, i.e., hypotheses (Eisenhardt, 1989; Yin, 2009). Eisenhardt (1989) emphasizes that the case study research approach has been especially appropriate in new topic areas. She further mentions that case studies can be used to test theory, generate theory or provide description. In this case, the low number of interviewed SMEs would undermine the external validity of a theory generation. However, theoretical saturation is only the sealing part of a case study research and if not possible, case study research may end with generation of hypotheses and comparison with literature. Forming hypotheses is possible through analytical generalization which is a process of the generalization from empirical observations. A good basis for such generalization is a cross-case analysis involving at least four case studies (Eisenhardt, 1989; Flyvbjerg, 2006). Due to this reason, the perspective of Lee, Collier & Cullen (2007) was adopted: "*Exploratory case studies tend to be conducted as preliminary research in advance of wide-scale surveys to map out the themes for the subsequent research.*" In that sense, this research is attempting to develop a hypothesis which can be expanded into a theory by future research. This position is also supported by Dul & Hak (2008), as they argue that "*an exploration of practice should be conducted first before a decision is made to conduct theory-building research.*"

As per Yin (2009), there are five important components for case studies:

1. a study's questions;
2. its propositions, if any;
3. its unit(s) of analysis;
4. the logic linking the data to the propositions; and
5. the criteria for interpreting the findings.

The case study's question, i.e., the research question, was shaped throughout two phases. First, casual reading of articles about innovative technology and digital transformation in combination with brainstorming about the potential topic lead to establishing interest in the field of AI. In an attempt to narrow down the scope of the interest area, it was identified that SMEs are lagging behind large enterprises in adopting AI technology which

is often argued to be crucial to stay competitive for the years coming. In the second phase, relevant sources were reviewed to confirm that the problem was real (see chapters 1.1 and 1.2).

The preliminary propositions of this case study were derived from the literature review and constructed into the conceptual framework presented in chapter 3.4.1. The framework was later used to construct the interview guide, thus influencing the data collection and analysis (Yin, 2009). As Eisenhardt (1989) points out, researchers could specify some potentially important variables with reference to existing literature but should avoid thinking about relationships between variables and theories during the research process as it may lead to biased findings.

As Yin (2009) states, if a case study research is about an organization or its perspective and questions about the organization are asked, despite interviewing individuals, the unit of analysis is the organization to which the individuals belong, not the individuals. "*The questions should cater to the unit of analysis of the case study, which may be at a different level from the unit of data collection of the case study.*" Therefore, the unit of the analysis (that is the "case") in this multiple-case study was an SME in the Nordics region that had little or no prior experience with adopting AI technology, where two executives, senior employees or decision-makers were interviewed, and their answers were analysed. Each case company was studied holistically, i.e., each company as a whole unit. Such unit was therefore fitting for exploring barriers preventing SMEs to adopt AI technology.

To select case companies, a combination of "the criterion sampling", "the variation sampling" and "the emerging sampling" strategies was applied (Patton, 2002). The criteria set for selecting a case company were that it must be (1) an SME, (2) based in the Nordics, and (3) has no or little prior experience with AI technology. To ensure the diversification of the sample, companies operating in different areas were targeted. Given limited contacts in companies, time constraints and the reluctance of a number of companies to cooperate, an opportunistic (or emerging) approach was chosen. Therefore, the first companies that agreed to cooperate were selected.

To establish a clear link between the data and the preliminary propositions and to ensure the validity of interpreted findings, the following analytical strategy and criteria were applied, as per Yin (2009):

1. Preliminary propositions (conceptual framework based on the literature review) guided the data collection (the interview guide);
2. the data collection and analysis processes were not only limited to findings within proposed topics;
3. for each unit of analysis (case):
    a. the raw data (the interview transcript) was stored in a separated document (see external Appendices D to K) that was further processed;
    b. the general inductive approach techniques (coding, theming, categorizing) were applied for each interview, accompanied by iterative explanation building (cross-matching findings and interpretations among researchers, comparing the findings to preliminary propositions, revising findings and propositions);
    c. findings and interpretations of the two interviewees were cross-matched among different interviewees which lead to an aggregated result;
    d. rival explanations of findings were examined (e.g., an observation can have multiple interpretations or can be the result of chance circumstances only);
    e. the processed and analyzed data was stored in the codebook in Appendix C;
    f. the results were displayed using a table summarizing important themes and showing contexts and categories;

4. findings from all cases were displayed using tables summarizing all themes, showing contexts and categories, providing a description for each theme and referring to evidence in the codebook;
5. cross-case analysis and synthesis was conducted (cross-matching findings and patterns, comparing cases, iterative explanation building);
6. rival explanations of synthesized findings were examined to check applicability for analytical generalization (e.g., a finding may apply to cases with certain properties only and thus may not be applicable for analytical generalization);
7. the synthesized results (final findings) were presented using a text list summarizing and sorting the most significant themes based on their tier of importance;
8. the final findings were also presented using a figure (a framework) showing themes grouped into contexts and logical categories;
9. a hypothesis was formed;
10. a logic model based on final findings was constructed and presented in the discussion part.

4.1.6 Validity and Reliability in Case Study Research

Gibbert, Ruigrok & Wicki (2008) have developed the *Framework for an investigation of the methodological rigor of case studies* based upon work of Cook and Campbell, Yin, and their predecessors in social science research. The framework presents an overview of four tests: *internal validity*, *construct validity*, *external validity*, and *reliability*. Several criteria are given for each test. Below is presented how were these criteria fulfilled in this case study.

Internal validity was ensured by conducting a thorough literature review on the topics related to the research question of this study where matched patterns (ideas, topics, concepts) were identified among different authors and next different theoretical lenses were explored concluding that the TOE framework was very popular among investigators in IS research and thus also suitable for the purpose of this case study.

Construct validity was achieved by explaining how data has been collected, by explaining the data analysis procedure, by reviewing transcripts, by key informants reviewing the draft, by the iterative explanation building, by the general inductive approach and by cross-matching themes and researchers' interpretations for each interview.

External validity was reached by conducting cross-case analysis and synthesis (i.e., cross-matching findings and interpretations among all studied cases and deducing new generalizable interpretations), by providing a rationale for case study selection (why this case study is appropriate to answer the research question) and by providing details on the AI phenomenon and each SME examined in this case study.

Reliability was achieved by providing a report on how the entire case study was conducted, which in the case of this research is this entire document, and by providing raw transcripts of the interviews in Appendices D to K, and the codebook in Appendix C where all processed and analyzed data can be found.

4.2 Data Collection

4.2.1 Non-Standardized Semi-Structured, Open-Ended Interviews

The single data collection technique was applied (mono-method) through non-standardized semi-structured, open-ended interviews, allowing broader freedom of researchers to adapt the process of questioning to each individual interview. Researchers follow a pre-developed interview guide consisting of pre-identified topics and prepared questions, but they may omit or adjust some questions depending on the context in relation to the research topic. Semi-structured interviews may be used for exploratory studies and are suitable for obtaining data in circumstances where you want your interviewees to explain or to build on their responses, where

questions are complex or open-ended, and where the logic and order of questioning may need to be varied (Saunders et al., 2009).

4.2.2 Interview Guide

The interview guide (see Appendix A) was designed to assist in the interviewing process with the objective of asking questions which would lead to authentic and truthful answers from the interviewees, in relation to the researched topic. In its introductory part, the interview guide comprised of the interview outline, stating the classification of interviewees, estimated time for the interview, and goal and format of the interview, preliminary information that should be provided to interviewees prior to the interview, and additional comments and instructions on how the interview guide should be used. Next, the interview guide contained introductory mapping questions which were designed to provide the context about a company that the interviewee was a representative of, and the primary questions consisting of three general questions and questions based on the ten concepts derived from the literature review (see chapter 3). For each concept (topic), several questions were constructed along with a few clarifying or backup questions, and several subtopics were mentioned to help researchers maintain a good overview of the identified concepts and the researched area during the interview.

4.2.3 Data Sources, Interview Setting and Interview Process

Interviews were conducted with eight employees from four different small and medium-sized companies; two employees from each company. All the participants were decision-makers, managers or senior employees. After initial contact with each participant, an e-mail was sent informing about the researched topic and the format of the interview. As interviewees were representatives of companies that had no or little experience with AI technology, which was intended, a five minutes long Microsoft PowerPoint document was presented prior each interview to briefly explain the theories behind AI, what is the AI technology about and what are the most common use cases of AI. The presentation also summarized the research and its objective and the process of the interview. The PowerPoint presentation can be found in Appendix B.

Smartphones Samsung Galaxy S9 and S8 and the mobile app Otter.ai were used to record audio tracks of the interviews. All the interviews were between 44 to 63 minutes long and they were conducted during the months of May and June in 2019, thus the time horizon of this research was cross-sectional. The interviews were organized in a two-to-one (two researchers, one interviewee) face-to-face setting and directed by questions of the researchers, which is an approach defined as participant (respondent) interviews (Saunders et al., 2009).

Table 7 shows summary of the interviews, including the date of the interviews, role of the interviewees and the companies that the interviewees were representatives of.

Table 7 – Summary of the interviews.

Case Company	#	Date	Interview Length	Role of the Interviewee
A	1	07/5/2019	63 minutes	Managing Director
	2	10/5/2019	52 minutes	Sales Manager
B	3	20/5/2019	46 minutes	Production Manager
	4	21/5/2019	48 minutes	Sales & Market, Graphic Advisor
C	5	23/5/2019	50 minutes	Head of Business Development
	6	07/6/2019	51 minutes	Senior Business Developer & Project Manager
D	7	06/6/2019	46 minutes	Operations Controller, System Administration & Development
	8	06/6/2019	44 minutes	Communications & Personnel Development Manager

Table 8 presents an overview of the four case companies with their focus area, turnover in millions of EUR and size in terms of number of employees. Each of the companies is fully presented in its respective subchapter in the results (see chapter 6).

Table 8 – Summary of the case companies.

Case Company	Industry / Focus	Based In	Turnover	Employees
A	Medical supplies and consumables	Norway	~ €20 mil.	16
B	Graphics, Printing, Product packaging, Promotional items, Logistics	Norway	~ €12 mil.	55
C	Digital solutions consulting for the financial sector	Denmark	< €42 mil.	92
D	Property and Facility Management, Caretaking, Gardening, Inspections, Project-based services	Denmark	~ €5 mil.	100

4.2.4 Transcribing

Audio tracks of the interviews were recorded using the AI-powered mobile app Otter.ai which automatically generated speech to text with relatively high precision. The app enables to listen to the audio track of an interview while indicating in real time which part of the text is being read. It allows moving across the timeline of an audio track according to a user's position in the transcript. The app was therefore very helpful and timesaving in subsequent process of manually revising and correcting the transcripts. Finally, each of the revised transcripts was saved in a separated Microsoft Word document in a Google Cloud repository.

4.2.5 Pilot Test

A pilot test was conducted with the first interview. The aim of the pilot test was to assess whether the interview setting, the planned length of the interviews and especially the design of the interview guide and the choice of questions is suitable in practice, and whether the interviewee's answers, induced by the questions prepared, are of sufficient value for the research question and its objectives, i.e., if the questions in the interview guide induce answers that are beneficial for the research in the context of barriers preventing SMEs to adopt AI technology. In addition to that, it was tested whether the quality of the audio recording of the interview is good enough, so that the Otter.ai app is able to auto-generate the transcript with high precision and so that the researchers can then recognize, when revising the transcript, what does the interviewee say.

The quality of the audio recording turned out to be high enough and after the transcript was generated and revised in Otter.ai, preliminary coding of the interview was conducted by researchers using Microsoft Word and the comments feature. Answers identified as potential barriers of adopting AI technology proved to be valuable, however, it was decided to amend the interview guide (see Appendix A) as it was too rigid, it contained too many detailed questions and asking easier questions proved to induce more interesting answers. Therefore, two mapping questions were ruled out and the primary questions were simplified, resulting in one or two questions for each topic.

5 Analysis

The following subchapters describe the process that led to revealing patterns and constructing findings from the collected data. Steps are described in chronological order as they happened.

5.1 Coding and Theming

5.1.1 Selection Criteria for Data to be Coded and Themed

During the coding process, the research scope defined in chapter 1.3.2 was kept in mind. The objective of the analysis was to reveal an SME representative's perception of current and past barriers, and perception of current state of the SME organization and other expected factors, which would eventually act as barriers, that currently prevent, prevented in the past or would in the future prevent the organization to engage in applying, implementing and maintaining benefits of AI technology. Only answers corresponding to these criteria were subjected to coding.

5.1.2 First Phase of Coding and Theming

In the first part of the process, researchers used the comments feature in Microsoft Word to separately pre-identify codes and themes in the interviews which were stored in Microsoft Word documents in a Google cloud repository.

After the coding procedure of the first interview was finished, researchers compared identified codes among each other and discussed the result. A decision was made that using only simple codes, such as "customers", "fear", "risk", "data" or similar, was not sufficient, as grouping such codes into themes would not be beneficial for the objective of the research. Business and management research is a complex inquiry and using simple codes would not always reflect the context and meaning of the answers. Therefore, more elaborate codes were mostly used, often consisting of more than one or two words and capturing the context and the implication for the organization. In that sense, the identified codes were in fact themes describing barriers implied from the answers of the interviewees. This approach was logical with respect to the nature and objective of this research.

During the first phase of the coding, researchers recognized the importance of distinguishing between (a) themes representing barriers that were perceived by the representatives of the companies and actually affected the companies, and (b) themes representing barriers that were perceived by the representatives of the companies but will affect or could potentially affect the companies. Hence, the categorization of "actual" and "perceived" barriers was established, as it was beneficial to have a clear distinction in the interpretation of the results of each case company. However, such distinction was not needed in the interpretation of the overall results as both categories qualify as relevant for the objective of the research.

After the researchers separately went through all the interviews in Microsoft Word documents and noted all the found themes in the comments, including whether the theme represents an actual or a perceived barrier, all the themes were reviewed by both of the researchers collectively. Some themes were changed or rephrased. Where themes identified for the same fragment of an answer differed among the researchers, the researchers discussed and agreed on the most meaningful and accurate choice of a theme.

After the themes were agreed, all the eight interviews were imported to the coding tool NVivo 12 and the themes were then registered as nodes with respective interview files. Themes were then reviewed again which resulted in number of changes. The NVivo 12 tool enabled to link each theme with a specific fragment of an answer to which the theme referred to, making it easier to refine the themes in the next steps of the analysis.

In result, a list of themes was created, classifying them into the two categories – "Actual" barriers and "Perceived" barriers. A snippet of the list is shown in Figure 10.

Name	Files	References
Actual barriers	0	0
Age factor - lack of technology support	5	8
AI or technology scepticism	6	12
AI perceived as limited	1	4
AI technology perceived as immature	1	1
Being too traditional or too slow to ado	1	3
Potential barriers	0	0
AI or technology scepticism	1	2
Being too traditional or too slow to ado	2	3
Bureaucracy and systems making it diffi	1	2
Cannot reallocate internal employees to	1	1
Competing priorities	1	2

Figure 10 – List of themes representing barriers in NVivo 12.

A total of 449 references (i.e., coded snippets of answers), labelled by 96 themes unique themes (codes), were registered across eight interviews which are summarized in Figure 11 below.

Name	Codes	References
Case A - Interview 1	50	83
Case A - Interview 2	41	85
Case B - Interview 3	28	53
Case B - Interview 4	32	45
Case C - Interview 5	29	48
Case C - Interview 6	25	40
Case D - Interview 7	26	41
Case D - Interview 8	32	54

Figure 11 – Summary of the interviews in NVivo 12.

5.1.3 Second Phase of Coding and Theming

For the second phase of the coding process, all the themes registered in NVivo 12 were exported to a Microsoft Excel table for further revision. The exported table contained following fields: *Node/Theme*, *Barrier Type* ("Actual" or "Perceived"), *File Name*, *Coded Text*. The *File Name* field was used to define new fields *Case* (A to D) and *Interview Number* (1 to 8), as file names of the interviews contained these values. Next, fields *Level*, *Engagement Barrier*, *T/O/E* and *Remove/Change* were added:

- The *Level* field (1 to 3) was used to define an indicative level of where the theme should be positioned within the logic hierarchy of all the themes. Its purpose was merely auxiliary.

- The *Engagement Barrier* field ("Yes" or "No") was used to define whether the barrier, represented by the theme, is indeed considered an obstacle to the adoption of AI technology.
- The *T/O/E* field ("T", "O", "E" or a combination of them) was used to preliminarily classify the theme within the TOE framework guided by the definitions, outlined in chapter 2.3.2, stating what qualifies within the technological, organizational or environmental context.
- The *Remove/Change* field was used to note whether the theme should be removed or changed, or to note any additional comments concerning the theme.

All the themes and their fields values were reviewed again with the help of the NVivo 12 tool that enabled to find coded fragments of text and examine them with their context in respective interview files. Simultaneously, the newly added fields were populated for each theme.

It was found that a third category of *Barrier Type* must be used as several of the identified themes, representing barriers, were only inferred from an interviewees' answers without being mentioned directly. Such themes were reclassified as "Potential" barriers and despite not qualifying as relevant for the result, they were left in the table as potentially useful points for discussion.

A preview of the coding table after the mentioned changes is shown in Table 9. The coding table represents the codebook of this research. The codebook can be found in Appendix C.

Table 9 – Fields and values of the codebook.

Node / Theme	**Barrier Type**	**Engagement Barrier**	**Remove / Change**	**Level**	**T/O/E**	**Case**	**Interview Number**	**Coded Text**
Theme name	Actual	Yes	Yes	1-3	T, O or E	A-D	1-8	Snippet of an answer
	Perceived	No	No		Combination of TOE, e.g., "T/O"			
	Potential	Or used as a comment field	Or used as a comment field					

Given the updated fields, more clear rules for the analysis were established. The rules can be found in the Table 10 below. The rules comprise of criteria assisting to identify themes (barriers) that fall within the technological, organizational or environmental context (as outlined in chapter 2.3.2), criteria for the distinction of "Actual", "Perceived" and "Potential" barriers, descriptions of how themes defined as level 1, 2 and 3 should be understood, and the definition of what qualifies as an engagement barrier to adopting AI technology.

Table 10 – The guide and rules for analysis.

Research question focus	Hesitance and barriers to adopting AI in SMEs.	
Technological context	Includes internal and external technology that is perceived to be relevant to the firm, both technologies currently in use and technology available in the marketplace. Technology consists of solutions, equipment and processes. Baker found several studies with technological contexts, focusing on factors and characteristics such as complexity, compatibility, perceived benefits and technological competence required.	
Organizational context	Considers resources and characteristics of a firm, employees, intra-firm communication, degree of centralization and formalization, managerial structure, human resources, organization size and the lack of resources.	
Environmental context	Covers the structure of the industry, risk assessment, external pressure, and the presence or absence of technology providers and the regulatory environment.	
Actual barrier	Past and present issue. An issue that currently exists in the company and does cause complications.	Note: *Actual barrier is also perceived.*
Perceived barrier	Potential future issue. A stated issue that the interviewee mentioned or addressed. Issue perceived by the interviewee.	
Potential barrier	Reading between the lines. What could be a barrier – something that could apply for another SME.	
Level 1	Upper level under T/O/E. For instance, “resources” is right under O.	
Level 2	The link between the root cause and the upper level if there is a current weak link. A barrier that has two or more underlying issues that can be easily differentiated.	
Level 3	Pragmatic root cause, no need of further "digging". Concrete, stated problem, where breaking down the issue provides no further insight than what is obvious. E.g., "lack of financial resources" should not be broken down to "not earning enough". Pragmatic root cause of a problem. Going more deeper is not relevant.	
Engagement barrier	The focus of the thesis is on barriers that transpire when representatives from an SME evaluate AI technology for their own organization. The barriers derive from representatives’ perception of current and past barriers, current state of SMEs and factors expected that would surface as barriers if the SMEs were to engage in applying, implementing and maintaining benefits from AI. If challenges related to implementation and post-adoption/maintaining benefits are perceived as barriers to engage with AI technology.	

During the second phase of coding, several themes were reclassified as “Potential” barriers or removed given that the researchers developed a more critical point of view on what qualifies as an engagement barrier or a barrier in general. Using clearer rules for the analysis, a few themes were reclassified from “Actual” to “Perceived” or vice versa. A number of themes were also merged together.

As a result, a total of 359 nodes (coded barriers), labelled by 78 unique themes, remained in the coding table. Of the 359 nodes, 335 nodes, labelled by 68 unique themes, were categorized as “Actual” or “Perceived” barriers.

5.1.4 Third Phase of Coding and Theming

In the third phase of coding, themes were reviewed for the final time. In the process of third reviewing, some themes were merged, split into multiple themes, some of which were new, or rephrased. Some coded texts (barriers) were also reassigned to more fitting themes or their *T/O/E* classification was changed, depending on the context of the text. A few themes and coded texts were ruled out as it was found that they did not represent engagement barriers. Last, the fields *Actual Frequency*, *Perceived Frequency*, *T frequency*, *O frequency* and *E frequency* were added to indicate how many times was each theme categorized as an "Actual" or "Perceived" barrier, framed within the technological, organizational or environmental context, and mentioned in a respective case and by a respective interviewee. The purpose of frequency fields was only to facilitate identification of matching themes in the next steps of the analysis.

As a result of the third phase of coding, a total of 391 nodes (coded barriers), labelled by 74 unique themes, remained in the coding table. Of the 391 nodes, 367 nodes, labelled by 65 unique themes, were categorized as "Actual" or "Perceived" barriers. The total number of nodes increased, compared to the result after the second phase of coding, due to the activity of splitting themes and assigning individual coded barriers to multiple themes.

5.2 Grouping Themes within the TOE Framework and into Logical Categories

Because the TOE framework was chosen to be used as a lens to present the findings, the final 65 themes, categorized as "Actual" or "Perceived" barriers, were listed under three groups of the TOE framework: technological context, organizational context and environmental context. The themes were listed under the three groups based on the *T/O/E* field value of individual coded nodes labelled with these themes in the coding table. As a result, 15 themes were listed under the technological context, 42 themes under the organizational context and 23 themes under the environmental context. A total of 13 themes were listed under multiple context groups.

Next, both researchers separately arranged themes within each context group into logical categories and then both versions were reviewed, compared and followed by a discussion. In result, there were 5 categories formed within the technological context, 10 categories formed within the organizational context and 5 categories formed within the environmental context (see Table 11). Categories were used in further steps when displaying findings of the study.

Table 11 – Logical categories to group themes within TOE contexts.

Technological Context	Organizational Context	Environmental Context
AI Black Box	Attention to AI	AI Expertise
Company-Tech Fitness	Automation of Tasks	Customer Concerns
Data Ecosystem	Human Resources	Industry Factors
Negative Perspectives of AI Tech	Internal Resistance	Legal and Policy Constraints
Value Perception	Investment Concerns	Risk Perception
	Owner and Management Views	
	Resources and Budgets	
	Strategic Benefits	
	Strategic Risks	
	Transformation Constrains	

5.3 A Case Company-Level Analysis

To obtain data relevant only for the analysis of a specific case company, the coding table was filtered using the *Case* field. Next, the data was filtered using the *Barrier Type* field to only include "Actual" and "Perceived" barriers. The filtered data was then transferred to a separate Microsoft Excel sheet where further analysis was conducted.

All the transferred themes were then cross-matched to find out how many of them occurred at least once in both collected interviews for the specific case. Furthermore, it was also examined if a theme was identified in both interviews within the technological, organizational or environmental context. Themes identified within the same context in both interviews were the most relevant findings. There were no themes that were identified in both interviews but not within the same context. Example of the analysis for case company B is shown in Table 12 below. Numbers representing the frequency of themes were only auxiliary.

Table 12 – Example of case company-level analysis: case company B.

Interview 3 "Actual" or "Perceived" barriers	Frequency	T freq.	O freq.	E freq.	Interview 4 "Actual" or "Perceived" barriers	Frequency	T freq.	O freq.	E freq.	Matched Themes	T theme	O theme	E theme
AI or technology scepticism	4	0	4	0	Lack of AI competence	2	0	2	0	Lack of AI competence	No	Yes	No
Data systems and their capabilities	4	4	0	0	Data systems and their capabilities	1	1	0	0	Data systems and their capabilities	Yes	No	No
Data systems are not properly connected	1	1	0	0	Dependency on external help	2	0	0	2	Dependency on external help	No	No	Yes
Firefighting	3	0	3	0	Firefighting	3	0	3	0	Firefighting	No	Yes	No
Unclear benefits of an AI initative	3	1	2	0	Change resistance	1	0	1	0	Change resistance	No	Yes	No
Competing priorities	2	0	2	0	Competing priorities	1	0	1	0	Competing priorities	No	Yes	No
Dependency on external help	3	0	0	3	Employee age	3	0	3	0	Employee age	No	Yes	No
Lack of AI understanding	3	1	2	0	Lack of IT competence or knowledge	1	0	1	0	Lack of IT competence or knowledge	No	Yes	No
No or little prior AI experience	2	0	2	0	No or little prior AI experience	1	0	1	0	No or little prior AI experience	No	Yes	No
Employee age	2	0	2	0	Employees to lead or promote an AI	1	0	1	0	Employees to lead or promote an AI initi	No	Yes	No
Lack of AI competence	5	0	4	1	Acquiring costly and problematic	2	0	2	0				
Human Resources	1	0	1	0	Incompatibility of an AI solution with an	2	1	1	0				
Losing human supervision	1	0	1	0	Lack of diversity to foster innovation	2	0	2	0				
Non-uniform structure or processes	2	0	2	0	Not perceived as necessary right now	2	0	1	1				
Resources constraints	1	0	1	0	Slow adoption process	2	0	2	0				
Change resistance	2	0	2	0	AI technology perceived as immature	1	1	0	0				
Lack of clear business case and strategy	1	0	1	0	Unclear use case	1	1	0	0				
Employees to lead or promote an AI	1	0	1	0	Financial constraints	1	0	1	0				
Lack of IT competence or knowledge	2	0	2	0	Industry specifics prevent long term	1	0	0	1				
Not following AI trends	1	0	1	0	Price of an AI solution	1	0	0	1				
Proving short-term benefits	2	0	2	0	Risk of draining more resources than	1	0	1	0				
Security concerns	2	0	1	1									
Tasks or processes that are challenging	2	0	2	0									

After the most relevant themes were identified, coded snippets of answers labelled by these themes were manually reviewed and discussed by both authors of this study to confirm the validity of the findings. Results were then interpreted in a respective case report.

5.4 Cross-Case Analysis and Synthesis

The coding table was filtered using the *Barrier Type* field to only include "Actual" and "Perceived" barriers and then the data was transferred and further processed in a separate Microsoft Excel sheet.

In the first step, it was examined whether any of the themes were identified in all 8 interviews within the same context. Given that there was only one such theme identified, it was decided to shift the threshold of what makes a significant finding. The boundary was defined as themes identified in 3 cases in at least 1 interview per case. Therefore, in the second step, the following range of five tiers of importance was established to classify themes representing barriers based on in how many case companies and in how many interviews per case they were identified within the same context:

1. Themes found in all 4 cases in both interviews per case.
2. Themes found in all 4 cases in at least 1 interview per case and in 3 cases in both interviews per case.
3. The rest of the themes found in all 4 cases in at least 1 interview per case.
4. Themes found in 3 cases in at least 1 interview per case and in 2 cases in both interviews per case.
5. The rest of the themes found in 3 cases in at least 1 interview per case.

A total of 20 themes were identified within the range of five tiers. Themes identified in all four cases in both interviews per case possessed the highest importance (see Table 13 below), while themes identified in the fifth group possessed the lowest importance within the defined range. However, all of the 20 themes together constituted the most significant findings of the study.

Table 13 displays a summary of the cross-case analysis to identify themes that classify within the first tier of importance. The summary only displays themes identified in at least 2 cases in both interviews per case.

Table 13 – Summary of the cross-case analysis: themes in both interviews per case.

Themes identified in both interviews per case	A	B	C	D	IN HOW MANY CASES	Context
Lack of AI competence	x	x	x	x	4	O
Dependency on external help		x	x	x	3	E
Lack of IT competence or knowledge	x	x		x	3	O
No or little prior AI experience	x	x		x	3	O
AI or technology scepticism	x			x	2	O
Competing priorities	x	x			2	O
Data systems and their capabilities	x	x			2	T
Employee age	x	x			2	O
Firefighting		x		x	2	O
Lack of AI understanding	x		x		2	O
Legislation, regulation and compliance constraints	x		x		2	E
Resources constraints	x			x	2	O

Table 14 displays a summary of the cross-case analysis to identify themes that classify within the second to the fifth tier of importance. The summary only displays themes identified in at least 3 cases in at least 1 interview per case. Numbers representing the frequency of themes in the table were only auxiliary.

Table 14 – Summary of the cross-case analysis: themes in at least 1 interview per case.

Themes identified in at least 1 interview per case	Case A	Case B	Case C	Case D					In all 4 cases			In 3 cases			In 2 cases		
	Total	Total	Total	Total	TOTAL	In all	In	In	T	O	E	T	O	E	T	O	E
Lack of AI competence	3	7	7	6	23	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
AI or technology scepticism	4	4	1	6	15	Yes	Yes	Yes	No	No	No	No	Yes	No	No	Yes	Yes
Change resistance	2	3	4	4	13	Yes	Yes	Yes	No	Yes	No	No	Yes	No	No	Yes	No
Unclear benefits of an AI initiative	6	3	1	5	15	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	No
Dependency on external help	1	5	9	4	19	Yes	Yes	Yes	No	No	Yes	No	No	Yes	No	No	Yes
Lack of IT competence or knowledge	7	3	2	3	15	Yes	Yes	Yes	No	Yes	No	No	Yes	No	No	Yes	No
No or little prior AI experience	3	3	1	3	10	Yes	Yes	Yes	No	Yes	No	No	Yes	No	No	Yes	No
Lack of clear business case and strategy	4	1	0	3	8	No	Yes	Yes	No	No	No	No	Yes	No	No	Yes	No
Competing priorities	5	3	0	2	10	No	Yes	Yes	No	No	No	No	Yes	No	No	Yes	No
Employee age	2	5	1	0	8	No	Yes	Yes	No	No	No	No	Yes	No	No	Yes	No
Insufficient employee training	3	0	1	1	5	No	Yes	Yes	No	No	No	No	Yes	No	No	Yes	No
Financial constraints	3	1	0	1	5	No	Yes	Yes	No	No	No	No	Yes	No	No	Yes	No
Firefighting	3	6	0	3	12	No	Yes	Yes	No	No	No	No	Yes	No	No	Yes	No
Incompatibility of an AI solution with an organization's legacy IT systems or processes	5	2	1	0	8	No	Yes	Yes	No	No	No	Yes	No	No	Yes	Yes	No
Lack of AI understanding	4	3	8	0	15	No	Yes	Yes	No	No	No	No	Yes	No	Yes	Yes	No
Not following AI trends	4	1	0	2	7	No	Yes	Yes	No	No	No	No	Yes	No	No	Yes	No
Price of an AI solution	0	1	1	8	10	No	Yes	Yes	No	No	No	No	No	No	No	Yes	Yes
Resources constraints	5	1	0	5	11	No	Yes	Yes	No	No	No	No	Yes	No	No	Yes	No
Risk of losing reputation and damaging customer relationships	4	0	1	4	9	No	Yes	Yes	No	No	No	No	No	Yes	No	No	Yes
Tasks or processes that are challenging to streamline	1	2	0	2	5	No	Yes	Yes	No	No	No	No	Yes	No	No	Yes	No

As indicated in Table 13, only 1 theme was identified within the first tier of importance. From the combination of Tables 13 and 14, it was also revealed that 3 themes were identified within the second tier of importance, 3 themes were identified within the third tier of importance, 5 themes were identified within the fourth tier of importance and 8 themes were identified within the fifth tier of importance.

5.5 Hypothesis Generation

Case study research enables to draw conclusions in a form of generating a hypothesis or, in its final step, a theory (Eisenhardt, 1989). Since this research was conducted on a sample of four case companies, theoretical saturation was not possible, and therefore this study proposed a hypothesis that would have to be further studied, tested and potentially confirmed in order to reach theoretical saturation and become a theory. However, to attempt to confirm or generate a theory is not a very pragmatic approach in this field, as the areas of business, management and technology advance fast and what applies today may change tomorrow, especially when it comes to barriers to adopting AI in SMEs. In this multiple-case study, the result was generated in the form of a hypothesis as it was the formal and academical requirement of the chosen research approach (Eisenhardt, 1989).

The proposed hypothesis stated that the most common barriers to adopting AI technology in SMEs could include the barriers represented by the 20 themes classified within the range of five tiers of importance. Before the hypothesis was interpreted, coded snippets of answers labelled by these themes were manually reviewed and discussed by both authors of this study to confirm the validity of the findings. It was also examined and discussed whether any of the barriers represented by the classified themes were identified only due to specific characteristics or specialties of the studied SMEs and could not, therefore, potentially act as barriers to adopting AI in any other SME. The authors of this study concluded that all of these 20 barriers are realistically likely to appear again and act as barriers to adopting AI in other SMEs.

6 Results

This chapter and its subchapters present findings of this multiple-case study. First, each case company is presented in a respective case report consisting of a company profile, a future outlook of the company and the perceived barriers preventing the adoption of AI technology that were identified from interviews with both representatives of the company. Next, a summary of all the findings is shown, and finally, the hypothesis is presented.

6.1 Case Company A

The following report was constructed based on publicly available materials and information about the company and the interviews with representatives of the company. The interviews can be found in external Appendices D and E.

6.1.1 Company Profile

Case company A is a Swedish-owned company based in Norway which considers itself a leader in the business area of trading medical disposables and supplies. The company currently resells about 10,000 products and its primary customers are public health services–hospitals and municipalities. As a result of the effort during the last couple of years and some important tender wins, the company is 2nd in both markets in Norway. In the municipalities market, the company has a market share of 26-27% and strives for leadership with an expected 40% in 2021. Four years ago, the company's turnover was only six million euros, while last year it was around 20 million euros. The company expects to reach a turnover of 27 million euros this year and a turnover of 50 million euros within 3-4 years. The company's revenue increased by 30% last year and is expected to increase by 35% this year.

The company currently employs 16 people: a Managing Director, a Sales Manager leading a team of nine people where six workers are concentrated on Sales and three workers on Customer Service, two Product Managers, a Tender Manager, and two employees working within Supply Chain and Master Data Management.

The interviewed representatives of the company were **the Managing Director**, and **the Sales Manager** with a background of a nurse and 10 years in Sales and Sales Management.

The organization is a growing, purely sales-oriented company with an entrepreneurial culture, high customer focus, flat hierarchy, low bureaucratic burden and short decision lines. Employees sometimes work on fluid tasks and given that they are only a few, they need to help each other and often take shortcuts through formal structures and processes. The company is ambitious and open to "do what has not been done yet" but has **no prior experience with AI** and its internal technical capabilities are limited due to lack of IT knowledge and competency among its employees. Absence of internal resources for operational purposes is addressed by outsourcing the IT department and back office functions such as HR, accounting and warehousing services to external contractors in Sweden.

The external IT department provides and manages hardware infrastructure and servers, central foundation systems such as Customer Relationship Management (CRM) systems, Enterprise Resource Planning (ERP) system and Business Intelligence (BI) system, and they also support the online store. The systems, however, require some internal knowledge to manage and operate too, as, for instance, the CRM system is different for each market and needs to be used along with other customer systems, such as the IBX which is a government e-trade portal for certain market in Norway. Customer Service personnel and Product Managers therefore need to know how to use these tools.

6.1.2 Future Outlook

The company expects to grow into a larger organization and with such change, more local resources will be required. The Managing Director expressed that especially local IT resources, more Product Managers and extended customer service will be needed. Such extension could be achieved by intelligent use of AI on the online store. The Managing Director's wish is to dispose of manual tasks via use of chatbot on the online store, make customers use the online store more, improve the BI system and obtain a better forecasting system. The Sales Manager highlighted that the CRM and order management system could be improved, and both the Managing Director and the Sales Manager would like to see the ordering process to be more automated. The Managing Director expects to see some progress within a year or two.

6.1.3 Perceived Barriers to Adopting AI Technology

The 18 most important themes representing barriers identified in both the interview with **the Managing Director** (external Appendix D) and the interview with **the Sales Manager** (external Appendix E) are displayed below in Table 15 in respective contexts and logical categories within which were the themes identified, as explained in chapter 5.2.

Table 15 – Most important themes for case company A.

Technological Context	Organizational Context	Environmental Context
Category: Company-Tech Fitness ▪ Incompatibility of an AI solution with an organization's legacy IT systems or processes	*Category:* Attention to AI ▪ Lack of AI understanding ▪ No or little prior AI experience	*Category:* AI Expertise ▪ Evaluating external vendors and consultants
Category: Data Ecosystem ▪ Data systems and their capabilities ▪ Data systems are not properly connected	*Category:* Human Resources ▪ Lack of AI competence ▪ Insufficient employee training ▪ Lack of IT competence or knowledge	*Category:* Customer Concerns ▪ Customers not being ready to adapt to change
	Category: Internal Resistance ▪ AI or technology scepticism ▪ Employee age	*Category:* Legal and Policy Constraints ▪ Legislation, regulation and compliance constraints
	Category: Owner and Management Views ▪ Management communication	
	Category: Resources and Budgets ▪ Competing priorities ▪ Financial constraints ▪ Resources constraints	
	Category: Transformation Constraints ▪ Dependency on IT department	

Note: *Numbers in parentheses (#) used in the following paragraphs refer to coded texts labelled with respective themes in the codebook in Appendix C.*

6.1.3.1 Themes of Technological Context

Data systems and their capabilities
The Managing Director stated that the current BI data system does not currently provide "*all the data you want in the way you want*" it and functions for deeper analysis that would help understand their business (#130, #131, #134, #139, #141), while the Sales Manager shared her concerns regarding the lack of precise information in the CRM system in certain areas (#135). Data systems' limitations may be a barrier to successfully adopting AI solutions.

Data systems are not properly connected
Both interviewees mentioned that certain data silos are still not interconnected or do not communicate properly. Specifically, the BI system could communicate better with the financial system and both of them could be connected with the warehouse management system and the ERP system (#142). Also, according to the Sales Manager, the CRM and order management system do not communicate with the warehouse management system. Employees must enter orders to the warehouse system manually which is time-consuming (#136).

Incompatibility of an AI solution with an organization's legacy IT systems or processes
The interviewed representatives perceived as potentially problematic if new technology or an AI solution would be difficult to integrate within the existing computer systems or working processes of the company (#241, #242, #244). The Managing Director expressed an opinion that if a solution for an SME has to be very customized, "*then it must be something wrong with our organization*" (#240).

6.1.3.2 Themes of Organizational Context

AI or technology scepticism
The Managing Director perceived that some employees might be sceptical due to fear of not being able to learn how to operate the technology and how to coexist with it, or in relation to fear of being replaced by the technology (#28). The Sales Manager even admitted that she is "*probably more sceptical*" (#27) and also argued that they as a group are not technologically very advanced, employees are used to current methods and are a bit sceptical of new technology that they might not master (#32). As she said, "*everything online or digital can be a bit scary*" (#33).

Competing priorities
The representatives stated that managers have different needs or wishes which cannot be executed all at once as resources are limited (#97, #98). As the Managing Director said, "*AI is here to stay, it's important to have it*", but it has to be first decided what can the organization afford and cope with, what is the most important and what has the most effect (#103, #104, #106).

Dependency on IT department
As the company relies on the external contractor in terms of IT matters, they are very much dependent on their proactivity, knowledge, resources, understanding of the company's business, and their policies regarding what can be implemented in the systems they provide and manage (#165-176). The decision line starts from the Swedish owners. If the IT department would not support the company in adopting new technology, the owners might change the external contractor which could be accompanied with high switching costs. In a worse scenario, the owners might not be willing to even change the contractor.

Employee age
While the Sales Manager stated that the average age in the company is around 40 years, the Managing Director thought it is even 53 years. Given the high age average of their employees, the representatives think that it might be one of the reasons of the company's limited knowledge and expertise in technology and why some employees could have difficulties to understand how the technology works (#180, #182).

Financial constraints
The Sales Manager talked about new owners that have just bought the company who might not do such investment at the moment (#208). She also mentioned that "*when it comes to AI, we have put that on ice*" given the expensive external IT resources (#212). The Managing Director also confirmed that he perceives the company could be constrained by financial resources (#209).

Insufficient employee training
The interviewees expressed that appropriate employee training would be necessary to execute before adopting any new or AI-based technology (#188-190).

Lack of AI competence
The interviewees stated that neither the outsourced IT department (#5) nor the employees of the company possess the necessary knowledge or skills to execute an AI project. It was mentioned that there is a "*little faith that the introduction* (to AI) *will come internally*" (#9). According to the Sales Manager, there are not "*so many* (employees) *who know what Artificial Intelligence is*" (#20).

Lack of AI understanding
Employees might not understand the technology and that it might free up their time for more intelligent work (#262, #266). They might not "*see its usefulness*", they have to understand that they might "*get their information quicker, faster or better*". Not understanding AI might lead to resistance (#269, #270).

Lack of IT competence or knowledge
Employees of the company do not feel very confident with technology (#247, #249). The customer service staff does not use a lot of advanced IT solutions and the sales representatives "*are not very much into IT or AI*". The company is "*not mature in terms of IT*" and it does not possess expertise in IT (#250, #253-255, #258).

Management communication
Communication from the top of the organization to the employees was also perceived as an important aspect to address employees' potential fear and lack of understanding of the purpose of the technology (#290, #291).

No or little prior AI experience
Both the Managing Director (#305) and the Sales Manager (#300, #301) stated that the company has no prior experience with AI nor is currently using anything that can be defined as an AI solution.

Resources constraints
In addition to financial constraints (#350), the representatives also addressed other types of resource restrictions. They expressed that it was not possible to free up operational employees to work on a new project, or that it was difficult to obtain the IT resources or human resources with appropriate IT knowledge (#345, #346, #351, #354).

6.1.3.3 Themes of Environmental Context

Customers not being ready to adapt to change
The representatives of the organization expressed that the customers, i.e., the health professionals, the organization works with are not or might not be prepared for technological changes. There are very conservative customers in the industry who have done things the same way for many years and might not be interested to adapt and work with systems they do not understand (#120, #122). There are "*many who may have hardly ever taken on a computer*" and for some it might be even "scary" to use the online store (#118).

Evaluating external vendors and consultants
The interviewed representatives indicated that the problem is not only that they are not be able to start an AI initiative alone, but also that they do not feel confident about where to look for potential vendors and how to evaluate them. "*You need to have external consultants for that.*" (#197-199, #200, #201) And if they found some vendors, it would be difficult to distinguish who is truly good and who just wants their money. "*I think that just to navigate in that market, I think it would have been quite, quite difficult.* […] *I think we would have needed... I call it a consultant I could trust as mine.*" (#202)

Legislation, regulation and compliance constraints
Since the organization's customers operate in the public sector, the Managing Director believes that the legislation constraints might cause problems when adopting a solution that might have an effect, for instance, on customers and contracts due to the public procurement law (#284). The Sales Manager perceived constraints in the form of strict policies that are being applied to the IT systems and might prevent the introduction of certain innovations (#285).

6.2 Case Company B

The following report was constructed based on publicly available materials and information about the company and the interviews with representatives of the company. The interviews can be found in external Appendices F and G.

6.2.1 Company Profile

Case company B is a printing, graphics, design and decoration manufacturer company based in Norway. The company produces marketing materials, prints on product packaging and textile, and designs and manufactures signs and decoration items. The firm was originally a traditional printing company which expanded into different areas through a merger of five companies and now they print, manufacture, store and even do the logistics of their products in-house. They have recently bought another printing company in Norway and thus some changes in the organizational structure will follow. The company primarily focuses on B2B market and works with all sorts of customers, such as a natural stone producer, a pizza company, a humanitarian organization, or a building products, hardware, kitchens and interiors supplier. It is a growing company operating in a fast-changing industry where it is successful in acquiring more diverse customers, but the number of printed products is decreasing and therefore they also grow to focus on different business areas. The company's turnover was 12 million euros last year.

The company can be split into several units: (a) printing – packaging and textile printing, (b) media – produces promotional material and sells advertisements to journals, (c) decorations – large format and signs manufacturing, and (d) warehousing and logistics.

The organization employs 55 people: a General Manager at the top who is also the IT decision-maker of the company, management team, a Sales Department Manager leading a team of seven-eight people, a Production

Department Manager leading a team of 10-12 people, a Warehousing and Logistics Department Manager leading a team of three people, and Managers of the Design Department and the Files Reception Department and their respective workers. The Production Department focuses on printing, folding, stapling and similar tasks, the Sales Department's responsibilities are pricing, customer contact and orders and the Files Reception department accepts files and processes them into the jobs flow. Apart from the obvious activity, the Warehousing and Logistics Department also reacts to the activity on the online store, i.e., manages stock and delivers products based on online orders.

The interviewed representatives of the company were **the Production Manager** whose responsibilities are planning jobs, ordering material for the jobs and controlling print results, and an employee working as **a Graphic Advisor, Sales & Market** who operates the printing and graphics unit.

The company has a flat hierarchy structure and an open atmosphere where it is easy for employees to talk to the General Manager or anyone across the organization. According to the representatives of the company, the organization is solution-oriented with customer needs in mind and puts emphasis on the quality of its products. Days are very busy with daily production, operational tasks and customer service due to the high tempo of the company and the employees usually spend their time focusing on how to do things faster rather than on thinking about innovations.

The competence of the employees mainly lies in professional certificates and years of experience. Majority of the employees have worked in the company for more than 10 years. The employee fluctuation is therefore low and that is apparently also due to a good environment in the company and the fact that there are not that many companies around that operate in the same industry. The company nor the interviewed representatives have **any experience with AI technology** and the IT knowledge in the organization is not very strong, but the Production Manager has an idea of what the technology could do. They are already using some advanced technology for 3D drawing and cutting that is delivered from their vendor, but it was not identified as an AI-based technology. They have someone with high IT expertise, but he is constantly busy with system maintenance.

The employees of the company are not satisfied with their current hardware equipment and IT infrastructure. The computers and printers could perform faster, and the company operates with outdated and cumbersome ERP and order management systems. Five years ago, there were about five systems running and currently, there are two or three systems running parallelly which should change now as the company found a vendor that will implement a new tailored system for administration and ERP purposes. The Production Manager will assist with the implementation of the new system and someone else will take over his current responsibilities. The company also uses a logistics system that works well. The system has an online interface so the customers can either log into the system and enter the data or call the operators working at the Warehousing and Logistics Department.

6.2.2 Future Outlook

The new system should be a cornerstone for the future growth of the company as it will centralize and synchronize customer information, orders and jobs flow across the organization. It should also address the fear of increasing administration resources which is a step they would like to prevent. It should also automatically prioritize jobs based on the entered criteria.

Whether the company will invest in AI is in the end up to the General Manager's decision. The Production Manager mentioned that they have not talked much about AI apart from their wish to automate the printing machines so that they could operate without a human operator. The Graphic Advisor saw the potential for

applying AI within their logistics system. He also expressed that the company is very careful and takes IT investments seriously and puts professional weight into the decision process.

6.2.3 Perceived Barriers to Adopting AI Technology

The 10 most important themes representing barriers identified in both the interview with **the Production Manager** (external Appendix F) and the interview with **the Graphic Advisor, Sales & Market** (external Appendix G) are displayed below in Table 16 in respective contexts and logical categories within which were the themes identified, as explained in chapter 5.2.

Table 16 – Most important themes for case company B.

Technological Context	Organizational Context	Environmental Context
Category: Data Ecosystem ▪ Data systems and their capabilities	*Category:* Attention to AI ▪ No or little prior AI experience	*Category:* AI Expertise ▪ Dependency on external help
	Category: Human Resources ▪ Lack of AI competence ▪ Employees to lead or promote an AI initiative ▪ Lack of IT competence or knowledge	
	Category: Internal Resistance ▪ Change resistance ▪ Employee age	
	Category: Resources and Budgets ▪ Competing priorities ▪ Firefighting	

Note: *Numbers in parentheses (#) used in the following paragraphs refer to coded texts labelled with respective themes in the codebook in Appendix C.*

6.2.3.1 Themes of Technological Context

Data systems and their capabilities
Both interviewees mentioned that there are multiple systems that run in parallel which makes administration and operations more difficult and slower (#132, #133). "*It will be a bottleneck for further growth…*" (#132). The Production Manager also stated that the systems are old and in a bad state as they do not always allow to export data or generate necessary reports (#137, #138, #140).

6.2.3.2 Themes of Organizational Context

Change resistance
The Production Manager perceived that there might be "*sceptical attitude towards change*" as the vast majority of employees have worked in the company for a long time and they will "*always compare the new to the old and the old system and processes is something you know no matter how bad it might be.*" (#51, #60) The Graphic Advisor stated that it is department-based; while some departments can cope with change quickly, others are rooted in their daily routine and do not want to change much (#57).

Competing priorities
An AI initiative is currently not a priority (#101, #105) and as the Production Manager stated, if they were "*properly geared*", they could get started with it within a couple of months but it would only be relevant in 1.5

years as right now the priority is the new ERP system and they "*have no capacity to keep up with several projects at the same time*" (#102).

Employees to lead or promote an AI initiative
The Production Manager stated that "*there are no clear candidates*" with whom a project could get far without external resources, perhaps apart from the current IT manager who would then have to be replaced by someone else (#193). The Graphic Advisor mentioned that they "*really need new ideas and new people in order to lift us* (the company) *into the digital world. We are very digital, but I mean the next step.*" (#192)

Employee age
The Graphic Advisor mentioned that currently there are leaders in the company who are 50+ years old, the employees in the company have uniform experiences and competences, and "*the older you are the worse it is"* in terms of IT acceptance, thus having younger employees "*with new impulses*" would help them to "*hang more*" and look "*a little into the glass ball*" (#179, #181, #185). The Production Manager guessed that the average age in the company is 45 years and stated that the company employed a few younger employees this year as they "*have a little spotlight on the age issue here*" (#183, #185). "*You don't get a 20 year old* (employee) *well experienced then, but in a way we must have more spotlight on the age when we hire, because it will end up with be a problem*" (#183).

Firefighting
The Production Manager said that "*most days are quite busy*" with daily production and therefore AI-related and similar projects do not get a high priority (#216, #217, #224). The Graphic Advisor also expressed that such projects are not a high priority as they are overwhelmed with calculations, orders filling, communication and other sales or customer-related activities and as he mentioned, "*wheels must roll*" (#221, #222, #225).

Lack of AI competence
The interviewees expressed that their company has little knowledge about how to begin with AI and how to set up a project, implement it and maintain the technology. They both stated that the company would require external help (#10, #12, #13, #18, #23, #24). The Production Manager also said: "*We would have to put ourselves more into the AI, to be told what opportunities exist* […] *it is a matter of getting help to see what are the possibilities.*" (#25)

Lack of IT competence or knowledge
The Graphic Advisor stated that the company does not possess very strong professional IT knowledge (#260). The Production Manager said that they have one employee "*who has a pretty good expertise in IT* […] *but he ends up spending all his time on system maintenance*" and that they would have to employ someone with (IT) knowledge as the current employees would not be able to maintain a potential AI solution (#256, #257).

No or little prior AI experience
Both interviewees expressed that the company has no prior experience with AI technology (#302-304).

6.2.3.3 Themes of Environmental Context

Dependency on external help
Both representatives mentioned that if the company were to implement an AI-based technology or an AI solution, they would need to pay for external services as they do not have the necessary knowledge or competence internally (#152, #153, #160, #162). The Production Manager said: "[…] *if we were to buy an AI system, then we had to have a supplier who comes to us and says that 'here we have something that suits you* (and) *also we can make local adjustments"*" (#151).

6.3 Case Company C

The following report was constructed based on publicly available materials and information about the company and the interviews with representatives of the company. The interviews can be found in external Appendices H and I.

6.3.1 Company Profile

Case company C is based in Denmark and focuses on digital solutions consulting for firms and institutions operating in the financial sector in Denmark. The company does not develop any solutions but cooperates with software development companies in order to deliver products according to customers' needs. Through the help of the developer suppliers, the company can currently offer more than 10 products. Some of the products are tools for orchestration of processes or migration of customer, account and financial data, software connecting financial institutions with other types of companies and authorities, products helping financial institutions cooperate with each other, or data supplies as the company has been collecting financial and transactional data for several years. The company's turnover was below 42 million euros last year.

The organization employs 92 employees. There is the CEO sitting at the top of the company, followed by the Vice President and two Directors. They together make technology investment decisions. A big part of the company is comprised of Product Owners, Project Managers, Key Account Managers, Business Developers and their respective teams which include Business Consultants, Scrum Masters or UX Designers. The Product Owners and Managers talk to the customers or get change requests from them, forward them to the backlog and manage development resources from the vendors. The company also has standard back-office functions such as HR, Legal and Finance.

The interviewed representatives of the company were **the Head of Business Development** and **the Senior Business Developer & Project Manager**. They are typically project owners and their agenda also include development of new product ideas or suggesting improvements for the existing products.

The company was described as informal and compromise-seeking with a great social climate. It was mentioned that it is easy to talk to anyone regardless of their role in the hierarchy, which, as was argued, is in contrast with their clients in the financial sector. Teams also typically help each other depending on needed competence. The organization is now trying to be more customer-facing and expand the dialogue as in the past they had not been very proactive and had been focusing on passive maintenance of a few products.

The company had no experience with AI before a machine learning-based project was executed two years ago in cooperation with a small start-up with expertise in machine learning (ML). The project transformed one of their products evaluating real estate prices which had until then applied a model based on linear regression. It was a clear-cut case as the company had all the data and knew what they want to achieve. Despite this project, the representatives stated that the employees do not hold much competence in AI or machine learning as all the data cleaning and preparation and the development was done by the development firm. The employees of the company only managed and consulted the project, but the deep technical knowledge was approached as a black box and it was left to the development firm.

If the organization is going to execute another AI-based project, the team involved in such a project could comprise of one employee who is very technical, can code and knows a lot about IT systems, the Head of Business Development, the Senior Business Developer & Project Manager who was also involved in the previous project, one very business-minded consultant who is "excellent" in estimations and analysis, and a UX designer and two Key Account Managers depending on what kind of a project it is.

6.3.2 Future Outlook

The company is currently in the process of moving their outdated legacy systems to a modernized platform which will allow for more flexibility and use of microservices. The organization is already planning a next AI-based project that will improve one of their products but has no plans to use AI technology internally and for supporting purposes so far, and neither intends to hire internal human resources with competence in AI or ML. If there were an intention to use AI internally, the Head of Business Development mentioned that a good investment in an AI solution could be in something that would eventually make operations cheaper, faster, more accurate or it would reduce manual and monotonous tasks for humans. They perceive AI more as "a tool in their toolbox" rather than a complete solution. When it comes to financial resources in relation to AI-based improvements in their products, there seem to be no issues as the funds for the projects flow from their customers who ask for the new or improved products.

6.3.3 Perceived Barriers to Adopting AI Technology

The 10 most important themes representing barriers identified in both the interview with **the Head of Business Development** (external Appendix H) and the interview with **the Senior Business Developer & Project Manager** (external Appendix I) are displayed below in Table 17 in respective contexts and logical categories within which were the themes identified, as explained in chapter 5.2.

Table 17 – Most important themes for case company C.

Technological Context	Organizational Context	Environmental Context
Category: AI Black Box ▪ Lack of AI understanding	*Category:* Attention to AI ▪ Lack of AI understanding	*Category:* AI Expertise ▪ AI talent access ▪ Dependency on external help
	Category: Automation of Tasks ▪ Unclear use case	*Category:* Legal and Policy Constraints ▪ Ethical consequences ▪ GDPR concerns ▪ Legislation, regulation and compliance constraints ▪ Regulator concerns
	Category: Human Resources ▪ Lack of AI competence	*Category:* Risk Perception ▪ Losing human supervision

Note: *Numbers in parentheses (#) used in the following paragraphs refer to coded texts labelled with respective themes in the codebook in Appendix C.*

6.3.3.1 Themes of Multiple Contexts

Lack of AI understanding (technological and organizational context)
The Senior Business Developer & Project Manager perceived that a potential barrier could be if people do not have the "*knowledge about what the technology can do for you*" (#264). The Head of Business Development also expressed that "*people's understanding of it is a big obstacle*" (#265) and mentioned as an example that their employees had to be taught by a vendor company to explain to them how the technology works (#268, #271).

6.3.3.2 Themes of Organizational Context

Lack of AI competence

In connection to AI competence, the representatives indicated that the company substitutes the competence by outsourcing the knowledge and skills that are necessary to be able to execute and implement an AI project (#6-8, #21, #22). The Head of Business Development stated that the company "*had a great experience with a small company that had the knowledge*" (#7, #21). He also expressed that their employees "*need to be educated a bit more than they are today, in order for us* (the company) *not to be vulnerable*" (#26). The Senior Business Developer & Project Manager mentioned that "*any discussion about how to crunch the data and which model* (should be used) *and which estimation, the principles* (which) *were best, that was entirely the vendor*" (#22). He said that he thinks the product owners should know about the technology to consider its use but he thinks "*it's hard to find time to educate them to a level where they can actually have those considerations*" (#11).

Unclear use case

Both interviewees expressed that it is important to explore first what the technology should be specifically used for in an organization otherwise the return on investment might be at risk. "*I think it's a good approach to see, what use cases do we have? And does machine learning actually fit in here? Otherwise, we will just, we risk spending time on the wrong technology.*" (#93) "*And then you have to know what the result, what* (is) *the machine trained for, what is the end? What is the result we're trying to achieve?*" (#94) "*But I think it's a mistake, just to start looking without really knowing what you want to achieve. So I usually advise people to think about the use case and think about the technology after they figured out which use case they want to pursue.*" (#95)

6.3.3.3 Themes of Environmental Context

AI talent access

Both representatives stated that hiring new employees with AI knowledge or AI developers might be difficult. The Senior Business Developer & Project Manager said that they "*would have a problem because AI developers are very, very popular so it's hard to get good AI developers*" (#44) and therefore they "*would have to pay quite a high price to convince them to work for us* (the company)" (#47). The Head of Business Development mentioned that "*if you had to go out and hire people with machine learning skills which are pretty short demand, it would have taken four months just to get someone to hire*" (#45, #46).

Dependency on external help

Both interviewees mentioned several times that they will always need external services of vendors or developer companies as the company does not employ any developers, neither has any AI or machine learning-related competencies nor hosts IT systems in-house (#146-149, #158, #159, #161, #163, #164). The Senior Business Developer & Project Manager stated that they "*will always need external help for any project, more or less*" (#161). The Head of Business Development talked about the vendors they cooperated with before and if they were to expand any solution, they would ask for their services again (#148, #158).

Ethical consequences

The Senior Business Developer & Project Manager said that "*there are a lot of pitfalls when you start using AI*" (#196) that might lead to ethical consequences or dilemmas which they presented to and discussed with the regulator, as the Head of Business Development also stated (#194-196). "*One is, of course, bias - have we created a model that's more beneficial for certain segments of the Danish population? Does it give women an advantage compared to men and older, younger and so on?*" (#196)

GDPR concerns
The interviewees mentioned potential data privacy concerns in relation to the cloud hosting services used by the company (#227-232). "*Privacy concerns, certainly, because we have lots of property information.*" (#231) "*We had some problems about cloud hosting, because we have GDPR that limits where you can put data, you need to make sure that they are within the EU…*" (#232) "*…if you have a sensitive model, the FSA will probably say, you can't give that data to Google or to Microsoft or to Amazon, it's customer sensitive data…*" (#229)

Legislation, regulation and compliance constraints
The Head of Business Development stated that they operate in a "*regulated area* […] *so the technology exists, it works great, but you have to get it approved. And that's one of the obstacles that we've overcome.*" (#281-283) The Senior Business Developer & Project Manager also mentioned "*highly regulated sector*" as a potential barrier given that the company consults solutions for the financial sector (#278). Both representatives indicated that due to this restriction, the company would first have to discuss a potential solution with the regulator before implementing it (#277, #279, #280-283).

Losing human supervision
The Senior Business Developer & Project Manager mentioned as a potential barrier elimination of humans in the entire process of how one of their solutions works because the regulator was not very happy about it and preferred to keep a real person included, who would be able to "pull the emergency brake" (#286, #287). The Head of Business Development stated that it could be problematic since "*there's potentially no human eyes on it*" and "*the machine doesn't use common sense*", therefore it would not notice things in an evaluation process that humans would notice (#289).

Regulator concerns
Both interviewees stated a number of concerns of the regulator that might act as potential barriers to adopting AI technology. Since AI is not mentioned in the law and the people working for the regulator institution did not understand how the technology works, they had to be educated and convinced about the technology and its application (#335, #341). "*They thought it was some kind of black magic or voodoo that happened inside the machine.*" (#336) The regulator was also concerned whether the company, before implementing it, considered other important aspects such as security, ethical consequences, backup, version history and other things, and can guarantee that it is safe when the process and people are replaced by a machine (#337-340, #342-344).

6.4 Case Company D

The following report was constructed based on publicly available materials and information about the company and the interviews with representatives of the company. The interviews can be found in external Appendices J and K.

6.4.1 Company Profile

Case company D is a Property and Facility Management company based in Denmark which also provides caretaking, personnel for receptions and service centres, plumbing and electrical services, gardening, cleaning, inspections and other project-based services. The company was established more than 10 years ago and operates in a B2B market where about 20% of its customers are companies that rent housing units and about 80% are companies that own or administer corporate and business units. The turnover of the company was 5 million euros last year.

The company employs around 100 people (80 FTEs), some of them as part-time employees, and is owned by two partners, each holding 50% of the company's shares. The owners are at the same time acting Directors of the company. The management group comprises of the two Directors and 10 managers or leaders of respective departments and teams. There are three major departments in the company: the Property Maintenance Department with people working as gardeners, caretakers and building inspectors, some of whom have a background of a landscaper, plumber, electrician or a different technical profession, the Facility Management Department with a high number of personnel working as receptionists, personal assistants, secretaries, and the Projects Department with six-seven people working in project management and with project-based services, such as insurance or key account management, and deal with tasks that go beyond the daily maintenance. There is also the administrative unit of the company where three-four employees have broader responsibilities over a wide variety of tasks and different functions including HR and wage management and to a certain degree also IT.

The headquarters of the company is based in the Greater Copenhagen area and a small branch consisting of eight people is located in Jutland and takes care of the business in the west of the country. Given its size, it functions as an all-in-one department.

The interviewed representatives of the company were **the Operations Controller, System Administration & Development** who primarily focuses on improving and supporting their operations management platform, and **the Communication & Personnel Development Manager** who is a member of the management group. They are both part of the administrative unit of the company.

The organization has a flat horizontal structure and a very open, down-to-earth culture. The management and the senior personnel do not micro-manage nor keep their employees on the leash, the company operates within the term "freedom and responsibility", and there is an open-door policy to the Directors' office. The company's strategy is to grow and be a trendsetter in its market, and it sells itself as trustworthy and transparent to which contributes greatly their real-time operations management platform where customers get access to ongoing and completed tasks with all the photo documentation and invoices. The platform was delivered by their IT vendor and it is their competitive advantage. The company and its employees have **no experience with AI technology** and are not very proficient in terms of advanced IT skills apart from the Operations Controller who primarily focuses on the operations management platform. The operations management platform is a bit smart as it can plan tasks in the optimal route based on the distance between locations, how much time is needed for a single task and other variables, but it is not fully automated and not very used since the tasks are often unpredictable. According to the representatives, days are busy and full of operational tasks and thus there is not always time to think about unprecedented new changes or innovations.

6.4.2 Future Outlook

At this time, the company has no tangible plans with AI. In the past, the company was in contact with a few vendors who presented their solutions and suggestions, but it always turned out to be too complex or expensive. If the organization were to invest in an AI solution, the decision would be up to the two Directors who own the company, and their point of view is that the company should now focus on improving their real-time operations management platform, not to start another IT project. Therefore, a potential AI solution would most likely be built on top of the operations management platform. Both interviewees expressed ideas where AI-based technology could be utilized. The operations management platform could be collecting more data which would enable it to recognize patterns, alert employees what is wrong or where to put extra effort to save or increase the revenue and optimize partnerships with their customers. The company could also optimize administrative and operational processes or use robots for lawn mowing and cleaning. However, the

Communication & Personnel Development Manager shared an opinion that the industry and their customers might not be mature enough for AI technology yet. The Operations Controller stated that an acceptable AI investment would have to pay off within a couple of years, not in 10 years, and a break in investments would have to be within two years. If the organization were to start an AI project, the team involved would comprise of the Communication & Personnel Development Manager who would act as a mediator and Project Manager, the Operations Controller who would oversee the operational part of the project, and the two Directors (owners) who are very good in strategic thinking.

6.4.3 Perceived Barriers to Adopting AI Technology

The 9 most important themes representing barriers identified in both the interview with **the Operations Controller, System Administration & Development** (external Appendix J) and the interview with **the Communication & Personnel Development Manager** (external Appendix K) are displayed below in Table 18 in respective contexts and logical categories within which were the themes identified, as explained in chapter 5.2.

Table 18 – Most important themes for case company D.

Organizational Context	Environmental Context
Category: Attention to AI ▪ No or little prior AI experience	*Category:* AI Expertise ▪ Dependency on external help ▪ Price of an AI solution
Category: Human Resources ▪ Lack of AI competence ▪ Lack of IT competence or knowledge	
Category: Internal Resistance ▪ AI or technology scepticism	
Category: Investment Concerns ▪ Price of an AI solution	
Category: Resources and Budgets ▪ Firefighting ▪ Resources constraints	
Category: Strategic Benefits ▪ Unclear benefits of an AI initiative	

Note: *Numbers in parentheses (#) used in the following paragraphs refer to coded texts labelled with respective themes in the codebook in Appendix C.*

6.4.3.1 Themes of Multiple Contexts

Lack of AI competence (organizational and environmental context)
The Communication & Personnel Development Manager perceived that the company is lacking "*internal skills*" (#15) and would require proper training and education to be able to handle an AI project (#4, #14, #16). He also said that "*…if we cannot do it ourselves, we need to hire someone outside. Definitely. We've done that before…*" (#19). The Operations Controller stated that "*…if it's very complicated, then it's out of my league*" (#17).

Price of an AI solution (organizational and environmental context)
Both interviewees were concerned about the price of a potential AI solution (#326, #327, #330, #331). The Communication & Personnel Development Manager asked a rhetorical question *"…what's the cost? Can we do it reasonably cheap?*" (#326) and the Operations Controller said: "*How can this solution help us and how much does it cost?"* (#327), "*…it's a very, very complex task that has a lot of variables, and has to have a lot of different input, then all of a sudden, it gets very expensive. And I think that in time when it gets cheaper, then of course…*" (#330), "*…we found it hard to find tasks that were standardized enough for it not to be incredibly expensive to develop*" (#331).

6.4.3.2 Themes of Organizational Context

AI or technology scepticism
The representatives mentioned two concerns in relation to AI technology: it could induce "*the feeling of being surveilled all the time*" (#29), and it could get "*too smart, smarter than people*" and "*be dangerous*" (#37, #38). In addition, the Operations Controller mentioned that "*people are often concerned about stuff they might not understand.*" (#39)

Firefighting
The Communication & Personnel Development Manager expressed that they are "*very busy* […] *and to implement this, a new system, a new technology takes a lot of resources, it really does, then that takes time away from something else.*" (#218) The Operations Controller also mentioned that it is difficult "*because a work day is full of other stuff*" (#223) and stated that a task as large as implementing a potential AI solution "*would be a process over several months, where you have to use maybe 30% of your work hours. And that's sometimes a bit harder to fit...*" (#220).

Lack of IT competence or knowledge
The Communication & Personnel Development Manager said: "*Especially in terms of our colleagues' skills, resources, competencies. They're not there fully. Let me give you an example. If you're not fully operating with the Microsoft Office, how can you operate something that's more elaborate, right? […] we need to have the right colleagues, the right staff in order to operate some sort of IT. And then that the maturity for me, isn't there yet cross-organizational…*" (#251). The Operations Controller also talked about the company in the sense that it is not "*where everybody is that well experienced in computer usage and stuff like that. So we might have problems with people who are not that good at using technology.*" (#261, #248)

No or little prior AI experience
Both interviewees expressed that the company has no prior experience with AI technology (#299, #306, #308). "*And not that I'm aware of have we ever implemented AI in our company. Not that I know of.*" (#299). "*…it is not something that we use…*" (#308).

Resources constraints
The representatives were concerned about finances, human resources, competence and time. They mentioned that their human resources are not skilled enough, or that it is hard to find available human resources that could spend time on filling out all required data and on other preparation tasks, in order to implement a new system (#347, #348, #352). "*…to implement a new system, it takes a lot of time, a lot of resources.*" (#349) "*To acquire the reasonable or the right amount of resources, I am talking time, talking cost, I'm talking skills, internal skills…*" (#353)

Unclear benefits of an AI initiative

In relation to the benefits of a potential AI solution, the Operations Controller made statements such as: "…*we also don't know exactly what the payoff is*" (#67), "*…that is just the two factors - how can this solution help us…*" (#73) or "*And then of course* […] *when can this be paid off*" (#77). The Communication & Personnel Development Manager also talked explicitly about the benefits of the technology: "*But also, is it really beneficial? Is this just a smart trend that isn't taking us anywhere* […] *or is it really beneficial for us and also for our clients? Does it add value to our company? I think that's the main factor.*" (#68), "*Can we do it so it's actually beneficial? It needs to be beneficial…*" (#70).

6.4.3.3 Themes of Environmental Context

Dependency on external help

Both interviewees expressed that if it is something as complicated as an AI solution, which the company and its employees cannot handle themselves, the company will seek external help (#154-157). "*If I can't - if I can see already that, well, this isn't anything I can handle then we acquire help.*" (#154) "*…if we bought some software, some AI software that needs to be implemented - maybe we could also hire consultant from that company, that would also be beneficial, I think.*" (#155) "*most often it is the company that delivers our operation system that would help us […] either in logging some data or predicting or whatever, with some data, so it will always, more or less always be them. And they're like an IT company.*" (#157)

6.5 Summary of All Findings

Tables in this subchapter display all 65 unique themes representing barriers to adopting AI, which were identified across all the interviews with representatives with the four SMEs.

Tables 19 a 20 display a summary of all 65 unique themes grouped within three contexts of the TOE framework and into logical categories, as explained in chapter 5.2. 15 themes were listed under the technological context, 42 themes under the organizational context and 23 themes under the environmental context. A total of 13 themes were listed under multiple context groups.

Table 19 – Summary of unique themes grouped within contexts and into logical categories, part 1.

Technological Context	Organizational Context	Environmental Context
Category: AI Black Box ▪ Lack of AI understanding ▪ Technology complexity ▪ Technology transparency ▪ Trust	*Category:* Attention to AI ▪ Lack of AI understanding ▪ No or little prior AI experience ▪ Not following AI trends	*Category:* AI Expertise ▪ Lack of AI competence ▪ AI talent access ▪ Dependency on external help ▪ Evaluating external vendors and consultants ▪ Price of an AI solution
Category: Company-Tech Fitness ▪ Complexity of technology adoption ▪ Incompatibility of an AI solution with an organization's legacy IT systems or processes	*Category:* Automation of Tasks ▪ Unclear use case ▪ Tasks or processes that are challenging to streamline	*Category:* Customer Concerns ▪ AI or technology scepticism ▪ Customer contract constraints ▪ Customers misunderstanding or not knowing what AI is ▪ Customers not being able to utilize AI ▪ Customers not being ready to adapt to change ▪ Lack of AI understanding ▪ Risk of losing reputation and damaging customer relationships ▪ Trust
Category: Data Ecosystem ▪ Data quality ▪ Data systems and their capabilities ▪ Data systems are not properly connected ▪ Lack of data	*Category:* Human Resources ▪ Lack of AI competence ▪ AI talent access ▪ Demanding and long onboarding process ▪ Insufficient employee training ▪ Employees to lead or promote an AI initiative ▪ Lack of IT competence or knowledge	
Category: Negative Perspectives of AI Tech ▪ AI or technology scepticism ▪ AI perceived as limited ▪ AI technology perceived as immature	*Category:* Internal Resistance ▪ AI or technology scepticism ▪ Change resistance ▪ Employee age ▪ Fear of losing job	*Category:* Industry Factors ▪ Industry specifics prevent long term investments ▪ Not perceived as necessary right now
Category: Value Perception ▪ Unclear benefits of an AI initiative ▪ Unclear use case		

Table 20 – Summary of unique themes grouped within contexts and into logical categories, part 2.

Organizational Context	Environmental Context
Category: Investment Concerns ▪ Acquiring costly and problematic solution ▪ Price of an AI solution ▪ Risk of draining more resources than expected before seeing benefits ▪ Risky investment	*Category:* Legal and Policy Constraints ▪ Ethical consequences ▪ GDPR concerns ▪ Legislation, regulation and compliance constraints ▪ Regulator concerns
Category: Owner and Management Views ▪ Management communication ▪ Not perceived as necessary right now ▪ Owner's interests ▪ Unrealistic expectations	*Category:* Risk Perception ▪ Losing human supervision ▪ Risk of becoming too vulnerable ▪ Risk of technology misuse ▪ Security concerns
Category: Resources and Budgets ▪ Budget constraints ▪ Competing priorities ▪ Financial constraints ▪ Firefighting ▪ Human resources ▪ Resources constraints	
Category: Strategic Benefits ▪ Unclear benefits of an AI initiative ▪ Lack of clear business case and strategy ▪ Proving short-term benefits	
Category: Strategic Risks ▪ Losing human supervision ▪ Moving too fast ▪ Risk of becoming too vulnerable ▪ Security concerns	
Category: Transformation Constraints ▪ Dependency on IT department ▪ Implementation capabilities ▪ Incompatibility of an AI solution with an organization's legacy IT systems or processes ▪ Lack of diversity to foster innovation ▪ Non-uniform structure or processes across organization ▪ Slow adoption process	

The following four tables below display titles of the themes, descriptions of the themes, cases in which they were identified, and references to snippets of answers (evidence) which were labelled with these themes in the codebook (see Appendix C).

6.5.1 Themes of Multiple Contexts

Table 21 shows 13 themes that were classified within multiple contexts. Themes displayed

Table 21 – Themes of multiple contexts.

Theme	Context	Description	Case	Codebook Reference
AI or technology scepticism	T/O/E	Having doubtful thoughts about the technology; fear of technology they do not understand; thinking that something could go wrong; concerns of being surveilled.	ABCD	#27-39
AI talent access	O/E	Difficulties in the process of finding and hiring AI experts.	C	#44-47
Incompatibility of an AI solution with an organization's legacy IT systems or processes	T/O	An organization's legacy IT systems or processes are not compatible with or easily adaptable to a vendor's AI solution or vice versa.	ABC	#240-245
Lack of AI competence	O/E	Lacking skills to be able to manage an AI adoption project.	ABCD	#4-26
Lack of AI understanding	T/O/E	Employees or customers of an organization not understanding what AI is, not knowing what its purpose is and what the AI technology can do, or not understanding how it works.	ABC	#262-271
Losing human supervision	O/E	An organization or a regulator being concerned about replacing a human in an organization's process by a potential AI solution.	BC	#286-289
Not perceived as necessary right now	O/E	The impression that adopting an AI solution is currently not necessary.	BD	#318-320
Price of an AI solution	O/E	An expensive AI solution or the high cost of adopting a potential AI solution in an organization.	BCD	#326-331
Risk of becoming too vulnerable	O/E	Concerns about becoming vulnerable due to reasons such as, e.g., not being able to contact a service provider's support while using its cloud services to host an AI solution.	C	#356
Security concerns	O/E	The perception that a potential AI solution may be vulnerable, or may increase the vulnerability of an organization's systems, to unauthorized external access.	AB	#376, #377
Trust	T/E	Distrust in a potential AI solution.	C	#389
Unclear benefits of an AI initiative	T/O	Unclear or no perceived benefits of the technology.	ABCD	#66-80
Unclear use case	T/O	Unclear or no perceived opportunity to use AI technology in the organization.	BC	#93-96

6.5.2 Themes of Technological Context

Table 22 shows 9 themes that were classified within the technological context, excluding 6 themes classified within multiple contexts of which one of them was technological context (see Table 21).

Table 22 – Themes of technological context.

Theme	Description	Case	Codebook Reference
AI perceived as limited	The perception that certain AI technology is limited for more ambitious use.	C	#40-43
AI technology perceived as immature	The perception that AI technology is still in its initial phase and not ready for use.	B	#48
Complexity of technology adoption	Factors involved in a complicated process of adopting AI-based technology.	A	#107
Data quality	Missing, insufficient, incomplete or inaccurate data, or poor structure of data.	CD	#125-129
Data systems and their capabilities	Parallelly running systems for the same purpose; outdated systems; systems difficult to operate or manage; insufficient options or functions of a system.	AB	#130-135, #137-141
Data systems are not properly connected	Systems do not communicate with each other, i.e., do not exchange information effectively or at all.	AB	#136, #142, #143
Lack of data	Missing data necessary to adopt a potential AI solution.	D	#272
Technology complexity	Attributes of AI technology that make it difficult to adopt it for certain use cases.	C	#387
Technology transparency	An AI solution not being transparent enough which makes it difficult to explain its decisions.	C	#388

6.5.3 Themes of Organizational Context

Table 23 shows 30 themes classified within the organizational context, excluding 12 themes classified within multiple contexts of which one of them was organizational context (see Table 21).

Table 23 – Themes of organizational context.

Theme	Description	Case	Codebook Reference
Acquiring costly and problematic solution	Being discouraged by a past technology acquisition which was costly, and it did not prove to be a good decision for the organization.	B	#1, #2
Budget constraints	An estimate of revenues and expenses for a set period of time preventing to acquire AI technology.	A	#49, #50
Change resistance	People in an organization reluctant or refusing to accept changes related to adopting new technology for various reasons.	ABCD	#51-63
Competing priorities	Projects, tasks and activities having higher priorities than an AI initiative.	ABD	#97-106

Theme	Description	Case	Codebook Reference
Demanding and long onboarding process	Difficulties in connection with the process when new employees competent in AI or IT acquire the necessary knowledge, skills and behaviors to be able to contribute to the adoption of AI technology in an organization.	C	#144-145
Dependency on IT department	An organization is dependent on knowledge, skills and IT resources of an outsourced IT services department, that was contracted by the owners.	A	#165-176
Employee age	High employee age in an organization.	ABC	#178-185
Employees to lead or promote an AI initiative	An organization lacks clear candidates to lead an AI initiative.	AB	#191-193
Fear of losing job	Employee concerns about being replaced by AI technology.	AD	#203-206
Financial constraints	Limited financial resources allocated to acquire AI-based technology in an organization.	ABD	#208-212
Firefighting	Spending time and resources on problems that need to be dealt with quickly, instead of focusing on innovation and moving the business forward.	ABD	#214-225
Human resources	Lack of skilled and experienced employees.	AB	#234-236
Implementation capabilities	The perception that insufficient implementation capabilities of an organization might hinder adoption of a potential AI solution.	D	#237-238
Insufficient employee training	Lack of training and educational solutions for employees in order to make them understand or be able to operate AI technology.	ACD	#186-190
Lack of clear business case and strategy	Unclear or no plan and estimation of time and costs to adopt the technology.	ABD	#81-88
Lack of diversity to foster innovation	An organization lacking diversity and new ideas due to the homogeneity of its employees that possess similar competencies and experiences.	B	#273, #274
Lack of IT competence or knowledge	Lacking IT expertise and experience with IT projects; low digital and computer skills necessary to operate or work with technology.	ABCD	#247-261
Management communication	Lack of communication of the management with employees about the onboarding of a potential AI solution, how the technology will work in an organization and how it will align and fit into an organization.	AD	#290-292
Moving too fast	An organization is not ready for, is unwilling to, cannot afford to, or cannot cope with change.	A	#294-298
No or little prior AI experience	An organization lacking experience with AI-based technology.	ABCD	#299-308
Non-uniform structure or processes across organization	Inconsistent structure, processes or workflow across an organization.	B	#309, #310
Not following AI trends	Not being aware of, not being interested in or not spending time to get informed about AI technology and its potential use cases and best practice strategies.	ABD	#311-317
Owner's interests	Owner(s) not being interested to invest in an AI solution.	A	#324

Theme	Description	Case	Codebook Reference
Proving short-term benefits	An organization not being content with the estimated return on investment in AI technology within a relatively long timeframe.	BD	#332-334
Resources constraints	Limited time, financial, human and IT resources, skills, tacit and explicit knowledge, IT infrastructure and equipment, and IT expertise of an organization.	ABD	#345-355
Risk of draining more resources than expected before seeing benefits	An organization's concerns that adoption of a potential AI solution might consume more financial or human resources than estimated before achieving any return on investment.	AB	#358-361
Risky investment	Investing time, financial and other resources in new technology perceived as risky.	D	#373-375
Slow adoption process	The perception that adopting new technology an organization is a slow and lengthy process.	AB	#379-381
Tasks or processes that are challenging to streamline	Tasks or processes in an organization that are not standardized or consistent and therefore are difficult to streamline using AI-based technology.	ABD	#382-386
Unrealistic expectations	Expecting more than what a potential AI solution can be or can do.	A	#391

6.5.4 Themes of Environmental Context

Table 24 shows 13 themes that were classified within the environmental context, excluding 10 themes classified within multiple contexts of which one of them was environmental context (see Table 21).

Table 24 – Themes of environmental context.

Theme	Description	Case	Codebook Reference
Customer contract constraints	Limited flexibility or conditions of a customer contract preventing the adoption of technology that would affect the relationship with a customer.	A	#110-114
Customers misunderstanding or not knowing what AI is	Customers discouraged due to used AI definitions; customers do not understand or are afraid of AI-based technology.	AC	#115, #116
Customers not being able to utilize AI	Factors preventing customers to use and benefit from AI technology.	C	#117
Customers not being ready to adapt to change	Customers are not mature enough or not prepared yet to use AI-based technology.	AD	#118-124
Dependency on external help	An organization needs consulting services, software development services or human resources of a vendor to able to adopt AI-based technology.	ABCD	#146-164
Ethical consequences	Moral concerns related to the use of AI-based technology such as due to potential biases of an AI solution.	C	#194-196
Evaluating external vendors and consultants	Inability to choose a reliable and competent company or consultants to help with the adoption of AI technology.	A	#197-202
GDPR concerns	Data privacy concerns. An organization or a regulator being concerned about how and where data is stored.	CD	#226-233
Industry specifics prevent long term investments	Concerns due to reasons such as, e.g., that the technology acquisitions of an organization operating in a fast-paced industry might become obsolete in a few years.	B	#246
Legislation, regulation and compliance constraints	Rules, policies and law requirements hindering adoption of a potential AI solution.	AC	#277-285
Regulator concerns	A regulator not understanding how AI works or being concerned about the use of AI technology due to ethical consequences, biases, security and other factors.	C	#335-344
Risk of losing reputation and damaging customer relationships	Concerns about adopting a potentially problematic AI solution and alienating customers, discouraging customers by using the term AI, or replacing personal services with an automated solution.	ACD	#362-370
Risk of technology misuse	Concerns about the misuse of an AI solution by a third party, e.g., by knowingly influencing parameters that the algorithm takes into account.	C	#371

6.6 Most Important Findings from the Cross-Case Analysis and Synthesis

The range of the five tiers of importance was defined and used to identify common themes across the interviews with representatives of the four SMEs, as described in chapter 5.4. Following themes were identified within the respective tiers of importance and represent the most important findings of this research:

1. **Themes found in all 4 cases in both interviews per case (1 theme):**
   - Lack of AI competence (O/E)[1]
2. **Themes found in all 4 cases in at least 1 interview per case and in 3 cases in both interviews per case (3 themes):**
   - Dependency on external help (E)
   - Lack of IT competence or knowledge (O)
   - No or little prior AI experience (O)
3. **The rest of the themes found in all 4 cases in at least 1 interview per case (3 themes):**
   - AI or technology scepticism (O/E)[2]
   - Change resistance (O)
   - Unclear benefits of an AI initiative (O/T)[3]
4. **Themes found in 3 cases in at least 1 interview per case and in 2 cases in both interviews per case (5 themes):**
   - Competing priorities (O)
   - Employee age (O)
   - Firefighting (O)
   - Lack of AI understanding (O/T)[4]
   - Resources constraints (O)
5. **The rest of the themes found in 3 cases in at least 1 interview per case (8 themes):**
   - Lack of clear business case and strategy (O)
   - Insufficient employee training (O)
   - Financial constraints (O)
   - Incompatibility of an AI solution with an organization's legacy IT systems or processes (T/O)[5]
   - Not following AI trends (O)
   - Price of an AI solution (O/E)[6]
   - Risk of losing reputation and damaging customer relationships (E)
   - Tasks or processes that are challenging to streamline (O)

Note: *The letters in parentheses indicate the context of the themes (organizational, technological, environmental).*

[1] Environmental context matched in all 4 cases in at least 1 interview per case.

[2] No context matched in 4 cases. organizational context matched in 3 cases in at least 1 interview per case, and environmental context matched in 2 cases in at least 1 interview per case.

[3] Technological context matched in 3 cases in at least 1 interview per case.

[4] Technological context matched in 2 cases in at least 1 interview per case.

[5] Organizational context matched in 2 cases in at least 1 interview per case.

[6] No context matched in 3 cases, organizational and environmental context matched in 2 cases in at least 1 interview per case.

It was found that only the theme "Lack of AI competence" within the organizational context was identified in all the eight interviews with the representatives of the four SMEs. Due to this fact, the theme "Lack of AI competence" was the most valid finding. The theme "Lack of AI competence" within the environmental context was also identified among all four cases (SMEs) but only in at least one interview per case.

The findings are also presented through the lens of the TOE framework and grouped into logical categories (as explained in chapter 5.2) below in Figure 12.

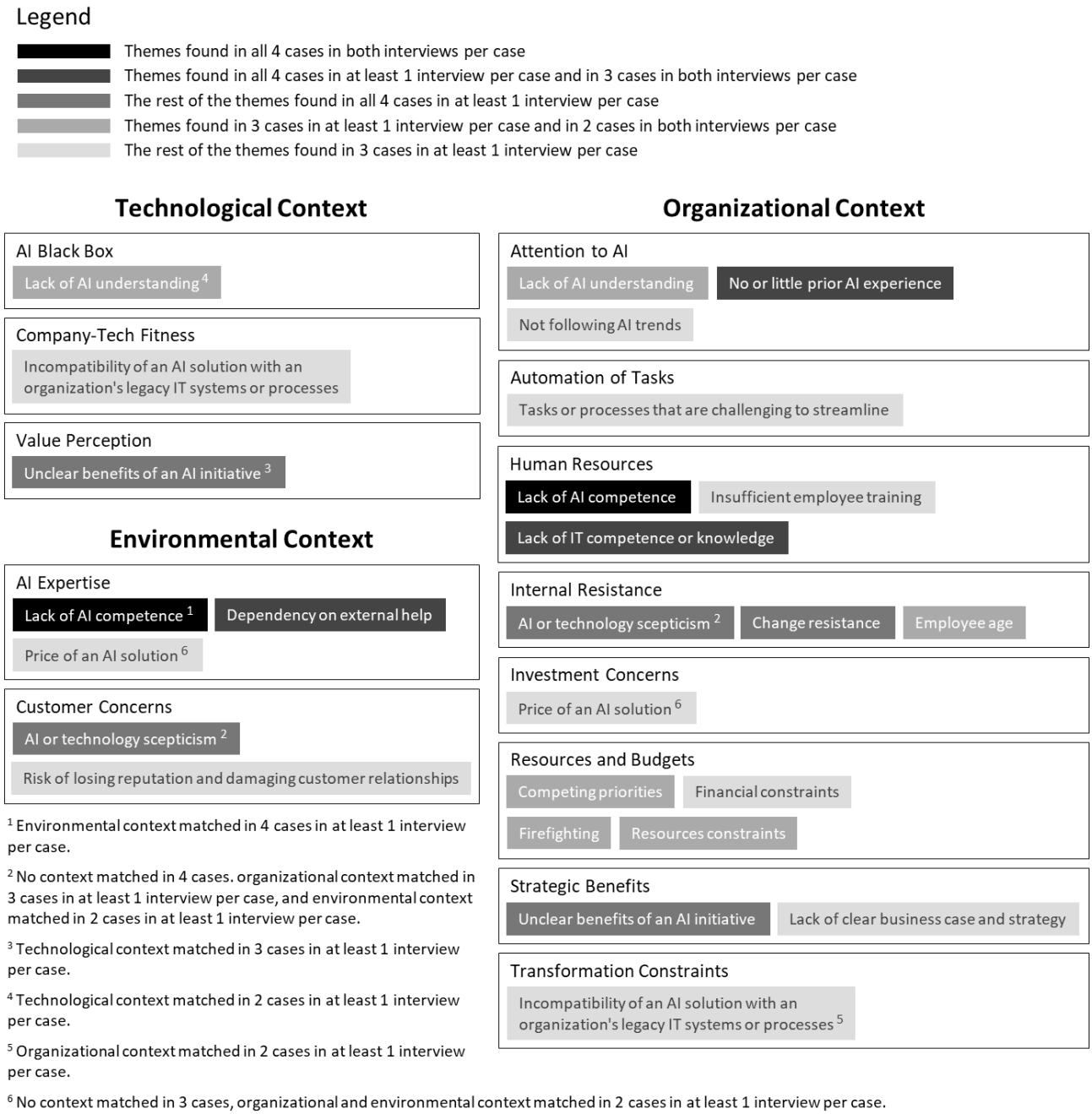


Figure 12 – The hypothesis: the most important AI adoption barriers among studied SMEs.

6.7 Hypothesis

Based on the above-presented results, the following hypothesis was formed:

"*The most common barriers to adopting AI technology in small and medium-sized sized enterprises could include: (1) Lack of AI competence, (2) Dependency on external help, (3) Lack of IT competence or knowledge, (4) No or little prior AI experience, (5) AI or technology scepticism, (6) Change resistance, (7) Unclear benefits of an AI initiative, (8) Competing priorities, (9) Employee age, (10) Firefighting, (11) Lack of AI understanding, (12) Resources constraints, (13) Lack of clear business case and strategy, (14) Insufficient employee training, (15) Financial constraints, (16) Incompatibility of an AI solution with an organization's legacy IT systems or processes, (17) Not following AI trends, (18) Price of an AI solution, (19) Risk of losing reputation and damaging customer relationships, (20) Tasks or processes that are challenging to streamline*."

7 Discussion

The discussion is dedicated to the interpretation of the results and hypothesis presented in the previous chapter. The implications for SMEs, limitations of the study and recommendations for future research is also presented.

7.1 Reflection on the Research Objectives

To answer the research question of "*why are some SMEs hesitant to adopt AI*", the following research objectives were fulfilled:

1. *Explain what factors come into play, discouraging SMEs from engaging in AI-investments.*
2. *Show similarities and differences with the perception of AI-adoption among selected SME case-examples.*
3. *Establish an AI technology adoption framework that would support SME managers in addressing challenges that arise from projects that require some degree of AI technology.*
4. *Contribute to progress the research field of AI adoption in SMEs, which was found to be barely explored.*

The first objective of the research question was to explain what factors come into play, discouraging SMEs from engaging in AI-investments. In this research, the factors are represented by perceived barriers identified in the answers of the interviewed representatives of the four companies. The findings were analyzed through multiple-case study research where five tiers of importance were established to classify themes representing AI adoption barriers based on in how many cases and in how many interviews per case were they identified. The highest tier contains a theme that was found in all four cases in both interviews per case, while the lowest tier contains themes identified in three cases in at least 1 interview. This was the range established to capture the most significant findings of this research for the construction of the final hypothesis. In addition, a summary of all unique themes found was presented with a description for each.

The second objective of the research question was fulfilled by presenting the four case companies through individual case reports where differences and significant AI adoption barriers for each company were highlighted and by presenting the final structured hypothesis of the research, where AI adoption common barriers among companies were highlighted–that is the similarities among the companies. The case company reports followed a similar structure where certain aspects of the company were explained, such as where and in which industry does the company operate, position on the market and turnover, the organizational structure of the company, culture and work style or IT skills and resources in the company.

The third objective of the research was addressed by presenting the final hypothesis and by presenting the summary table of the unique themes representing barriers and their respective descriptions. The framework can be understood as both the hypothesis and the summary of all the unique themes. The reader, e.g., an SME Manager, should first pay attention to themes representing AI adoption barriers and their tiers of importance in the hypothesis and the discussion part of findings where themes in the hypothesis are reflected back to the literature review. Only in the second step should the SME Manager focus on the summary table where all the unique themes found across the interviews with representatives of the four companies are presented. The framework is not an AI adoption guide, it is an overview of what factors could typically act as AI adoption barriers and readers should also consider the limited scope and sample of this research. If a company has no prior experience with AI at all, desires to get informed while considering to adopt AI technology, or wants to assess its maturity in terms of AI, the company's Manager could use the framework as an assessment tool to evaluate and understand the situation of a company.

The fourth and final objective of the research question was to contribute to the research field of AI in SME setting. It was discovered that no substantial research on what makes SMEs hesitant to adopt AI was conducted, even though the problem of SMEs lagging behind large enterprises in AI adoption was recognized by many institutions, including the European Parliament (2019). To fill the research gap, a preliminary multiple-case study with a small sample of four companies was conducted. The study specifically targeted the AI adoption decision and presented the results, that were directly related to the above-mentioned issue, through the lens of the TOE framework. In addition, with respect to the findings, future recommendations for the researched field were presented in the discussion part of this paper.

7.2 Expectations of the Research

There were several expectations to how the data collection and results would turn out, both based on the literature review process and prior understanding of what the issues with AI adoption could be.

Since four companies from different industries were chosen, it was expected that some of the organizations would be more technologically advanced than others and that they would have different basis when considering adopting AI. These differences were addressed in the individual case descriptions in the results. It turned out that there were also several unique key issues discouraging the different SMEs, issues that could not be generalized upon. "Dependency on IT department", regulations in the public sector, and "customers not ready for change" make the issue of AI adoption complicated to address as one must consider each SME's context separately.

The results were expected to vary depending on what type of representatives of an organization would be interviewed–the higher in the hierarchy the representatives would be, the more they would potentially know or heard about AI and that they would have a more holistic approach to considering AI adoption. In the SMEs, it turned out that the hierarchies were very flat, so all the interviewees were quite close to a role of participating in a potential adoption evaluation process. Prior to the interviews, it was a bit worrisome that the interviewees would potentially not be able to follow the topic or provide any valuable answers. Though the case companies (A-D) were chosen due to their lack of AI experience, it was not really an issue to discuss the topic. Due to the focus on perception among decision makers, interviewees had the freedom to assess and discuss AI for their respective SMEs based on their knowledge and attitude towards the topic.

There were also some assumptions made on "Advantages and disadvantages" that SMEs typically experience, as seen in Table 3 in chapter 2.2.2. In the results, the themes of "Resource Constrains", "Lack of AI experience" and "Tasks or processes that are challenging to streamline" are quite comparable to the disadvantages that SMEs typically experience during innovation processes.

Presumptions were made concerning whether companies would have their own distinct barriers due to factors such as company culture, legacy systems' and organizational structure and the staff's competence. What can be seen from the results is that the organizations listing of staff is closely connected to operational activities, and that only company cases C and D have some employees that have certain capacity for innovation-related tasks. The SMEs have little room for long-term activities and projects, as it usually implies taking key-employees away from more crucial short-term tasks. In cases B, C, and D, the organizations would have to hire external help as they do not have dedicated IT business units that do anything more than the maintenance of current systems.

Regarding lack of competence and lack of resources, which are typical issues for SMEs, they were expected to be mentioned more and it was also expected that the representatives would talk more about the difficulty with streamlining or automating certain business processes. The interviews turned out to focus more on issues

connected to people and experience rather than system issues. This might suggest two things; the technical evaluation comes second to organizational issues, or/and the interviewees were influenced by the interview context, grasping the topic from a place where they knew they could contribute with knowledge and helpful answers to the research. This might not be necessarily a negative aspect, as decision-makers would most likely want to have confidence in that their employees are able to see through the project.

Drawing conclusions on whether the competitive environment is a decisive factor among the interviewed SMEs was found to be difficult, as none of them were currently experiencing any competitive pressure to adopt AI. They did talk about considering to adopt AI if a competitor started to scale AI, but it was also said that they would not either necessary adopt AI just for the sake of it. They need to see that it can create value before using it, and this might create future complications, as the risk of falling behind is serious. The consequence might be that once it comes to public knowledge that competitors have adopted AI technology, starting with AI initiatives without preparation might make it difficult to catch up. There is a strong presence of the previously mentioned "fast adoption" mentality that Mahidar and Davenport addressed and did not recommend, proposing that some organizations might underestimate what it takes to generate value through insight generation, productivity measurement or automation of tasks (Mahidar & Davenport, 2018). The issue of short-term thinking and "firefighting" was very present, therefore it is considered a huge threat to AI initiatives once the resource requirement is finally estimated, as there is little acceptance for a longer development period and AI is currently a "patient man's game".

7.3 Implications for SMEs

The most important barriers for SMEs to adopt AI technology were identified, analyzed and are presented through the lens of the TOE framework. The constructed hypothesis answers the research question of this study but does not reflect on relationships between the identified obstacles. Therefore, this subchapter puts barriers into a broader perspective and discusses how the found barriers influence each other. Figure 13 below demonstrates one of the possible interpretations adopted by the authors of this research. The interpretation is not absolute or final, it is a pragmatic view on the results of this study. Displayed connections do not imply that "A is the only reason why B occurs", they merely indicate "A might be one of the reasons why B occurs".

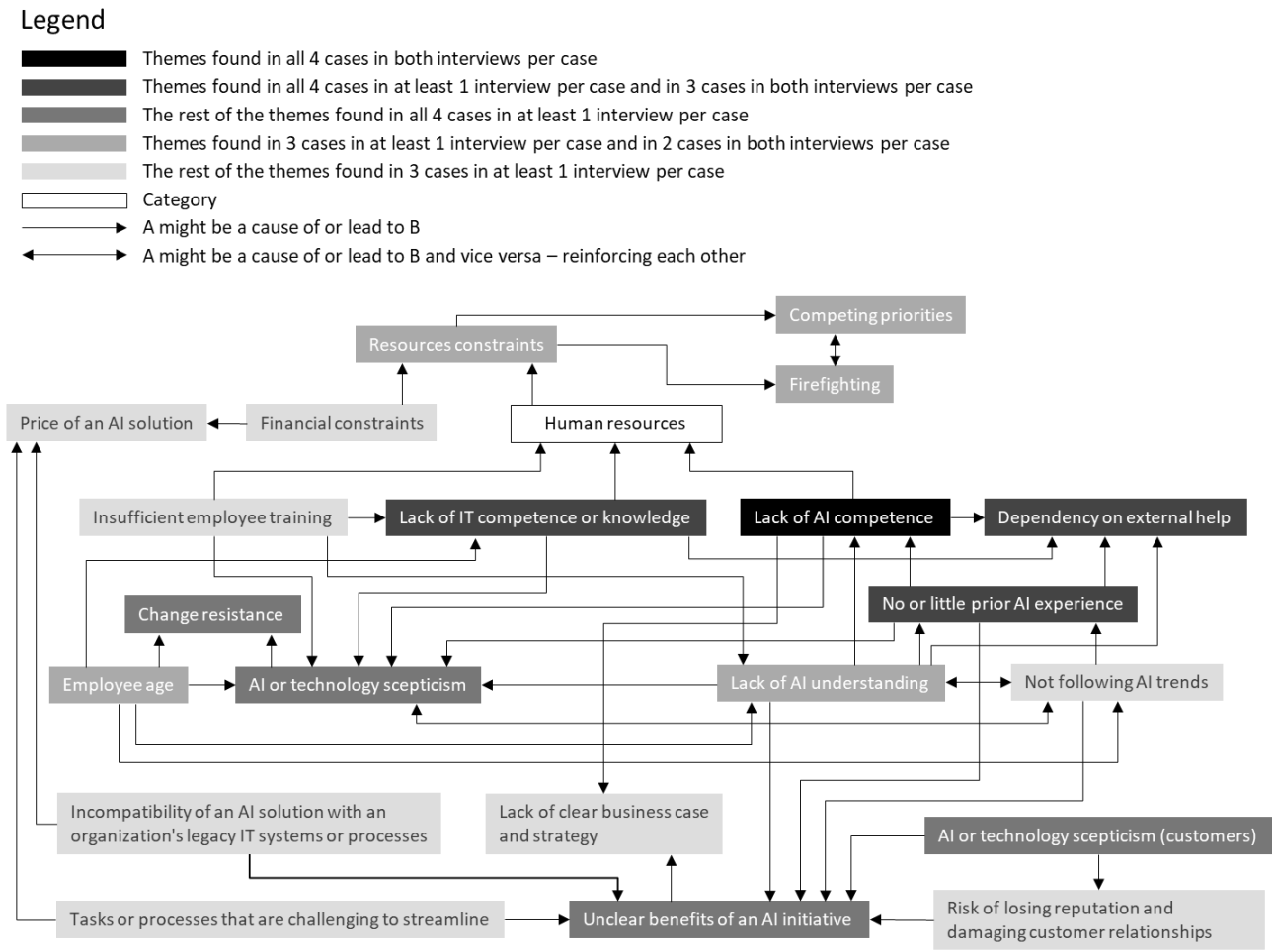


Figure 13 – A logic model of potential relationships among identified AI adoption barriers in SMEs.

To be able to successfully manage an AI adoption project (Lack of AI competence), SME managers need to have experience with the technology (No or little prior AI experience), which is likely not to happen if they do not understand how AI technology works (Lack of AI understanding) or do not stay informed about the potential use cases and best practice strategies in the field (Not following AI trends). If an SME does not understand the technology, has little prior experience with AI and lacks the internal expertise to engage with the technology, it must seek outside help (Dependency on external help).

The most common barriers related to human resources were found to be lack of AI competence, insufficient training for employees who need to know how to operate the technology, and lack of internal IT expertise and skills. Human resources along with financial constraints are part of general resources constraints. If an SME does not have enough resources to run day-to-day operations, research and innovate at the same time, its focus might shift primarily towards daily tasks and any innovation-related activities might fall to the lowest priority or be put on hold.

Insufficient employee training, lack of IT competence or knowledge and lack of AI competence might also, along with no or little prior AI experience, not following AI trends and lack of AI understanding, cause AI or technology scepticism among employees of an SME. Another important factor is the average age of employees which, if higher, might also contribute to technology scepticism. Both factors employee age and AI or technology scepticism might be causes of change resistance within an SME.

If an SME works with tasks or processes that are challenging to streamline and where different variables come into play, it might also increase the complexity of a potential AI solution and thus lead to higher price of the service or solution delivered by the vendor. If an organization's legacy IT systems or processes are not compatible with or easily adaptable to the vendor's solution or vice versa, the solution might have to be customized more which would also push up the price of the AI solution. Whether the solution is perceived as too expensive depends on the financial situation of an SME.

To be incentivized to adopt AI-based solutions, SMEs must perceive clear benefits of an AI project. That could be difficult if an organization's employees have no or little prior AI experience, do not follow AI trends or do not understand the technology. Unclear benefits of an AI initiative could be also perceived by an organization if its employees work with tasks or processes that are challenging to streamline and where different variables come into play. Also, if customers of a company are sceptical about AI technology, if a company perceives any risks connected to a potential AI solution that might alienate customers, such as not being confident about the outcome of an AI project that would affect the service being delivered to customers, or if the solution needs to be more customized and becomes too expensive due to its incompatibility with an organization's legacy IT systems or processes, these external factors might decrease the perceived value of a potential AI solution. If an SME cannot perceive clear benefits of an AI initiative and lacks internal AI competence, it might be challenging to create a clear AI business case and strategy, which are essentials to be able to successfully execute an AI project.

7.4 Comparison to Research

There are several comparisons and differences that can be drawn between the results of this research and the literature review. From Table 4 in chapter 3.1.2, four authors that were rated 5 out of 5 in terms of relevancy are being compared to in this subchapter.

In the report from McKinsey & Company (2018b), which includes a survey on experienced "barriers to AI adoption", the results point to similar aspects that the hypothesis in this study also connects to perceived engagement barriers. The top three barriers found by the report were "Lack of clear strategy for AI", "Lack of talent with appropriate skills sets for AI work", and "Functional silos constrain end-to-end AI solutions". The last-mentioned barrier is similar to the theme "Incompatibility of an AI solution with an organization's legacy IT systems or processes" identified by this study. The survey also found "Lack of leaders' ownership of and commitment to AI" and "Limited usefulness of data", factors that were also identified in this research but are not supported by sufficient evidence in order to be included in the hypothesis (most important barriers). While this research found that SMEs struggle with competing priorities and resource constraints, the report addressed a similar issue "Under-resourcing for AI in line organization". What could not be identified was the factor "Personal judgment overrides AI-based decision making", meaning that the human intuition is often perceived as more effective than what AI currently can offer, though the literature review of this research includes the concept. The survey is based on a strong data sample (collected from organizations of all sizes) but does not show what the research suggests as additional important issues, such as "AI or technology skepticism", "Dependency on external help" and the common aspect of "Firefighting", caused by "Resource constraints" in SMEs.

In Ghobakhloo et al.'s (2012) literature review on IT adoption in SMEs, they found several reasons for failed IT adoption initiatives such as "Inadequate teaching and preparation of end users", "Inappropriate connection between adopted IT and enterprise strategies" and "Business size and fund limitations to employ IT specialists". Several of these issues could be perceived as a more holistic view of the issues that the hypothesis highlights. Similar to "Insufficient employee training", the first mentioned reason points to that employees are

somewhat right in their concerns that they might not understand or be able to operate AI technology. The second reason mentioned addresses the barrier that is similar to the theme found in this research "Lack of clear business case and strategy". As previously mentioned, in the literature review, the result of a lack of a clear plan and purpose for the adoption of AI will likely lead to project failure (Ghobakhloo et al., 2012). Last, the authors state that "Business size and fund limitations to employ IT specialists" is crucial, partly due to their role as the source of an organization's capabilities and could reflect barriers from the hypothesis, such as "Resource constraints", "Lack of IT competence or knowledge" and "Lack of AI competence". Though the issues the authors found were based on practical experience rather than perception, this supports to some degree that some of the issues revealed by the interviewees from the data collection do hold weight in practical application.

In Dyerson & Spinelli's (2011) conceptual framework for strategical evaluating of ICT readiness in SMEs, some connections to this research can be noticed. First, there are clear similarities to the framework's concepts of "ICT budget intensity", "ICT competence (internal/external)" and last, "ICT motivations" which they describe as being motivated by seeing benefits and opportunities. The authors include that imitation of competitors is an important motivational factor, something that differs from the results of this study. This is most likely due to that most companies interviewed stated that they did not currently experience any external threats from competitors due to AI. It should be noted that it is challenging to compare the results of this study directly to other research, as the lens and terminology used differs. For instance, the authors emphasize "infrastructure maturity" and "application maturity" to be important for ICT adoption, which could be argued to target similar issues as this study does with the theme of "Incompatibility of an AI solution with an organization's legacy IT systems or processes". These authors also suggest that "Commitment of top management", by showing interest in ICT innovation and through the delegation of sufficient resources, and the "Presence of a facilitator", that is able to translate business needs into ICT investment choices, are crucial. The "Presence of a facilitator" is also important due to barriers "Unclear benefits of an AI initiative" and "Lack of clear business case and strategy", that were identified in this study, as the facilitator might be needed to overcome these issues. The research points to that key players in an SME need to be both present and onboard with ICT initiatives, a perspective that shows some similarity to the themes "Employees to lead or promote an AI initiative" and "Owner's interests" identified in this study, though they were not discussed in the majority of the conducted interviews.

Many of the issues the hypothesis proposes are similar to findings of other researches on AI adoption, or technology adoption in SMEs, but the interpretation logic differs as the technicality of the technology, or AI in this case, is left out as the management perspective was chosen when addressing the issue. For instance, Ghobakhloo et al.'s (2012) conceptual model focuses more on IT requirements analysis, IT services and products availability, and organization readiness when addressing the initial adoption stage for SMEs. The hypothesis and barriers of this thesis are more rooted in factors that affect the perception of adoption and relates to issues that discourage or convince decision-makers. The same can be seen with (Dyerson & Spinelli's (2011) conceptual framework, where the framework's focal points are assessing adoption readiness based on strategic vision and IT maturity, which, when looking at their arguments, indirectly ignores the premise of whether an organization's employees are ready for change, issues with resource boundaries and the perception of risk factors that were found as discouraging factors in the hypothesis. In conclusion, the hypothesis of this study proposes a more holistic focus on management level but with less evidence to more extensively support more technical limitations and challenges, compared to the two conceptual models mentioned.

Warner & Wäger (2019) propose several capabilities as important to scout and plan for digital opportunities. The authors include concepts in their framework that is built of capabilities such as "scanning for technological

trends", "Formulating digital strategies" with the ability to "interpret digital future scenarios" and analyze "scouted signals". Compared to the results of this study, the lack of attention to AI caused by organizations "not following AI trends" and "lack of AI understanding" can be understood as an absence of capabilities to identify opportunities. What the result of this research did not point towards, was the long-term planning that might be required in order to "interpret digital future scenarios". What the results of this research did not point toward was the long-term planning that might be required in order to "interpret digital future scenarios". The interviewed SMEs seemed to have more responsive digital strategies, where more short-term technological needs usually had SMEs' attention when it comes to digital innovation.

The authors found that in order to adopt AI, a digital strategy might be required. This research divided the opportunities and resource costs of an AI initiative into two separate themes, being "Unclear benefits from an AI initiative", meaning the opportunities AI could add, and "Lack of clear business case and strategy", implying there is a lack of plan and no estimation of the time and costs to adopt the technology. In similarity, "Change resistance" was found in their research as a crucial barrier and "Executive support" was considered as an important enabler for engagement. In this research, the theme "Management support" did not have enough data evidence to be included in the results, even though it was also identified in the literature review as an important factor.

In comparison to these authors, this study identified several themes that were not found in the above-mentioned researches. These themes are "Competing priorities", "Firefighting", "Risk of losing reputation and damaging customer relationships", "Price of an AI solution", and "Tasks or processes that are challenging to streamline".

7.5 Research Limitations

The conducted study is unique in its attention to an increasingly relevant issue of the hesitancy to adopt AI technology. Although the results from the research were found to be promising, there are some limitations that should be mentioned.

In the presented findings, too much attention was not drawn to relations between themes, as it was believed it to be pushing the research boundaries to an extent that it would be too flawed or logical errors would appear. The themes are instead evaluated based on the number of cases it appeared in. Since the contribution of this research is fairly novel and due to the complexity of the research topic, it is likely that there are barriers that have not been covered or identified yet.

Due to limited time and scope of the research, the data sample is considered as a minimum sample for a case study, and that it would require more evidence to build a stronger case for either a more accurate hypothesis or a theory. The results are based on 8 interviews from 4 case companies and they are sufficient for a preliminary study, but with a bigger sample, it would be plausible to strengthen the credibility of the results. It was neither always possible to interview C-level executives, making the collected data based on answers of senior employees or decision-makers from the top two management levels of the interviewed SMEs.

Another limitation is the level of maturity and experience with qualitative research and interviewing of the researchers. This can be seen in the modification of the interview guide (see Appendix A) which had to be narrowed down after the pilot interview with interviewee 1 (see chapter 4.2.5). The interview guide was simplified in order to straighten up the data collection process and to achieve the intended open semi-structured format.

There was a lack of opportunity to observe how the companies function as it was considered to not be feasible. This would have required a more longitudinal data collection and gaining access to internal reports on strategy

and the competitive environment. Even though it would provide additional value, fulfilling the research goals was not dependent on this data.

It is important to address that there are alternative approaches to researching the topic. The data could be inferred with a more interpretivist approach; one could try to identify underlying causes. A more interpretivist approach would perhaps include breaking down hesitation and perception as a part of the research, but it was omitted from the scope as this research is more pragmatic.

7.6 Future Directions

Through the research process, there were found several substantial research ideas that could be promising to investigate in future research. In the overview below, four suggestions are listed that either expand upon the findings of this thesis or point to alternative views on the topic of adopting AI among SMEs.

(1) The hypothesis that arose from the qualitative results shows promise towards building more quantitative evidence to evaluate the perceived importance of the different themes. By conducting surveys for either more specific industry segments or addressing the level of digital maturity in relation to the highlighted issues would provide value for practical implications for SMEs. The focus of quantitative research could also be aimed at looking at which barriers hold most weight or are most important among SMEs. This could be addressed by a survey asking SMEs to rate the importance of each issue that was identified.

(2) Another interesting research path that can be addressed is to continue to investigate implementation difficulties, by looking into issues that would surface once the adoption process is initiated. This could be done by collecting data from SMEs that have adopted AI, and it could potentially enhance the results from this thesis by strengthening the foreseeing of even more potential barriers earlier on in a transformation process. This is recommended to be more studied in the theoretical context of Change Management.

(3) Regarding the way the results are collected and structured, other researchers are proposed and invited to critically evaluate whether there are other existing frameworks that could be used to explain the results in a different adoption-related theoretical context. Researchers are also invited to evaluate whether there are different ways of building new frameworks from the themes seen in Table 21 or Figure 12. For instance, using the Diffusion of Innovations theory (see chapter 2.3.1) could be used to look at what slows down adoption.

(4) The “opposite side of the coin” approach would be to investigate AI adopting among SMEs from vendors’ point of view. Vendors could potentially hold valuable insights on why SMEs are currently using their services at a lower rate compared to larger organizations.

As shown, there are many research gaps that do require attention, and would benefit SMEs as they might struggle to address these issues themselves.

8 Conclusion

AI technology is believed to be the biggest commercial opportunity in today's fast-changing economy and SMEs are struggling to reap its benefits. The research of this thesis focused on the issue that SMEs are adopting AI technology at a much lower rate in Europe compared to larger, more resourceful organizations. The focus is also directed towards the lack of empirical research focusing on the AI adoption constraints and barriers perceived by SMEs.

The outcome of this thesis contributes to explain what factors come into play, discouraging SMEs from engaging in AI-investments. It also shows similarities and differences with the perception of AI adoption among selected SME case-examples, establishes an AI technology adoption framework for SMEs to help SME managers address challenges that arise from AI technology engagement and last, contributes to progress the research field of AI adoption in SMEs.

The research question guiding this study was formulated as: "*Why are some SMEs hesitant with adopting AI technology?*" With a combination of explorative, abductive, inductive, and pragmatic approach, the research focused on obtaining a better understanding through a multiple-case study design and qualitative data collection. Individual executives, senior employees or decision-makers in SMEs were targeted and their perception of barriers when considering AI adoption was the focus of the non-standardized semi-structured, open-ended interviews. 65 unique themes were found from the analysis process, where 20 themes are highlighted as the findings with the greatest significance, functioning as the proposed research hypothesis. The themes provide preliminary evidence of barriers that have not been previously collected in the context of SMEs. The 20 most significant themes are summarized in Table 25 below.

Table 25 – Summary of the barriers discouraging SMEs to adopt AI technology.

(T) = Technological context	(O) = Organizational context	(E) = Environmental context
1. Lack of AI competence (O/E)	11. Lack of AI understanding (O/T)	
2. Dependency on external help (E)	12. Resources constraints (O)	
3. Lack of IT competence or knowledge (O)	13. Lack of clear business case and strategy (O)	
4. No or little prior AI experience (O)	14. Insufficient employee training (O)	
5. AI or technology skepticism (O/E)	15. Financial constraints (O)	
6. Change resistance (O)	16. Incompatibility of an AI solution with an organization's legacy IT systems or processes (T/O)	
7. Unclear benefits of an AI initiative (O/T)		
8. Competing priorities (O)	17. Not following AI trends (O)	
9. Employee age (O)	18. Price of an AI solution (O/E)	
10. Firefighting (O)	19. Risk of losing reputation and damaging customer relationships (E)	
	20. Tasks or processes that are challenging to streamline (O)	

The authors of this study concluded that all of these 20 barriers are realistically likely to appear and act as barriers to adopting AI in other SMEs.

Building the hypothesis was conducted through a rigid methodology where the interpretation of the case interviews was pragmatic in the sense of labeling the quotes based on the literal meaning of each quote. This was done to minimize logical flaws and to prevent misinterpretation. As the analysis process was quite thorough, and that the hypothesis only contains themes with significant support, it was found fair to assume that these factors can hold weight for other SMEs that have not yet adopted AI technology. As it was also

found that every SME has its own unique barriers, SMEs will have to uncover barriers that are, along with the above-mentioned factors, important for them.

The literature review provided a strong foundation that guide the research findings, but it had to be collected from a vast set of literature that did not address the research topic directly. The literature review is in its own way a strong contribution to concretizing what the potential issues with AI adoption in SMEs are, and in combination with the results from this study, there are many factors present (likely some unidentified as well) that make the topic as complex as it is. Hence, the process of reviewing the literature that addressed the issue was quite challenging, in order to achieve a good research scope.

Additionally, the scope had to be limited to investigate engagement barriers and not the full scope of AI adoption (which would include implementation, further development, and obtaining and maintaining benefits), as targeting the issue as a whole was found to be too complex and would require several more steps in terms of reviewing change management and technology implementation literature, plus additional rounds of data collection and analysis. By focusing on one part of the issue of AI adoption, the result ended being much more valuable for both future research and practical implication. Using four case companies with eight interviews was adequate to fulfil the objectives of this preliminary study, as it enabled the analysis to limit some level of complexity and at the same time provided several novel findings from the chosen units of analysis.

This thesis is a preliminary study, resulting in a total of 65 themes of barriers. The themes that are not in the hypothesis do contain interesting points for the research topic, but they were left out to maintain a strong validity. With a more extensive set of data, it could be feasible to find more evidence and also reveal more new themes. As there is limited research that covers AI engagement barriers for SMEs, the results are quite novel and should contribute to inspire future research directions that target the topic of AI adoption in SMEs.

The issue in focus of this thesis draws attention to show the extensive potential and complexity of AI technology, and that SMEs are most likely dependent on external help to achieve to reap benefits from AI. SMEs and larger organizations in Europe have many similar barriers, but in comparison there are factors due to SMEs' size and resources that limit their AI adoption capabilities. Though there is a significant number of barriers identified in this study, organizations will have to reflect upon these issues with their own basis in mind.

In conclusion, there are currently many discouraging factors that threaten SMEs in competitive environments where AI could have more presence in the coming years. Since AI is most likely here to stay, authors of this study encourage SMEs to seek out for more potential benefits that would outweigh the perceived barriers highlighted in this thesis in order to get started on the AI journey.

9 References

Akerkar, R. (2018). *Artificial Intelligence for Business*. Cham, Switzerland: Springer Nature Switzerland AG.

Baker, J. (2011). The Technology-Organization-Environment Framework. *Information Systems Theory*, *28*(September), 231–245. https://doi.org/10.1007/978-1-4419-6108-2

Barann, B., Hermann, A., Cordes, A.-K., & Chasin, F. (2019). Supporting Digital Transformation in Small and Medium-sized Enterprises: A Procedure Model Involving Publicly Funded Support Units. *Proceedings of the 52nd Hawaii International Conference on System Sciences (HICSS)*, (January).

Bergstein, B. (2019, February 13). This is why AI has yet to reshape most businesses. Retrieved March 25, 2019, from https://www.technologyreview.com/s/612897/this-is-why-ai-has-yet-to-reshape-most-businesses/

Bryman, A., & Bell, E. (2011). *Business Research Methods*. *Oxford University Press* (3rd ed.). Oxford: Oxford University Press Inc.

Bughin, J., Hazan, E., Ramaswamy, S., Chui, M., Allas, T., Dahlström, P., … Trench, M. (2017). Artificial Intelligence: The Next Digital Frontier. *McKinsey Global Institute*.

Burgess, A. (2018). *The Executive Guide to Artificial Intelligence: How to identify and implement applications for AI in your organization*. London, United Kingdom: Springer. https://doi.org/9783319638195

Cartelli, A. (2010). Frameworks for the Benchmarking of Digital and knowledge Management best Practice in sMe and organizations. *International Journal of Digital Literacy and Digital Competence*, *1*(2), 39–47. https://doi.org/10.4018/jdldc.2010040105

Chong, A., Ooi, K.-B., Lin, B., & Raman, M. (2009). Factors Affecting The Adoption Level of C-Commerce: An Empirical Study. *Journal of Computer Information Systems*, *50*.

Corea, F. (2017). *Artificial Intelligence and Exponential Technologies: Business Models Evolution and New Investment Opportunities*. *Studies in Computational Intelligence*. Rome, Italy: Springer Nature Switzerland AG. https://doi.org/10.1007/978-3-319-51550-2

Coyne, R. (2018). Hunch, symptom, clue. Retrieved June 7, 2019, from https://richardcoyne.com/2018/02/10/hunch-symptom-clue/

Cragg, P., Caldeira, M., & Ward, J. (2011). Organizational information systems competences in small and medium-sized enterprises. *Information & Management*, *48*(8), 353–363. https://doi.org/10.1016/j.im.2011.08.003

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (4th ed.). SAGE Publications Ltd.

Danner, G. E. (2019). *The Executive's How-To Guide to Automation: Mastering AI & Alogrithm-Driven Business*. Cham, Switzerland: Springer Nature Switzerland AG.

Davenport, T. H. (2018). *The AI Advantage: How to Put the Artificial Intelligence Revolution to Work*. Cambridge, MA; Lodon, England: MIT Press.

Davis, F. D. (1985). *A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results*. *Doctoral dissertation, MIT Sloan School of Management*. MIT Sloan School of Management. https://doi.org/oclc/56932490

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease Of Use, And User Acceptance of Information

Technology. *MIS Quarterly*, *13*(3), 319–340.

Deloitte Insights. (2019). *Tech trends 2019: Beyond The Digital Frontier*. Retrieved from https://www2.deloitte.com/content/dam/insights/us/articles/Tech-Trends-2019/DI_TechTrends2019.pdf

Delponte, L. (2018). *European Artificial Intelligence (AI) leadership, the path for an integrated vision*. Retrieved from http://www.europarl.europa.eu/RegData/etudes/STUD/2018/626074/IPOL_STU(2018)626074_EN.pdf

DePietro, R., Wiarda, E., & Fleisher, M. (1990). *The context for change: Organization, technology and environment. The processes of technological innovation*. Massachusetts, USA: Lexington Books.

Dul, J., & Hak, T. (2008). *Case Study Methodology in Business Research* (1st ed.). New York, NY: Butterworth-Heinemann/Elsevier.

Dyerson, R., & Spinelli, R. (2011). Balancing Growth: A Conceptual Framework for Evaluating ICT Readiness in SMEs. *International Journal of Online Marketing*, *1*(2), 43–56. https://doi.org/10.4018/ijom.2011040103

Earley, S. (2016). There is no AI without IA. Retrieved May 25, 2019, from https://www.infoq.com/articles/artificial-intelligence

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *Academy of Management Review*, *14*(4), 532–550. https://doi.org/10.5465/amr.1989.4308385

Ertel, W. (2017). *Introduction to Artificial Intelligence* (2nd ed.). Weingarten, Germany: Springer.

European Commission. (2003). Comission Recommendation of 6 May 2003 Concerning The Definition of Micro, Small and Medium-Sized Enterprises. *Official Journal of the European Union*, 36–41. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003H0361&from=EN

European Commission. (2015). User guide to the SME Definition. https://doi.org/10.2873/782201

European Digital SME Alliance. (2019). Manifesto For The 2019 European Parliament Elections: A Vision For Europe's Digital Future. Retrieved May 26, 2019, from https://www.digitalsme.eu/digital/uploads/EN-MANIFESTO.pdf

European Parliament. (2019). European Parliament resolution (2018/2088(INI)) - Comprehensive European industrial policy on artificial intelligence and robotics. Retrieved April 24, 2019, from http://www.europarl.europa.eu/doceo/document/TA-8-2019-0081_EN.pdf

Flyvbjerg, B. (2006). Five Misunderstandings About Case-Study Research. *Qualitative Inquiry*, *12*(2), 219–245. https://doi.org/10.1177/1077800405284363

Frank, M., Roehrig, P., & Pring, B. (2017). Automate: The Robots Aren't Coming; They're Here. In *What to Do When Machines Do Everything: Five Ways Your Business Can Thrive in an Economy of Bots, AI, and Data* (pp. 95–114).

Gentsch, P. (2018). *AI in Marketing, Sales and Service: How Marketers without a Data Science Degree can use AI, Big Data and Bots*. *AI in Marketing, Sales and Service*. Frankfurt, Germany: Springer. https://doi.org/10.1007/978-3-319-89957-2

Ghobakhloo, M., Hong, T. S., Sabouri, M. S., & Zulkifli, N. (2012). Strategies for Successful Information Technology Adoption in Small and Medium-Sized Enterprises. *Information*, *3*, 36–67. https://doi.org/10.3390/info3010036

Gibbert, M., Ruigrok, W., & Wicki, B. (2008). What passes as a rigorous case study? *Strategic Management Journal*, *29*(13), 1465–1474. https://doi.org/10.1002/smj.722

Grant, K., Edgar, D., Sukumar, A., & Meyer, M. (2014). Risky business: Perceptions of e-business risk by UK small and medium sized enterprises (SMEs). *International Journal of Information Management*, *34*(2), 99–122. https://doi.org/10.1016/j.ijinfomgt.2013.11.001

Hansen, H. (2017). The SAGE Handbook of New Approaches in Management and Organization Abduction. In H. Hansen & D. Barry (Eds.), *The SAGE Handbook of New Approaches in Management and Organization* (pp. 454–463). 1 Oliver's Yard, 55 City Road, London EC1Y 1SP United Kingdom: SAGE Publications Ltd. https://doi.org/10.4135/9781849200394.n77

Hinkin, T. R. (2005). Scale Development Principles and Practices. In *Research in Organizations: Foundations and Methods of Inquiry* (1st ed., pp. 161–180). Berrett-Koehler Publishers, Inc.

Ho, Y. C. (1994). Abduction? Deduction? Induction? Is there a Logic of Exploratory Data Analysis? In *Proceedings of the Annual Meeting of American Educational Research Association (1994)* (Vol. 180, pp. 110–122). New Orleans, Louisiana. Retrieved from https://files.eric.ed.gov/fulltext/ED376173.pdf

Jabło, M. R., & Pólkowski, Z. (2017). Artificial Intelligence-Based Processes in SMEs. *Studies & Proceedings of Polish Association for Knowledge Management*, *86*, 13–23.

Jarrahi, M. H. (2018). Artificial intelligence and the future of work: Human-AI symbiosis in organizational decision making. *Business Horizons*, *61*, 577–586. https://doi.org/10.1016/j.bushor.2018.03.007

Jeude, J., & Smith, J. A. (2018). AI : Ready for Business. Retrieved April 19, 2019, from https://www.cognizant.com/whitepapers/ai-ready-for-business-codex3752.pdf

Johnson, M. (2010). Barriers to innovation adoption: A study of e-markets. *Industrial Management & Data Systems*, *110*(2), 157–174. https://doi.org/10.1108/02635571011020287

Kane, G. C., Palmer, D., Phillips, A. N., Kiron, D., & Buckley, N. (2015). Strategy, not Technology, Drives Digital Transformation: Becoming a Digitally Mature Enterprise. Retrieved February 2, 2019, from http://sloanreview.mit.edu/projects/strategy-drives-digital-transformation/

Kelsey, S., & St.Amant, K. (2008). *Handbook of Research on Computer Mediated Communication*. New York, USA: Information Science Reference.

Lee, B., Collier, P. M., & Cullen, J. (2007). Reflections on the use of case studies in the accounting, management and organizational disciplines. *Qualitative Research in Organizations and Management: An International Journal*, *2*(3), 169–178. https://doi.org/10.1108/17465640710835337

Liu, D.-Y., Chen, S.-W., & Chou, T.-C. (2011). Resource fit in digital transformation. *Management Decision*, *49*(10), 1728–1742. https://doi.org/10.1108/00251741111183852

Loonam, J., Eaves, S., Kumar, V., & Parry, G. (2018). Towards digital transformation: Lessons learned from traditional organizations. *Strategic Change*, *27*(2), 101–109. https://doi.org/10.1002/jsc.2185

Lovelock, J.-D., Tan, S., Hare, J., Woodward, A., & Priestley, A. (2018). Forecast: The Business Value of Artificial Intelligence, Worldwide, 2017-2025. Retrieved June 6, 2019, from http://www.gartner.com/resources/348100/348137/forecast_the_business_value__348137.pdf

Mahidar, V., & Davenport, T. H. (2018). Why Companies That Wait to Adopt AI May Never Catch Up. Retrieved March 11, 2019, from https://hbr.org/2018/12/why-companies-that-wait-to-adopt-ai-may-never-catch-up

Massimo, C. G., Laursen, K., Magnusson, M., & Rossi-lamastra, C. (2012). Small Business and Networked Innovation: Organizational and Managerial Challenges. *Journal of Small Business Management*, *50*(2), 181–190.

McKinsey & Company. (2018a). Notes from the AI frontier: AI Adoption Advances, but Foundational

Barriers Remain. Retrieved February 23, 2019, from https://www.mckinsey.com/featured-insights/artificial-intelligence/ai-adoption-advances-but-foundational-barriers-remain#

McKinsey & Company. (2018b). Unlocking Success in Digital Transformations. Retrieved February 27, 2019, from https://www.mckinsey.com/~/media/McKinsey/Business Functions/Organization/Our Insights/Unlocking success in digital transformations/Unlocking-success-in-digital-transformations.ashx

McKinsey Digital. (2016). Digital Transformation: The three steps to succes. Retrieved April 29, 2019, from https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/digital-transformation-the-three-steps-to-success

MIT Technology Review Insights. (2018). 2018 Global Report: The Artificial Intelligence Imperative. Retrieved April 20, 2019, from https://www.purestorage.com/resources/type-a/unlocking-data-insights-to-fuel-business-growth.html

Molinillo, S., & Japutra, A. (2017). Organizational adoption of digital information and technology: a theoretical review. *Bottom Line*, *30*(1), 33–46. https://doi.org/10.1108/BL-01-2017-0002

Møller, T. H., Czaika, E., Bax, H. J., & Nijhon, V. (2019). Artificial Intelligence in Europe: Outlook for 2019 and Beyond. Retrieved June 11, 2019, from https://pulse.microsoft.com/uploads/prod/2018/10/WE_AI_Report_2018.pdf

Ng, A. (2019). AI Transformation Playbook: How to Lead Your Company Into the AI Era. Retrieved June 25, 2019, from hhttps://landing.ai/content/uploads/2018/12/AI-Transformation-Playbook-v8.pdf

Østergaard, H., Bughin, J., Andersen, J. R., Rugholm, J., Poulsen, M., & Chui, M. (2019). How Artificial Intelligence Will Transform Nordic Businesses. Retrieved June 3, 2019, from https://www.mckinsey.com/~/media/McKinsey/Featured Insights/Artificial Intelligence/How artificial intelligence will transform Nordic businesses/How-artificial-intelligence-will-transform-Nordic-businesses.ashx

Paschek, D., Luminosu, C. T., & Draghici, A. (2017). Automated Business Process Management – in Times of Digital Transformation using Machine Learning or Artificial Intelligence. *MATEC Web of Conferences*, *121*. https://doi.org/10.1051/matecconf/201712104007

Patton, M. Q. (2002). *Qualitative Reseach & Evaluation Methods*. *Qualitative Inquiry* (3rd ed.). London, United Kingdom: SAGE Publications Ltd.

Peirce, C. S. (1992). *The Essential Pierce: Selected Philosophical Writings, Volume 2 (1893-1913)*. (The Pierce Edition Project, Ed.). Bloomington, Indianapolis: Indiana University Press.

Puklavec, B., Tiago, O., & Popovic, A. (2014). Unpacking Business Intelligence Systems Adoption Determinants: An Exploratory Study of Small and Medium Enterprises. *Economic and Business Review*, *16*(2), 185–213. Retrieved from http://www.ebrjournal.net/ojs/index.php/ebr/article/view/344/pdf_11

Pullen, A., De Weerd-Nederhof, P., Groen, A., Song, M., & Fisscher, O. (2009). Successful Patterns of Internal SME Characteristics Leading to High Overall Innovation Performance. *Creativity and Innovation Management*, *18*(3), 209–223. https://doi.org/10.1111/j.1467-8691.2009.00530.x

Ramdani, B., Chevers, D., & Williams, D. A. (2013). SMEs' adoption of enterprise applications: A technology-organisation-environment model. *Journal of Small Business and Enterprise Development*, *20*(4), 735–753. https://doi.org/10.1108/JSBED-12-2011-0035

Rao, A. S., & Verweij, G. (2017). Sizing the prize: What's The Real Value of AI for Your Business and How Can you Capitalise? Retrieved June 29, 2019, from https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf

Reichertz, J. (2010). Abduction: The Logic of Discovery of Grounded Theory. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *11*(1), Art. 13. https://doi.org/10.17169/fqs-11.1.1412

Robson, C. (2002). *Real World Research: a Resource for Social Scientists and Practitioner-Researchers* (2nd ed.). Oxford: Blackwell Publishers Ltd.

Rogers, E. M. (1995). *Diffusion of Innovations*. *Diffusion of Innovations* (4th ed.). New York, USA: Free Press. https://doi.org/citeulike-article-id:126680

Rowe, F. (2014). What literature review is not: diversity, boundaries and recommendations. *European Journal of Information Systems*, *23*(3), 241–255. https://doi.org/10.1057/ejis.2014.7

Russel, S., & Norvig, P. (2010). *Artificial Intelligence: A Modern Approach* (3rd ed.). New Jersey, USA: Prentice Hall. https://doi.org/10.1017/S0269888900007724

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research Methods for Business Students* (5th ed.). Harlow, UK: Pearson Education Limited.

Sekaran, U., & Bougie, R. (2016). *Research Methods for Business: A Skill-Building Approach* (7th ed.). Wiley.

Shank, G., & Cunningham, D. (1996). Modeling the Six Models of Peircean Abduction for Educational Purposes. In *MAICS* (pp. 1–7).

Spiceworks. (2018). The annual report on IT budgets and tech trends. Retrieved June 2, 2019, from https://www.spiceworks.com/marketing/state-of-it-2018/

Stake, R. E. (2003). Case Studies. In *Strategies of Qualitative Inquiry* (2nd ed., pp. 134–164). SAGE Publications Ltd.

Thomas, D. R. (2006). A General Inductive Approach for Analyzing Qualitative Evaluation Data. *American Journal of Evaluation*, *27*(2), 237–246. https://doi.org/10.1177/1098214005283748

Tidd, J., & Bessant, J. (2009). *Managing Innovation: Integrating Technological, Market and Organizational Change* (4th Editio). Chichester, United Kingdom: John Wiley & Sons Ltd.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of information technology: Toward a Unified View. *MIS Quarterly*, *27*(3), 425–478.

Walczak, S. (2017). Artificial Neural Networks and other AI Applications for Business Management Decision Support. *International Journal of Sociotechnology and Knowledge Development*, *8*(4), 1–20. https://doi.org/10.4018/ijskd.2016100101

Wallace, M., & Wray, A. (2011). *Critical Reading and Writing for Postgraduates* (Second). London, United Kingdom: SAGE Publications Ltd.

Warner, K. S. R., & Wäger, M. (2019). Building Dynamic Capabilities for Digital Transformation: An Ongoing Process of Strategic Renewal. *Long Range Planning*, *52*(3), 326–349. https://doi.org/10.1016/j.lrp.2018.12.001

Webster, J., & Watson, R. T. (2002). Analyzing the Past To Prepare for the Future : Writing a Literature Review. *MIS Quartely*, *26*(2). Retrieved from www.jstor.org/stable/4132319

Wodecki, A. (2019). *Artificial Intelligence in Value Creation: Improving Competitive Advantage*. Warsaw, Poland: Springer.

Wymer, S., & Regan, E. (2011). Influential Factors in the Adoption and Use of E-Business and E-Commerce Information Technology (EEIT) by Small & Medium Businesses. *Journal of Electronic Commerce in*

Organizations, *9*(1), 56–82. https://doi.org/10.4018/jeco.2011010104

Yin, R. K. (2009). *Case Study Research Design and Methods* (4th ed.). Thousand Oaks, CA: SAGE Publications Ltd.

Yoon, T. E., & George, J. F. (2013). Why aren't organizations adopting virtual worlds? *Computers in Human Behavior*, *29*(3), 772–790. https://doi.org/10.1016/j.chb.2012.12.003

10 Appendices

10.1 Appendix A: Semi-Structured Open-Ended Interview Guide

Guidelines for Interviews on Barriers of AI adoption in SMEs
Interview Outline
▪ Individual interviews with executives, senior employees or decision-makers ▪ **Estimated time for an interview:** 50-60 min per person, time can exceed if it's found fitting ▪ **Goal:** To capture barriers they perceive preventing adoption of AI technology (case specific) o Focus on discussing potential barriers from the literature review + identify additional perceived barriers ▪ **Format:** Semi-Structured Open-Ended Interviews ▪ In order to make the discussion less abstract, we provide some context – explaining a potential scenario where they would consider adopting AI
Some comments to the interview guide
▪ Underlined questions are key questions ▪ The other questions are optional for probing different perspectives, based on the individual interview ▪ Structure of questions: Start with general questions, then narrow down to more specified concepts. The structure in the table is based on organizing the concepts from most general (top) down to more in-depth concepts (bottom).
Preliminary information for the interviewee
▪ Introduce yourself ▪ Explain briefly about the scope and topic of the research ▪ Explain the purpose of the interview, the contribution we expect from interviews. ▪ Explain briefly about what we mean by using AI, adoption of AI, and explain what we mean by barriers/factors
Part 1: Introductory mapping (M)
(M1) Can you introduce yourself? (M2) Can you introduce your company? - What industry do you operate in and where do you stand in the industry? - How would the business and financial cycle of your company look like? - How does the organizational and management structure look like? - How would you describe the culture in your company? - How does your organization translate business or strategic goals into IT-specifications/solutions? (M3) Does your organization have any prior experience with AI?

(M4) Do you personally have any AI competency? (M5) Have you considered adopting AI? (– If not, why not?) (M6) Do you perceive your organization to be an Org that could benefit from AI? (M7) Who would make an IT investment decision in your organization? (M8) Does your organization have any future plans to start using AI?		
Part 2: Optional questions derived from literature review concepts		
Area/Topic	**Question(s)**	**Backup/Refinement Question**
General	**A) What are the main reasons for why your organization has not yet engaged (more) in the use of AI?** **B) What problems or complications would immediately emerge if you were now to consider adopting AI?** **C) What would it take for your organization to consider AI technology?**	
1. Value Perception	1A) What is your opinion on the potential benefits for using AI? **1B) Return on Investment – What would you consider to be a valuable AI investment?** 1C) What would it take for AI to be considered interesting enough for your organization? 1D) What would convince you to favor a decision to adopt AI-technology in your organization? **1E) Are there any negative aspects you see that would outweigh an AI value proposition?** 1F) In what setting would you say barriers are low enough for you to engage with AI?	If so, what kind? What is not? In what way could AI-technology create direct value for your organization?
2. Strategy and Resources	**2A) What would prevent your organization from obtaining a success with AI technology today? (in terms of strategy, planning etc.)** 2B) What would it take for an initiative like AI to gain prioritization or compete with other priorities? 2C) Are there any resource constraints in your organization? If so, how would it affect investment decisions in an AI initiative? 2D) How does your organization perceive projects that need long time to generate ROI? What is an acceptable time before an investment like AI should deliver a ROI? 2E) What affects/draws your organizations attention to certain technologies/solutions, such as AI? **2F) What does negatively affect your opinion on potential IT investments, such as AI?** 2G) Are there potentially any business objectives AI could solve for you or that you know about? What would make it difficult to achieve the business results? 2H) Are there any types of external pressure that affects how you think about the possibility of adopting AI?	Competing priorities Firefighting What type of timeframe does your organization operate with/have and how would it affect an AI initiative? (Long-term/short-term?) Acceptance to loss Customers/partners. Tech usage trend. Larger enterprises

3. Risk Perception	3A) What types of risks do you see when thinking about AI adoption in your organization? **3A) Are there any risks that you see being too high to be able to justify an AI initiative?** 3B) What is your organization's general behavior when being introduced to untested tech or unfamiliar tech? 3C) Are there any security concerns? 3D) How do you perceive cost in terms of adoption AI, what would (not) be acceptable? 3E) Are there any negative perceived consequences that you might want to avoid when considering AI?	How do you act in relation to high risk initiatives?
4. AI Black box	**4A) What are your main concerns with AI technology?** 4B) How much knowledge or understanding about AI is necessary for you to consider adopting AI? 4C) Do you think AI can be personalized for your organization's objectives or needs for insights? 4D) What makes AI seem complex or hard to understand/grasp? 4E) What would it take for you to trust the insight and decisions an AI would make?	What about; Observability Transparency How is AI perceived in your organization?
5. Organization Readiness	5A) Does your organization have any IT department or IT resources? Do you perceive this negative or positive? **5B) Do you think your organization's IT-maturity is sufficient for adopting AI? How mature is it?** 5C) In what types of situation would you experience change resistance from employees? Would it affect adopting AI? 5D) Are there any reasons to think your organization is not ready to adopt AI? **5E) Is there anything in your organization that would make the adoption of AI more difficult?** 5F) Is there anyone that would fight against this initiative?	Anything that needs to be improved first? Are these things changeable? Change resistance with org. culture Compatibility with business legacy processes (that it's a fit)
6. DT capabilities	6A) Are there any negative experiences from prior IS engagements that affect the way you perceive future IS investments (future investments to adopting AI)? **6B) How do you perceive your organization's capabilities when considering to successfully implement AI technology?** 6C) How would proceed when identifying a potential AI solution or AI technology that would fit your organization's needs? 6D) How quickly do you think you could obtain benefits from AI? What would be acceptable in terms of time a perspective?	E.g., maintaining benefits? Ability to redesign internal structures Decision making speed Rigid strategic planning Capability of managing IS investments
7. Management Support	7A) How urgent do you feel it is for your organization to adopt and start using AI? 7B) How would the other managers/longest working employees react to potential AI initiatives? **7C) What would it take for you, for other managers and the**	Do you perceive any consequences or threats of not adopting/using AI? Supportive? Positive/negative? What would you be willing to

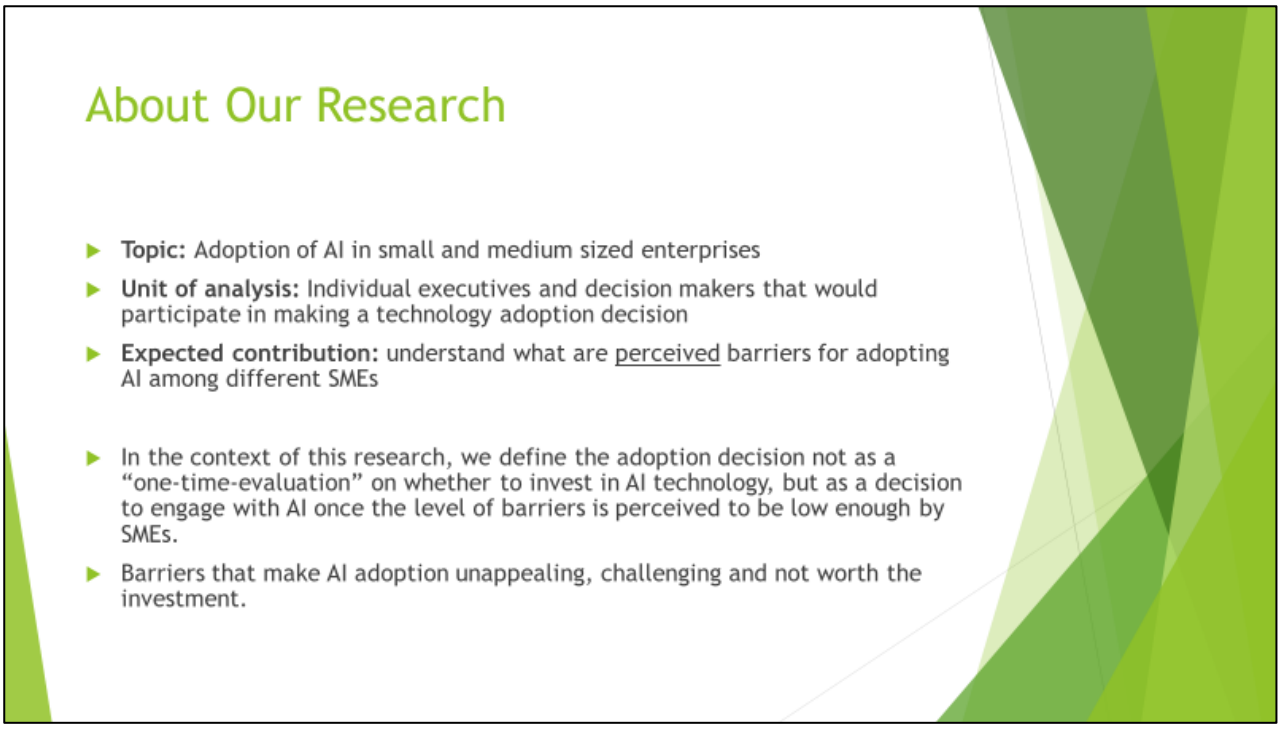
	management to support an AI initiative? 7D) What is the level of your organization's managerial skills in terms of IS? **7E) Would there be any conflicting opinions in your organization on the use of resources for AI?**	commit to? Do they know what's possible with AI/ML?
8. AI Talent	8A) Does your organization have any AI Competency? Are there any individuals working for you with special competence that might be relevant for AI? 8B) What do you think would be sufficient/enough competency needed to start using AI? **8C) Who would you expect to lead a potential AI initiative in your organization? Would you have any clear candidates?** 8D) Do you think your organization would be able to obtain more AI competency if needed?	- Feeling of restricted access to Talent? - What would be needed in terms of competency? Would it be realistic to obtain?
9. Data Ecosystem Requirements	9A) Is there any type of data that you store and could make use of for a potential AI solution? **9B) Do you see any specific barriers in your current data ecosystem, meaning access to data, how you capture data, how valuable it is, if and how are your data silos interconnected?** 9C) Is anything perceived as hard or too painful/complicated to deal with in terms of data ecosystem changes? 9D) How compatible do you perceive your ecosystems potential to build AI on or to feed data?	Compatibility with your data ecosystem Could you change/ do something about your current ecosystem? Do you use your data, know how to use it?
10. AI Technology Accessibility	10A) How would you potentially go about to obtain AI? (cloud-based – e.g., AI as a service, SaaS; tailored solution; etc.) **10B) How much external help do you think your organization would need?**	Ways to obtain AI: Off-the-shelf AI AI platform Bespoke AI Collaborate with other organizations
Open Discussion (OD)	**OD) Is there anything that you feel like we have not covered in terms of the perspective of adopting AI?**	Is there anything else you would like to add?

Simplified Version of the Questions

Area/Topic	Question(s)
General	A) What are the main reasons for why your organization has not yet engaged (more) in the use of AI? B) What problems or complications would immediately emerge if you were now to consider adopting AI? C) What would it take for your organization to consider AI technology?
1. Value Perception	1A) Return on Investment – What would you consider to be a valuable AI investment? 1B) Are there any negative aspects you see that would outweigh an AI value proposition?
2. Strategy and Resources	2A) What would prevent your organization from obtaining a success with AI technology today? (in terms of strategy, planning etc.) 2F) What does negatively affect your opinion on potential IT investments, such as AI?

3. Risk Perception	3A) Are there any risks that you see being too high to be able to justify an AI initiative?
4. AI Black box	4A) What are your main concerns with AI technology?
5. Organization Readiness	5B) Do you think your organization's IT-maturity is sufficient for adopting AI? How mature is it? 5E) Is there anything in your organization that would make the adoption of AI more difficult?
6. DT capabilities	6B) How do you perceive your organization's capabilities when considering to successfully implement AI technology?
7. Management Support	7C) What would it take for you, for other managers and the management to support an AI initiative? 7E) Would there be any conflicting opinions in your organization on the use of resources for AI?
8. AI Talent	8C) Who would you expect to lead a potential AI initiative in your organization? Would you have any clear candidates?
9. Data Ecosystem Requirements	9B) Do you see any specific barriers in your current data ecosystem, meaning access to data, how you capture data, how valuable it is, if and how are your data silos interconnected?
10. AI Technology Accessibility	10B) How much external help do you think your organization would need?
Open Discussion (OD)	OD) Is there anything that you feel like we have not covered in terms of the perspective of adopting AI?

10.2 Appendix B: Presentation Used in the Interview Process



Some AI Definitions

- Bellman thinks of AI as "*automation of activities that we associate with human thinking*" **(thinking humanly)**
- Kurzweil talks about AI as "*the art of creating machines that perform functions that require intelligence when performed by people*" **(acting humanly)**
- Winston ponders about AI as "*computations that make it possible to perceive, reason, and act*" **(thinking rationally)**
- Poole and Nilsson mention intelligent agents and intelligent behavior in artifacts, respectively **(acting rationally)**

Six Disciplines That Compose Most of AI:

Technology	Brief Description	Example Applications
Statistical machine learning (ML)	Automates process of training and fitting models to data	Highly granular marketing analyses on big data
Neural networks (NN)	Uses artificial "neurons" to weight inputs and relate them to outputs	Identifying credit fraud, weather prediction
Deep learning (DL)	Neural networks with many layers of variables or features	Image and voice recognition, extracting meaning from text
Natural language processing (NLP)	Analyzes and "understands" human speech and text	Speech recognition, chatbots, intelligent agents
Rule-based expert systems	A set of logical rules derived from human experts	Insurance underwriting, credit approval
Physical robots (Robotics)	Automates a physical activity	Factory and warehouse tasks
Robotic process automation (RPA)	Automates structured digital tasks and interfaces with systems	Credit card replacement, validating online credentials

Business Use Cases for AI

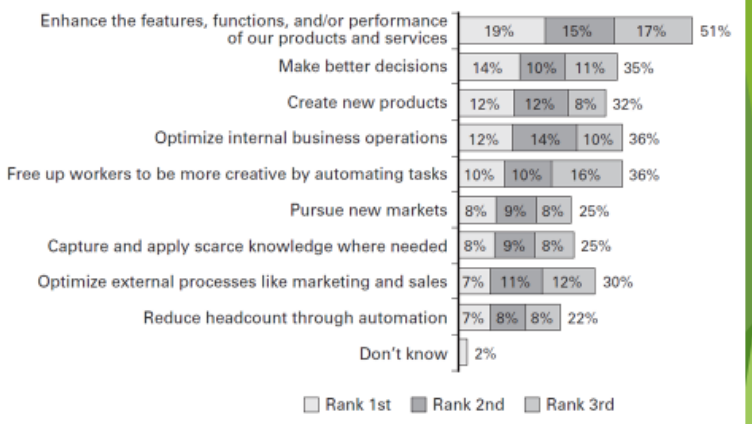


Figure 4.1
Benefits Sought from Cognitive Technologies
Source: 2017 Deloitte "Cognitive Aware" Survey

Scenario and Interview Process

- *Scenario:* You are about to evaluate the adoption of AI-technology for your organization. The evaluation concerns whether it's suitable for your organization to adopt AI and what you perceive as barriers that would prevent your organization from deciding to engage with AI-technology

- Semi-structured
- Interview time estimation: 50-60 minutes
- Interview process is recorded for transcription purposes

10.3 Appendix C: Codebook

Due to the limited space, a simplified version of the codebook is displayed below. Full version can be found under external appendices that are available on the two enclosed USB flash drives and in a cloud repository folder at: https://drive.google.com/drive/folders/1gAG2nv6GLJeXiMHoECqcGJ16qVuMcdDb

Note that themes classified as "Potential" barriers were ruled out of the analysis (as explained in chapter 5.1.3).

#	Theme	Barrier Type	T/O/E	Case	Interview Number	Coded Text (Answer)
1	Acquiring costly and problematic solution	Perceived	O	B	4	Because you can go a bit wild which projects like this. We have an example from, among other things, a printing company in Gothenburg that we know who has invested a couple of million in an IT system first, hey were not satisfied and then invested a couple more, in the end they invested so much that they realized that the table catches (poker reference) and it can be a little dangerous. In the company I previously worked in, it was also a bit like this, they had bought an IT system that didn't function as wanted, they had bought a graphic system called Printvis and then they had also connected you to SAP which is a big German system, and ended up not being compatible with our online store. We sold large format printers, roller blinds and beach flags online.
2	Acquiring costly and problematic solution	Perceived	O	B	4	When you invest into a system that we can't keep up with orders, so that was the first thing I said when we sold the company that we cannot work like this, if we can't solve the problems here within the 3 years that I should be Then I would not be willing to work there anymore. But it's still like that that could end up ruining your company, that's what I see as a big danger.
3	Acquiring costly and problematic solution	Potential		A	1	We had a couple of instances so that where we were for one of our planning tools for forecasting systems in a supply chain organization, we bought a too small system. That was because of money constraints or budget constraints. So that though the project group would have liked to have this system, they've got down to this one. Because it's been 5 million more expensive or something. And now we see that after three, four years, that system is not big enough. So we should have had the first one in the first place. And those five millions, whatever it was, would have been maybe a bit cheaper. Now we have to change the whole system which will cost you probably 20 million or something. So it's, it's always difficult. So, I think that it's probably jungle out there.
4	Lack of AI competence	Perceived	O	D	8	Absolutely. But also the operational level of employees, of course, they do, but we will need proper training and implementation, otherwise, it won't work.
5	Lack of AI competence	Perceived	O	A	1	And also the IT department, they have certain knowledge about the systems we use. But when it comes to AI, they are not very knowledgeable and is within always be various, it can be one AI case here, one there one there.
6	Lack of AI competence	Actual	O	C	6	As I said, we have vendors doing all the coding and all the data cleaning.

7	Lack of AI competence	Actual	O	C	5	As I said, we started with a small company that had the knowledge or could write the Python code, so we used external help to get it up and running.
8	Lack of AI competence	Actual	O	C	5	But again, when we further develop the system, if we find new data source, which we've already identified, and want to develop a version 2.0, then we'll take the external help again, in order to do it right, so to speak.
9	Lack of AI competence	Actual	E	A	2	I have little faith that the introduction comes internally in (COMPANY NAME). I think we need to get the introduction from the outside and bring it into the group.
10	Lack of AI competence	Actual	O	B	4	I imagine the same process that we have had with the order system, if we were to buy an AI system then we had to have a supplier who comes to us and says that "here we have something that suits you also we can make local adjustments" Well, that's what I see. I cannot see that we should start implementing it ourselves, we are not there, I do not think we will be either.
11	Lack of AI competence	Perceived	O	C	6	I think just the knowledge about what the technology can do for you, it's, it's important that all the product owners in this in this company actually remember that AI is a tool in your toolbox. So if you have a problem, see if AI can help you. And in between all the important tasks that they have, I think it's hard to find time to educate them to a level where they can actually have those considerations.
12	Lack of AI competence	Actual	O	B	3	I think we needed external help to somehow set up the project and to assist us in implementing it. Afterwards, I hope we could manage it ourselves.
13	Lack of AI competence	Actual	O	B	4	I think we would need help. We have no knowledge of it. We would need external people.
14	Lack of AI competence	Actual	E	D	7	If it's something I can figure out a solution to in, I would say, less than a week, we might do it ourselves. If I can't - if I can see already that, well, this isn't anything I can handle the we acquire help.
15	Lack of AI competence	Perceived	O	D	8	I'm talking skills, internal skills
16	Lack of AI competence	Perceived	O	D	8	Internally, education. I think so. And implementation.
17	Lack of AI competence	Actual	O	D	7	It's not something like - if it's very complicated, then it's out of my league. But...
18	Lack of AI competence	Actual	O	B	3	Knowledge is probably one of them , and I really believe that will is not the issue, it is more in a way to set aside time to nail the process so that you get started ...
19	Lack of AI competence	Actual	E	D	8	Maybe we'll hire some consultants, I don't know. But we're always looking for a way to do it ourselves. But if we cannot do it ourselves, we need to hire someone outside. Definitely. We've done that before with (NAME). So maybe we'll do that...
20	Lack of AI competence	Actual	O	A	2	No, I don't think so as it is now. I have one at the customer center who is very interested in system and data so curiosity is in place, so she could probably have participated in it. But now she doesn't have the skills. I don't think there are so many who know what artificial intelligence is

21	Lack of AI competence	Actual	O	C	5	So these two vendors are the ones who do the programming. And both of them have machine learning competencies in-house. But, again, we've had great experience with this small, smaller company. And if we were to further expand it we will use them again.
22	Lack of AI competence	Actual	E	C	6	So we have the discussions about which data can we put into the model, but any, any discussion about how to crunch the data and which model and which estimation, the principles were best, there was entirely the vendor.
23	Lack of AI competence	Actual	O	B	3	We don't really have enough knowledge or capabilities today... So if we were to start using AI-solutions we had to run it as a project and bought the services ... I'm sure we can't do it ourselves.
24	Lack of AI competence	Actual	E	B	3	We probably probably need help to maintain it, I think maybe that ... or we had to have employed someone with that knowledge, there are not people in the organization that could maintain it, I am absolutely sure
25	Lack of AI competence	Actual	O	B	3	We would have to put ourselves more into the AI, to be told what opportunities exist, in that way it would link up with the processes we have today... it is a matter of getting help to see what are the possibilities.
26	Lack of AI competence	Perceived	O	C	5	Well, of course, as we talked about the need to be educated a bit more than they are today, in order for us not to be vulnerable, because if if the resources of the company we're using right now, that actually decides we don't want to work with (CASE COMPANY) anymore, then we've lost that knowledge. So we have to spread knowledge and put it in (CASE COMPANY) so we can keep developing.
27	AI or technology scepticism	Actual	O	A	2	I'm probably more skeptical.
28	AI or technology scepticism	Perceived	O	A	1	How do we use a chat function? How do we, how do we interact with the customer? Always that little bit afraiding... should we be afraid of all this, will the machine take over my, my function, you know
29	AI or technology scepticism	Perceived	O	D	7	I think if you talk like generally speak generally, there's two concerns, and that is the feeling of being surveyed or surveillance all the time. That's one concern.
30	AI or technology scepticism	Actual	E	C	6	I think their concern was that one of the models could in some cases go totally wrong. If you have a small house in the suburbs of (LOCATION) or something and it suddenly says 12 million DKK for this one and you're not able to explain it or there are some errors in the data for that house, maybe it's registered wrongly the land register or something.
31	AI or technology scepticism	Actual	O	B	3	I think we are basically skeptical about things we can't do, that's why I mention that they should have references ...
32	AI or technology scepticism	Actual	O	A	2	No, it may be, I think of our group here, we are all a bit like this, we are not confident of the technological aids we have today, which has led us to be a little skeptical of new things, we like it safely , old and traditional. The fear of new things and technological things that we do not master.
33	AI or technology	Perceived	O	A	2	So a little fear of it, the fear of everything online or digital

	scepticism					can be a bit scary.
34	AI or technology scepticism	Perceived	O	B	3	the employees will always compare the new to the old and the old system and processes is something you know no matter how bad it might be, so skeptical attitude towards change it will always be
35	AI or technology scepticism	Perceived	O	B	3	Then I think they should have come up with quite concrete Cases they had been to before and compared to what we do, and had to have very good references for us to work on with them . I think we are basically skeptical about things we can't do, that's why I mention that they should have references ...
36	AI or technology scepticism	Perceived	O	B	3	There may be someone in the organization here then ... I think someone in the organization here is more skeptical than me I think.
37	AI or technology scepticism	Perceived	O	D	8	There's always the risk of being too smart. Right? For AI I think - maybe it's a science fiction movie, but it could be - it could add value, I'm sure. But if it gets too smart, smarter than people then I don't know. Not right now, it is not in top of my head, but it could contemplate it being too smart and be dangerous.
38	AI or technology scepticism	Perceived	T/O	D	8	Too smart, meaning for me that it's outsmarting us. If outsmarts us - maybe we can learn a lot from it, that could be beneficial - but if it's - if it's a science fiction movie scenario - but if it's too smart, maybe it will take over. I don't know.
39	AI or technology scepticism	Perceived	O/E	D	7	Yeah, people are often concerned about stuff they might not understand.
40	AI perceived as limited	Actual	T	C	5	And maybe in two or three years, we can do much more than then we can today. But right now machine learning is very specific on a specific task. And then you can train it, and you can do it much faster, but it can't just hand it any task. You have to be very specific on the use case.
41	AI perceived as limited	Actual	T	C	5	through the knowledge we had, we knew that you can't use machine learning for everything, that you have to have a specific goal for it to train up on at least the ones that people are at the moment applying.
42	AI perceived as limited	Perceived	T	C	5	Well again, machine learning is great for doing specific tasks. But I think a lot of people overrate what machine learning can do and say, could we use this for portfolio management? Or could we use this? Do we have any data concerning portfolio management? No, it's just powerful. Then machine learning doesn't really apply, you can read, well maybe it can. But right now...
43	AI perceived as limited	Actual	T	C	5	we're not there yet where we can assist them (clients) making strategic decisions, but maybe in a year or two years. And we're following that progress and seeing when can it do much more than just a specific task. But right now, from the best of my knowledge, it can perform very well on a specific task. But once you have handed 10 different tasks, it's not there yet. But it will get there, I'm sure of it.
44	AI talent access	Actual	E	C	6	And it could - if they weren't successful and closed tomorrow, we would have a problem because AI developers are very, very popular. So it's, it's hard to get

						good AI developers. And that's my, that's one of my concerns.
45	AI talent access	Perceived	O/E	C	5	But it because if you had to go out and hire people with machine learning skills which are pretty short demand. And it would have taken four months just to get someone to hire. And then for them to understand what kind of data and in order to build a model that would, instead of seven months it would have taken a year and a half. So it's been a shortcut by using these, this small company because they knew what they were doing. We could give them all of the data and then we're up and running.
46	AI talent access	Perceived	O/E	C	5	it's been a great process for us. But it because if you had to go out and hire people with machine learning skills which are pretty short demand. And it would have taken four months just to get someone to hire.
47	AI talent access	Actual	E	C	6	Well, they are so popular that we would have to pay quite a high price to convince them to work for us instead of the medic companies or whoever.
48	AI technology perceived as immature	Actual	T	B	4	I believe it's a little early for us. We have thought that the technology is still its initial phase, we do not quite see where we should use it.
49	Budget constraints	Actual	O	A	1	But that you always have the budget constraints
50	Budget constraints	Perceived	O	A	1	that's the main constraint and then necessarily you have the budgets, as you always have.
51	Change resistance	Actual	O	B	3	A challenge had been guaranteed since, since so many people have worked here for so long and so. Since the vast majority of people working here have worked here for a long time and so ... you will get a lot ...You get some slowness in the system against changes ... and it would probably come ...
52	Change resistance	Actual	O	C	5	And that has also been a journey of trying to convince our own people, or trying to teach our own people, how does it work and what can it do, so.
53	Change resistance	Perceived	O	D	7	But there will always be a group of people that is at least hesitant when it comes to to change.
54	Change resistance	Perceived	O	A	2	if it had demanded that we had to work much harder a period or worked with much more extra then we quickly get resistance to it, because the days are more than full, so all the change gives you As far as ever resistance is concerned, it asks how it is done and how to see its usefulness.
55	Change resistance	Perceived	O	D	7	If they - there's also always the problem with people who worked jobs like this before computerization of everything - they were used to, they could handle everything with a phone and a pen. And they didn't have to use a lot of time to register, or document and stuff like that. This might be or there is hesitation when it comes to like, over-administrative, or too much computer work when you might not see that as the main part of your job.
56	Change resistance	Perceived	O	C	5	it depends on the people, there are some people who are very reluctant, and there are people who are onboard since the beginning

57	Change resistance	Actual		B	4	It's a little department based. So some departments can take changes very quickly others are more germinated in a form where they stand and do the same things every day and do not want to change that much.So it is clear that it is a challenge for everyone, we also see this in connection with introducing a new IT system on the house, so it is a threshold for the vast majority and the older you are the worse is it. And I have been involved in such processes before and see that you just have to take the step, if you as an employee are not part of the change, it will be hard for you.
58	Change resistance	Actual	O	C	5	originally, they had a project that lasted seven years, so they're used to this old way
59	Change resistance	Perceived	O	D	7	The biggest issue is knowledge about using the tools available. And might also be willingness to learn to use it because they might see it as like an unnecessary thing.
60	Change resistance	Perceived	O	B	3	the employees will always compare the new to the old and the old system and processes is something you know no matter how bad it might be, so skeptical attitude towards change it will always be
61	Change resistance	Perceived	O	C	5	When you have been around for 40 years in this business, you trust the things you know, and these new things, we have to see if it catches on, so to speak.
62	Change resistance	Perceived	O	D	7	Yeah, yeah. So, some people always like the way it was, or is in compared to the new setting. Just a general hesitation. And then more often than not, people will be happy afterwards. But there is of course, always something - some technology advancements. Advancements might not - the first blink of an eye seemed like it does anything good for somebody, but it might be that one colleague has to do something that takes one minute more, but it saves the organization 15 minutes some other place. And that might not always be obvious to the person that used the one minute extra.
63	Change resistance	Perceived	O	A	2	Yes, of course, everything new is scary, so we've always done it, and it's a part that has that attitude. Someone has such an attitude and can influence others with it.
64	Change resistance (Fire people)	Potential	O	D	8	There's always the case of - do we need to fire people? Or could we use these people, these colleagues in another department, in another area of our organization? Of course, this is business, hardcore business. Of course, there is - can we optimize something? And maybe letting go some people, then that's sometimes the case, of course it is. But that could be one.
65	Clear benefits of an AI initative	Potential		B	4	That a supplier takes the initiative and presents an unfinished, yet completely finished solution that makes us see that this has a value for us.
66	Unclear benefits of an AI initiative	Perceived	O	C	5	And then you have to know what the result what what does the what does the machine trained for, What is what is the end? What is the result we want to we're trying to achieve? Once these three things are solved, then you can start the training and machine learning, right.
67	Unclear benefits of an AI initiative	Actual	O	D	7	And we also don't know exactly what the payoff is.

68	Unclear benefits of an AI initiative	Perceived	O	D	8	But also, is this really beneficial? Is this just a smart trend that isn't taking us anywhere but this is something we can do in the market for marketing purposes (note: just an example) or is it really beneficial for us and also for our clients? Does it add value to our company? I think that's the main factor.
69	Unclear benefits of an AI initiative	Perceived	O	B	3	But we must be able to understand what it is before we can bet on it. It cannot be a "nice-to- have" solution , but that we must be able to relate it to what we do today ... and be able to see the benefit of it.
70	Unclear benefits of an AI initiative	Perceived	O	D	8	Can we do it so it's actually beneficial? It needs to be beneficial, it shouldn't just...
71	Unclear benefits of an AI initiative	Perceived	O	A	2	Cost benefit??? then I think, whether it is artificial intelligence or what it is, we would never be able to invest in an expensive system or artificial intelligence that we are unable to obtain in the form of increased efficiency and increased sales. So that's the highest risk. We could never invest in expensive systems or solutions as long as we do not know that we manage to take it on board... that we manage to handle more customers or increase our turnover.
72	Unclear benefits of an AI initiative	Actual	O	A	2	I have never thought about artificial intelligence . But now you have introduced me to something that triggers my curiosity. So if you had, or if I had known about what it was, what benefits it could provide, it could have been interesting to look at, but for the time being I am happily ignorant of it and what benefits it could have given us.
73	Unclear benefits of an AI initiative	Perceived	T	D	7	If we find the right solution for the right price, yes. And that is, that is just the two factors - How can this solution help us and how much does it cost?
74	Unclear benefits of an AI initiative	Perceived	O	B	3	If we had a case where we saw that it was profitable in the short or half-time then we had considered it
75	Unclear benefits of an AI initiative	Perceived	T	A	2	if we have something in our systems that can extract more information then there will be positive conditions for us against the competitors. If it had also enabled us to provide better information or better service to our customers then it would be better for the customers as well, and it could be an advantage when we were to respond to requests for then can also describe the solution or service that might be an advantage over what the others have.
76	Unclear benefits of an AI initiative	Perceived	T	B	3	It must be clear what the benefits will be from using the technology.
77	Unclear benefits of an AI initiative	Perceived	O	D	7	Of course, it requires a - we will need to know the data on what we use for completing the task right now, how much it costs, and we need to know how much the new solution costs. And then of course, it's a way of - well, when can this be paid off.
78	Unclear benefits of an AI initiative	Perceived	O	A	2	one had to get a good explanation of why we do this and how long will this last, and then a good management that this will actually last a month and then we will be able to reap the fruits of it . So you have to know why we do this, then we fold our sleeves up but then you have to know that it gives something on the other end.

79	Unclear benefits of an AI initiative	Perceived	O	A	2	then one had to look at whether one finds a solution that sounds brilliant, what would it give us in the form of that we could then free time for some people or given one better service for our customers.
80	Unclear benefits of an AI initiative	Perceived	O	A	2	Yes, if it has a cost / benefit ?? Then I think so. But it is important that you think or that you have calculated and made a qualitative assessment that we will benefit from it.
81	Lack of clear business case and strategy	Perceived	O	D	8	But we really need to make sure it's a great investment if we do a long term investment. We're not in the market for doing short term investments. But if it has to be, if it... We have to make a plan, that's what I'm saying, our strategy - we need to see, does this work after three years, five years? When does this work? When does this optimization come into place?
82	Lack of clear business case and strategy	Perceived	O	B	3	first you have to make the specifications and goals clear and easily understandable, and so ready to divide it into good sub-goals, then I do not really think that end time is not so important, because then you will feel that That process is underway.
83	Lack of clear business case and strategy	Perceived	O	D	8	I think it's very, very wise to do your homework before you start. And then have some pre definition of what you're looking for, what would create value for us and our clients, and then predetermine that. And I don't think we're there yet. But we will be of course, but it's a process, it is an ongoing process, work in progress of what you call it.
84	Lack of clear business case and strategy	Perceived	O	A	2	Not necessarily, but one had to make a good process around it, or a kind of concrete project if one were to introduce something like that. Also, one had to anchor it well in the organization. ”Why / what is the purpose of this and what utility will it provide for motivation to learn it”. Then I probably think it would have gone well, but you had to do it thoroughly.
85	Lack of clear business case and strategy	Perceived	O	A	2	So if we had also thought that this solution here is awesome for Norway, it costs a few hundred thousand, then we always had to, yes we have to create a business case , but we have to address it in IT and they must also approve that yes... “This is in line with further strategy and fits in with IT plans you have with IT in the future”.
86	Lack of clear business case and strategy	Perceived	O	D	8	We need a lot of time, we need a clear cut plan, strategy. And we need time to really think this over
87	Lack of clear business case and strategy	Perceived	O	A	2	Yes, if it has a cost / benefit ?? Then I think so. But it is important that you think or that you have calculated and made a qualitative assessment that we will benefit from it.
88	Lack of clear business case and strategy	Perceived	O	A	2	Yes, in a organization as ours… it’s not a lot of time, you usually do not get permission to do such investments without having a good business case, and the business case should include a clear plan of then you break even on the inflicted cost. So it must be followed, so I think that allowed to do something like that needs to be based on being able to prove this…. Because it is considered an

						investment
89	Lack of clear business case and strategy	Potential	O	B	3	I think it had gone smoothly, as long as you can clearly convey where you are going ... preferably quite concrete… then I think it's not a problem.
90	Lack of clear business case and strategy	Potential	O	B	4	No it roots in the fact that you are supposed to deliver on an IT project that should be operational within a reasonable time-span… and we see that there are too many faults or deficiencies in relation to the specifications that are given then we will... that if it is not given axed straight away... you will get some time constraints.
91	Lack of clear business case and strategy	Potential		A	2	To us, we are not very much steered by the group, but if we say that we are going to invest 500,000 but have no plan for why we will be able to get it out then we are not allowed to do so.
92	Lack of clear business case and strategy	Potential	O	B	3	You may need to have a little more knowledge or you must have some knowledge about identifying opportunities and such ... to be able to choose the right goals
93	Unclear use case	Perceived	O	C	6	And I think it's, it's always difficult to just take a technology and say - well, it looks smart, how can we use it? And I don't think we should make the same mistake with machine learning, at least to some extent, we shouldn't take them just like technology and start with the technology and go figure figure out which use cases there are. It's, I think it's a good approach to see, what use cases do we have? And does machine learning actually fit in here? Otherwise, we will just, we risk spending time on the wrong technology.
94	Unclear use case	Perceived	O	C	5	And then you have to know what the result what what does the what does the machine trained for, What is what is the end? What is the result we want to we're trying to achieve? Once these three things are solved, then you can start the training and machine learning, right.
95	Unclear use case	Perceived	O	C	6	But I think it's a mistake, just to start looking without really knowing what you want to achieve. So I usually advise people to think about the use case and think about the technology after they figured out which use case they want to pursue.
96	Unclear use case	Actual	T	B	4	I believe it's a little early for us. We have thought that the technology is still its initial phase, we do not quite see where we should use it.
97	Competing priorities	Actual	O	A	1	And then, and that's why we always had to prioritize, yeah, but all we managers in the different markets, we necessarily like to have this, that and that and Wwy can't you provide us with this? And why can't we have this? And so if you were able to choose on the top shelf, then you would probably say I would like to have it all.

98	Competing priorities	Actual	O	A	2	But as long as we are to have any major investments or need need support from IT or finance or the teams or whatever it is we need to fight as much about the resources that the other countries have. Then things can go slow, because it depends on where the priority list is put on the group. If it is said that this is very important, this will be useful for several markets and more long then probably the initiative will be initiated quickly, if only for Norway is probably the process slower.
99	Competing priorities	Actual	O	D	8	I definitely think so. Absolutely. I think so because this is a growth company, we've been for 15 years, that means we're very busy, very busy. And to implement this, a new system, a new technology takes a lot of resources, it really does, then that takes time away from something else. And some will definitely say, okay, we need to look for maintenance, we need to look for improvements in what we already have, instead of looking for another technology. New ways to do new things, or current things, but I think, definitely think there's dividing opinions, but I think most of the management team, the management group will look at some form of AI with positive eyes, definitely, I think so.
100	Competing priorities	Actual	O	D	8	I think our main - I think it's because our main focus is to develop the current system that we have, then we can build on that on top of that, but not simultaneously with another project, IT project. I don't think that would work. And I don't think it's a focus area. I think that's one of the main reasons, but also, we know, to implement a new system, it takes a lot of time, a lot of resources. So I think we need to focus on our (DANISH EXPRESSION) - that's the directors' point of view, we need to focus on constantly improving the current system.
101	Competing priorities	Perceived	O	B	3	it is more in a way to set aside time to nail the process so that you get started ...
102	Competing priorities	Actual	O	B	3	No, not so fast, but we could get it started in a couple of months if we had been properly geared. But had it actually been right now, I had to say that maybe it would be relevant in 1.5 years… We will start on the ERP project and have no capacity to keep up with several projects at the same time.
103	Competing priorities	Actual	O	A	1	So it wouldn't probably work either, but I think we are quite in common on that we wanted, and what we want. But we also understood that we have to prioritize and so there's no question that AI is here to stay. It's important to have it, we should have more of it. But we just have to do it in the sequence we can both afford and what the organization can cope with.
104	Competing priorities	Perceived	O	A	1	So that you have to to prioritize it and start with this and then do that.
105	Competing priorities	Actual	O	B	4	That's correct. It's not a priority. We do not work much with such tasks. It would be interesting to work more with development projects, where we could do our own things. But the “wheels must roll”.

106	Competing priorities	Perceived	O	A	1	then it's a little bit what do we take when because you can't do everything at once at the same time. So you have to prioritize what is most important and what has the most effect
107	Complexity of technology adoption	Perceived	T	A	1	maybe you had to do some adoptions or changes personally etc. So it's not just a bit, press a button and think that it's okay. And then it has to be understood,
108	Considering to adopt customized AI solutions	Potential		A	1	So I think the most important thing is that you have something that's proven, it doesn't have to be the most fancy, because then you have all the child diseases and all that. Something that you know works, it's modern enough or quite modern, fulfills our tasks, has a supplier that can maintain it or upgrade it when needed. And that you know that is there tomorrow for you. And that the system is fully... and that you as little as possible have to customize it, because then you have to customize it for all the different markets.
109	Culture doesn't support R&D	Potential	O	A	2	If you have a business case and you are unable to deliver it then we are quick to put a foot on the break and stop the project. If we cannot show progress to our owners then it it's not that fun to work with, it will be tough.
110	Customer contract constraints	Actual	E	A	1	the contract systems don't really always cater for you to do something very differently.
111	Customer contract constraints	Perceived	E	A	1	But the systems and approval methods and the contract systems don't really always cater for you to do something very differently.
112	Customer contract constraints	Actual	E	A	1	So opposite to a private private customer who can say: that, oh, we have this thing here - oh, very good idea. We just write it in contract. And and then we agree. And, but here is that - no, this is... then it has to go to the juridical department, it has to go through the systems, it's outside the law of public procurement. So we cannot do this. And it's looked upon as a major change to the contract, maybe then we are, then we cannot do it before the next contract comes in three years time. So it's in that respect, it can be frustrating for the customers.
113	Customer contract constraints	Actual	E	A	1	So we cannot do this. And it's looked upon as a major change to the contract, maybe then we are, then we cannot do it before the next contract comes in three years time. So it's in that respect, it can be frustrating for the customers.
114	Customer contract constraints	Perceived	E	A	1	The contract doesn't always, always contain the possibility or the flexibility to do things different. So that that might be an obstacle.
115	Customers misunderstanding or not knowing what AI is	Actual	E	A	1	And I think for that's also a buzzword in our industry. And if you talk about AI, I don't think they will understand what you're saying or understand the topic or the content. So you have to be aware that welfare technology is something that the customers can understand, they maybe have a very different definition of it than what we have. They're saying that everything has to do with computer, for instance, is welfare technology, everything that has to do with a chip is welfare technology and all but so, but I think you had to put that aside and say that: Oh,

						yes, yes, it's all welfare technology and we will help you on this. So yeah.
116	Customers misunderstanding or not knowing what AI is	Actual	E	C	5	But we couldn't get it approved because the regulator didn't understand machine learning. They thought it was some kind of black magic or Voodoo that happened inside the machine.
117	Customers not being able to utilize AI	Actual	E	C	6	I think the ones most affected, or would have the most challenges, would be our customers. Also, in this housing estimation project, the problem is also how to enable our customers to have to use it, given that they have all this regulation.
118	Customers not being ready to adapt to change	Actual	E	A	2	But just that is quite difficult for our customers. So now we have gone back and realized that we need to manage the process as we did ten years ago; make a list of product abcd where you can check when to order, that is at the level they are. Return to how it was 10 years ago. And our customers are also there that there are very many who may have hardly ever taken on a computer and it is scary scary, and going into an online store is certainly scary, so there is a lot of fear of IT among many health professionals, it is very varying level. That means we have to work at that level.
119	Customers not being ready to adapt to change	Perceived	E	D	8	a market and industry maturity - you talked about maturity before, maybe that's not there yet.
120	Customers not being ready to adapt to change	Perceived	E	A	1	Also, on the customer systems we can't introduce system that the customer cannot use, for instance. So it's very different from the consumer market where you can just offer what you like, and you will always find entrepreneuers and the starters and those guys, and the followers will come afterwards. Here, you have to really ensure that the customers understand what you do. He's able to cope with it. Yes, he has system, he has personnel that understands it, and all those kinds of things.
121	Customers not being ready to adapt to change	Actual	E	D	8	and the industry - is the industry ready? Are the marketers and tenants ready?
122	Customers not being ready to adapt to change	Actual	E	A	1	But in our conservative industry, we have conservative customers, public customers, who are used to it and saying: We have done this for 20 years, it works fine with us and you don't come here and try to teach us and don't come here and give us something new that we don't understand or don't have the systems for or is outside the scope or the contract or blablabla.
123	Customers not being ready to adapt to change	Perceived	E	D	8	I think it's very important that our clients, and the tenants are ready for this development as well. You know the saying that maybe you are couple of years ahead of your time, right? That could also be a factor in a negative way. You're too far ahead, not behind, but ahead. Is this really what the market is looking for right now? If it isn't, then

						we can't implement it anywhere. Noone would buy it. And that's, that could be a factor. Maybe that's ingenious, maybe that's innovative but it's too early. That could be a factor.
124	Customers not being ready to adapt to change	Perceived	E	D	8	I think the key factors are, can our clients and our tenants relate to this type of machinery or software, whatever it is,
125	Data quality	Actual	T	C	5	label the data in order to make the machine learning really understand what does this represent. What is this, if you get a number of 3.5, what does that mean? Is that a between a figure of one to five, or one to 10, on one to 100? So that it can understand what kind of information is out there. And also, again, for the listing price, or the listing texts that we had to describe, this is a text about what condition is this housing, the value youshould try to extract from it this this kind of value
126	Data quality	Actual	T	C	5	So we thought our data was pretty well structured. But actually, I think about 50-60% of the work was restructuring the data and further labeling, what is this data about... So yeah, again, about 50 or 60% of the effort went into further structuring the data that we had.
127	Data quality	Actual	T	C	5	So you have to label it in order to make sure that was that we thought we were pretty structured. But it turned out we had to do a lot of work there.
128	Data quality	Perceived	T	D	7	There's a lot... you have to make an investment in filling out all required data for a system like this to work.
129	Data quality	Actual	T	D	7	Yeah, there's a barrier, because our data is all - most of the data isn't captured automatically. It is put in in our system by our colleagues. And there can be a lot of variations of how good and valid the data is, or how much is missing. So that is a barrier because our data is not perfect. It's an approximation.
130	Data systems and their capabilities	Actual	T	A	1	And maybe you don't get all the data you want in the way you want them. Like, we don't have any dashboard systems or stuff like that.
131	Data systems and their capabilities	Actual	T	A	1	And we would like to have a better BI systems as we would like to see more and more of this and to do more analysis when in this way your...
132	Data systems and their capabilities	Actual	T	B	3	
133	Data systems and their capabilities	Actual	T	B	4	because we have the old structure, with that there are actually 5 companies that are in the same house and everyone is sitting on their own system. We drive to send mailers to each other and registers orders in one system and then sends mail over to another who registers in their system. So it is very much double the job and we will be away from it. Plus, when people call in here, it is not always that we have the overview because it is not everyone who can all systems or have access to all the systems.

134	Data systems and their capabilities	Actual	T	A	1	I would like to have something more updated... it must be that it could do some more details and more drill down functions and stuff like that, if you really need to go into a contract or certain customer group or whatever. But we can do that. But it's done manually in Excel and... you know, so it's... there are more modern systems on the market.
135	Data systems and their capabilities	Actual	T	A	2	If customer A has ten items that he has not received, then we cannot go into customer A's order history to see that which goods has not been delivered... We must also go into each individual order number, And then there can be ten orders... then one can see there was one item that was the two. If you have the customer on the line who is wondering what has not been received on the last goods in the last two months, then the customer center cannot easily give the answer, they have to go into each individual order. It's really unnecessarily complicated.
136	Data systems are not properly connected	Actual	T	A	2	If we were to make an investment where we are going to integrate public customers, that is, the municipalities and the hospitals 'purchasing system with our storage system, we do that manually today , that is, all the customers' orders we are punching in, it takes a lot of time, which must do one integration and it can quickly cost several hundred thousand
137	Data systems and their capabilities	Actual	T	B	3	No, not as it is today, not something that is easy to get out at least. For what we have today is an old system that we really only use to calculate prices and invoices, where we have no form of back reporting ... In addition, it is very cumbersome set up and built on and built on by the supplier, so it is very complex . We have tried sometimes to get out information, but it is very difficult. It's been a year since last we managed to get reports in Excel from our system … Then you can see for yourself how forward-looking they are. That is why we are overripe to change the whole system.
138	Data systems and their capabilities	Actual	T	B	3	The administrative data, because they are the ones you think of, it is quite impossible to get something out of now, because the systems are too bad. I hope that it might be an opportunity with the new ERP system when it is finished. Then I hope we can get the statistics or data we want to access ... For the system that is in use today is really very closed and very difficult to get something out of it.
139	Data systems and their capabilities	Actual	T	A	1	we don't have the best business intelligence systems, that has to be improved.
140	Data systems and their capabilities	Actual	T	B	3	We have some machines that are a bit old and they can't talk to the system to do any operations. So if you need more automation then we need new machines.The administrative is not good at all, hence a new ERP system.
141	Data systems and their capabilities	Actual	T	A	1	We just had discussed better BI systems that can also help us in understanding the business.

142	Data systems are not properly connected	Actual	T	A	1	And then you have that warehouse management systems that work quite well and talk to the ERP system. And then you have your standalone more or less BI systems and some finance system, etc. They are a little connected in, in the ways of, of finance dreams, and stuff so that you can can work on contract and profitability and sales and all those kinds of things. But not very advanced.
143	Data systems are not properly connected	Actual	T	B	3	We have some machines that are a bit old and they can't talk to the system to do any operations. So if you need more automation then we need new machines.The administrative is not good at all, hence a new ERP system.
144	Demanding and long onboarding process	Perceived	O	C	5	But it because if you had to go out and hire people with machine learning skills which are pretty short demand. And it would have taken four months just to get someone to hire. And then for them to understand what kind of data and in order to build a model that would, instead of seven months it would have taken a year and a half. So it's been a shortcut by using these, this small company because they knew what they were doing. We could give them all of the data and then we're up and running.
145	Demanding and long onboarding process	Actual	O	C	5	We had a long period of this with the small company trying to explain it to the people maintaining it, and getting them on boarded in what, how does machine learning work. And it's actually a billions of calculations. It's not some magic that happens inside the computer. And that has also been a journey of trying to convince our own people, or trying to teach our own people, how does it work and what can it do, so.
146	Dependency on external help	Actual	E	C	5	And then we got in contact with a small startup that are experts in machine learning, but been working in the pharmaceutical industry.
147	Dependency on external help	Actual	E	C	6	As I said, we have vendors doing all the coding and all the data cleaning.
148	Dependency on external help	Actual	E	C	5	As I said, we started with a small company that had the knowledge or could write the Python code, so we used external help to get it up and running.
149	Dependency on external help	Actual	E	C	5	But again, when we further develop the system, if we find new data source, which we've already identified, and want to develop a version 2.0, then we'll take the external help again, in order to do it right, so to speak.
150	Dependency on external help	Actual	E	A	2	I have little faith that the introduction comes internally in (COMPANY NAME). I think we need to get the introduction from the outside and bring it into the group.
151	Dependency on external help	Actual	E	B	4	I imagine the same process that we have had with the order system, if we were to buy an AI system then we had to have a supplier who comes to us and says that “here we have something that suits you also we can make local adjustments” Well, that's what I see. I cannot see that we should start implementing it ourselves, we are not there, I do not think we will be either.
152	Dependency on external help	Actual	E	B	3	I think we needed external help to somehow set up the project and to assist us in implementing it. Afterwards, I hope we could manage it ourselves.
153	Dependency on	Actual	E	B	4	I think we would need help. We have no knowledge of it.

	external help					We would need external people.
154	Dependency on external help	Actual	E	D	7	If it's something I can figure out a solution to in, I would say, less than a week, we might do it ourselves. If I can't - if I can see already that, well, this isn't anything I can handle then we acquire help.
155	Dependency on external help	Actual	E	D	8	if we bought some software, some AI software that needs to be implemented - maybe we could also hire consultant from that company, that would also be beneficial, I think.
156	Dependency on external help	Actual	E	D	8	Maybe we'll hire some consultants, I don't know. But we're always looking for a way to do it ourselves. But if we cannot do it ourselves, we need to hire someone outside. Definitely. We've done that before with (NAME). So maybe we'll do that...
157	Dependency on external help	Actual	E	D	7	most often it is the company that delivers our operation system, that would help us because it is more or less always a question of getting something, something, something, something to work with our operation system, either in logging some data or predicting or whatever, with some data, so it will always, more or less always be them. And they're like an IT company.
158	Dependency on external help	Actual	E	C	5	So these two vendors are the ones who do the programming. And both of them have machine learning competencies in-house. But, again, we've had great experience with this small, smaller company. And if we were to further expand it we will use them again.
159	Dependency on external help	Actual	E	C	6	So we have the discussions about which data can we put into the model, but any, any discussion about how to crunch the data and which model and which estimation, the principles were best, there was entirely the vendor.
160	Dependency on external help	Actual	E	B	3	We don't really have enough knowledge or capabilities today... So if we were to start using AI-solutions we had to run it as a project and bought the services ... I'm sure we can't do it ourselves.
161	Dependency on external help	Actual	E	C	6	We will always need external help for any project, more or less.
162	Dependency on external help	Actual	E	B	3	We would have to put ourselves more into the AI, to be told what opportunities exist, in that way it would link up with the processes we have today... it is a matter of getting help to see what are the possibilities.
163	Dependency on external help	Perceived	E	C	5	Well, of course, as we talked about the need to be educated a bit more than they are today, in order for us not to be vulnerable, because if if the resources of the company we're using right now, that actually decides we don't want to work with (CASE COMPANY) anymore, then we've lost that knowledge. So we have to spread knowledge and put it in (CASE COMPANY) so we can keep developing.
164	Dependency on external help	Actual	E	C	6	We're, we're a little special because we don't actually, we don't have developers, we don't host our own stuff. We have some subcontractors doing everything for us. In this case, we used a small company, which is a startup company.

165	Dependency on IT department	Perceived	O	A	1	Then that will be the responsibility of the IT department. Just say that, okay, we put one, one FTE, here you're in your organization for a year. But it wouldn't be acceptable from top management either to have somebody running around here for a year. And if you spent that much time on the project, then it I don't think it would have been accepted.
166	Dependency on IT department	Actual	O	A	2	And then there is this - how can we get it to communicate with the system, and almost before we have started it has been stopped in Sweden. Because it is quite unlikely that we will introduce this because then it must already be in the system or determined that it should be in all countries.
167	Dependency on IT department	Actual	O	A	2	As long as we are not dependent on pitching to the IT-department... so we can decide it now so we start right away.
168	Dependency on IT department	Actual	O	A	2	But as long as we are to have any major investments or need need support from IT or finance or the teams or whatever it is we need to fight as much about the resources that the other countries have.
169	Dependency on IT department	Actual	O	A	1	But the IT department is quite clear on that we should have as much as possible ready from the shelf products, we should not develop very much ourselves to take quite a lot of resources to update, maintain, all those kind of things.
170	Dependency on IT department	Actual	O	A	2	It stops in the IT department in the way with the people there
171	Dependency on IT department	Actual	O	A	1	It's not very much up to me to decide, because it's the IT department that has to decide all the IT systems.
172	Dependency on IT department	Actual	O	A	2	Our IT is located in Sweden and it's no secret that IT resources are always difficult to obtain, I think it's the case in all organizations, it's always scarce and they have plenty to do. We do not have expertise in IT here in Norway, so if one should integrate something like that or implemented it then we would have been totally dependent on having set off IT resources from Swedish colleagues.
173	Dependency on IT department	Actual	O	A	2	The best thing for us when there are new things is that Sweden or the IT department that finds useful measures, that they take it into the first round is the easiest compared to getting it out different countries, but that is not an obstacle to We can do things in Norway but you always go through IT. So if we had also thought that this solution here is awesome for Norway, it costs a few hundred thousand, then we always had to, yes we have to create a business case , but we have to address it in IT and they must also approve that yes...
174	Dependency on IT department	Actual	O	A	2	Then we had to have had a person from the IT department who worked with us in projects.
175	Dependency on IT department	Actual	O	A	2	We've looked at some new systems and the process stops us pretty quickly because there are strict policies on what we are allowed to integrate to the IT-systems, that is why it is super important to bring IT-department on the track when assessing new solutions.

176	Dependency on IT department	Actual	O	A	2	When it comes to AI, we have put that on ice. It is here where the aspect of security comes to - first of all, it's super expensive… licenses are expensive… so we are totally dependent on getting external IT resources and when you put this into consideration, it also becomes a huge expense.
177	Dependency on Sweden / IT / owners	Potential		A	2	Yes, but we are governed by our owners, they make most IT-decisions and in the end choose the different systems. We must often use what is adopted our Swedish sister company, something that is also a reason that we don't always have the last say.
178	Employee age	Perceived	O	C	5	and also, it's also an age question. Mostly.
179	Employee age	Actual	O	B	4	Here there are leaders who are 50+ and should perhaps have had someone who is a little younger who looked a little ahead into the glass ball.
180	Employee age	Actual	O	A	2	our average age on those who work here is about 40, so we are like many who are well over 40 , so we think we also have limited knowledge and expertise on common technology , so it will certainly require a change in both structures and routines and that we have to learn how to use it. So a little fear of it, the fear of everything online or digital can be a bit scary.
181	Employee age	Actual	O	B	4	So it is clear that it is a challenge for everyone, we also see this in connection with introducing a new IT system on the house, so it is a threshold for the vast majority and the older you are the worse is it.
182	Employee age	Actual	O	A	1	The average age here is 53 of the 16 employees we have. Some are necessarily quite up to speed. Definitely the younger ones. The older ones are like: wooo this is the dangerous. Maybe not dangerous, but it's "oh, how does it work? Can/Do I have to learn this?"
183	Employee age	Actual	O	B	3	We have employed some this year, both younger and on the average. We somehow have a little spotlight on the age issue, but we also hunt a lot of experience at the same time..., you don't get a 20 year old well experienced then, but in a way we must have more spotlight on the age when we hire, because it will end up with be a problem.
184	Employee age	Actual	O	B	4	Yes it is the danger with such a company that we have, we are quite uniform in competence, the people who work here. We have many of the same experiences. Getting some younger ones with new impulses will help us to hang more .
185	Employee age	Actual	O	B	3	Yes it is a slightly larger case for us versus a younger environment then. The average age here is enough ... I want to tip 45 here then
186	Insufficient employee training	Perceived	O	D	8	Absolutely. But also the operational level of employees, of course, they do, but we will need proper training and implementation, otherwise, it won't work.
187	Insufficient employee training	Actual	O	C	5	And then we trained the people that we have there. So now they can maintain it for themselves.
188	Insufficient employee training	Perceived	O	A	1	How do we ensure that the organization understands it and is able to use it? It has to do with training and educational stuff

189	Insufficient employee training	Perceived	O	A	1	So it's not just a bit, press a button and think that it's okay. And then it has to be understood, it has to be trained and people have to be trained.
190	Insufficient employee training	Perceived	O	A	2	we have to learn how to use it.
191	Employees to lead or promote an AI initiative	Perceived	O	A	2	No, I don't think so as it is now. I have one at the customer center who is very interested in system and data so curiosity is in place, so she could probably have participated in it. But now she doesn't have the skills. I don't think there are so many who know what artificial intelligence is.
192	Employees to lead or promote an AI initiative	Actual	O	B	4	We really need new ideas and new people in order to lift us into the digital world. We are very digital, but I mean the next step.
193	Employees to lead or promote an AI initiative	Perceived	O	B	3	Well ... I think we had to depend on someone from the outside to be able to control it, that it had to be part of the program ... otherwise I am afraid that we will not be able to go through it. So there are no clear candidates, not without it had gone too much beyond too much else that we do not have backup resources for. Our IT manager might have led it, but then we had to find someone new to do the job he does today.So then they might as well use another one.
194	Ethical consequences	Actual	E	C	5	But the machine doesn't use common sense. It just has these input variables and then predicts the price. And it so that's one of the ethical dilemmas that we've described for the regulator.
195	Ethical consequences	Actual	E	C	5	it was about developing a framework that would enable them to understand what kind of model have you built. Had you thought it through? By presenting what are the ethical dilemmas that we think there is... and what's the governance around the model? How do you store data? How do you validate data? And what's the bias on data and all of these things.
196	Ethical consequences	Actual	E	C	6	There are a lot of pitfalls when you start using AI. We discussed some of them during the process, especially with the regulator - what are the ethical consequences of this. One is, of course, bias - have we created a model that's more beneficial for certain segments of the Danish population? Does it give women an advantage compared to men and older, younger and so on?
197	Evaluating external vendors and consultants	Actual	E	A	1	And that's what they're good at. And so if it pops up on a satellite here satellite there that there are new things you want to integrate, then you need to have external consultants for that.
198	Evaluating external vendors and consultants	Actual	E	A	2	I do not know about which solutions that might be there that could be relevant.
199	Evaluating external vendors and consultants	Actual	E	A	2	I think it must be that you either get tips from someone or know about or see that there are solutions that can make our everyday life easier so can work more efficiently, without necessarily needing more people.

200	Evaluating external vendors and consultants	Perceived	E	A	2	Then one had to know which service, tool or solution exists. Number one is what is it, it is useful to us, and then one had to look at whether one finds a solution that sounds brilliant, what would it give us in the form of that we could then free time for some people or given one better service for our customers.
201	Evaluating external vendors and consultants	Actual	E	A	2	We do not spend any time finding out either, but if one had been presented with it and had found out there are solutions or tools that could have helped us then it could have been relevant, but I just think we Don't know what it is.
202	Evaluating external vendors and consultants	Perceived	E	A	1	Well, I don't know too much about it. But I think sometimes it is, and it could just as well be that they are hard for a company like ours if we had to do some of these standalone... where do we search? How do we... there you have a lot of bidders out there that would love to take on your account. How do you separate them? How do you know which one is good and one is not so good and your ability to look beyond the advertising and PR and all the sales gimmicks and arguments they have. And really find out who is really good at this and can really help us to put an affordable sum of money and give us what we want and all the extravaganza that they would like to sell to you. I think that just to navigate in that market, I think it would have been quite, quite difficult. So I think that if we were alone, and we are over 200 million kr. (NOK) company and just around 16 people and maybe some people in a warehouse and stuff, I think we would have needed... I call it a consultant I could trust as mine. That could help me out and do that navigation.
203	Fear of losing job	Perceived	O	D	7	If you fear for your job.
204	Fear of losing job	Perceived	O	D	7	In the short term, it might have a negative impact on employee satisfaction or work morale, if it's something that might be...
205	Fear of losing job	Perceived	O	A	1	should we be afraid of all this, will the machine take over my, my function, you know
206	Fear of losing job	Perceived	O	D	7	Yeah, of course, of course, everywhere, everywhere, where a group of workers can see that some optimization might cost someone the job, there will be hesitation, at least.
207	Fear of losing job	Potential	O	B	3	I feel that it is exciting and forward-looking. I am not so skeptical in view of the fact that all people become superfluous
208	Financial constraints	Actual	O	A	2	But then we have not made the investments because we have just been bought by a new owner and then one does not make such investments, so everything is a little on ice.
209	Financial constraints	Perceived	O	A	1	It takes time and it takes some resources and or maybe most importantly, it takes money. Investment budgets. And, and that's always a constraint necessarily.
210	Financial constraints	Actual	O	B	4	No, not really. It is clear that after all, it is an organization that cannot blindly spend money... we have no such capital that we could spend on something that we think might end up successful. We are not. We are very careful

						about what we acquire of tech and it is very professional weight put into the decisions.
211	Financial constraints	Actual	O	D	7	There's money.
212	Financial constraints	Perceived	O	A	2	When it comes to AI, we have put that on ice. It is here where the aspect of security comes to - first of all, it's super expensive… licenses are expensive… so we are totally dependent on getting external IT resources and when you put this into consideration, it also becomes a huge expense.
213	Financial constraints	Potential		C	5	Not for us, but I think it would be for other companies.
214	Firefighting	Actual	O	A	2	But it is probably our challenge and probably many others that we get tougher and tougher demands in terms of what we are to deliver on turnover and on the bottom line, and it is not always, or within those limits, it is largely not It is possible to employ all the people that you probably thought you needed, so you need the system to be able to streamline the way you work.
215	Firefighting	Perceived	O	A	2	Should it have been an artificial intelligence project then it would likely be hard to integrate and balance the project with next to the current system without interrupting daily operations...
216	Firefighting	Actual	O	B	3	because everyday life takes us in a way so that we just do the same again and try to do it faster, and do not move anyway
217	Firefighting	Actual	O	B	3	Haha, most days are quite busy... and we have to in a way have it like this to be able to survive and make money so we must have low administration and tasks of that kind ..
218	Firefighting	Actual	O	D	8	I definitely think so. Absolutely. I think so because this is a growth company, we've been for 15 years, that means we're very busy, very busy. And to implement this, a new system, a new technology takes a lot of resources, it really does, then that takes time away from something else.
219	Firefighting	Actual	O	A	2	if it had demanded that we had to work much harder a period or worked with much more extra then we quickly get resistance to it, because the days are more than full, so all the change gives you
220	Firefighting	Actual	O	D	7	It's more those small ones where you can see - okay, with a five hour investment, I might be able to save someone at the company half an hour a day. Those small tasks we tried to do. But a task like the other one would be a process over several months, where you have to use maybe 30% of your work hours. And that's sometimes a bit harder to fit...
221	Firefighting	Actual	O	B	4	That's correct. It's not a priority. We do not work much with such tasks. It would be interesting to work more with development projects, where we could do our own things. But the "wheels must roll".
222	Firefighting	Actual	O	B	4	There is a lot of calculation, order filling, communication on email with customers. For example, I am one of those who receive about 70 emails a day and one should answer this, so there is a lot of time for it. It is some of the sale aspects that consumes our time we get so much inquiries

						with different things that we have to sit with, we have no time to be out with our customers
223	Firefighting	Perceived	O	D	7	Well, that's just because a work day is full with other stuff.
224	Firefighting	Actual	O	B	3	Yes its like you never have the chance to get started with stuff like that, it doesn't get a high priority on our list… We become very busy with the daily production..
225	Firefighting	Actual	O	B	4	Yes, that is the case. Everyday life gets us, we get some respite some Fridays like today where it is the day before a holiday, then the activity level goes down and then we get some breathing space and then we can make room for you as now
226	GDPR concerns	Perceived	E	D	7	And, yeah, and then the general data security.
227	GDPR concerns	Actual	E	C	6	But it was actually, it was a mixture of our security guys who said that Azure was more secure, and you will be more certain that the data would stay within the EU, than you did with Google. So they, they advised us to use Microsoft Azure. So that was the decision. So it's a corporate decision - move all stuff to Microsoft Azure.
228	GDPR concerns	Actual	E	C	6	But it was actually, it was a mixture of our security guys who said that Azure was more secure, and you will be more certain that the data would stay within the EU, than you did with Google. So they, they advised us to use Microsoft Azure. So that was the decision. So it's a corporate decision - move all stuff to Microsoft Azure.
229	GDPR concerns	Perceived	E	C	5	But that's because our model isn't sensitive, if you have a sensitive model, the regulator will probably say, you can't give that data to Google or to Microsoft or to Amazon, it's customer sensitive data, you have to build it on premise. And, again, when you move something on premise, and adopt a machine learning model that can only learn as good as it gets on premise and it won't be as good as when you use it in the cloud. And then again, that would be a consideration in order to what's the use case for this model.
230	GDPR concerns	Actual	E	C	5	How do you store data?
231	GDPR concerns	Actual	E	C	6	Privacy concerns, certainly, because we have lots of property information.
232	GDPR concerns	Actual	E	C	6	We had some problems about cloud hosting, because we have GDPR that limits where you can put data, you need to make sure that they are within the EU and all that stuff.
233	GDPR concerns	Perceived	E	D	7	Yeah, I think that - at least it is getting more and more common that both customers and subcontractors and employees are aware of what data is stored and where and if it can be accessed and by who and stuff like that.
234	Human resources	Perceived	O	A	1	the barriers is always a constraint of the number of people in the IT department and how fast they are able to execute. It's I think that's the main constraint
235	Human Resources	Actual	O	A	1	Unless they provide some funds that can fund my resource. That would have to take someone from the outside. Because the 16 people I have here, they are fully

						operational and work toward customers and how that... So I cannot take one person out for a year to work on something. It doesn't work that way. Then that will be the responsibility of the IT department.
236	Human Resources	Actual	O	B	3	We have the one who has pretty good expertise in IT at least as seen from the outside when you do not have it yourself. But he ends up spending all his time on system maintenance.
237	Implementation capabilities	Perceived	O	D	8	And implementation
238	Implementation capabilities	Perceived	O	D	8	If we don't implement well. That's a key factor for us.
239	Incompatibility of an organization with AI	Potential		A	1	There's no way or no reason for mid/small sized company like us should invent anything or this kind... We're not good at it and if we or if the system provider has to customize a lot of things for us, then it must be something wrong with our organization, I think.
240	Incompatibility of an AI solution with an organization's legacy IT systems or processes	Perceived	T	A	1	I imagine plug and play, very much. A shelf product, put the core into... all the systems or whatever... And it works. Probably not that easy but in general terms. There's no way or no reason for mid/small sized company like us should invent anything or this kind... We're not good at it and if we or if the system provider has to customize a lot of things for us, then it must be something wrong with our organization, I think.
241	Incompatibility of an AI solution with an organization's legacy IT systems or processes	Perceived	T	A	2	It requires that it is integrated into our system.
242	Incompatibility of an AI solution with an organization's legacy IT systems or processes	Perceived	T	A	2	There must also be solutions that can fit the computer system or the future computer system we get in the future.
243	Incompatibility of an AI solution with an organization's legacy IT systems or processes	Actual	T	C	6	I think that in this case the difficult thing was that the machine learning system didn't fit into our existing hosting environment. So we have, we have used Google Cloud. And it's actually the only thing we have up in Google Cloud. So the the difficult thing about this system is not that it's based on machine learning, it is that it's actually hosted on an entirely different platform than all the other systems.
244	Incompatibility of an AI solution with an organization's legacy IT systems or processes	Perceived	T/O	A	1	So that the system structure and logic overrides our system and logic, because we have been doing the same thing for 20 years with an old fashioned system. And so, you cannot then take a modern ERP system and adopt it to an old-fashioned organization. Then you need to take the modern system... and say this is a new way of working, this is the way the business should be driven.
245	Incompatibility of an AI solution with an organization's legacy IT systems or	Perceived	T/O	B	4	We have an advanced calculator in relation to pricing of print that we see can be a challenge integrate with. That the biggest issue we have, we have used the old calculation system and then retrieved the output from

	processes					this and ran to on the new one in the meantime. We do not want to work like this in the future. It's hard to change.
246	Industry specifics prevent long term investments	Actual	E	B	4	- Interviewee 4 We plan no longer than 5 years. Because it happens so much in the industry. - Researchers So you allow yourselves to work with such a long-term perspective? - Interviewee 4 With the kind if investments just described, we do. I think that machine will last much longer than 5 years, it's like 22 million NOK. You do not replaced in with that fast. So it will be enough to stand there for a number of years, but it may be that the printer we have bought in there now may be out in 4 years because on that market it happens very much on speed, print quality , widths etc.
247	Lack of IT competence or knowledge	Actual	O	A	2	It is a low level, but at such a level that we are able to do the things we need in relation to how we know it should be done. So it may well be that there is much more that we could have exploited, but we cannot.
248	Lack of IT competence or knowledge	Actual	O	D	7	It's not something like - if it's very complicated, then it's out of my league. But...
249	Lack of IT competence or knowledge	Actual	O	A	2	No, it may be, I think of our group here, we are all a bit like this, we are not confident of the technological aids we have today, which has led us to be a little skeptical of new things, we like it safely , old and traditional.
250	Lack of IT competence or knowledge	Actual	O	A	2	No, we are not first in line there, because we do not use a lot of advanced IT-solutions, we can use the PC in a easy way, we have telephones and IPads. Our focus is that we should spend time with the customer and on them. We are not mature in terms of IT, and we are even not confident at all when it comes to Excel spreadsheets to receive statistics.
251	Lack of IT competence or knowledge	Actual	O	D	8	No. Especially in terms of our colleagues' skills, resources, competencies. They're not there fully. Let me give you an example. If you're not fully operating with the Microsoft Office, how can you operate something that's more elaborate, right? So, but still, a lot of our managers are capable of doing that. And also, using these IT platforms on a strategic and tactical level, not just an operational level - day to day maintenance, but also in terms of development. So we need to have a great balance, and we need to have the right colleagues, the right staff in order to operate some sort of IT. And then that the maturity for me, isn't there yet cross-organizational...
252	Lack of IT competence or knowledge	Actual	O	C	5	So it's a large part of it is built by product owners and we don't have programming as a...

253	Lack of IT competence or knowledge	Actual	O	A	1	the sales representatives, for instance, are not very much into IT or AI. For some of them it will take quite a while to understand it and to be acquainted with it, to use it in a proper way.
254	Lack of IT competence or knowledge	Actual	O	A	2	we do not have enough knowledge about the system, and I think it can be just as much, that we do not have enough system expertise so we do not know how we could possibly have done it through the system anyways
255	Lack of IT competence or knowledge	Actual	O	A	2	We do not have expertise in IT here in Norway, so if one should integrate something like that or implemented it then we would have been totally dependent on having set off IT resources from Swedish colleagues.
256	Lack of IT competence or knowledge	Actual	O	B	3	We have the one who has pretty good expertise in IT at least as seen from the outside when you do not have it yourself. But he ends up spending all his time on system maintenance.
257	Lack of IT competence or knowledge	Actual	O	B	3	We probably probably need help to maintain it, I think maybe that ... or we had to have employed someone with that knowledge, there are not people in the organization that could maintain it, I am absolutely sure
258	Lack of IT competence or knowledge	Actual	O	A	2	we think we also have limited knowledge and expertise on common technology , so it will certainly require a change in both structures and routines and that we have to learn how to use it. So a little fear of it, the fear of everything online or digital can be a bit scary.
259	Lack of IT competence or knowledge	Perceived	O	C	5	Well, of course, as we talked about the need to be educated a bit more than they are today, in order for us not to be vulnerable, because if if the resources of the company we're using right now, that actually decides we don't want to work with (CASE COMPANY) anymore, then we've lost that knowledge. So we have to spread knowledge and put it in (CASE COMPANY) so we can keep developing.
260	Lack of IT competence or knowledge	Actual	O	B	4	Yes what should I say, no, as you probably realize then we do not have the big heavy IT professional background.
261	Lack of IT competence or knowledge	Perceived	O	D	7	Yes. This kind of company or our line of work is not a - it's not somewhere where everybody is that well experienced in computer usage and stuff like that. So we might have problems with people who are not that good at using technology.
262	Lack of AI understanding	Perceived	O	A	2	Also, one had to anchor it well in the organization. ”Why / what is the purpose of this and what utility will it provide for motivation to learn it”.
263	Lack of AI understanding	Perceived	O	B	3	But we must be able to understand what it is before we can bet on it. It cannot be a "nice-to- have" solution
264	Lack of AI understanding	Perceived	T/O	C	6	I think just the knowledge about what the technology can do for you, it's, it's important that all the product owners in this in this company actually remember that AI is a tool in your toolbox. So if you have a problem, see if AI can help you. And in between all the important tasks that they have, I think it's hard to find time to educate them to a level where they can actually have those considerations.

265	Lack of AI understanding	Perceived	O	C	5	people's understanding of it is it is a big obstacle. And but again, it will get there. No matter what kind of new technology you're introducing, theres always be someone who were late adopters or what it's called.
266	Lack of AI understanding	Perceived	O	A	1	So, and that is more up to the knowledge of the customer service department. How do we use a chat function? How do we, how do we interact with the customer? Always that little bit afraiding... should we be afraid of all this, will the machine take over my, my function, you know, but then, but that's more advanced management to tell the tale customer service department, this means only that you have more time to do more intelligent work, we work more closely with the customer. Give more advice or training, maybe on the phone or, or through the chat, chat functions or whatever.
267	Lack of AI understanding	Actual	T/O	B	3	That's because I don't know enough about it. I don't have enough pegs to hang it on. I think people in the organization have heard about AI a bit like me that they envision a system that thinks a little for you and prioritizes a little for you, but more understanding than that I do not believe we have
268	Lack of AI understanding	Actual	T/O	C	5	The people maintaining it are also the people who built the old model, that linear regression model, and that one day understood fully. So every time that someone asked something about machine learning that they can't properly explain, they just switched back to the old model and start, how does it work in the old model. So but they will get there, it's just a matter of them becoming more comfortable, or secure in the new model. So...
269	Lack of AI understanding	Perceived	O	A	2	then we quickly get resistance to it, because the days are more than full, so all the change gives you. As far as ever resistance is concerned, it asks how it is done and how to see its usefulness.
270	Lack of AI understanding	Perceived	O	A	1	they have to find it useful that they instead now will then use their time on more intelligent work, so to say, then the repetitive work they maybe did. They have to see that they get their information quicker, or faster or better or whatever.
271	Lack of AI understanding	Actual	T/O/E	C	5	We had a long period of this with the small company trying to explain it to the people maintaining it, and getting them on boarded in what, how does machine learning work. And it's actually a billions of calculations. It's not some magic that happens inside the computer. And that has also been a journey of trying to convince our own people, or trying to teach our own people, how does it work and what can it do, so.
272	Lack of data	Perceived	T	D	7	Of course, it requires a - we will need to know the data on what we use for completing the task right now, how much it costs, and we need to know how much the new solution costs. And then of course, it's a way of - well, when can this be paid off.

273	Lack of diversity to foster innovation	Actual	O	B	4	I think this is very important, to bring in people who think a little bit new, because it is kind of like to similar people in the organization, we have grown up in the same industry. We have done the same things, we have our disciplines each and every one of us, but nevertheless it becomes very similar. We really need new ideas and new people in order to lift us into the digital world. We are very digital, but I mean the next step.
274	Lack of diversity to foster innovation	Actual	O	B	4	Yes it is the danger with such a company that we have, we are quite uniform in competence, the people who work here. We have many of the same experiences. Getting some younger ones with new impulses will help us to hang more
275	Lack of formal education	Potential	O	B	3	The professional competence lies more from the professional certificates and lots of experience.
276	Lack of formal education	Potential		B	3	You may need to have a little more knowledge or you must have some knowledge about identifying opportunities and such
277	Legislation, regulation and compliance constraints	Actual	E	C	6	And they have very specific regulation about how to figure out the price of a house. And AI is not mentioned in the law. On the contrary, on the other side, in the law, it says that you have to actually inspect the house with a person going out and inspecting the house. So if we needed to improve the valuation process, we needed to challenge or have a dispensation from this requirement of physical inspection. So we needed to convince the regulator that this method was at least as good as inspecting house. So we had a project with the regulator, where we were actually just educating them to use - to figure out what is machine learning.
278	Legislation, regulation and compliance constraints	Actual	E	C	6	And we are also a highly regulated sector, the financial sector is...
279	Legislation, regulation and compliance constraints	Actual	E	C	6	regulator made clear many times, and it was - this is a new technology but don't forget all the other stuff that you've learned - it is still important to have security, it's still important to have backup, it's still important to have a version history and, and all the other things.
280	Legislation, regulation and compliance constraints	Actual	E	C	6	How do the clients convince the regulator that, well, it's - we're still a safe client, even though we have a machine replacing some of our employees.
281	Legislation, regulation and compliance constraints	Actual	E	C	5	So, again, we're regulated area, and as pharma is also regulated area, so the technology exists, it works great, but you have to get it approved. And that's one of the obstacles that we've overcome.
282	Legislation, regulation and compliance constraints	Actual	E	C	5	The biggest challenge, as we talked about, because we're a regulated financial industry, was getting the approval

283	Legislation, regulation and compliance constraints	Actual	E	C	5	The biggest challenge, as we talked about, because we're a regulated financial industry, was getting the approval and getting the regulator to understand the model in order to get the approval. And that took about a bit of seven or eight months, in order for that process to take place in order to have all of these meetings with the regulator
284	Legislation, regulation and compliance constraints	Actual	E	A	1	then it has to go to the juridical department, it has to go through the systems, it's outside the law of public procurement
285	Legislation, regulation and compliance constraints	Actual	E	A	2	We've looked at some new systems and the process stops us pretty quickly because there are strict policies on what we are allowed to integrate to the IT-systems
286	Losing human supervision	Actual	E	C	6	The regulator also had some considerations about how far can we go in automatization? If we have a machine learning model, can we actually eliminate the human and the entire process and make an online the mortage process? And they were very keen on - we should not do that. We might consider dropping or dispensate from the physical inspection. But we would still prefer that, in the end of the process, there's a human being approving all the mortgages.
287	Losing human supervision	Actual	E	C	6	They would like someone to sit and take the emergency break and say - no, this is totally insane. But they couldn't really explain what's the basis for this person. How much is this person supposed to also look at the data and draw his/hers own conclusions. So the task for this approval person was a little hard to explain.
288	Losing human supervision	Actual	O	B	3	We are very concerned with quality, so that human would be part of the process as an extra quality control function. I feel we are not mature to drop this type of monitoring.
289	Losing human supervision	Perceived	O/E	C	5	Yeah, and again, because there's potentially no human eyes on it. Because if there was an evaluation person that looked at it and my house suddenly was 70 million kronas (DKK), you would say no that can't be right. But the machine doesn't use common sense. It just has these input variables and then predicts the price.
290	Management communication	Perceived	O	A	2	Also, one had to anchor it well in the organization. ”Why / what is the purpose of this and what utility will it provide for motivation to learn it”.
291	Management communication	Perceived	O	A	1	How do we use a chat function? How do we, how do we interact with the customer? Always that little bit afraiding... should we be afraid of all this, will the machine take over my, my function, you know, but then, but that's more advanced management to tell the tale customer service department
292	Management communication	Perceived	O	D	8	If we don't implement well. That's a key factor for us. We need to implement this in every aspect of our organization, we need to have all the leaders, all the managers on board for this idea. They need to be the role models, they need to be the spokespersons.

293	Management communication	Potential		A	1	So I think it's a little bit more on how we all hope that management presented and how we tell how it will work in the organization.
294	Moving too fast	Perceived	O	A	1	And so you have to be, I think quite down to earth. What works for us? How are we to do it? How do we ensure that the organization understands it and is able to use it?
295	Moving too fast	Perceived	O	A	1	But we just have to do it in the sequence we can both afford and what the organization can cope with.
296	Moving too fast	Perceived	O	A	1	I don't really see any, any obstacles, except that you might rush too fast.
297	Moving too fast	Perceived	O	A	1	I guess you cannot rush too fast.
298	Moving too fast	Perceived	O	A	1	So that you have to to prioritize it and start with this and then do that. Also so we don't overstress their local organizations.
299	No or little prior AI experience	Actual	O	D	8	And not that I'm aware of have we ever implemented AI in our company. Not that I know of.
300	No or little prior AI experience	Actual	O	A	2	Artificial Intelligence, good question. No, to the extent that we have something that comes up against then of course we have computer systems and inventory management system and order system, but no I don't think we have something that can be defined as AI.
301	No or little prior AI experience	Actual	O	A	2	I have never thought about artificial intelligence . But now you have introduced me to something that triggers my curiosity. So if you had, or if I had known about what it was, what benefits it could provide, it could have been interesting to look at, but for the time being I am happily ignorant of it and what benefits it could have given us.
302	No or little prior AI experience	Actual	O	B	3	no
303	No or little prior AI experience	Actual	O	B	3	No not so much ... we have I have a printing machine that is 2 years old. It works a bit like AI ... Because it reads the sheets/papers all the time when it is running and then it uses the input to always ahead plan the next job... so it kind of works lite AI I would say... but it is built into the machine ... So all the software is in the machine so we really do nothing special with it ...
304	No or little prior AI experience	Actual	O	B	4	No we have not.
305	No or little prior AI experience	Actual	O	A	1	No, I think we're quite simple in that respect but we have a plan.
306	No or little prior AI experience	Actual	O	D	8	Not that I know of.
307	No or little prior AI experience	Actual	O	C	6	Only from what I know, from the project that we just finished here.
308	No or little prior AI experience	Actual	O	D	7	We've thought about a lot. We have a bit of experience, but it is not something that we use, like, in a large scale. It's something that we plan to use more. But there's no deadline on it set or anything, but we have, like, our operation systems can, for example, plan tasks in the optimal route. Like with, if I have 20 tasks somewhere around the Copenhagen area, it can plan them and plot them in a day in the optimal route dependent on how long does the task take nd the distance.

309	Non-uniform structure or processes across organisation	Actual	O	B	3	Sure we do, but since we have not had enough spotlight on it, different ways of working have developed, especially in different departments. So it's going to be a huge challenge with our structure to also implement that ERP system, so we'll have to test a little in that process then.
310	Non-uniform structure or processes across organisation	Actual	O	B	3	What we see as being a challenge is that everyone must work in a relatively structured and equal/uniform way to compliment the system. And we are a little too unstructured, it's a bit too poor structure throughout the company really ... that people have work processes a little in their own way. And it is clear that it will be for many of them so it does not help whatever type of system you have.
311	Not following AI trends	Actual	O	D	7	And that's not really AI, but that's the direction we have chosen. So far, at least,
312	Not following AI trends	Actual	O	A	2	Had I only known what AI could do then it would have been easy
313	Not following AI trends	Actual	O	A	2	I do not know about which solutions that might be there that could be relevant.
314	Not following AI trends	Actual	O	A	2	I have never thought about artificial intelligence . But now you have introduced me to something that triggers my curiosity. So if you had, or if I had known about what it was, what benefits it could provide, it could have been interesting to look at, but for the time being I am happily ignorant of it and what benefits it could have given us.
315	Not following AI trends	Perceived	O	D	7	It could have a negative impact on one or selected employees, then that's always in different ways... Either maybe someone is not capable of keeping up with new technology and you...
316	Not following AI trends	Actual	O	B	3	No more than we are aware of it and know about it ...
317	Not following AI trends	Actual	O	A	2	We do not spend any time finding out either, but if one had been presented with it and had found out there are solutions or tools that could have helped us then it could have been relevant, but I just think we Don't know what it is.
318	Not perceived as necessary right now	Actual	E	B	4	It is not always in our industry that you should be first out because it is something with technology that those who produce the technology are very keen on getting it out quickly and it is not always that you have been just as successful.
319	Not perceived as necessary right now	Actual	O	B	4	No I do not feel that we are in a hurry quite yet. I am quite up to date on what is happening in our industry in the world and I have not seen anything like this very revolutionary solutions .
320	Not perceived as necessary right now	Actual	O	D	8	No, not with me, at least, AI. But it could be definitely. Recently, a couple of months ago, we had a meeting with a developer, software developer, who spoke about robots for the administration, in order to optimize processes, pre-defined processes, that could be much easier done by robots. Much faster by robots. That could be a possibility, but not right now.

321	Not understanding implications of AI	Potential	O	A	1	And then that took a little while for people to say: but this is more easy than what we used to do. And we don't have to do all this anymore. We can just... and the system does it for me
322	Organization readiness	Potential	O	D	8	And is our organization ready?
323	Organization readiness	Potential	O	D	7	So maybe someday we want to do or not, and I think it's something that we will do at some point. It's just a question of when it's feasible.
324	Owner's interests	Actual	O	A	2	But then we have not made the investments because we have just been bought by a new owner and then one does not make such investments, so everything is a little on ice.
325	Price of an AI solution	Potential	O/E	B	4	It could still be interesting. There may be an upside with it. Often you get a really good price since you are the first company to implement it. can certainly be a viable option
326	Price of an AI solution	Perceived	O/E	D	8	And what's the cost? Can we do it reasonably cheap?
327	Price of an AI solution	Perceived	O/E	D	7	If we find the right solution for the right price, yes. And that is, that is just the two factors - How can this solution help us and how much does it cost?
328	Price of an AI solution	Actual	O	C	6	It's the special requirements for the environment that this technology has. That that makes it difficult. We simply can use our normal hosting environment, we have to use the Google Cloud, otherwise, it would be extremely expensive.
329	Price of an AI solution	Perceived	E	B	4	No it is a combination of solution, price, references. I think that is very important.
330	Price of an AI solution	Perceived	O/E	D	7	So the, the couple of companies we've had presenting, they could probably solve everything. But if it's a very, very complex task that has a lot of variables, and has to have a lot of different input, then all of a sudden, it gets very expensive. And I think that in time when it gets cheaper, then of course,
331	Price of an AI solution	Actual	O/E	D	7	we have had a couple of companies out here to present different solutions. And but the problem was that we were, we found it hard to find tasks that were standardized enough for it not to be incredibly expensive to develop
332	Proving short-term benefits	Perceived	O	B	3	If we had a case where we saw that it was profitable in the short or half-time then we had considered it
333	Proving short-term benefits	Perceived	O	B	3	If we had a case where we saw that it was profitable in the short or half-time then we had considered it
334	Proving short-term benefits	Actual	O	D	7	The return of invest in this company, it has to be monetary and it has to not be in like, has to be quite on the short hand... It might, might not be it has to pay off itself in a year, but it has to at least be in a couple of years. I don't think it would we would make a change to say: well, this is a huge investment now and over the next 10 years it will pay itself off. I think the time - the horizon of when you have to at least have break even on the investment is - I cannot imagine more than two years.

335	Regulator concerns	Actual	E	C	6	And they have very specific regulation about how to figure out the price of a house. And AI is not mentioned in the law. On the contrary, on the other side, in the law, it says that you have to actually inspect the house with a person going out and inspecting the house. So if we needed to improve the valuation process, we needed to challenge or have a dispensation from this requirement of physical inspection. So we needed to convince the regulator that this method was at least as good as inspecting house. So we had a project with the regulator, where we were actually just educating them to use - to figure out what is machine learning.
336	Regulator concerns	Actual	E	C	5	But we couldn't get it approved because the regulator didn't understand machine learning. They thought it was some kind of black magic or Voodoo that happened inside the machine.
337	Regulator concerns	Actual	E	C	6	regulator made clear many times, and it was - this is a new technology but don't forget all the other stuff that you've learned - it is still important to have security, it's still important to have backup, it's still important to have a version history and, and all the other things.
338	Regulator concerns	Actual	E	C	6	How do the clients convince the regulator that, well, it's - we're still a safe client, even though we have a machine replacing some of our employees.
339	Regulator concerns	Actual	E	C	6	I think their concern was that one of the models could in some cases go totally wrong. If you have a small house in the suburbs of (DANISH LOCATION) or something and it suddenly says 12 million DKK for this one and you're not able to explain it or there are some errors in the data for that house, maybe it's registered wrongly the land register or something.
340	Regulator concerns	Actual	E	C	5	it was about developing a framework that would enable them to understand what kind of model have you built. Had you thought it through? By presenting what are the ethical dilemmas that we think there is... and what's the governance around the model? How do you store data? How do you validate data? And what's the bias on data and all of these things.
341	Regulator concerns	Actual	E	C	5	The biggest challenge, as we talked about, because we're a regulated financial industry, was getting the approval and getting the regulator to understand the model in order to get the approval. And that took about a bit of seven or eight months, in order for that process to take place in order to have all of these meetings with the regulator
342	Regulator concerns	Actual	E	C	6	The regulator also had some considerations about how far can we go in automatization? If we have a machine learning model, can we actually eliminate the human and the entire process and make an online the mortage process? And they were very keen on - we should not do that. We might consider dropping or dispensate from the physical inspection. But we would still prefer that, in the end of the process, there's a human being approving all the mortgages.

343	Regulator concerns	Actual	E	C	6	There are a lot of pitfalls when you start using AI. We discussed some of them during the process, especially with the regulator - what are the ethical consequences of this. One is, of course, bias - have we created a model that's more beneficial for certain segments of the Danish population? Does it give women an advantage compared to men and older, younger and so on?
344	Regulator concerns	Actual	E	C	6	They would like someone to sit and take the emergency break and say - no, this is totally insane. But they couldn't really explain what's the basis for this person. How much is this person supposed to also look at the data and draw his/hers own conclusions. So the task for this approval person was a little hard to explain.
345	Resources constraints	Actual	O	A	1	and you have the resource constraints.
346	Resources constraints	Actual	O	A	2	But as long as we are to have any major investments or need need support from IT or finance or the teams or whatever it is we need to fight as much about the resources that the other countries have.
347	Resources constraints	Actual	O	D	7	But it's also the implementation process. There's a lot... you have to make an investment in filling out all required data for a system like this to work. And sometimes the time needed for that investment is a bit hard to find in a team of not that many people.
348	Resources constraints	Actual	O	D	8	Especially in terms of our colleagues' skills, resources, competencies. They're not there fully.
349	Resources constraints	Actual	O	D	8	I think that's one of the main reasons, but also, we know, to implement a new system, it takes a lot of time, a lot of resources.
350	Resources constraints	Perceived	O	A	1	It takes time and it takes some resources and or maybe most importantly, it takes money. Investment budgets. And, and that's always a constraint necessarily.
351	Resources constraints	Actual	O	A	2	Our IT is located in Sweden and it's no secret that IT resources are always difficult to obtain
352	Resources constraints	Perceived	O	D	7	That's, that's just the general underestimation on how much how many resources is needed for implementation for new technologies.
353	Resources constraints	Perceived	O	D	8	To acquire the reasonable or the right amount of resources, I am talking time, talking cost, I'm talking skills, internal skills
354	Resources constraints	Actual	O	A	1	Unless they provide some funds that can fund my resource. That would have to take someone from the outside. Because the 16 people I have here, they are fully operational and work toward customers and how that... So I cannot take one person out for a year to work on something. It doesn't work that way. Then that will be the responsibility of the IT department.
355	Resources constraints	Actual	O	B	3	We have the one who has pretty good expertise in IT at least as seen from the outside when you do not have it yourself. But he ends up spending all his time on system maintenance.
356	Risk of becoming too vulnerable	Actual	O/E	C	6	Google, whom you can't call, then it's an entirely different task for our maintenance people. So it's not the AI part, it's that the AI requires some special requirements that

						makes it very good to put in the cloud.
357	Risk of becoming too vulnerable	Potential	O/E	C	5	Well, of course, as we talked about the need to be educated a bit more than they are today, in order for us not to be vulnerable, because if if the resources of the company we're using right now, that actually decides we don't want to work with (CASE COMPANY) anymore, then we've lost that knowledge. So we have to spread knowledge and put it in (CASE COMPANY) so we can keep developing.
358	Risk of draining more resources than expected before seeing benefits	Perceived	O	A	1	and businesses are using two to three years, and many of them go bankrupt before they finished. And... but if you actually use one year, two years on such a project... Only over my dead body.
359	Risk of draining more resources than expected before seeing benefits	Perceived	O	B	4	As I know the board here, it had been cut and been terminated. If they cannot solve it there and then, then we have to look for other solutions.
360	Risk of draining more resources than expected before seeing benefits	Perceived	O	A	1	But still, the most common thing, I guess, is that it runs out of budget, it becomes much more expensive than what you thought or more complicated or something.
361	Risk of draining more resources than expected before seeing benefits	Perceived	O	A	1	Then that will be the responsibility of the IT department. Just say that, okay, we put one, one FTE, here you're in your organization for a year. But it wouldn't be acceptable from top management either to have somebody running around here for a year. And if you spent that much time on the project, then it I don't think it would have been accepted.
362	Risk of losing reputation and damaging customer relationships	Perceived	E	A	1	But then the biggest failure will be if it's a system that you introduced towards the customer and the customer starts to use it and then it doesn't work. And then you really have shown towards the customer that you don't have control, you don't know what you're doing and he has spent resources. And that makes it quite easy for him not to trust you in a next tender around... To put you in the next contract.
363	Risk of losing reputation and damaging customer relationships	Perceived	E	D	8	can we operate it, can we still look ourselves in the eyes and say - okay, we're true to our vision in terms of creating transparency and in terms of being trend-setters, are we true to our vision of our mission, at least, to always look our customers in the eyes and say - this is a personal services, but we're also using the technology that's available.
364	Risk of losing reputation and damaging customer relationships	Perceived	E	D	8	Maybe we can alienate some of our clients, we could push that potentially. Take this building. Our customer, our client is not the tenants in the building, that's the administrator than the tenants. Higher.
365	Risk of losing reputation and damaging customer	Perceived	E	A	1	So you have to play it by ear to, to ensure that you are on the level with customer, you have to be a little bit ahead of the customers you have to push him, but you shouldn't

	relationships					overkill him which is easy to do.
366	Risk of losing reputation and damaging customer relationships	Actual	E	C	6	The clients have a huge interest in an exact valuation of a house, because they have lots portion of bonds that have issued, and the security for these bonds is houses. So they are very keen on knowing exactly what's the value of this amount of houses that we have as security for this bond.
367	Risk of losing reputation and damaging customer relationships	Perceived	E	A	1	They're saying that everything has to do with computer, for instance, is welfare technology, everything that has to do with a chip is welfare technology and all but so, but I think you had to put that aside and say that: Oh, yes, yes, it's all welfare technology and we will help you on this. So yeah.
368	Risk of losing reputation and damaging customer relationships	Perceived	E	D	8	Yeah, actually B2B. But we have a lot of contact with the tenants, either it's corporate tenants, or it's private tenants. But maybe we can alienate some of these people who really appreciate the personal services. And we also highlight our service by doing it personally. Right? The personal services, combined with the technology, of course, but if the technology takes over, maybe we wouldn't get the job in the future.
369	Risk of losing reputation and damaging customer relationships	Perceived	E	D	8	Yeah, that could be definitely a risk, because the tenants also have a say in who gets to provide the services. Maybe we're not - well maybe we are B2B but the tenants also have something to say in terms of who's going to be the service provider. That could be one risk.
370	Risk of losing reputation and damaging customer relationships	Perceived	E	A	1	Yeah, that will definitely destroy my reputation, I guess, depending on the scale of what it is, but that can be everything from irritating to catastrophic depending on what it is. But with AI internal things, you can always cope with because the customer doesn't see it unless it's so big internally, as a big internal failure that it takes focus away from the customer or that the customer service department had acted totally different and extremely slow, for instance, so they can't cope with the orders coming in or something like that. Then necessarily you have a big problem. But I mean, if your business intelligence system fails, and it doesn't really give you the data you want, or it gone somehow more expensive or whatever, it's not a catastrophe, because nobody sees applied. And you can still live with it. I think it all depends.
371	Risk of technology misuse	Perceived	E	C	5	Because our model, again, isn't something that's presented to the customer. But if you had a model that presents the house prices, my house price to me, and I knew how the model worked, and I knew what the input parameters go into the model, I could just go onto the public records and just change the house size from 200 square feet to 2000 square feet, then that's the parameters fed into the model, and then it would evaluate the price much higher than it would be. So there's a little bit of gamification, if you if the if evil persons understand what the how the model works.

372	Risk of technology misuse	Potential	E	C	5	Yeah, and again, because there's potentially no human eyes on it. Because if there was an evaluation person that looked at it and my house suddenly was 70 million kronas (DKK), you would say no that can't be right. But the machine doesn't use common sense.
373	Risky investment	Perceived	O	D	8	And then there's the financial risk and in investment.
374	Risky investment	Perceived	O	D	7	Of course, there's also risk in investing both time and money. But if you do your careful consideration on where to invest and when to invest, I don't think it will have a negative impact.
375	Risky investment	Actual	O	D	7	the risk is more or less the investment of money and time.
376	Security concerns	Perceived	O/E	B	3	What I might see as a bit negative is that you might be too vulnerable, that someone else can get into the system, such as security. It may be a disadvantage we must at least check out. We have previously had servers that have gone down because they have been hacked.
377	Security concerns	Perceived	O/E	A	2	When it comes to AI, we have put that on ice. It is here where the aspect of security comes to
378	Shareholders' interests	Potential		A	1	We got new owners couple of months back and they have said that they are absolutely willing to invest.
379	Slow adoption process	Perceived	O	B	4	I have it from my point of view. But I don't really think so in the company. I think that what I see is that it is with the administration system that it should be done something about it, long before I became part of the organization. So I was really a little surprised that they hadn't seen it. They hadn't thought about it until recently.
380	Slow adoption process	Perceived	O	B	4	It must not be completely finished. But it must be that you do not spend too long, maybe within a year when you start looking at it until you sign paper that you start. But it is over three years since we are talking about order system, it is only now that we have started.
381	Slow adoption process	Actual	O	A	2	No, now we are a traditional operation and work the way we have been working for many years so I never think we will be the first in class on things.
382	Tasks or processes that are challenging to streamline	Actual	O	D	7	And but the problem was that we were, we found it hard to find tasks that were standardized enough for it not to be incredibly expensive to develop.
383	Tasks or processes that are challenging to streamline	Actual	O	B	3	Because the machines we have today require quite a lot of settings, so you only get the benefit of watching and accepting the jobs when you run a job and the jobs we do just get smaller and less you just have to work more and more Lower circulation really… So we don't have the big jobs where you stand and produce the same many days. The number of orders goes up but the size of the jobs goes down. A robot should preferably, as we saw it, then preferably stand to do the same all the time, so it really only becomes ideal if you are to stand and do a job for a week for example.

384	Tasks or processes that are challenging to streamline	Actual	O	D	7	We don't use it that much yet because we don't use the - what do you say the, the detailed planning for the task because a lot of the tasks are right now, until now at least, difficult for us to really quantify how long it would take. Also, because a lot of the tasks, especially for the building inspectors, they go to a property and then they find something that might be wrong while they're there. And you can't always say how long it would take. And also a lot of the work is more or less emergency work and that you cannot plan. But we probably should use it more like if we have like the gardeners or caretakers for the outside, you can quantify more or less, this will take an hour or one or half hour and so and that is where we should start to use it more.
385	Tasks or processes that are challenging to streamline	Perceived	O	B	3	Yes it is start and stop, driving and moving so is the new job, new job, new job. There is some human interaction needed because one has to ask about each time. Little or much is changed or changed material.
386	Tasks or processes that are challenging to streamline	Actual	O	A	2	Yes lots, because we are constantly trying to adapt to the customer, even if the customer experiences something negatively we must find the reason for how and why they experience it, so customer relation tasks are constantly have been made into manual routines to ensure that the customer does not experience the same again, because the system does not support it.
387	Technology complexity	Actual	T	C	6	And we experimented with it, we found all the pictures of bathrooms, and then we labeled a subset set of those pictures, to see whether houses with bad quality bathrooms were significantly lower in price than our estimation. And vice versa with the good bathrooms. And that was actually the case. But we currently we don't consume pictures into the model, we don't use them as input, even though we can see they can explain something. But they are quite hard to interpret for machine. We simply weren't successful in having the machine express whether this was a picture of a good bathroom or not. So we have to manually label them now, that would be too big of a task for us.
388	Technology transparency	Actual	T	C	6	if a customer complains, what will your answer be? Will you just say - well, 2 million DKK because that's what the machine says? Or will you provide some additional - well, look at all this, and we actually found some methods to take one house price out of this population, and get a list of the five most important parameters for this house exactly. It could be that it's larger than all the other houses in the area or...
389	Trust	Perceived	T/E	C	5	We're trying to see, again, we were making a proof of concept to see how accurate can we get with the technology. Because in order to if the advisor doesn't have to read it, it has to be pretty accurate. They have to trust it.
390	Unrealistic expectations	Potential		B	4	We do not want a ready-made solution, we want a dynamic flexible solution that makes us tolerate change. Things happen all the time.

391	Unrealistic expectations	Perceived	O	A	1	You can you can always have the risk that you are getting too fancy. And so you have to be, I think quite down to earth.

10.4 External Appendices D, E, F, G, H, I, J, K and Additional Appendices

External appendices are available on the two enclosed USB flash drives and in a cloud repository folder at: https://drive.google.com/drive/folders/1gAG2nv6GLJeXiMHoECqcGJ16qVuMcdDb