Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Information Technology and Electrical Engineering
Department of Computer Science

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Understanding Organizations' Adoption of AI Technologies: Challenges, Opportunities and Impact

Master's thesis in Datateknologi
Supervisor: Jon Atle Gulla
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Abstract

Where many published works and research contributions can easily be influenced by various external forces, a master thesis from NTNU has the benefit of representing an academically-rooted product. This thesis explores the potential of comparing and characterizing organizations across industries, and see what kind of value can be extracted in the context of an organization's relationship with artificial intelligence. The information retrieval has been made possible through qualitative and quantitative research methodologies were interviews and a survey takes center stage, and the different organizations make up the official collaborating partners of the thesis.

In total, 8 different themes related to how an organization relates to and defines the adoption and use of AI have been extracted from the interviews where different comparisons are supported and validated through direct quotes from the different representatives. A survey has also contributed to further characterize differences and priorities between the different partners. The knowledge has contributed to confirming that value can be extracted in the form of the learning experience and experience which the different partners bring to the table, both similarities and differences, and by showing that it's relevant to conduct a study of this kind.

A discussion of the research and state-of-the-art in respect of AI-maturity has resulted in a coarse end-product, an approach towards an AI maturity model. The approach is expressed through five defined dimensions in relation to organizational AI: technical, data, people, societal, and responsible, and five levels of AI-maturity: initial, believer, adopter, managed, and optimized. This foundation constitutes an important result with the potential to continue the research of this thesis, or to guide it in a new direction.

Sammendrag

Der hvor mange publiserte verk og forskningsbidrag har lett for å bli påvirket av diverse eksterne krefter, vil en masteroppgave fra NTNU ha fordelen av å representere et akademisk forankret produkt. Denne oppgaven utforsker potensialet ved å sammenligne og karakterisere organisasjoner på tvers av industrier, og se hva slags verdi som kan bli hentet ut i kontekst av en organisasjons forhold til kunstig intelligens. Informasjonsinnhenting har blitt gjort gjennom kvalitative and kvantitative forskningsmetoder hvor intervjuer og en undersøkelse står i sentrum, og de ulike organisasjonene utgjør offisielle samarbeidspartnere til oppgaven.

Totalt 8 ulike temaer relatert til hvordan den enkelte organisasjon forholder seg til og definerer adopsjon og bruk av AI, har blitt trukket ut fra intervjuene hvor ulike sammenligninger er understøttet og validert gjennom direkte sitater fra de ulike representantene. En undersøkelse har også bidratt til å ytterligere karakterisere forskjeller og prioriteter mellom de ulike partnerne. Kunnskapen har bidratt til å stadfeste at verdi kan hentes ut i form av den lærdommen og erfaringen de ulike partnerne "tar med til bordet", både likheter og ulikheter, og gjennom å vise at det er hensiktsmessig å kunne utføre en studie av denne typen.

En diskusjon av forskningen og state-of-the-art i respekt av AI-modenhet har resultert i et grovkornet sluttprodukt, en tilnærming mot en AI maturity model. Tilnærmingen er uttrykt gjennom fem definerte dimensjoner i forhold til organisatorisk AI: technical, data, people, societal, og responsible, og fem nivåer av AI-modenhet: initial, believer, adopter, managed, og optimized. Dette fundamentet utgjør et viktig resultat med et potensial for å kunne fortsette forskningen der denne oppgaven slapp, eller ta det i en helt ny retning.

Preface

This master thesis represents the final submission for the course TDT4900 - Master's Thesis. The thesis has been submitted to the Norwegian University of Science and Technology (NTNU) for the study program of Computer Science and the Faculty of Information Technology and Electrical Engineering. Jon Atle Gulla, Director of NorwAI and Professor at NTNU, has functioned as the main supervisor for the project. His continuous guidance and feedback have been integral to the progress of the thesis. A great number of representatives from various companies and organizations have all contributed to the end-result by providing valuable and necessary help, expertise, information, and data. Credited as official partners, these companies have been independent collaborators recruited either by the means of NTNU or by the researcher. Their contributions were integral for the end result.

Finally, I would like to thank my mom and dad for their continuous support and understanding throughout my entire course of study.

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1 Introduction

Along with the motivation and project description for the thesis, the *introduction* chapter presents the research questions, approach, and results. An outline of the thesis is provided at the end of the chapter.

1.1 Motivation

After decades of being relegated to science fiction, today, AI is part of our everyday lives. The surge in AI development is made possible by the sudden availability of large amounts of data and the corresponding development and wide availability of computer systems that can process all that data faster and more accurately than humans can. [19] Through hype, the word artificial intelligence is on everyone's lips, but the industry is still waiting for its "iPhone moment." The possibility of contributing to a relevant field through a new research endeavor is exciting. As said by (Keller et al.): the connection between AI-capabilities and the creation of business value is largely unexplained [26].

The biggest motivation can be said to be the opportunity to collaborate and experience how some of the top players in the industry work and utilizes AI in a professional manner. An opportunity to both learn from these partners, engage in lively conversations and discussions, and hopefully raise some important thoughts and points, even as a student. The project provided a foundation that could benefit all of the parties involved. To be able to experience the AI journey through ambitious and technology-driven organizations with a goal to become more mature with adopting and utilizing AI represents a unique learning experience. As does the theme of proposing a separate and new state-of-the-art, as a result of the conducted research. Combine this with a longtime interest in the subject, this master thesis represented a "can't miss" opportunity, where the project description only made for great motivation.

1.2 Project description

Artificial Intelligence encompasses a range of different technologies that enable companies both to innovate with new products and services and to automate or eradicate existing processes. The technology may be used to cut costs, but also to create new value chains or transform entire industries. Whereas some companies build up in-house AI competence, other companies collaborate with partners to take full advantage of the technology. In any case, due to the intrinsic complexity and generality of AI, companies need to think hard about how AI can be properly adopted and used to enhance their value creation. In this project, the student will examine how AI has been adopted and used by large industrial companies from different domains. Some of these companies develop AI solutions for the commercial market, while others make use of AI internally to offer better or cheaper products to their customers. The student will through interviews with key figures analyze how AI is helping these companies, what challenges or problems they may face, and to what extent they are adapting their organizations to an AI-driven business model. The student will uncover similarities and differences among companies and propose a framework for characterizing companies' maturity with respect to AI maturity.

The project is carried within the context of the Norwegian Research Center for AI Innovation (NorwAI). This is a center for research-based innovation that includes some of the most ambitious AI-driven companies in Norway.

1.3 Limitations

A research study can be influenced or affected by any number of causes. The approach and strategy used in accordance with the chosen research methodologies can influence both in which way the findings are obtained, under which circumstances, and what the findings ultimately turn out to be. As such the research and associated findings are ultimately affected by a variety of different limitations and constraints.

An expansive research goal calls for the need to narrow down the project specifications in service of wanting to deliver a realistic final product. Along with centering and focusing the research, an overview of the different influencing characteristics and limitations have been been mapped out. From partner interactions, to relevant industry segments, to relevant AI-technologies, to previous research efforts, the different limitations and their reasoning are featured below.

1.3.1 Partner interactions

The study have been limited or otherwise strongly affected by the different partner interactions, both through the means of the two main methodologies, qualitative and quantitative. Ultimately the information and data which have been gathered through the means of the two research methods, have both to some extent been limited by a number of different factors:

- What ultimately each representative and informant has emphasized, and chosen to allow to be shared, have been such a factor. Perceptions of what is important or relevant can differ from person to person. Not necessarily only across companies, but possibly even within the same company. Also, if a level of secrecy or necessary permission is relevant, it can subsequently effect what information can be used and what can not be used.
- With interviews as a main data collection tool, a standard interview guide have been used as the base for each conducted interview. Each interview and subsequently the information shared from the informant can have been somewhat ”stained” by the interview template in question. By sending out the template in advance of each interview, thoughts and answers made up earlier may have differed from interpretations made on the spot.
- Partner hierarchy have been an important factor. From a variation in different collaborating companies and organizations, upper and higher level management have been a preferred point of contact when approaching each partner. Their background, and understanding of the situation at hand, is unmatched. A recurring occurrence have been reaching out and untimely engaging with management, senior and not, of each partner.
- The ultimate number of representatives and informants from each partner have varied, along with their respective roles. As an influencing factor, their affiliation with the parent company, or knowledge of additional interviews with colleagues can have a say.
- As the majority of companies included have an involvement in the NorwAI research center, credited as official partners, their contribution can be influenced by this collaboration.

1.3.2 Relevant industry segments

Experiences and insights extracted from professional actors are a major part of the information and data gathering, with the goal of learning from industry expertise. The experience in focus for the research stems from a number of different industry segments. In attempting to provide a an academically-rooted research as opposed to other endeavours, the research has been shaped by focusing the work on a number of predetermined industry segments. A number of unique companies and businesses constitutes a fundamental core for the thesis, a core that provides access to a first-hand learning experience, an experience represented by a number of different industry segments. The relevant industry segments represented in the thesis are:

- **The oil and gas industry**
- **The research industry**
- **The telecommunications industry**
- **The financial and banking industry**
- **The software, hardware, and computing industries**
- **The media industry**
- **The maritime sector**

1.3.3 Relevant AI-technologies and sample applications

As common as artificial intelligence is today, understanding AI and AI terminology can be difficult because many of the terms are used interchangeably; and while they are actually interchangeable in some cases, they aren't in other cases. [19] AI is a wide term, and involves several different technologies and fields. An AI-solution can vary greatly from the next one, and involve unique contextualised merits. This thesis will emphasize some more specific types of AI-technologies or familiar areas of AI. With a study based on qualitative and quantitative information collection, and following results gathered from relevant industry partners and their representatives and informants, it is desirable to clarify which technologies the subsequent information will be based on. The technologies used can also have an effect on what type of applications the information represents, as well as the main operations of the company in question. Ultimately being a user or developer in terms of AI is another factor for the applications used as references. The experiences and projects discussed have involved the following technologies:

- **Artificial intelligence**
- **Machine learning**
- **Deep learning**
- **Computer vision**
- **Natural language processing**

1.3.4 Previous research efforts

Previous research endeavours in the form of articles, reports or thesis's have all influenced the research through imitating the work. Either being prominent through what angels have been explored, which themes have been sought-after, or how one should approach a research heavily dependent on partner collaboration, previous research efforts have resulted in valuable lessons learned. Especially influences which emphasizes the parts of a given company to approach, what realistic collaborations can ultimately lead to and what can eventually be derived, what previous research have explored and how one should approach big and independent companies, have all been taken into consideration.

1.4 Research questions

In light of the project description, three different research questions have been formed. The research questions of this thesis are:

- **RQ1** *What are the applications and underlying technologies of AI that generate value among companies?*
- **RQ2** *What characterizes and separates AI adoption and use across companies and across domains?*
- **RQ3** *How can a framework for understanding issues relevant to organizations' adoption of AI technologies be defined?*

1.5 Approach

The research relies on and utilizes the findings collected through both a qualitative and quantitative research method, as well as a literature review in order to approach the research questions. Partners in the form of external and independent companies have been chosen as a result of their AI portfolio and operations which can be compared and characterized, along with their mission to become an AI-driven organization. The participants of the project will be the researcher, the supervisor, and the partners. Each partner will be recruited either by the means of the supervisor or the researcher and the planning process along with any occurred ethical issues or individual demands, will be facilitated for and agreed on in advance.

With a research emphasizing a learning aspect investigated through the experiences and expertise of the different partners involved, the extraction and collection of data have been made possible through in-depth interviews, and a survey establishing some general understandings, priorities, and perceptions across the industries. Investigating within a real-life context is representative of a case study strategy which has been the preferred approach. A literature review will also be employed researching relevant sources and otherwise published information, academic and not, to obtain an overview of related work in the field. While using the qualitative data analysis for the main information collection, a collection of data was also made possible through a quantitative questionnaire and survey. The research is therefore somewhat mixed in terms of analysis, and approach.

Positivism research philosophy concerns quantifiable observations leading to statistical analyses, limiting the research-role to data collection and objective interpretations [18]. With a research emphasizing qualitative and quantitative research methodologies, and data accumulation through

interviews and a survey, which are subjective by nature, it's desired to remain committed towards a positivism approach as much as possible. The research contributes to a mostly objective discussion and interpretation of the quantitative results. Positivism while not being the only philosophy fits the research specifications to a certain degree.

1.6 Results

The results of the research take both the form of a new learning experience and a coarse product.

Using both a quantitative and qualitative research methodology as the research foundation, valuable information and data have been extracted from the various means followed by the processing of the results. The end result has taken the form of several important and suitable aspects or themes based on the comparisons of the different partners. Targeting organizational use and relationships with AI the resulting aspects has proved value to continue with.

The quantitative study has especially been useful for giving numerical and visual representations of the accumulated data. A better overview and understanding has been provided by visualizing distinctive experiences, abilities, and perceptions associated with each company in light of each question.

Through a discussion of the knowledge and insights gained through the research and state-of-the-art, an attempt to define what aspects are most representative and subsequently must be addressed when talking about AI-adoption has been completed. The result is two critical aspects: a dimensional approach to AI, and a leveled division of AI-maturity. Hence, five dimensions of an AI-project and five levels of AI-maturity have been found to best represent an approach towards an AI maturity model.

1.7 Thesis outline

The following outline provides a short description of the master thesis in its entirety, with a short description provided for each unique chapter and its contents.

Chapter 1 - Introduction presents the introduction to the thesis, involving the motivation, the approach, and the results of the project. The associated research questions and overall project goal attempted answered with this thesis are also featured.

Chapter 2 - Background: The field of AI represented through relevant AI technologies and otherwise essential theory will in this chapter be under scrutiny. This chapter presents all the necessary background and theory behind the technologies, concepts, and industry contexts in order to establish a necessary foundation, and provide the need-to-knows for the project.

Chapter 3 - Related Work presents an opportunity to include and compare related work and research endeavors in light of the project specifications and development. A number of different research articles and other published relevant literature will here be taken into consideration.

Chapter 4 - Project Context addresses the *purpose* for doing the research. Discussing the context of the project and research in light of scientific references assists in validating the relevance

of the project.

Chapter 5 - Methodology: Along with providing an overview of the different research methodologies used in the thesis, chapter 5 introduces the partners and their representatives who have contributed to the research, focusing on the completion of the case study.

Chapter 6 - Results is the culmination of the qualitative and quantitative research methods. All the acquired results gathered through the interviews and survey will here be presented according to a unique set of determined topics.

Chapter 7 - Discussion presents a discussion of the obtained results in relation to the research questions. The discussion addresses the findings in light of state-of-the-art.

Chapter 8 - Conclusion and Future Prospects is the conclusion to the discussion, including both a presentation of the learning experience from the project and a summary of the research. Any future suggestions and prospects for continuing the research will also be disclosed.

Appendices A to C: Appendix A all throughout appendix C contains the different appendices for the project. Templates of the interview guides along with the survey are displayed here.

2 Background

A proper introduction into the technologies, concepts and otherwise essential academia behind the research will first be established, before embarking on the research itself and the upcoming processing of the results. The following chapter introduces the necessary background and foundation for the thesis.

2.1 The AI-technologies

Artificial intelligence is a wide term and envelops numerous technologies, terms, and applications. As such there is a need to clarify the scope of the field of AI in this thesis, and as a result distinguish between different technologies which support or can be classified under the term *Artificial intelligence*. As already established in the *limitations* section in introduction chapter, all researched cases, applications and uses of artificial intelligence have been limited to a number of relevant AI technologies.

2.1.1 Relevant AI technologies

With Artificial intelligence (AI) and related technologies representing a major field of research and appliance, the focus of the research as a result needed to be more constricted. Therefore it was early on decided that the research would primarily focus on the data-driven part of AI and its application areas. More specifically center the research on the organizational use, and leveraging through sample applications of *Machine Learning*. As the research adapted to the circumstances of the study however, it was deemed necessary to expand on the initial focus. With a study dependent on learning from the experiences, history, and portfolios of industry players, technologies represented through the different and relevant sample applications will be taken into consideration. Before delving into the relevant AI-technologies, a short overview of the different inclusions follows:

- Artificial Intelligence
- Machine Learning
- Deep Learning
- Computer Vision
- Natural Language Processing

2.1.2 Artificial intelligence

"*AI is the science of making machines to do things that would require intelligence if done by men*" - Marvin Minsky [14]. "*It is the science and engineering of making intelligent machines, especially intelligent computer programs*" - John McCarthy [72]. "*The field of artificial intelligence, or AI, goes further still: it attempts not just to understand but also to build intelligent entities.*" - Stuart Russell, Peter Norvig [82].

Three definitions of the term Artificial intelligence attempting to describe an expansive and extraordinary field. Artificial intelligence (AI) have over recent times become a trend word usually associated with robots, or more progressive and future-oriented possibilities and capabilities. The term is subject to many different interpretations and as such there are no formal definition covering all aspects of intelligence. In the twenty-first century, AI techniques have experienced a resurgence following concurrent advances in computer power, large amounts of data, and theoretical understanding; and AI techniques have become an essential part of the technology industry, helping to solve many challenging problems in computer science, software engineering and operations research. [100] From advanced automation to decision-making entities, from complementary tools to replacing functionalities, "Artificial intelligence constitutes a paradigm shift in computer science, enabling substantially shorter development cycles, extremely powerful solutions, and immediate transfer of technologies from one domain to another." [30]

Russell and Norvig also goes further as to categorize numerous other definitions of AI across four categories [82]:

Thinking Humanly	**Thinking Rationally**
"The exciting new effort to make computers think . . . *machines with minds*, in the full and literal sense." (Haugeland, 1985)	"The study of mental faculties through the use of computational models." (Charniak and McDermott, 1985)
"[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning . . ." (Bellman, 1978)	"The study of the computations that make it possible to perceive, reason, and act." (Winston, 1992)
Acting Humanly	**Acting Rationally**
"The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990)	"Computational Intelligence is the study of the design of intelligent agents." (Poole *et al.*, 1998)
"The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)	"AI . . . is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

Figure 2.1: Some definitions of artificial intelligence, organized into four categories.

Another helpful way to classify the field is to focus on two dimensions of AI, as done by Pinar Özturk [101]:

Science

- The science of understanding intelligent entities, developing theories which attempt to explain and predict the nature of such entities.
- Discover ideas about knowledge that help explain various sorts of intelligence
- Model functions of the human brain

Engineering

- Solving real-world problems by employing ideas of how to represent and use knowledge
- Engineering of intelligent entities

- Produce intelligent behaviour by any means

As stated by The High-Level Expert Group: Artificial intelligence (AI) systems are software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the given goal. AI systems can either use symbolic rules or learn a numeric model, and they can also adapt their behaviour by analysing how the environment is affected by their previous actions. As a scientific discipline, AI includes several approaches and techniques, such as machine learning (of which deep learning and reinforcement learning are specific examples), machine reasoning (which includes planning, scheduling, knowledge representation and reasoning, search, and optimization), and robotics. AI algorithms may involve different kinds of epistemic or practical reasoning (detecting patterns and shapes, applying rules, making forecasts or plans), as well different ways of learning. [74] When discussing what AI is, IBM defines the term in several relevant contexts. In computer science, the term artificial intelligence (AI) refers to any human-like intelligence exhibited by a computer, robot, or other machine. In popular usage, artificial intelligence refers to the ability of a computer or machine to mimic the capabilities of the human mind—learning from examples and experience, recognizing objects, understanding and responding to language, making decisions, solving problems—and combining these and other capabilities to perform functions a human might perform, such as greeting a hotel guest or driving a car. [19]

The concept of rationality is central in the field of AI. Rationality concerns an ideal performance measure, and can be seen as the ultimate ”goal state” when designing autonomous machines. Thinking and acting rationally is in theory impossible to achieve, choosing the optimal choice in each given situation, but it can be approximated. Thinking and acting humanly can also be another approach when modeling the behavior or thinking. This of course depends on the context and area of use. [82] [32] As an approximation to a goal state or a ”simple” improvement upon on a familiar norm, AI have shown a tendency and ability to act as a means of change designated to provide with helping in decision making, streamlining existing standards, or even creating entire new prospects. AI implementations will occur when a specific AI technology needs to meet specific requirements such as increasing revenue, enhancing infrastructure, providing real-time analysis, or increasing efficiency and customer satisfaction [21]. In some cases, AI can fully replace human activities (e.g., in driverless vehicles, cleaning robots, and certain planning and scheduling tasks in logistics). In many cases it rather complements human capacities: it enhances the human ability to know and act, it supports creativity and invention. Thanks to AI, it may be possible to achieve a new cooperation between humans and machines, which overcomes the classical model in which machines only performed routine and repetitive tasks. [74] AI will affect economies, societies and cultures profoundly at a national, international, and global level. Achieving the global benefits of artificial intelligence will require international cooperation. [30] When discussing the challenges around ethics in AI, Bill Gates said under a chat with graduates of Stanford AI4ALL in 2019, “The world hasn’t had that many technologies that are both promising and dangerous,” as a reference to nuclear energy and nuclear weapons. “With AI, the power of it is so incredible, it will change society in some very deep ways,” Gates reflecting on the future of artificial intelligence. [80]

2.1.3 Machine learning

”Machine learning gives computers the ability to learn without being explicitly programmed,” as defined by Arthur Samuel in 1959 on what Machine learning is [62]. *”Methods and techniques*

that enable computers to improve their performance through their own experience," presented by Bach and Nguyen as the definition of Machine Learning [43]. *"Machine learning is a subset of AI application that learns by itself. It actually reprograms itself, as it digests more data, to perform the specific task it's designed to perform with increasingly greater accuracy."* [19]

Learning can be thought of as a process where a system improves on its performance, a person executes useful changes, or constructing or modifying representations of what is being experienced. *Machine learning* (ML) consists of methods and techniques which enables computers to improve their performance through their own experience. Three perhaps familiar niches for machine learning is data mining (using historical data to improve decisions), self-customizing programs (recommendation systems), and software applications we cannot program by hand (such as autonomous driving or speech recognition). [43] "Machine learning allows a machine to interpret a set of data and learn from those interpretations to apply them to another similar set of outputs" [45].

Machine learning focuses on the ability of machines to receive a set of data and learn for themselves, changing algorithms as they learn more about the information they are processing. The current generation of AI systems offer tremendous benefits, but their effectiveness will be limited by the machine's inability to explain its decisions and actions to users. There are always different design choices to evaluate when using ML such as *what experience can we learn from?*, *what exactly is to be learned?*, *how shall it be represented?*, and *what specific algorithm can we use to learn it?*. On the topic "Why study learning in computers?", Bach and Nguyen lists three motives [43]:

- To model learning in human beings
- To study learning as a theoretical phenomena
- To automate the development and maintenance of computer systems

Machine learning systems discover correlations between data and build corresponding models, which link possible inputs to presumably correct responses (predictions). In machine learning applications, AI systems learn to make predictions after being trained on vast sets of examples. Thus, AI has become hungry for data, and this hunger has spurred data collection, in a self-reinforcing spiral: the development of AI systems based on machine learning presupposes and fosters the creation of vast data sets, i.e., big data. The integration of AI and big data can deliver many benefits for the economic, scientific and social progress. However, it also contributes to risks for individuals and for the whole of society, such as influence on citizens' behaviour, polarisation and fragmentation in the public sphere. [74] Through a study forecasting the machine learning market published in 2017, MarketsandMarkets put forward an insight denoting how the market were expected to grow significantly by 2022 during the forecast period. Machine learning enabled solutions are being significantly adopted by organizations worldwide to enhance customer experience, ROI, and to gain a competitive edge in business operations. Moreover, in the coming years, applications of machine learning in various industry verticals is expected to rise exponentially. Technological advancement and proliferation in data generation are some of the major driving factors for the market. [46]

Learning can be an ambiguous term, and machine learning envelops different types of learning. As emphasized by Bach and Nguyen [43] and Wikipedia [99], learning can involve three areas or three basic machine learning paradigms:

- Supervised learning

  - Training data includes desired outputs.

- Unsupervised learning

  - Training data does not include desired outputs.

- Special forms

  - Reinforcement learning: How intelligent agents ought to take actions in an environment in order to maximize the notion of cumulative reward.

Serving as a closing act, machine learning in practice can involve a number of different things [43]: (1) Understanding domain, prior knowledge, and goals, (2) Data integration, selection, cleaning, pre-processing, etc, (3) Learning the model, (4) Interpreting results, and (5) Consolidating and deploying discovered knowledge. Machine learning offers potential value to companies trying to leverage big data and helps them better understand subtle changes in behavior, preferences or customer satisfaction. Business leaders are beginning to appreciate that many things happening within their organizations and industries can't be understood through a query. The hidden patterns and anomalies buried in the data can either help or hurt [37]. "Machine learning's growing adoption in business across industries reflects how effective its algorithms, frameworks and techniques are at solving complex problems quickly." [13]

2.1.4 Deep learning

Deep learning is a machine learning technique, a specialized form of machine learning, that teaches computers to do what comes naturally to humans: learn by example. Key technology application areas involve self-driving cars and voice control. [49] Deep learning is a subset of machine learning application that teaches itself to perform a specific task with increasingly greater accuracy, without human intervention [19], but at the same time differs from traditional machine learning techniques in that they can automatically learn representations from data such as images, video or text, without introducing hand-coded rules or human domain knowledge [57]. Deep learning AI is able to learn without human supervision, drawing from data that is both unstructured and unlabeled [31]. Instead of organizing data to run through predefined equations, deep learning sets up basic parameters about the data and trains the computer to learn on its own by recognizing patterns using many layers of processing. There are traditional pros and cons related to the technology [67]:

Pros:

- Efficiently learning from high-dimensional data.
- State of the art in Computer Vision/Speech Recognition/NLP tasks.
- Representation learning.

Cons:

- Data-greedy.
- Training Computationally intensive.
- Hyperparameter tuning.

A key advantage of deep learning networks is that they often continue to improve as the size of the data increases. Most deep learning methods use neural network architectures, which is why deep learning models are often referred to as deep neural networks. [49] The term ”deep” usually denotes the number of hidden layers in a neural network. The concept of deep learning is to dig large volume of data to automatically identify patterns and extract features from complex unsupervised data without involvement of a human, which makes it an important tool for Big Data analysis [25]. First, the process of deep learning is entirely data-driven. Rules are solely based on data (answers can be understood as labeled data). Second, decisions are determined by machine. In the deep learning process, rules are derived from data and contribute to the management of data. Deep learning distinguishes itself from other prevailing machine learning methods in its ability to process unlabeled data. Based on the identification of deep learning functionalities, changes in data collection, data analysis, and algorithms can collectively influence how organizational agility (organizational agility captures the capability of firms to quickly sense and respond to market dynamics) works in current theorization. [23]

2.1.5 Computer vision

Computer vision is a field of artificial intelligence (AI) that enables computers and systems to derive meaningful information from digital images, videos and other visual inputs — and take actions or make recommendations based on that information. If AI enables computers to think, computer vision enables them to see, observe and understand. [36] At an abstract level, the goal of computer vision problems is to use the observed image data to infer something about the world. [11] Thanks to advances in artificial intelligence and innovations in deep learning and neural networks, the field has been able to take great leaps in recent years and has been able to surpass humans in some tasks related to detecting and labeling objects [53].

Computer vision is one of the areas in Machine Learning where core concepts are already being integrated into major products that one use every day. One of the driving factors behind the growth of computer vision is the amount of data generated today, which is then used to train and make computer vision better. Along with a tremendous amount of visual data, the computing power required to analyze the data is now accessible. As the field of computer vision has grown with new hardware and algorithms so has the accuracy rates for object identification. In less than a decade, today’s systems have reached 99 percent accuracy from 50 percent making them more accurate than humans at quickly reacting to visual inputs. [53] Computer vision needs lots of data. It runs analyses of data over and over until it discerns distinctions and ultimately recognize images. One of two essential technologies used to accomplish this are deep learning. There is a lot of research being done in the computer vision field, but it’s not just research. Real-world applications demonstrate how important computer vision is to endeavors in business, entertainment, transportation, healthcare and everyday life. A key driver for the growth of these applications is the flood of visual information flowing from smartphones, security systems, traffic cameras and other visually instrumented devices. This data could play a major role in operations across industries, but today goes unused. The information creates a test bed to train computer vision applications and a launchpad for them to become part of a range of human activities [36] The effects of these advances on the computer vision field have been astounding. Accuracy rates for object identification and classification have gone from 50 percent to 99 percent in less than a decade, and today’s systems are more accurate than humans at quickly detecting and reacting to visual inputs. ”Computer vision is one of the most remarkable things to come out of the deep learning and artificial intelligence world. The advancements that deep learning has contributed to the computer vision field have really set this field apart.” [88]

2.1.6 Natural language processing

”Natural language processing strives to build machines that understand and respond to text or voice data—and respond with text or speech of their own—in much the same way humans do.” Natural language processing (NLP) refers to the branch of computer science—and more specifically, the branch of artificial intelligence or AI—concerned with giving computers the ability to understand text and spoken words in much the same way human beings can. [20] One of the most challenging and revolutionary things artificial intelligence (AI) can do is speak, write, listen, and understand human language. Natural language processing (NLP) is a form of AI that extracts meaning from human language to make decisions based on the information. This technology is still evolving, but there are already many incredible ways natural language processing is used today. [48] To extract value from unstructured data, companies across industries are turning to Natural Language Processing [73]

NLP combines computational linguistics—rule-based modeling of human language—with statistical, machine learning, and deep learning models. Together, these technologies enable computers to process human language in the form of text or voice data and to ‘understand’ its full meaning, complete with the speaker or writer’s intent and sentiment. NLP drives computer programs that translate text from one language to another, respond to spoken commands, and summarize large volumes of text rapidly—even in real time. There’s a good chance you’ve interacted with NLP in the form of voice-operated GPS systems, digital assistants, speech-to-text dictation software, customer service chatbots, and other consumer conveniences. But NLP also plays a growing role in enterprise solutions that help streamline business operations, increase employee productivity, and simplify mission-critical business processes. [20] NLP is continuously playing a larger role. MarketsandMarkets have accounted for the future growth, and have predicted that the global Natural Language Processing market size to grow from USD 11.6 billion in 2020 to USD 35.1 billion by 2026, at a Compound Annual Growth Rate (CAGR) of 20.3% during the forecast period. ”Growing demand for cloud-based NLP solutions to reduce overall costs and better scalability and increasing usage of smart devices to facilitate smart enviroments are expected to drive the NLP market growth. The rise in the adoption of NLP-based applications across verticals to enhance customer experience and increase in investments in the healthcare vertical is expected to offer opportunities for NLP vendors.” [47]

2.2 Important terms, concepts, and otherwise essential theory

For the second part of the background chapter, the focus will be on related, but just as important theory which must be taken into account when researching the organizational use of AI-based solutions. Their role in the IT/OT industry (Information Technology/Operational Technology) will become clear.

2.2.1 Big data

You cannot realise AI without data, and more specifically large quantities of it. ”Real impact of data-driven AI depends on the availability of live data of sufficient quality and quantity in an automatically discoverable format that both humans and machines can understand” - Alexander Gleim for Norwegian Research Center for AI Innovation (NorwAI). [30] ”Data is an important starting point for AI. Today, large quantities of information from a variety of sources, are generated. AI and machine learning can use these data to provide us important insights. To utilize the potential found in AI, access to large datasets of good quality is crucial. [60]

Big data (BD) are large quantities of quantitative or qualitative data which essentially boils down to management and decision-making tools [93]. Big Data is data that's too large to handle with traditional methods. This poses new challenges when it comes to storing, manipulating, retrieving, and analyzing Big Data. [35] Big data is a field that treats ways to analyze, systematically extract information from, or otherwise deal with data sets that are too large or complex to be dealt with by traditional data-processing application software. Big data challenges include capturing data, data storage, data analysis, search, sharing, transfer, visualization, querying, updating, information privacy and data source. Big data was originally associated with three key concepts: volume, variety, and velocity. [94] Big Data is not a buzzword or even a passing fad. In fact, it is a fundamental, majorly 'table stakes' ability for organizations in all sectors. Thus any business that is not investing in its company's ability to accumulate and harness this data in different ways is more likely to fall behind the competition, even without knowing it. [69] Some common techniques include data mining, text analytics, predictive analytics, data visualization, AI, machine learning, statistics and natural language processing.[34] Big Data is a way of harvesting raw data from multiple, disparate data sources, storing the data for use by analytics programs, and using the raw data to derive value (meaning) from the data in a whole new ways. "We're talking data from traditional business applications like CRM and web applications, combined with data from a growing number of sensors (IoT), and social media like Facebook, Twitter, and LinkedIn. This means that no single technology can be called Big Data, which requires a tightly coordinated ecosystem of data acquisition, storage, and application technologies to make it work." [64]

"So now more than ever it's important for Norwegian companies to invest in their data foundation, in liberating data from the silos and making it available for mass AI applications that we've just started to scratch the surface of. These investments and sense of urgency is not only crucial for the transformation of the Norwegian industries. They are equally important for the transformation of Norway"- John Markus Lervik , CEO and Co-Founder at Cognite. [30] As AI is dependent on technologies collecting, processing and storing large amounts of data in real-time, without big data machine learning in general is worthless in a modern context. Then it's a question of how the collection of data is done. Data is integral in enabling AI. Businesses are using different unusual methods designed to collect critical information and data. Everything from satellite imagery, employer databases to sensors are sources for data. Data sets grow rapidly, to a certain extent because they are increasingly gathered by cheap and numerous information-sensing Internet of things devices such as mobile devices, aerial (remote sensing), software logs, cameras, microphones, radio-frequency identification (RFID) readers and wireless sensor networks. [94] Especially sensor data are more relevant for certain industries. With a sensor, a machine observes the environment and information can be collected. A sensor measures a physical quantity and converts it into a signal. Sensors translate measurements from the real world into data for the digital domain. There is an almost infinite diversity of parameters that can be measured, such as location, displacement, movement, sound frequency, temperature, pressure, humidity, electrical voltage level, camera images, color, etc. The goal is to detect events or changes in the environment. [1]

Many AI applications process personal data. On the one hand, personal data may contribute to the data sets used to train machine learning systems, namely, to build their algorithmic models. On the other hand, such models can be applied to personal data, to make inferences concerning particular individuals. The integration of AI and big data technologies into the global data-processing infrastructure can deliver a lot of benefits: better access to information; generation and distribution of knowledge across the globe; cost savings, greater productivity, and value creation;

new creative and well paying jobs; individualised private and public services; environmentally-friendly management of utilities and logistics; novel information and consulting services; support for transparency; remedies against biases and discriminations, etc. Great advances are enabled in many domains, and more good can come in the future. [74] ”We need to undertake the steps of liberating the data, connecting it together, building a foundation for advanced analytics and AI so we can ultimately reimagine how minds and machines work together.” [30] Mikalef et al. concludes from their study that big data are more than just the data itself, and that developing a capability, the ability of a firm to effectively deploy technology and talent to capture, store, and analyze data, requires a number of complementary resources to be taken into account [29]. Big Data Analytics capability (BDAC) defined as the ability of the firm to capture and analyze data toward the generation of insights, by effectively deploying its data, technology, and talent through firm-wide processes, roles and structures, is a important takeaway from the study measuring how to become more effective and experienced in the use of data. ”With big data analytics, you can ultimately fuel better and faster decision-making, modelling and predicting of future outcomes and enhanced business intelligence.” [34]

The amount of data in today’s world is staggering. But big data offers vast opportunities for businesses, whether used independently or with existing traditional data. Data scientists, analysts, researchers and business users can leverage these new data sources for advanced analytics that deliver deeper insights and to power innovative big data applications. [34] ”Our experience has also shown us that we have a lot of work to do when it comes to ensuring that our technologies not only help us persevere, but actually allow us to continue to build and innovate through times of crisis. The single greatest and still largely untapped resource to do this, is data” - John Markus Lervik [30]

2.2.2 GDPR

The General Data Protection Regulation (GDPR) is a regulation in EU law on data protection and privacy in the European Union (EU) and the European Economic Area (EEA), also addressing the transfer of personal data outside the EU and EEA areas. The GDPR’s primary aim is to give control to individuals over their personal data and to simplify the regulatory environment for international business by unifying the regulation within the EU. [95] The GDPR seeks to create a harmonised data protection law framework across the EU and aims to give citizens back the control of their personal data, whilst imposing strict rules on those hosting and ‘processing’ this data, anywhere in the world. It is complex and far-reaching legislation, comprising many components that touch organizations in numerous ways and at all levels. [38]

In the context of data regulation and management, the increasing presence and shift which has followed alongside AI, the field’s reliance on data consumption have been cause for focus adjustment. New and critical questions have been raised by the rise of big data. The need to address and act in line with the GDPR can however be more industry-dependent. While an industry like oil and gas has less exchange with personalized data and has operations characterized more by sensor- and machine-generated data, other industries such as finance and backing, or media have a far more strained and urged situation with personalized and private data, such as user sensitive information. When discussing AI, the ”how”, the ”where”, and ”for what” in relation to the usage of contextualized data, are three notions that must be accounted for. The increased focus on the use and importance of big data calls for more careful approaches and practices.

GDPR coming into effect coincides with the more widespread adoption of artificial intelligence as the technology becomes embedded in more and more enterprise applications. The GDPR, a

sprawling piece of legislation applies to artificial intelligence when it is under development with the help of personal data, and also when it is used to analyze or reach decisions about individuals. GDPR provisions that are squarely aimed at machine learning state "the data subject shall have the right not to be subject to a decision based solely on automated processing, including profiling, which produces legal effects concerning him or her or similarly significantly affects him or her." (Article 22 and Recital 71). It is clear that the regulation expects the technologies like AI to be developed while taking into consideration the following principles: fairness, purpose limitation, data minimisation, transparency, and the right to information. The principles mentioned above are supposedly some of the major challenges facing AI to adapt to the new world of GDPR. The problem is because most of the machine learning decision-making systems are "black boxes" rather than old-style rule-based expert systems, and therefore fail to comply with the GDPR requirements of transparency, accountability, and putting the data subject in control. [92]

The GDPR allows for the development of AI and big data applications that successfully balance data protection and other social and economic interests, but it provides limited guidance on how to achieve this goal. A successful application of GDPR to AI-application depends heavily on what guidance data protection bodies and other competent authorities will provide to controllers and data subjects. Appropriate guidance would diminish the cost of legal uncertainty and would direct companies in particular small ones that mostly need such advice to efficient and data protection-compliant solutions. [74]

AI is not explicitly mentioned in the GDPR, but many provisions in the GDPR are relevant to AI, and some are indeed challenged by the new ways of processing personal data that are enabled by AI. There is indeed a tension between the traditional data protection principles – purpose limitation, data minimisation, the special treatment of 'sensitive data', the limitation on automated decisions–and the full deployment of the power of AI and big data. The latter entails the collection of vast quantities of data concerning individuals and their social relations and processing such data for purposes that were not fully determined at the time of collection. However, there are ways to interpret, apply, and develop the data protection principles that are consistent with the beneficial uses of AI and big data. [74] Organizations should conduct data protection impact assessment at the beginning of an AI project and document the process. A report by the Norwegian Data Protection Authority, "Artificial intelligence and privacy" suggests that the impact assessment should include the following as a minimum: a systematic description of the process, its purpose, and which justified interest it protects; an assessment of whether the process is necessary and proportional, given its purpose; an assessment of the risk that processing involves for people's rights, including the right to privacy; and the identification of the measures selected for managing risk. [92]

The importance of big data in relation to AI becomes apparent when emphasizing how data is made applicable. As explained by Anamika Ved for TechGDPR, when addressing bias in AI: Some data sets used to train AI systems have been found to contain inherent biases, which results in decisions that unfairly discriminate against certain individuals or groups. To become GDPR compliant, the design, development and use of AI should ensure that there are no unlawful biases or discrimination. Companies should invest in technical research to identify, address and mitigate biases. She also follows up with how to combat bias in machine learning: One way to address bias in trained machine learning models is to build transparent models. Organizations should improve AI systems transparency by investing in scientific research on explainable artificial intelligence. They should also make their practices more transparent ensuring individuals are informed appropriately when they are interacting with AI and provide adequate information on the purpose and

effects of AI systems. [92]

Norway is no exception to the GDPR. As stated in the *National strategy for AI*, development and use of artificial intelligence in Norway must retain the integrity and privacy of the individual. The government have made a priority and goal to maintain and reinforce the trust between private and governmental businesses, and each other, at the same time as AI are used in new and innovative ways. [60] There has been an overall goal to facilitate sharing of data from the public sector so that business, academia and ”civil society” can use the data in new ways.

2.2.3 Maturity models

Capability Maturity Model or CMM is a method for evaluating how mature an organization is on a scale from 1 to 5. The method was developed by Software Engineering Institute at Carnegie Mellon University. The term ”maturity” relates to the degree of formality and optimization of processes, from ad hoc practices, to formally defined steps, to managed result metrics, to active optimization of the processes. The model's aim is to improve existing software development processes, but it can also be applied to other processes. [97] A maturity model shows how capable an organization or a system is of achieving continuous improvement [66]. It helps to think of a maturity model as a benchmark which an organization or business or even a system can be evaluated against. By targeting one or more suitable parts in the organization such as a certain technology, a process or even in relation to personnel, the maturity model can help understand and discover where the organization currently is, and where they want to be based on their business goals or missions. [2]

A maturity model consists of different levels of maturity. While targeting a software development process, the level definitions defined in CMM provides simple characterizations for measuring maturity. The five levels defined by CMM are [97]:

1. **Initial** - (chaotic, ad hoc, individual heroics) - the starting point for use of a new or undocumented repeat process.
2. **Repeatable** - the process is at least documented sufficiently such that repeating the same steps may be attempted.
3. **Defined** - the process is defined/confirmed as a standard business process.
4. **Managed (Capable)** - the process is quantitatively managed in accordance with agreed-upon metrics.
5. **Optimizing (Efficient)** - process management includes deliberate process optimization/ improvement.

IBM also bases their IT maturity model on the CMM or more specifically the CMMI (Capability Maturity Model Integration), a superseding model of the CMM. While emphasizing the same kind of maturity levels, more concise explanations follows. (1) Initial: No standards are in place and inconsistency exists across the organization, (2) Managed: A process is in place and activities are managed, but the process is orchestration without insights, (3) Defined: A process is defined as a standard across the organization and is tailored for individual projects, (4) Quantitatively Managed: The process is measured and any deviation from the standard is addressed, and (5) Optimizing: The process is continuously improved. ”Given the general nature of maturity levels, it's not surprising that you can apply them to all manner of IT-related areas. You might focus the levels on a narrow area, such as different elements of the infrastructure landscape. Or you

might be much more general and align with seven dimensions that are strategically important for organizations that are moving to the cloud." Seven dimensions in this instance refers to key elements and their dependencies in providing a holistic view to the decision making, helping drive the transformation to achieve the greatest impact. [2]

2.2.4 Internet of things

In a nutshell, the Internet of Things (IoT) is the concept of connecting any device (so long as it has an on/off switch) to the Internet and to other connected devices. The IoT is a giant network of connected things and people – all of which collect and share data about the way they are used and about the environment around them. That includes an extraordinary number of objects of all shapes and sizes – from smart microwaves, which automatically cook your food for the right length of time, to self-driving cars, whose complex sensors detect objects in their path, to wearable fitness devices that measure your heart rate and the number of steps you've taken that day, then use that information to suggest exercise plans tailored to you.[12] This allows us to remote control the devices and collect data in a way which previously was not possible. With IoT we can streamline work- and business-processes, reduce costs or create new digital services- and through this increase the company's competitiveness and profitability. The possibilities are endless. [87]

The "Things" in IoT are physical products which can communicate over the internet. Inside the thing is a communication-unit which makes it possible for the thing to talk with the outside world. There are several important factors to consider when choosing a communication unit, such as size, correct network technology, power consumption and more. [87] Devices and objects with built in sensors are connected to an Internet of Things platform, which integrates data from the different devices and applies analytics to share the most valuable information with applications built to address specific needs. These powerful IoT platforms can pinpoint exactly what information is useful and what can safely be ignored. This information can be used to detect patterns, make recommendations, and detect possible problems before they occur. [12] Over the past few years, IoT has become one of the most important technologies of the 21st century. Now that we can connect everyday objects—kitchen appliances, cars, thermostats, baby monitors—to the internet via embedded devices, seamless communication is possible between people, processes, and things. By means of low-cost computing, the cloud, big data, analytics, and mobile technologies, physical things can share and collect data with minimal human intervention. In this hyperconnected world, digital systems can record, monitor, and adjust each interaction between connected things. The physical world meets the digital world—and they cooperate. [61]

Putting this in context with AI and more specifically machine learning, Software AG provides an overview of machine learning for IoT [4]: IoT and Machine learning deliver insights otherwise hidden in data for rapid, automated responses and improved decision making. Machine learning for IoT can be used to project future trends, detect anomalies, and augment intelligence by ingesting image, video and audio. Machine learning can help demystify the hidden patterns in IoT data by analyzing massive volumes of data using sophisticated algorithms. It can supplement or replace manual processes with automated systems using statistically derived actions in critical processes. With machine learning for IoT, you can: (1) Ingest and transform data into a consistent format, (2) Build a machine learning model, and (3) Deploy this machine learning model on cloud, edge and device.

2.3 Conclusion

In concluding the background chapter, different areas and technologies of AI have been disclosed. From machine learning and deep learning to computer vision and natural language processing, these inclusions summarize what has been emphasized with this thesis. These aspects is the researcher's understanding of AI. This also involves the themes categorized as other important terms, concepts, and otherwise essential theory. While not a direct AI-technology in of themselves, these featured aspects are part of the larger picture which must be disclosed as well. While some are more context dependent than others, when attempting to understand, research and evaluate AI, these aspects should not be missed.

3 Related Work

The intention of a related work chapter is to present, incorporate, and understand previous research endeavors in regard to the research goal at hand. Related and published endeavors and efforts which emphasize research or work conducted by others, and in one way or another ties in with the proposed themes of the study. As such, with a related work chapter the motivation has been to include different approaches taken by other researchers to solve or study similar themes, and use the insights accumulated to help with facilitating for a more reflective and relevant discussion.

3.1 State-of-the-art

State-of-the-art envelops modern standards, and involves using the latest ideas, methods, and research. In defining state-of-the-art there are two schools of thought: (1) Methods for analyzing organization's use and relationship with AI, and (2) Actual analysis-efforts determining success factors, challenges and how value is measured or perceived given different experiences with AI. Research papers and articles, books and otherwise published works make up the basis of the related work and contributes to this chapter. The overall focus when analyzing and interpreting these research papers and documentations will be to extract information deemed valuable in light of the following defined topics or themes.

3.2 Maturity Models

As first introduced in subsection 2.2.3, the contents of a maturity model tend to deal with similar structures. A number of determined maturity levels as well as a categorization of different dimensions to be consulted at each level. However, in being a maturity model concerned with traditional software processes or with an IT focus, it has been interesting to see if this translates to an AI maturity model as well. Are the priorities in question relatable or is there ambiguity as to how one approaches maturity model in relation to AI?

In terms of prominent AI maturity models or framework-oriented guides, new examples or efforts surfaces. Element AI, an AI company, have published an AI maturity framework. In addition to a set of stages, the company emphasizes five dimensions of enterprise AI, more specifically strategy, data, technology, people, and governance. "Each dimension is integral. A lack of progress in one will hold back overall progress on AI, even if other dimensions are further along." In more detail, the five dimensions are:

1. **Strategy:** The plan of action for achieving the desired level of AI maturity in the organization.
2. **Data:** The data required to support specific AI techniques defined by the AI strategy.
3. **Technology:** The technical infrastructure and tools needed to train, deliver and manage AI models across their lifecycle.
4. **People:** The leadership practices as well as roles, skills and performance measures required for people to successfully build and/or work with AI.

5. **Governance:** The policies, processes and relevant technology components required to ensure safe, reliable, accountable and trustworthy AI solutions.

From plan of action, to support and infrastructure, to people and policies, the framework is designed with the intention to help with understanding and prioritizing impacting actions with AI through predefined dimensions targeting a set of documented levels. The five dimensions "enable enterprise AI and how each one contributes to advancing AI maturity over time." [5] Mansion House Consulting (MHC), a global consultancy, have explored the capabilities required of an organisation in order to successfully advance its AI adoption journey. "An AI maturity model provides an organisation with a framework for assessing its current AI readiness and capabilities. This then informs the firm when prioritising investments toward AI technologies, skills and processes which are needed to develop, manage and maintain AI-based systems, including mitigating any potential risks associated with their development and use." Their work have resulted in an AI maturity model, comprising four levels of maturity targeting an organizations posture:

- **Level 1 - Assessor:** The organization is still in assessment mode, the AI adoption and journey has not begun.
- **Level 2 - Tester:** Progress has been made in understanding how AI can solve/meet objectives. Possible solutions are being looked at, and proof of concept projects my have been started.
- **Level 3 - Believer:** Gaps and limitations still exist which prevents a comfortable relationship with an organization-wide AI acceptance and adoption. Solid progress have nonetheless been made in the AI journey, with a reasonable degree of practical experience with AI and understanding of leveraging a single use case.
- **Level 4 - Converted:** The organization is at the most mature level. Along with a good level of expertise, AI is now embraced in the organization as support tool, and can demonstrate a proven track across several use cases.

Summed up, MHC describes the benefit of such a model "Once an organisation understands its level of AI maturity in terms of its readiness and capabilities, it can identify the required actions and relative priorities to safely progress through the AI journey to the point where the organisation has successfully converted to AI." [52]

How an organization approaches an AI-initiative, can be crucial. (Khodabandeh et al.) addresses how many companies approaches their AI-efforts in a wrong way, by having an IT-centric focus. "The companies that derive value from AI view it as a core pillar of their business strategy and tightly integrate their AI strategy into their overall business strategy. Tying AI with business strategy ensures that AI initiatives get the right focus across the organization." [27] BearingPoint highlights the necessity to have a holistic business picture when adopting a new technology, AI included. "It is easy to generate high volumes of data and implement the newest technology. But without the business in mind and a structured and holistic approach, you will never reap the full value of your investments." [63] Steven Nooijen for GoDataDriven highlights that the AI maturity journey features two axes, analytical capability, and business adoption. "Maturing your organization's AI capabilities requires work from two sides. The analytical capability is best enhanced from the bottom-up, while the business adoption aspect needs to be improved top-down. Education and the designation of people to bridge that gap are the key to success." [54] Davenport and Ronanki's four step framework can be evaluated as a maturity model in trying to help a company to see where they are [84]. Basing their model and framework on understanding the technologies, creating a portfolio of projects, launching pilots, and scaling up, they provide a tool to evaluate if

a business can have a cognitive nature. (Keding) states that organizational culture and the process of how AI is applied are decisive for organizational success [42]. AI-capabilities are not based on expert knowledge, but built up from large training data sets [26]. While evaluating the concept of AI and its application areas, (Aquaro and Susar) mentions that increased data collection and usage are magnifying the learning process of computers and improving the quality of AI systems which are heavily data-dependent. A key understanding is as such that an important requisite for utilizing AI are the access to data and the available amount [83].

”An organisation needs to understand AI before it can successfully harness its potential and as such, an organization should establish an understanding of its AI readiness and capabilities before embarking on its AI journey. Common reasons cited for wasted time and effort on AI initiatives are poorly chosen pilot projects, incorrect assumptions regarding how ready the data and teams were to deploy AI-based systems, and how ready the technology was to deliver results. These failures may lead to the potential loss of confidence in AI from the organisation’s leadership and other key internal stakeholders, leaving the programme dead in the water.” [52] In a meta study, Van Looy, Poels, and Snoeck’ have evaluated existing BPMMs (business process maturity models) towards developed criteria. Their discoveries reads as follows: ”For instance, a well-designed BPMM incorporates a number of assessment items, techniques for data collection, activities for improving capability areas, etc. ... A next logical step in the BPMM evolution might be to simultaneaously examine particular and all business processes in an organization.” [91] In order to be able to leverage the use of AI and ultimately succeed with it, any future use require certain measures and infrastructure to be in place. Keding argues the leveraging the use of AI systems in strategic management places requirements on both the appropriate organizational infrastructure and the working methods of management teams [42]. From a value perspective, measures need to be in place. (Keller et al.) discusses a framework for business value generation: Three assets: data, algorithms, and computing, are the starting point for value creation. The five basic capabilities design, procure data, train, deploy, and optimization use the three assets [26]. From a more political perspective regarding national use of AI, The Norwegian government states that: To succeed with AI in Norway, the use must build on ethical principals, respect for privacy issues and digital safety. [60] When discussing how to bring AI into an organization, (Makarius et al.) argues that to successfully bring and integrate AI into the organization, it is important to consider its social aspects [28].

3.3 AI success factors

”For AI to work well, companies need to integrate it into their fabric and into the individual processes that power the core of the business” [27]. As with other technologies or research fields, different researchers can define different success factors aiming to solve problems of a different nature, or entirely have different perceptions of what constitutes a success factor. The Norwegian government lists new services as a success factor. There are many benefits related to the use of AI for the consumers, for example through the development of new services simplifying everyday life [60]. (Makarius et al.) states that AI technologies are associated with a plethora of benefits that range from greater efficiency, faster and more accurate results, and reduced error rate at the process level, to more effective and improved strategic outcomes at the organization level [28]. Accenture explains how AI can be defined in many different ways, but directs the focus towards what AI enables. Their interpretation highlights the following factors: Empowered employees, end-to-end efficiency, improved accuracy and decision-making, intelligent offerings, and superior customer service. [3]

On the topic of treating AI as a major business tranformation effort,(Khodabandeh et al.) explains how ”AI doesn’t thrive in a vacuum. Companies that generate value from AI treat it as a major business transformation initiative that requires different parts of the company to come together and work as one.” [27] (Hunter et al.) discusses how to leverage AI successfully, and what one must take into consideration in order to do it correctly. There are a number of factors to consider. ”Successfully leveraging AI, however, requires more than data and algorithms. A skilled workforce, guided by ethical policies and standards, is necessary to under- stand the “ins and outs” of the data, the algorithms, and the problems to which AI is being applied.” [24] ”Unlike prior technology, AI will have the capability to collaborate, learn from, and adapt to employee interactions. Thus, to successfully bring and integrate AI into the organization, it is important to consider its social aspects.” [28] Keding denotes the importance of large amounts datasets for strategic decision-making, and how the conversion of unstructured data into machine-readable data is crucial for organizational success [42]. Targeting a more adoption-directed focus, a perceived understanding refers to companies planning to introduce AI in their operations, and that they should do so in an incremental way, as opposed to a transformative approach. The focus should be on augmenting rather than replacement. Thinking of AI as a means to help the human resources rather than replacing them. (Davenport Ronanki) provides a four-step framework for helping companies integrate AI-technologies in order to reach their objectives where an objective is classified as business-process enhancement or a moon shoot. A business-process enhancement can be thought of as the enhancement of current measures and ”less-ambitious” processes, while ”moon shots” can be seen as highly ambitious projects and jobs. A proposed success factor states that one should not start with moon shots, instead focus on not so ambitious projects. [84] Success factors can also emphasis using the right tool for the right problem. ”In addition, while machine learning can bring highly valuable benefits to all sectors, some technologies are particularly suited for business application in specific sectors, such as robotics for retail and manufacturing, computer vision for health care, and natural language processing and generation for education.” [51] Cognizant and Kwon outlines five standout steps when reflecting on the business impact of AI and how to deliver real business benefits using the technology. An AI-project must as such involve five essential steps: Identify the source of value, data modeling, classification modeling, impact delivery, and industrialization of AI project. The common denominator throughout the steps are the presence of qualified individuals, and the processing of and access to data. [8] There are no shortage of success factors, but they won’t appear by themselves. A wholehearted effort and focus must be dedicated to promote successful and healthy utilization.

3.4 The challenges of AI

With the introduction of new technologies, challenges are expected to follow. ”AI promises benefits, but also poses urgent challenges that cut across firms, developers, government, and workers.” McKinsey Global Institute emphasizes some expected challenges [51]: The workforce needs to be reskilled to exploit AI rather than compete with it, cities and countries serious about establishing themselves as a global hub for AI development will need to join the global competition to attract AI talent and investment, and progress will need to be made on the ethical, legal and regulatory challenges that could otherwise hold back AI. This is supported and recognized by (Aquaro and Susar): challenges are to be expected. It brings along challenges such as its impact on the workforce, the ethical implications of some of its applications, and the need for capacity-building which would essentially overhaul the kind of education required for the next generation [83]. The nature of a perceived challenge can vary, with different companies likely to be affected by a number of similar limitations, yet their current state and infrastructure can affect how ”receiving” they are to expected changes. In trying to nail down common and general perceived challenges

related to introducing AI, the basis have been made in respect to the mentioned AI-technologies in the chapter. The challenges results from identified factors which have come across as being a source for a stalemate or derailing of AI initiatives. These are listed below in order from most experienced obstacles to least [84]:

- Difficult to integrate cognitive projects with existing infrastructure
- The different technologies and associated expertise are too expensive
- Management have a lacking understanding of cognitive technologies and their application areas
- A shortage of available expertise and resources related to the technology
- Immature technologies
- Overselling of the technologies in the marketplace

The Norwegian government champions responsible and reliable AI, wanting Norway to stay ahead in the development and use of AI in relation to the rights and freedom of individuals. However, the development and use of AI can offer challenges. Especially concerning AI building on personal information. In order to promote responsible and reliable AI, challenges related to the quality of data, autonomy, big data and data minimization, and lack of transparency must be accounted for. [60] Clear direction is essential when leveraging data, or the final product can end up useless: ”One key reason is that organizations are often not ready, or are reluctant, to adopt the behaviors required to leverage data-driven insight” [63]. With big data needing to be addressed in light of AI, (Mikalef et al.) mentions how findings from research and practice regarding investment enthusiasm in big data where results varies significantly in terms of success. Their research highlights that the challenge for most companies in realizing performance gains from their big data investments is not related to technology. The biggest impediments are of an organizational nature and include leveraging big data analytics to support and shape strategy. [29] In exploring if and how Artificial Intelligence can contribute to marketing strategy formulation, (Eriksson et al.) addresses the potential of the AI toolset. ”The potential [of AI] is enormous, the problem is that companies do not realize [it] because those in power are a little old, in my opinion it is also that, or the new generations do not really want to change, they are out of time.” As such digital culture readiness is an identified challenge as a fully adoption require business culture change. [22] Naturally readiness or willingness is not the only decisive factors, when defining challenges related to AI and its potential, (Alsheibani et al.) talks about AI for strategic management, and a business leaders role in meeting AI implementation. Two of the critical challenges is the lack of direction from leaders. Second, what business leaders need to determine is how to place their organizations in the stages of AI technology as a way to increase the degree of AI value. [21]. Challenges affect both experienced and inexperienced companies, and while several challenges can be seen as to be present in different contexts, some are more context-dependent.

3.5 The value of AI

Value can mean many different things. The value of AI can emphasize the changes the technologies brings along, it can emphasize new possibilities, or something else. Changes or small alterations, value can be defined differently for different contexts and actors, but are there some recurring factors? ”While some companies look to AI for its cost-cutting and productivity benefits, most executives believe the highest future value from AI will be on the revenue and growth

side. The survey revealed that the organizations most effective at obtaining value from AI are twice as likely to focus on revenue rather than cost savings alone." [27] (Keller et al.) concludes their research with understanding the business value of artificial intelligence can help to overcome skepticism and help to align its strategic use with the company's goals and use them more efficiently [26]. When discussing how AI can transform the business of energy, John Markus Lervik, Cognite co-founder and chief executive, lists a three-step process to make the oil and gas sector more effective through digitalisation [65]: The first step involves enabling people to make better decisions by giving them the information they need. The second step is optimising the decision-making process using AI, followed by the third and final step: the creation of an autonomous industry. When addressing digitalisation in light of an autonomous industry, AI and using data science to optimise more complex systems makes this possible.

AI is expected to improve productivity by automating routine tasks and allowing employees to focus on work that adds more value to the organization [28]. From the insights gathered through qualitative research, (Eriksson et al.) dictates how the importance of AI addresses the perceived relevance of AI in the organization, as an element that adds value to the entire system [22]. When addressing AI in the context of the evolution of radar and electronic warfare (EW), (Hunter et al) measures value in light of the transformation of the workload between humans and machines. The value added is where AI and people are not competitors; where humans are freed up to execute more highly dimensional tasks [24]. When approaching how AI matter, Accenture explains: "AI has long been regarded as a potential source of business innovation. With the enablers now in place, organizations are starting to see how AI can multiply value for them. Automation cuts costs and brings new levels of consistency, speed and scalability to business processes." [3] "AI holds the promise to be a catalyst in accelerating development and allowing developing countries to leapfrog over some traditional obstacles" [83]. (Alsheibani et al.) observe from different description cases that AI enables advantages such as accelerating conversions in order to increase revenue, improve asset utilization, and provide real-time insights in terms of business goals [21]. Arguments can be made that a disruption can be both positive and negative, but in employing AI, changes are to be expected. "AI-backed technology is a strong driver for business disruption" [63]. Understandably there are a number of different ways to measure and categorize the value of AI, resulting from practises with different interpretations, focus areas and backgrounds.

3.6 Specialization project

In the fall of 2020, a research project of a similar nature was conducted in accordance with NTNU and the study program of Computer Science. The research conducted during a six-month period uncovered valuable lessons learned for any potential continuation of the work. As well as providing important information regarding AI-projects and how different companies approach their AI efforts across different industries, the research also uncovered a more realistic frame and suitable expectations when conducting a qualitative study with companies in the private sector. Valuable lessons was learned when approaching a research project dependent on external collaboration. Especially concerning the execution of a case study and realistic expectations in terms of what could eventually be derived following interviews and academic conversations with external companies, ultimately proved useful. The project thesis named "The Value of AI-technologies" touched upon similar themes as the current research endeavor, but in the end, the project description of the project thesis involved attempting to determine how AI creates value along the value chain, and model real outcomes associated with AI-development projects by experiencing how AI-based solutions are evaluated and applied in a variety of industry sectors. This was achieved by focusing the work on collaborating with different partners and emphasizing four different in-

dustry segments, namely the oil and gas industry, the energy industry, the telecommunications industry, and the financial and banking industry. By examining, comparing, and determining success factors, challenges, and consequent values derived from artificial intelligence, the research revealed that despite challenges and misfires, AI development projects are highly evaluated in the industry. ”AI has both improved on existing services through streamlining and updating, and enabled completely new ones: what previously wasn’t possible, now is” [32].

As aforementioned, four independent companies, Cognite AS, DNB, Telenor Group, and TrønderEnergi, were approached and all contributed to the research of the project thesis. Challenges resulting from AI development projects, along with improving effects which AI can have on existing operations or how it can help to form completely new ones, were thoroughly investigated. The culmination of the research also emphasized future prospects, possible directions to continue the research. The potential of a new research effort and priorities focusing on the comparison of different industry segments and actors in relation to AI can have big application areas and subsequently prove to be valuable. Therefore a number of the future prospects presented in the conclusion of the project thesis, such as (1) enter into new partnerships and include more companies, (2) Have a more practical and technical emphasis, and (3) limit and narrow down the project specification and emphasize a specific approach rather than a general one, now have the opportunity to be followed or expanded upon going forward. [32]

4 Project Context

To better exemplify the context and importance of the research goal, external and appropriate sources will here be included. The *Project Context* chapter highlights the current relevance of the project.

4.1 Purpose

”Today, AI has impact on almost all aspects of our society. Data-driven AI, where systems learn and gradually improve by analyzing large amounts of data, has led to dramatic improvements in, for example, language processing and image analysis, while enabling completely new products for personalization, decision support and automation.” [56] The project scope has been formed by a number of ideas and realistic delimitations. These have been important choices, either working as limiting factors in terms of the project scope or ultimately setting the research on the right track. The project scope has been formed by the purpose of the research, a narrowed-down scope influenced by which type of AI has been under scrutiny, and ultimately which companies have been included.

The common denominator for interviewing some businesses while leaving others out can be summed up as a requirement to include and approach larger, ambitious, and technology-driven companies that already have introduced and applied AI in their operations. Their ambitions, resources, and talent along with their journey to become more mature with adopting and utilizing AI-technologies, have made for desired collaborations. To produce a realistic and new learning experience with general application areas targeting a wide range of industries, the project scope has been limited by focusing on specific ”types” of data-driven AI. AI is an expansive field so emphasizing each ”division” or sub-field would neither be productive nor possible and are beyond the scope of this thesis. Both through the continuous contact with external partners, and from the aforementioned specialization project, one lesson learned has been the need to ”avoid biting off more than you can chew.” This can be seen through focusing on experiences and applications rooted in the private industry and limiting the focus to a fixed number of industry segments.

Realistic goals supersede ambitions. For this project, the intention has always been to compare and categorize organizations and actors across domains and industries, even if over time the research goals have seen some alterations or deviations. Deviations meaning departing from the initial course while still maintaining the standard set. The standard has emphasized a research effort that contributes to and constitutes a part of a learning experience that affirms the utilization of artificial intelligence in a way that can be adopted and later implemented targeting independent organizations and companies. The end result of the research endeavor will in this instance move towards an applicable AI framework, along with the insights and knowledge latter represented in the results and discussion chapters. Working within the set project scope, learning from experienced companies, and emphasizing a heavy-handed literature review all contribute to producing a new learning experience. The ambition of the research project concerned a real opportunity to contribute to the field of AI through an organizational and business-oriented approach.

4.2 Scientific references

As with any literature review, study- or even research paper, external sources can be used to increase the validity of the given research effort. Emphasizing the project context, scientific references in service of the project are represented through two main actors. As both an academic and business-related matter, external and related sources can validate the legitimacy of the research objective.

4.2.1 NorwAI

The Norwegian Research Center for AI Innovation (NorwAI) is a new research center on AI and Big Data. The goal of the center is to develop cutting-edge theories, methods and technology for efficient, effective and responsible exploitation of data-driven AI in innovative industrial solutions. With central notions of trustworthiness and sustainability, the main goal of the new center is described as being "To accelerate the innovation of sustainable and trustworthy artificial intelligence solutions across Norwegian industries." Trustworthy AI requires technology improvements like explainability and transparency, as well as a better understanding of societal and regulatory effects and needs of AI. While striving to achieve its main research and innovation goals, the center aims at aligning and evaluating its activities with respect to UN's sustainability goals. [56]

With a strong focus on applied research and innovation, the center relies both on internal and external resources. "NorwAI consists of strong research and innovation partners. The center includes the strongest academic communities in AI and data science in Norway and some of the most ambitious industrial drivers in Norway. Our goal is to enable NorwAI to transform Norwegian industry at large, in areas that are important to Norway, such as shipping, clean energy, and interaction with a technology-willing population." [56] NorwAI has a composition of different industrial partners and as a product in the context of NorwAI, this thesis has had the benefit of having first access to some of these innovation partners for the research going forward. Either talking about master theses, PhD theses, or other research and innovation contributions, the partners have recognized the value and potential of investing in AI. The official partners of the center are Cognite, DigitalNorway, DNB, DNV, Kongsberg Digital, NRK, Retriever Norway, Schibsted, SINTEF, SpareBank1 SMN, Telenor, and TrønderEnergi.

"Close collaboration between prominent research communities, industry partners and public administrative bodies has proven to be an effective model for innovation" [70]. "This center is important for NTNU strategically speaking. It connects our research environments with relevant business segments. It means that we can conduct research which can be developed further and transferred to the business world, at the same time as it constitutes a huge education component." [44]

4.2.2 DigitalNorway

DigitalNorway, an initiative founded on the notion to accelerate the digitization of Norwegian business and industry, recognizes the need and potential of connecting relevant research activities, industry projects, and businesses. The investment in AI and subsequent value creation should benefit the broad layer of the industry. When talking about competence demanding value creation with AI, the manager of DigitalNorway Liv Dingsør summarizes the effort spearheaded by the research center as "a good arena for realizing synergies between our strategic focus areas, and for innovation across research and industry." Research and investment efforts will contribute to a powerful ecosystem for increased availability of data, and use of AI. [15]

5 Methodology

The *Methodology* chapter examines different research methodologies used for the thesis. Conducting a thorough and comprehensive case study requires the inclusion of one or more applicable methodologies. As the work is characterized by cooperating with external partners, the extent of their role and contribution will be expanded upon here.

5.1 Qualitative research method

The project specifications call for a qualitative research method. Qualitative research involves collecting and analyzing non-numerical data (e.g. text, video, or audio) [10]. With qualitative research, interviews of different forms take center stage. In attempting to extract data, interviews are the most widely used method for data generation in qualitative research. *In-depth interviews*, also know as *semi-structured interviews* are emphasized with this case study, but awareness remains to address the need for potential follow-up interviews or *focused interviews*. Focused interviews denote a shorter form of in-depth interviews, usually with fewer prioritized focus areas. Focused interviews become more relevant as the overall theme becomes more narrowed. [90] Different encounters call for different approaches, but with each partner, the focus will be on single encounters and attempting to remain faithful to the general interview template. As summarized by (Holmsen, 2020) [32]: A qualitative research method builds on a person's life experiences, perceptions, and stories. This can be explored through interviews, observations, or surveys. [6] The primary objective will be to collect and analyze non-numerical data to understand concepts, opinions, or experiences. Qualitative research can be used to gather in-depth insights into a problem or generate new ideas for research. [9]

5.1.1 In-depth interviews

In-depth interviews take center stage of the qualitative research and make up the main component of the case study. Based on the project goal, the primary objective is to lay a foundation and to facilitate for a relatively free conversation circling specific predetermined themes. As the preferred method for the partner collaborations, each involvement in the form of an in-depth interview has the goal of aiding the interviewee in reflecting over subjective experiences and opinions related to the current theme of the research topic. Hence, the in-depth interview is by no means a survey consisting of *closed questions* with fixed alternatives, but instead *open questions* which encourages the interviewee to elaborate and be more thorough. [90] "An in-depth interview is a loosely structured interview. It allows freedom for both the interviewer and the interviewee to explore additional points and change direction, if necessary. The interview is conducted using a discussion guide which facilitates the flushing out of the respondent's views through open-ended questioning." [41]

As explained by Axel Tjora: "As a main rule we can say that one uses in-depth interviews where one wants to study opinions, attitudes and experiences." The in-depth interview is a method based on a phenomenological perspective, where the researcher wishes to understand the informant's experiences as well as how the informant reflects over them (Spradley 1979). "We can in studies of organizational changes for example be preoccupied with which changes the different employees have been affected by, how they have experienced certain changes, what they eventually did in

order to handle challenges which appeared, how this handling eventually have dampened any negative experiences, about if experiences are related to special conditions for one's position or work, about if it's related to the work itself or other conditions at the workplace, and such." [90] Along with developing an interview template or guide, focusing on gathering as much relevant data as possible in service of the research goal, facilitating for a relaxed and welcoming environment is key. Digressions are a welcomed occurrence.

5.1.2 Focused interviews

Unexpected or unexplored themes or areas of interest can occur during an in-depth interview, with new or different information that is difficult to prepare for in advance. Either introducing completely new focus areas or uncovering a bigger potential for already chosen themes, focused interviews continue the research with a more narrowed scope extending a given in-depth interview. [90] As such, any potential follow-up interviews will be conducted as focused interviews, if deemed necessary.

5.2 Quantitative research method

For purposes regarding the collection of distinct and valuable insights, an investigation of industry differences, relationships, priorities, and otherwise useful information related to the partners involved, has been completed. Quantitative research is the process of collecting and analyzing numerical data. It can be used to find patterns and averages, make predictions, test causal relationships, and generalize results to wider populations. Hence quantitative research is the opposite of qualitative research. [10] Quantitative research, in contrast to qualitative research, deals with data that are numerical or that can be converted into numbers. The basic methods used to investigate numerical data are called 'statistics'. Statistical techniques are concerned with the organization, analysis, interpretation, and presentation of numerical data. [75]

In this instance, a quantitative research method will be taken advantage of through a questionnaire or a small survey. On how to use a survey, Pritha Bhandari explains: "Ask questions of a group of people in-person, over-the-phone or online" [10]. Similarly, a survey containing a small number of questions will be sent over subsequently to each of the representatives of the partners which have collaborated through interviews.

5.3 Literature review

A literature review discusses published information in a particular subject area, and sometimes information in a particular subject area within a certain time period. A literature review can be just a simple summary of the sources, but it usually has an organizational pattern and combines both summary and synthesis. For professionals, they are useful reports that keep them up to date with what is current in the field. For scholars, the depth and breadth of the literature review emphasize the credibility of the writer in his or her field. Literature reviews also provide a solid background for a research paper's investigation. Comprehensive knowledge of the literature of the field is essential to most research papers. [58] Shona McCombes on how to write a literature review: "A literature review is a survey of scholarly sources on a specific topic. It provides an overview of current knowledge, allowing you to identify relevant theories, methods, and gaps in the existing research. Writing a literature review involves finding relevant publications (such as books and journal articles), critically analyzing them, and explaining what you found. There are five key

steps: (1) Search for relevant literature, (2) Evaluate sources, (3) Identify themes, debates, and gaps, (4) Outline the structure, and (5) Write your literature review." [50]

The University of Southern California goes further as to list a number of reasons for a literature review. Among these are [59]:

- Place each work in the context of its contribution to understanding the research problem being studied.
- Reveal any gaps that exist in the literature.
- Identify areas of prior scholarship to prevent duplication of effort.
- Point the way in fulfilling a need for additional research.
- Locate your own research within the context of existing literature [very important].

The purpose of using a literature review and study for the thesis is to obtain a better understanding and overview of both the themes at display, the relevant literature, and previously conducted research endeavors. The advantage of conducting a literature study early on can be seen as carrying out thorough preparations for the process ahead. Both in terms of reviewing relevant literature or targeting the planning of the preferred methodologies, particularly the planning and execution of the interviews, a literature study is preferred. Another benefit of the literature review, especially under conditions out of the ordinary, is that the method does not demand contact, interaction with, or "access" to other individuals. The review and research of available information and literature require no more than time and interest. Literature reviews are designed to provide an overview of sources you have explored while researching a particular topic and to demonstrate to your readers how your research fits within a larger field of study [59].

5.4 The partners

Eight unique partners have all contributed to the research. A "partner" will in this context denote external and independent organizations and companies which have agreed to contribute and collaborate on the work. As real-life experiences, actual applications, use-cases, and expertise have been instrumental as a basis for the research, and for achieving the desired end result, external sources and outreach advisory were needed as part of the analysis. An introduction of each partner will be provided in the following section. For each partner, it has been interesting to look at the company as a whole, and their relationship and maturity with AI.

The official partners of the thesis are:

1. **Cognite AS**
2. **DNB ASA**
3. **DNV**
4. **IBM**
5. **Schibsted**
6. **SINTEF**
7. **SpareBank 1 SMN**

8. **Telenor Group**

Elaborating on why each of the partners has been included in the research: Each partner has an explicit strategy on how to become a data-driven and AI-driven organization. They invest actively in building competence and capabilities towards AI internally. While some partners are recognized as global and renowned actors in the world of AI, others show their commitment and investment by among other things asserting their role in new endeavors. A majority of the partners have all justified their willingness from their involvement and contribution to The Norwegian Research Center for AI Innovation (NorwAI).

5.4.1 Cognite AS

Cognite is a Norwegian industrial software company founded in late 2016, which enables companies in the oil and gas industry and other capital-intensive sectors to improve their operations through efficient data collection and sharing. [7] The company is a global industrial AI Software-as-a-Service company enabling full-scale digital transformation of the given industries. With a core software product, the Cognite Data Fusion, the objective is to power companies with contextualized OT/IT data to develop and scale solutions that increase safety, sustainability, efficiency, and drive revenue. Originally a subsidiary of Aker solutions, the company have over the last four years grown rapidly as a result of a continued success. As a result of the business operations of Cognite, their work can be classified as both in-house development and more consulting targeted work. They are operating as consultants developing solutions for the different areas of Aker solutions among others, but at the same time doing in-house development being a subsidiary and collaborator.

Cognite is unique in the sense that the company have been built up with AI in mind. AI has always been a part of the agenda, making Cognite an experienced and unique contribution. Because of the expertise at display and history with relevant AI development projects and attractive portfolio, Cognite brings a lot of relevant experience to the table. The inclusion of Cognite as a partner has also posed a need to approach the interview process differently. Because of the day-to-day operations and the company's relationship with AI, the focus for the planned interview process has been slightly altered. Now with the emphasis being twofold, the interview will focus both on the use and application areas for Cognite's clients and customers, as well as the use within the organization itself.

5.4.2 DNB ASA

DNB ASA is today the biggest financial group in Norway, with the Norwegian state being the largest shareholder. Targeting the financial and banking industry, DNB's strategy targets the transformation of the group in the face of new technology, macroeconomic changes, regulations and policy conditions, changes in customer behavior, and competition. As the industry is changing, the company works to prove themselves adaptable. DNB is divided into the following business areas: Personmarked, Corporate Banking, Payment and Innovations, Markets, Wealth Management. In addition, there are the support units: Technology and Services, Konsernfinans, Risikostyring, Compliance, People and Communications. DNB is also represented internationally. [16]

For DNB, the focus ahead is about conserving and increasing existing revenue streams, as well as finding new ones. The overall goal is to create the best kind of customer experiences, and deliver on financial goals. [16] Achieving lesser goals in service of this focus, AI can prove to be an applicable tool. DNB have various AI-related development projects targeting the financial

and banking industry and have become a more data-driven company over the last couple of years. Their focus on applying AI in various areas have resulted in several relevant discussion topics.

5.4.3 DNV

DNV (formerly DNV GL) is an international accredited registrar and classification society headquartered in Høvik, Norway. The company currently has about 12,000 employees and 350 offices operating in more than 100 countries, and provides services for several industries including maritime, oil gas, renewable energy, electrification, food beverage, and healthcare. DNV was created in 2013 as a result of a merger between two leading organizations in the field — Det Norske Veritas (Norway) and Germanischer Lloyd (Germany). [98] DNV is the world's leading classification society and a recognized advisor for the maritime industry delivering world-renowned testing, certification, and technical advisory services to the energy value chain including renewables, oil and gas, and energy management. The company is also a world-leading provider of digital solutions for managing risk and improving safety and asset performance for ships, pipelines, processing plants, offshore structures, electric grids, smart cities, and more. Their open industry assurance platform Veracity, cybersecurity, and software solutions support business-critical activities across many industries, including maritime, energy, and healthcare. [17]

Every year, DNV invests heavily in research and development, amounting to 5% of its total revenue. Since 1864, DNV has always maintained a department dedicated to research that enhances and develops services, rules and standards for various industries. Many of the innovations and findings by DNV have often been used as a basis for international standards. As of 2021, the main research programs include maritime, power renewables, oil gas, precision medicine, digital assurance, ocean space, artificial intelligence, and energy transition. [98] The research focus on AI in the maritime sector along with the organization's role in the NorwAI research center have made DNV being a particularly interesting partner to include in the thesis.

5.4.4 IBM

A multinational technology company with operations in over 170 countries, IBM or International Business Machines Corporation are one of the world's largest employers. IBM produces and sells computer hardware, middleware and software, and provides hosting and consulting services in areas ranging from mainframe computers to nanotechnology, as well as being a major research organization. [96] IBM is a company that tries to eradicate all the problems with technology that a company or big business can face. Once upon a time, IBM used to manufacture PC and PC parts. However, they have sold that part of their business. Now, IBM has turned its eyes on offering software and storage based services to various organizations all around the world. At the moment, IBM is primarily offering network services, application services, cloud services, digital workplace services, business processes and operations, technology consulting services, and even AI services. [89] "Our scientists are pioneering the future of artificial intelligence, creating breakthroughs like quantum computing that will allow us to process information in entirely new ways, defining how blockchain will reshape the enterprise, and so much more. We are driven to discover." [33]

IBM was the largest owner of active machine learning and artificial intelligence (AI) patent families worldwide with 5,570 families owned as of July 2019. In 2018, the company had claimed the leading position from Microsoft now ranked second with 5,330 active families owned. [13] IBM's Watson represents a portfolio of business-ready tools, applications, and solutions, designed to reduce the costs and hurdles of AI adoption while optimizing outcomes and responsible use of

AI. A means to help organizations with prediction, automation, and the optimization of employees' time. Targeting "business in general", the portfolio is designed to better predict, recommend, and create more value from AI-models. [39] [40] The unique relevance of IBM's portfolio, experience, and maturity with AI, represented through their local CTO, have presented an important contribution and addition to the research.

5.4.5 Schibsted

Schibsted is an international family of digital consumer brands with more than 5 000 employees. As a company, Schibsted have world-class media houses in Scandinavia, leading marketplaces, and digital services that empower consumers. Millions of people interact with Schibsted companies every day. With a mission of "Empowering people in their daily lives", Schibsted contributes to a more sustainable society by empowering people. Wanting to understand their future needs means that it is necessary to know what kind of tools and services people really want and need to make their life easier. "We express these ambitions in our mission and our vision. This guides everything we do from our RD, to new business ventures, recruitment policy and running our everyday business." News media and Nordic marketplaces are part of the family, and consist of media houses such as VG, Aftenposten, Bergens Tidende, Aftonbladet, and Svenska Dagbladet, and digital marketplaces such as Finn.no and Blocket.se. "We're on an ambitious mission to provide leading online marketplaces, build world-class media houses, and help great companies scale." [71]

"At Schibsted we work with various aspects of machine learning, which is a subset to the wider term AI. We have machine learning services in internal processes as well as user-facing products and applications across our ecosystem." Among these are a few examples: ad category suggestions and content moderation with computer vision, distribution route optimization with AI, and print prediction with ML. [81]

5.4.6 SINTEF

SINTEF is a broad, multidisciplinary research organisation with international top-level expertise in the fields of technology, the natural sciences, medicine and the social sciences. They conduct contract RD as a partner for the private and public sectors, and are one of the largest contract research institutions in Europe. "Our vision is Technology for a better society." [76]

SINTEF was established in 1950 by the former Norwegian Institute of Technology, which today is a part of NTNU. As a result of its own growth and mergers with other institutes, SINTEF has developed into one of Europe's largest independent research organizations. SINTEF is an independent, not-for-profit organization organized as an enterprise group consisting of seven research institutes. SINTEF has a partnership with the Norwegian University of Science and Technology (NTNU) in Trondheim. The collaboration between SINTEF and NTNU is a key component of the Norwegian research system, which has produced high levels of innovation for the benefit of the Norwegian industry and communities. NTNU personnel work on SINTEF projects, and SINTEF employees have teaching assignments at NTNU. The partnership also includes almost 30 long-term research centers and the sharing of about 200 laboratories. [76] SINTEF's situation provides a different perspective as the following research contribution will focus more on the development of AI-solutions for external clients, rather than on the use of the technologies in-house. SINTEF consists of several different institutes and a large number of subject areas, but for this thesis, their institute SINTEF Digital was the point of interest as a result of their multi-disciplinary knowledge base, which is used across all industries and helps their customers exploit and meet the opportu-

nities created by digitalization and digital transformation [77]. ”In AI@SINTEF we work with algorithms that interpret sensor data, images, sounds, and text and which shapes our joint future.” [68] As is the case with Cognite, the SINTEF process has been approached differently as a result of their operations being characterized by development rather than the use of AI.

5.4.7 SpareBank 1 SMN

SpareBank 1 SMN is Central Norway’s leading financial group and a part of the SpareBank 1 Alliance. The head office is in Trondheim and the group and its subsidiaries employ close to 1,500 staff. SpareBank 1 SMN aims to contribute to society’s value creation through responsible banking operations that instill public confidence in the bank. As a regional independent bank with a local footing, SpareBank 1 SMN are present in 46 locations across 42 municipalities in Trøndelag, Møre and Romsdal, and Vestland. ”A one-stop provider to households and firms in the fields of financing, savings and investment, insurance and payment services, we have 223,000 retail customers and 15,000 corporate customers.” [79]

”AI and machine learning is no longer just something we talk about. Now we use the technology actively to make ”everyday-economy” even easier for our customers.” The company has already applied AI in the following areas: Fraud and financial crime, the mobile bank, the digital advisor ”Anne”, and check-ups of new customers. [78]

5.4.8 Telenor Group

Telenor Group is an international provider of tele, data and media communication services. The company has a leading Nordic position in mobile, broadband and TV services, as well as substantial activities in subsidiaries and joint venture operations, including mobile financial services and online classifieds in the Asia region. Worldwide, Telenor Group and its operations’ teams are 18,000 people strong. With a purpose of connecting customers, in safe, reliable and efficient ways is the number one priority requiring a dedicated focus on modernisation as a pre-requisite to creating efficiencies and enabling growth. Their strategy towards 2020 is driven by the ambition to transform the customer experience. [85]

Telenor intends to become a data-driven company, where AI/ML capabilities will be an asset, and ultimately, create a competitive advantage. AI could be used for optimizing network operations, automating customer interactions, personalizing marketing and sales campaigns. ”This is a change of focus that our company must embrace, which also requires a fundamentally new approach to Data Management. Our ambition is to strengthen AI and advanced data analysis both in core business and by taking new positions, such as within IoT where there are considerable growth opportunities and the global giants are not dominant.” [86] In order to unlock the transformational potential of technologies, where 5G, IoT and AI comes together to accelerate digitalisation, no single company is an island: partnerships are crucial for innovation [85]. Telenor are actively pursuing the realization of AI targeting the telecommunications industry. Their journey from a company not built up with AI in mind to one which invests heavily in the field makes Telenor an interesting inclusion.

5.5 Including independent companies as partners

With a research project attempting to develop an end-product with actual application areas intended for exploitation in the Norwegian industry, partnerships and collaborations are necessary

with the overall goal of learning from experienced and industry-leading companies within the given industry. Learning from and analyzing industrial use and innovation appeared in this context in the form of in-depth discussions with each company. The continuous contact with each partner would consist of meetings and in-depth discussions contributing to an overall more comprehensive analysis. As was stated in the original project description: "In-depth discussions with companies may be needed as part of this analysis." As it turned out, it would be required.

Both more experienced and less experienced companies constitute the different partners. A variation in experience in the sense that each respective company has a variation in terms of the current portfolio with AI-driven solutions, both in general and represented through more specific AI-technologies. A secondary aspect was the importance of including companies with differences regarding organizational structure and operations. Hence companies have been included where their use of AI-solutions targets their own organization or specific department as a whole, while other inclusions concern the development of AI-solutions and how they are applied represented through their clients. The first case is concerned with use in its own operations while the latter focuses on use and deployment out at relevant clients of the partner. With many of the partners being international companies and global actors, it follows that their staff is often represented by multilingual backgrounds. This in turn required different approaches when collaborating with each partner. Finally, the selection of partners also represented several different industry segments. All of these aforementioned variations and distinctions in companies and resources had some implications for the scheduled interviews. While going for a general interview template and setup, each interview needed to be approached differently as a result of the parent company and role. The context also affected the interview content as some of the content, if not deemed useful or applicable, was cut where it didn't make sense.

All partners are relevant for the project highlighted through their operations and history with AI. Especially through their connection to NorwAI, it was easier to include the independent companies.

5.5.1 Partners included by NTNU

A listing of the partners included by NTNU, is featured below. The majority of companies have been included by recommendation of the supervisor. This final list have been expanded throughout the project period, similarly as the limitations and specifics were narrowed down. This section only lists each partner. For an extended presentation and description of each company, see section *5.4 - The partners* earlier in the methodology chapter. The final list of partners included by NTNU and the supervisor is:

- **Cognite AS**
- **DNB ASA**
- **DNV**
- **Schibsted**
- **SINTEF**
- **SpareBank 1 SMN**
- **Telenor**

This group makes up a significant part of the industrial partners in NorwAI.

5.5.2 Partners included by the researcher

Already in the early stages of the project period, the researcher was given the opportunity to include appropriate partners on their own accord. These potential partners would differ from the inclusions of the university, but still be suitable and relevant for the overall project description. The conclusion of this effort resulted in the inclusion and contribution from an additional company, more specifically:

- **IBM**

Through the previous sales director of IBM Norway (until 01.09.20) working as the initial and key contact at the company, a continuous collaboration was established between the company and the researcher. Including an organization of this stature poses a unique contribution to the thesis. The partnership was made possible through the sales director which put the student in contact with the appropriate contacts at IBM.

5.6 Completion of the qualitative method

A significant effort and time have been dedicated to creating a foundation targeting the completion of the qualitative method and case study. The foundation and culmination of these efforts will in this section be addressed and laid out accordingly. After establishing initial contact with each of the partners, conversations were held trying to determine relevant contacts and find appropriate interviewees. When approaching global companies of a considerable size, a crucial step is to establish contact with the ”right and relevant” representatives, either as direct contacts contributing themselves or arrange for appointments with more suitable employees. One or more appropriate interviewees from each company were approached based on the research goal. This section provides an overview of each partner and company represented through their representatives and relevant contributors, both contacts and actual interviewees. Each representative has been listed under their respective company along with a description including their role, background, and area of responsibility. Their expertise, experience, role, and background have been invaluable for the project.

As part of the preparation for the multiple upcoming interviews, the relevant interview template was sent out in advance to each interviewee. Proved to be effective in the previous specialization project, early access to the template gave each interviewee a better chance to familiarise themselves with interview themes and questions. An understanding of the topics to come ultimately worked as an advantage.

5.6.1 Cognite AS

Extending the partnership with Cognite, **Trygve Karper**, vice president of ML Engineering at Cognite AS, functioned for the second time as the link and business contact for the company. While a physical component originally seemed possible, the continued influence of COVID-19 limited the partnership to digital interactions. **Alexander Gleim** once again contributed to the research as an interviewee and contact, and arranged for additional interviews, namely with **Sindre Stavseng**.

- **Alexander Gleim - Industry Solutions Team Lead**
  Alexander has been with Cognite for three years. He is currently leading the industry solutions team for power and utilities. With a background and Ph.D. in mathematics, he has

worked with AI-related topics ever since graduation, predominantly in a power and utility setting, and has been doing this for almost 10 years. Working closely with data and AI targeting a more high stakes industry, especially in Cognite's contextualization efforts, Alexander has first-hand experience in seeing what significance AI has had for his department and the company as a whole, and how AI plays a role in the ecosystem together with "centuries" of engineering and physics knowledge.

- **Sindre Stavseng - Senior Director of Engineering.**
  As an engineering manager for three development-teams in the CDF-department of Cognite, Sindre is currently working on the development of the CDF-product where the aforementioned teams are responsible for data integration, execution of code, and what they call contextualization, building smart solutions in order to connect data in a meaningful way. He has a background in applied physics and mathematics at NTNU with a big focus on IT and software development in the years after graduation. Having previously worked as an engineer and tech lead, and with a background from Apple, Sindre is now the current engineering manager of the contextualization team at Cognite.

5.6.2 DNB ASA

Karl Aksel Festø worked once again as the link when establishing the first contact with DNB. However, this time Karl Aksel himself contributed to the partnership in terms of an interview. After an initial meeting discussing the progress and thesis goals, an in-depth interview followed.

- **Karl Aksel Festø - Head of CoE Advanced Analytics**
  Karl Aksel has worked at DNB since 2005, currently in the role of head of advanced analytics in corporate finance under Chief Data Officer. His background stems from social economics, skilled in modeling, econometric, and statistics, and he has previously worked as an analyst in DNB for many years. DNB invests heavily in digitization, and Karl Aksel is under the impression, in a broadly defined context, that AI is becoming increasingly important for DNB as well as already being important in the current operations.

5.6.3 DNV

When first approaching DNV, **Asun Lera St. Clair** became the official contact. As Program Director, Digital Assurance - Group Technology and Research at DNV, Asun understood the thesis specifics early on and facilitated for the collaboration by putting the researcher in contact with two relevant colleagues, **Elizabeth Traiger** and **Kristian Ramsrud**. Kristian later arranged for the final interview with **Henrik Smith-Meyer**.

- **Elizabeth Traiger - Senior Researcher in Digital Assurance**
  Having joined DNV back in 2013, Elizabeth is currently a senior researcher in digital assurance and is part of a core that looks into the assurance, verification, validation, and assessing the trustworthiness of data-driven algorithms, products, and assets. As a lifelong learner, Elizabeth has a Ph.D. in statistics and has previously worked on AI and ML algorithms within the renewable industry space as well as having worked in the business area of renewables as a data analyst consultant who has done data-driven products and works for DNV and its clients. She's also part of the NorwAI group, leading the work package on trust and ethics, and looking into explainable AI.

- **Kristian Ramsrud - ML Team Lead, Maritime Production Systems, Maritime**
  Kristian has worked at DNV for 19 years, currently as the leader of the machine learning team in the maritime part of DNV. With a career where data and advanced analytics

have been the leading focus, his competence and experience emphasize the analysis and realization of data, and what it will involve and require to deploy analytical solutions into production with the intention of supporting decision making. Kristian has an IT-education targeting traditional science and system development, and experiences the meaning and impact of AI first-hand through his role at DNV, both in his department and through the organization as a whole. With a first-hand involvement of what machine learning can offer, he has experienced how AI has in a way opened the digitization door for DNV in many fields.

- **Henrik Smith-Meyer - Principal Specialist, AI and Knowledge Engineer at DNV - Maritime**
  Henrik fueled his AI engagement with pioneers at Stanford 25-30 years ago. He has been part of DNV since 1989 and graduated as an AI engineer from the university of Utah. As an AI professional and consultant, and as part of the maritime department class development, he has utilized AI and knowledge-based techniques to serve a variety of customer needs, research challenges, productification of ideas and emerging opportunities through some decades, as well as proudly contributing to the university classes on intelligent systems through the AI winter. With insights on how to make things work, he is currently engaged to take advantage of ML and Robotics at DNV Maritime. AI has become important for his department as class development is the part of maritime with the responsibility of processes, tools, and the organizing of work in maritime.

5.6.4 IBM

Lars Hovind, former Sales Director at IBM, facilitated for the partnership and established contact with an appropriate colleague during his final months at the company, more specifically **Loek Vredenberg**, technical leader at IBM Norway.

- **Loek Vredenberg - Chief Technical Officer, IBM Norway**
  With 35 years of experience at IBM, Loek Vredenberg is today the CTO of IBM Norway. In terms of AI competence, he possesses both overall and applied expertise related to implementation and pre-sales. While originally an economist by nature, a focus on programming led him to the IT industry. He has a long and extensive career in the IT industry where he has acquired deep technical and leadership experiences on a variety of projects in different industries, and has held many different technical positions from programmer/analyst and deep technical roles to enterprise architecture and technical advisor to CxO level executives with clients. He has seen the increasing influence AI has had on IBM, posing a more and more central role in the different strategies used.

5.6.5 Schibsted

For Schibsted, **Eivind Throndsen** operated as the connection between the company and the researcher, and introduced two of his colleagues for the work ahead, **Ioana Havsfrid** and **Ludvig Smedh**. Eivind himself also contributed to the research through an interview.

- **Eivind Throndsen - Product Manager, Machine Learning team**
  Eivind has been part of Schibsted since 2017, currently as product manager in the department known as ”Data and Technology.” As an ”ex-technologist” he has a significant understanding and relationship with AI from a product perspective: what AI can be expected to do or accomplish, and where it might not. He previously held the position of product manager for a team working with machine learning for over 3 years. AI has been a part

of his journey at Schibsted, having been part of and experienced different AI-efforts and utilization's.

- **Ioana Havsfrid - Departing Engineering Manager at Schibsted Products and Technology**
  As the engineering manager, Ioana has experience in leadership and product development along with a strong technical background. She has a history involving different roles in big corporations as well as small startups, with the overall goal to build high-performing teams. Describing herself as an educator and expert in machine learning, Ioana has actively worked with AI for the last year and a half, working a lot with NLP, better understanding language, and AI tooling, specifically in the context of advertising.

- **Ludvig Smedh - Product manager**
  Ludvig has worked at Schibsted for almost 3 years and leads the team known as data foundations as the product manager. As a civil engineer in information technology with a master in machine learning, he has worked as a machine learning engineer for two years, and is now part of the data and tech organization in the company. He was worked with image classifiers, recommendation algorithms, and prediction models among others things through different products and features at Schibsted, and has experienced the great impact which AI has had on the department and for his work.

5.6.6 SINTEF

- **Anne Marthine Rustad - Research Manager Analytics and Artificial Intelligence at SINTEF Digital**
  Anne Marthine has been at SINTEF for 4 years, in the institute named Digital and more specifically the department known as mathematics and cybernetics, and has substantial experience from the industry. Having worked at DNV, Aker Solutions, and Boston Consulting Group, and as the co-manager of the Norwegian Artificial Intelligence Network for Europe (NAINE), she brings with her valuable experience and insights. From a background involving an M.Sc. in cybernetics, and a Ph.D. in marine cybernetics, she is currently the research manager of the Analytics AI group. Her responsibilities involve working on a more overall strategic level including business and the understanding of cases and issues related to the industrial world and combine it with technical understanding.

5.6.7 SpareBank 1 SMN

- **Kjersti Wold - Leader of Advanced Analytics**
  With an economic and analytical background, Kjersti has worked for six and a half years at SpareBank 1 SMN. She is currently the leader of a department called advanced analytics, organized under "technology and development." The department emphasizes analytics and data science, and Kjersti's competence is about how to manage appropriately qualified people and the notion of how to realize use cases with the help of analytics. Working at the border between automation and machine learning, Kjersti and her department create and operates learning models.

5.6.8 Telenor Group

- **Ieva Martinkenaite - Vice President Telenor Group Research, Head of AI and Analytics:**
  Ieva Martinkenaite is among the key figures at Telenor Group contributing to building AI

research and innovation ecosystem in Norway. She leads a team of data scientists and Machine Learning engineers and is responsible for advancing AI/ML research in Telenor and developing data and AI products. She also holds several high-profile regional and national appointments in AI. As Vice President at Telenor Research, Ieva has led the Telenor-NTNU AI Lab development project (later transformed to Norwegian Open AI-Lab), a Centre of Excellence for AI and Machine Learning in Norway. She also spearheads Telenor's Start IoT initiative, aimed at stimulating research and innovation in the Internet of Things (IoT) in Norway. Her work involves research and advisory to Telenor executives and business leaders on AI, Internet of Things (IoT), innovation strategy, and digital partnerships. [55]

5.6.9 Choosing the appropriate interviewees

With various contributing and independent organizations, each employing a greater number of talent, an important step is to reach out and establish contact with the right representatives: "More suitable" individuals in relation to the research goal. Role, responsibilities, background, and history with the company and the relevant field are here the decisive factors. A research project of this kind brings with it numerous matters which need to be accounted for. From a company's current situation and commitments to availability and accessible resources, history and track record, and the state of the available resources, these are important aspects to be aware of. As such the project plan needed to account for and to provide for the individual needs.

As was the case with some of the partners, the supervisor and researcher were already aware of suitable figures. However, for the majority of the partners, the approach involved reaching out to the senior or upper management of the respective companies. By approaching the management of each company or a particular relevant department, it was easier to schedule interviews with the "correct" individuals as the management themselves arranged for additional communication and contacts. After initial contact was established, consecutive talks and planning meetings were held followed by the actual interviews.

5.6.10 The interviews

Variations are to be expected in terms of each partner's availability. With differences in schedules and locations, the completion of the interviews required flexibility and had to be scheduled accordingly. When engaging with industry specialists and professionals, full schedules and varying accessibility can complicate the work. A significant effort has as such been dedicated to the planning and conducting of the interviews and case study. In addition, the goal when finalizing the specifics and details of the project plan was to conduct all interviews, both in-depth and potential follow-ups, before the latter part of the project period. If possible a substantial amount of time would be dedicated to the coming discussion and processing of the accumulated results.

However, as previously anticipated the process involving the interviews and qualitative method dragged on, and by the time the last interview was completed, a significantly smaller part of the project period remained.

As the interview process involved conversations with both Norwegian and English speaking representatives, interviews in both languages were held. On that account two interview templates have been created, one in Norwegian and one in English. Their content however remains identical. All interviews were completed as in-depth interviews. As such no focused interviews took place. From considering different factors like time constraints, availability issues, and first-time obtained results and data, it was decided that there was no need for any follow-up conversations.

See *Appendix A* for the general interview template used for the interviews in Norwegian, and *Appendix B* for the general interview template in English.

5.7 Completion of the quantitative method

At the end of the qualitative method, a questionnaire and survey was sent out to the participating companies. Each of their representatives was given a copy where the content, in this instance the included questions, was identical. The motivation for including a survey so late in the process was to better understand some desired values, opinions, and perceptions. From the data gathered through the survey, different statistics, diagrams, and tables will be made. The result is a better highlighting and differentiation of properties.

The questionnaire and survey can be found in its entirety in *appendix C*.

5.8 Completion of the literature review

The thesis encompasses a combination of a qualitative method and case study, and a literature review. When approaching such a comprehensive subject area, the field of AI and its impact, it's not only important to look at academia, but investigate and analyze previous independent research endeavors. All have provided for a better understanding of realistic results and outcomes from different approaches, with and without external collaborations. The literature review has been a continuous endeavor over the entire project period, consisting of including and evaluating different relevant literature such as research articles, studies, company reports, and other academia.

Finding relevant literature, identifying the contexts and compare conclusions through evaluation, and incorporating the lessons learned in the research have proved to be beneficial for the project. For each source of interest, the goal has been to extract information and data to both increase the validity of the thesis, as well as to gain an overview of the current state of relevant or related themes, backgrounds, influences, and research efforts. A good literature review doesn't just summarize sources – it analyzes, synthesizes, and critically evaluates to give a clear picture of the state of knowledge on the subject [50].

6 Results

The *Results* chapter presents the findings from the quantitative and qualitative methods. The culmination of each method and data gathered will be presented through distinctive categorical themes and topics.

6.1 Processing of the results

A total amount of 13 interviews were conducted for the study. Each interview has been dissected, studied, and examined, and ultimately the information relevant in the context of the research goals and interview themes have been extracted from each effort. The relevant outcomes of each collaboration will be presented throughout the chapter, along with the findings from the survey and quantitative method. Each representative's story and experience, originating from specified use cases and applications, have been the foundation for this chapter.

The accumulation process was characterized by a high degree of enthusiasm and eagerness to contribute to research. As was the case with the majority of the interviews, there was such a commitment from both sides, both from the interviewee and the researcher, that each interview often lasted a while longer than initially planned. At times it can even be said that the process resulted in too much of the good as digressions have a tendency to go beyond the scope of the research goals.

For the sake of argument, the definition "AI-project" can be misleading. As opposed to other kinds of technologies or solutions, an AI-solution is not done or in any way finished when deploying and handing over a project. AI-solutions require care, maintenance, updates, and further development as the industry or context progresses. In relation to its adapting nature, it would be more accurate to think of a project as a service, but as has been the case with the partner collaborations, AI-project has been the term used. As such from here on, an AI solution, or perhaps more appropriately an AI-service, will be referred to as an AI-project.

6.2 Culmination of the qualitative method

Each individual interview was originally meant to be approached similarly with an unchanged interview template, and therefore remain unaffected by the differences in business or ventures of the partners in question. However, the final execution was affected to some extent, and as a result, some of the interviews were somewhat altered. Altered meaning that the relevance of particular questions would change, at times even entirely lose their meaning or certain formulations needed to be changed depending on the given interview. The context would however remain the same. Despite targeting independent involvements with AI, "a red thread" was present through the case study: To draw a picture actively representing an organization's history, familiarity, and experience with AI. A common thread throughout the processing of the results has been to investigate where similarities and commonalities can found across the information provided by the informants. Compliance in responses has been the focus for the themes ahead.

To that end, in accordance with the research questions provided, the culmination or end results of

the qualitative research method will be presented below. The numerous amounts of data and information gathered are represented through specific themes, outlining a number of unique topics which will be subsequently expanded upon.

6.2.1 Why AI?

AI can be one solution used to solve a problem. The field has gained an increasingly great foothold in the industrial world as the associated technologies have become more and more accessible, supported, and widely used. As such it's interesting to see exactly why one chooses to adopt AI and ultimately decides to use it rather than other appropriate or capable solutions.

"Artificial intelligence is here to stay. The train has left the station, whether you like it or not" **(Loek Vredenberg, IBM)**. There can be any number of reasons behind why an organization or business chooses to embark on an AI-journey. From experiencing the fear of missing out, to exploiting the potential of data, to first exploring new technology, there are several recurring motivations. With data at the core, there is a desire to leverage the opportunities that data brings with it. "Seeing the opportunities of new sensors and greater data, it just made sense that we want the most accurate predictions. We want the most information available to make the best decisions and qualitative analysis, and AI is just a tool that helps us get to the best answer. You know, it's used as you said, complementary. It doesn't replace things, but it genuinely provides valuable, meaningful insights for the type of work that we do, so one cannot just ignore it. It has intrinsic value based on what we do and how we do it" **(Elizabeth Traiger, DNV)**. Also representing DNV, Kristian emphasizes the increasing availability of the technology, "I will say that the technology became more accessible, and there was help where the data could be used for the models. For us, it was more about that we now see the opportunity and we're taking it. There is an internal motivation, and we're staying relevant by doing this" **(Kristian Ramsrud, DNV)**. New possibilities brought on by the technologies are another obvious reason. "When you see that data-driven methods can deliver for your business, then you are much motivated to look into this and deploy it at scale" **(Ieva Martinkenaite, Telenor)**.

Another valid point is staying competitive. "I think the biggest leverage there is, is fear of missing out. Competitors start to talk about it, it's talked a lot in the media, you're like: Should I jump on this technology? What is it about? I think the main triggers are that it's in the air" **(Ioana Havsfrid, Schibsted)**. Also from Schibsted is product manager Eivind, who emphasizes the impact of external forces: "A bunch of people with different work backgrounds has joined where they previously have used ML on a large scale for many years. So I believe that these kinds of cultural additions may have a say and that they have pushed us in the right direction" **(Eivind Throndsen, Schibsted)**. Competence and talent refilling can in other words help guide a company in new directions. The hype associated with AI is a larger factor by creating excitement and wonder as different uses can reminiscent of how the organizational environment is currently heading. A direct cause of this is increased marketability. As part of a company where AI has been part of the foundation, two motivations to utilize the technologies at Cognite have been, "The first is that we have all the data available, and it is in a way a good solution to the problem. Another big motivation is concerned with sales and marketing. AI and ML are very salable, so we want to use them for that reason" **(Sindre Stavseng, Cognite)**.

SINTEF Digital has seen some desired gains or motivations from a customer point of view. "A recurring aspect is the desire to do things more efficiently, and more lean than what is current practice. Other motivations could be to reduce the climate footprint or improve resource utilization" **(Anne Marthine Rustad, SINTEF)**. When discussing expected outcomes and where the

focus of the endeavor began, Loek for the global actor of IBM summarized: ”In short, improving the quality of our products and services, more streamlining, efficient delivery, and reduced costs. And as the quality improves, we in return gain growth” **(Loek Vredenberg, IBM)**. The financial and banking industry is no exception. ”In many projects, one chases a clear monetary value. In others it’s more about the customers, and if a solution will be used and appreciated” **(Karl Aksel Festø, DNB)**.

Competition, the role of data, a more mature field, curiosity, and new talent can all be listed as causes behind investing in AI as a means of aid. From seeing why one chooses to adopt AI, another interesting angle concerns what exactly one is hoping or expect to achieve from utilizing AI in their operations. From reducing expenses to streamlining and replacing outdated processes, to becoming more environmental, to create new revenue streams, these are all different business values that have been the goal to realize by adopting the technologies. There has been a repeating focus to not only use AI to facilitate for only the organization itself, but for the customers as well. Both through indirect effects and direct, there have been clear consequences. A business sense, with social tendencies.

6.2.2 The changing nature of AI

The introduction of an AI-solution can bring along noticeable changes. With the focus on success factors/benefits, and disadvantages/cons, experienced effects will follow be under scrutiny by comparing the states ”before and after”. In examining the influence of AI and the long-term changes brought along, the focus from the different experiences is on what can be viewed as actual success factors, disadvantages, and general alterations of the business itself.

Success factors

“So far, I will say that our use of AI has first and foremost increased efficiency and the quality of existing services” **(Kristian Ramsrud, DNV)**. ”So briefly explained we see that those who have been very prominent in using AI have gained value from the data, and they have established new services, have become efficient as well as reducing their costs, relative to those which have not” **(Loek Vredenberg, IBM)**. On a different accord, AI has also had a positive influence throughout an organization in terms of competence. “What I would like to highlight as a positive factor is that the hype has caused more of the higher-level management of the organization to take a stand. Thus, you have gained more competence in management. They are curious and excited as to what this can do and how it can be used. Investments, initiated initiatives, and recruitment’s have been invested in order to become better” **(Karl Aksel Festø, DNB)**. Realizing the value of data is possible through more advanced use as suggested by Ieva Martinkenaite. ”A little bit more advanced use of data can empower a company to make good decisions for the environment, and also to save costs” **(Ieva Martinkenaite, Telenor)** Finally, the inclusion of the technologies can also have a positive impact on the sales ability of a company. ”A huge advantage for us, to be honest, is the ability to say that we have AI in our solution, which is a really great selling point” **(Sindre Stavseng, Cognite)**

Reflecting on the aforementioned ”profits or improvements” hoped to be achieved with AI in the previous section, has this actually been the case? As the maturity increases, more of the expected outcomes are being achieved, but success factors have been achieved independent of experience level. Among the experienced success factors are prospects that previously weren’t possible to achieve, reduced costs, increased attention and salability, streamlining of work processes, and better utilization of the available data.

Disadvantages

Disadvantages or problems brought on by the introduction of AI can have different impact areas. As suggested by Ioana Havsfrid, people can easily experience the changes at hand. "So, I think the technical people have an easier time. A harder time I see in everybody else around it. The product, the business, and sometimes the users" **(Ioana Havsfrid, Schibsted)**. AI brings along new technologies to learn, and less technical individuals can have a harder time adapting. Data-driven AI also brings with it a level of uncertainty, and it can be make or break if one can't trust the results. "The negative side involves AI explainability in a way. Machine learning has a tendency to be a "black box." It's very hard for the end-users to exactly understand why one particular thing has been matched" **(Sindre Stavseng, Cognite)**. "There are some negatives, adopting new AI processes can be costly and attitudes aren't there yet" **(Elizabeth Traiger, DNV)**. Using advanced and top-level solutions for small or easy problems is a wasteful approach. "The worst you see is when one is to use extreme top-notch technologies to solve relatively trivial problems, just because it has a nice name and is hyped up" **(Karl Aksel Festø, DNB)**. Finally, biased AI can pose a problem for industries dealing with personalized data and information. "Possible consequences and a thing that can be a little scary is if we somehow contribute to a kind of bias or discrimination, in the end treating people worse based on who they are or which group they belong to." **(Eivind Throndsen, Schibsted)**. Similar statements have been provided by DNB and SpareBank 1, two companies that find themselves in similar waters as personalized data must be accounted for.

From habituating technological changes to needing to be aware of biases, to uncertainty, to attitudes and costs, and misuse, in the current stages of AI there are a number of inconveniences or disadvantages seen across the industries in question.

Alteration of a value chain

Emphasizing the importance of access to operational data, and the control it provides for AI-models, Alexander Gleim explains how the combination and application of data and AI can lead to gradual shifts, and affect business models. "In some interesting ways, we've seen now a gradual shift where the combination of data availability and the subsequent application of AI to it can really make fundamental changes to business models, for instance a pump manufacturer. Now it doesn't actually sell you a pump, it sells you pump-as-a-service. They are in control over their AI models and they can actually do so now for the first time because they have access to operational data from their equipment at a customer's installation, which is something that they never had before" **(Alexander Gleim, Cognite)**. This conclusion is shared by Elizabeth Traiger over at DNV, "DNV has a digital assurance group that five years ago we didn't really have. It was something new that we saw coming, so we've changed that. We've changed some of our business models. To incorporate AI we are further developing software as a service offerings" **(Elizabeth Traiger, DNV)**. The shifting nature of going from a product to a service had been representative for IBM as well. The value chain here have ultimately been altered. "We have gone from being a product supplier to a service supplier. We deliver our software-products as services, and by the help of AI, we have become more efficient in production as well as having a number of available services previously not existent, also in our own usage. The quality of our solutions has increased considerably, and the value chain has clearly gone from being a supplier to a customer to being partners. The business model is much more partnership-based, more ecosystem-based than a customer-supplier relationship" **(Loek Vredenberg, IBM)**.

While not targeting the parent company, a change in the need for external collaborations or out-

sourcing have been experienced at Eivind's time at FINN. "I have not experienced that we have removed the need for a job, at least not internally, but eventually as we introduced machine learning for the investigation of ads the amount of work became a fraction of what it was. An external firm with responsibility of doing exactly this became angry as the need and volumes sent to them was cut quite drastically" **(Eivind Throndsen, Schibsted)**. For DNB, AI becomes increasingly important, and have already become an essential part. "I will say that for most of the initiatives we have, it's about using AI-techniques in existing processes. That is in order to improve them and sometimes, we experience that they can contribute to radically improve processes" **(Karl Aksel Festø, DNB)**. In the long run, its important to know that it's how one uses AI which can lead to a change. "We have to remember that these are not AI tools per se that drive change in the society. It is their use that help us solve many problems" **(Ieva Martinkenaite, Telenor)**.

A number of examples have been provided wanting to better exemplify how AI has in one way or another altered a value chain or a business model for a company. Both in a more grand context such as changing entire value chains, offering services instead of products, to "smaller" alterations in the form complementing existing processes, the field of AI has had significant and small-scale organizational changes.

6.2.3 Evaluating an AI-project

How is an AI-project evaluated in the industry? What constitutes a successful AI-project? As the term successful can symbolize different qualities or values for different companies and be highly context-dependent, an effort has been made to shed some light on the matter. As such, the focus will be on how a company evaluates their different projects in a general matter of speaking, and what makes an endeavor or project successful.

Success is value dependent, and there are different ways for how one measures value. In can be industry, context, or even case specific, but basing the evaluation on a metric or baseline with the intention of comparing the results and outcomes, can be integral. Value can be money saved, it can be incidents reduced, it can be production increased, but in principle one needs a metric from the get go that a number can be put on. "I think the whole topic of success criteria or acceptance criteria is extremely crucial, and what we really aim at. Cognite is to have this laser focus on value, and then there are of course different ways of how you measure that value, but in principle you need a metric from the get-go that you tried to put a number on. This could be money saved, it could be incidents reduced, it could be production increased. So you need to sort of both have a baseline according to or against which you compare your outcome, and you need an agreed way of measuring that/it at, and that needs to be aligned with the client in our case" **(Alexander Gleim, Cognite)**. This experience is shared by Elizabeth Traiger at DNV. "For an AI project in DNV to be successful, it has to be compared to some sort of a baseline. Most of our active industries are regulated. If you think about maritime and class, the active industry actors get together and agree on a standard. In addition there are regional governmental standards. There are many benchmarks and standards to meet. For an AI to be successful it has to exceed a benchmark that is set before the project is started, so we have a set that we're going to compare it against, and that's well defined before the project starts" **(Elizabeth Traiger, DNV)**. Loek Vredenberg and Kristian Ramsrud emphasizes the value of productionalizing. "It's very dependent on the level of ambition prior, but what we often do is establishing clear goals, what we hope to achieve with for example the MVP's, and see how to scale. For me, success criteria number one is that the AI based solution is put into production" **(Loek Vredenberg, IBM)**. "For a project being successful, it must be put into production, be experienced as useful, and create a profit" **(Kristian Ramsrud, DNV)**.

At Schibsted, it boils down to asking and answering the right questions when seeing if an AI-project has been successful. "We have been more: Do we produce value? Are we doing what we planned to do? A more qualitative approach as we see if it can be used here, if it produces customer value, and perhaps less focus on measurements and monetary profits" **(Eivind Throndsen, Schibsted)**. Among improving a given process where it is used, a successful project can help support data-driven growth of the company. "It's clear that this technology can contribute to streamlining your operations, but for the larger areas of the bank, the focus is on efficient growth through data-driven initiatives" **(Kjersti Wold, SpareBank 1)**. A machine learning project demands constant maintenance, constant operation. There is no button one can press to start and then let it run for years. Discussing what constitutes a successful AI-project, Sindre Stavseng explains how in terms of success, a project with AI is evaluated along the same lines as a project without. "The simple answer to that is the same as for any other project, to be seen as successful it must provide value. So if it's based on AI or not is almost a detail in this regard, one must have provable value. There is an added complexity, especially if one is to use machine learning it should almost provide extra value to compensate for the extra complexity and cost it brings along" **(Sindre Stavseng, Cognite)**. Ieva Martinkenaite discusses how success differs from project to project, but base the views on some important success factors. "Everyone working with AI should always start with the problem definition. Does that AI tool solve our problem, and at which cost? Fast failures in deploying the AI technology is for me an ingredient of success, because then you show that you are innovative, you improve your capability of working with new technology, but you drop stuff that doesn't work. Another important ingredient of success is upskilling and reskilling your people" **(Ieva Martinkenaite, Telenor)**.

Determining if a project have been successful can be a means of evaluation in its own right. In terms of having specific methods or measures in place for evaluating an IA-project, recurring answers have been everything from that there exists no such methods, or that plans for creating such standards are still under development. For a number of the companies which have started, but haven't been in the AI game for too long, this is a research priority and currently in the works. For others, standards and regulations can pose a new level of evaluation. In other words technical standards which must be followed. "DNV has some recommended practices on data management on data driven algorithms, on simulation models, on sensor systems. We're governed by the IEEE; the IEEE has many existing regulations that are based on AI and computer software systems. We're part of the European Union's AI Commission, so we follow the ethics systems. We are governed by those, and we're increasingly seeing more technical standards surrounding AI, be it data fairness, data completeness, looking for bias in the data itself, the methodology, GDPR, DNV follows all of those standards" **(Elizabeth Traiger, DNV)**. No matter if the evaluation is based on methods, standards, regulations, or even success in general, there has been an ongoing focus to produce value internally as well as for the company's customers or clients.

6.2.4 The challenges of AI

As with any new technology or organizational change, challenges follow. However, it's easy to limit the focus on the limitations of the technology. AI is something special as its branches stretch far beyond just a technical aspect and different algorithms. Targeting both organizational, enterprise, and technological impacts, what are the perceived challenges from utilizing AI?

"Some years ago, "everybody" wanted to have an AI-project, as they thought of it as forward-leaning. However, that is not how we work. We always start by understanding the problem at hand. Thereafter we evaluate the methodologies and technologies to be applied. It could be ma-

chine learning, AI, or more "traditional" methods" **(Anne Marthine Rustad, SINTEF)**. Adopting AI should of course serve a real purpose, not because if would be cool to have. As such it's important to make sure AI is suitable for the problem at hand. "If AI is a part going forward, then I think it's important to make sure this truly is an AI problem. Is there a gain from using an AI-technology or a ML model? Accuracy must be accounted for, and to which degree. For 100% accuracy, you should in no way use AI" **(Eivind Throndsen, Schibsted)**. This understanding is shared by colleague Ioana: "I think one of the big challenges is not technological wise, but more integrated into business and product development. And especially since in AI you have this inherited error rate, you cannot guarantee that your prediction is 100% correct" **(Ioana Havsfrid, Schibsted)**.

AI-related challenges is not limited to only technical aspects or performance. "I believe that one of the biggest challenges in deploying AI at scale in large organizations is lack of experimental culture and relevant skill base" **(Ieva Martinkenaite, Telenor)**. There is an organizational aspect to it, and people are ultimately the ones behind the initiatives and projects at display. The development process raises challenges as well. "I believe a major challenge is our ability as humans to abstract and create useful models for every problem or issue one faces. The variation in the "abstraction space" is a factor that can lead to this challenge persisting. Creating a digital model from our thoughts and consciousness is a challenge." **(Henrik Smith-Meyer, DNV)** Creating a model can be difficult, but for AI the process doesn't stop there. It demands continues improvement which can be challenging. "I think it's making sure that the application's stay relevant over time, after being put in production. Measuring effect and quality, proper supervision, maintaining the service of the solutions, it's real hard. Maybe the most challenging part is ensuring the control of data quality, inputs, the correct learning of a system, and supervising the quality of the service. It doesn't mean it should be entirely automatic, but you need routines, systems to make sure everything is preserved. I will say that is the most challenging with AI-production" **(Kristian Ramsrud, DNV)**. AI's reliance on data can make things difficult. More specifically in relation to the access to quality data. "The data is not there. Schibsted and companies in general do have mountains of data, but it's very "garbage in, garbage out." It's not annotated in any way, it's not organized in any way. As many algorithms need structured data, to get from a pile of mush with the structured data, there are different techniques, but that's a big problem" **(Ioana Havsfrid, Schibsted)**. Among emphasizing the challenge of data sharing, several other relevant challenges are addressed by Elizabeth Traiger at DNV, such as competence and the need to maintain state-of-the-art in the field. "Data sharing in the belief that "my data holds some information that will be of benefit to my competitor" stops a lot of AI projects from going forward. It's a big problem. Another challenge is the reskilling of existing engineers. The performance of ML/AI solutions isn't always better, or the payout isn't there, so in many cases it's not worth the investment, and the changing nature of AI means it has not reached maturity. New algorithms come out all the time, and we're finding things are quickly improved. Keeping on top of the research is very difficult. It is a challenge maintaining state of the art, but also having something that is proven to be trustworthy" **(Elizabeth Traiger, DNV)**

Some industries find themselves in a situation where privacy issues must be addressed, where personal data is prominent, and as such can face a whole new set of challenges. DNB and SpareBank 1 are two such companies. "I would like to say privacy. It's a challenge, data minimization versus training on large quantities of data. For us, to be able to create a design that is little privacy intrusive, but still has access to large datasets, that's important" **(Karl Aksel Festø, DNB)**. "The privacy if the most challenging aspect and prevents progress. Many assessments must be made constantly regarding everything we do. So it's a time consuming and competence-related chal-

lenge. This is a new field which makes it difficult for the bank as an employer to find enough "data analysis" people, despite our location close to NTNU" **(Kjersti Wold, SpareBank 1)**. Moving on to the ethics-side of things, IBM recognizes the need to promote ethical use when utilizing AI. "First is perhaps ethical use as it's so context dependent, what's ethical and what's not. There is a difference between being ethical and legally right. Second is the focus on taking small steps and not being too ambitious in the beginning. This is a common mistake made by many, to go too big too fast" **(Loek Vredenberg, IBM)** The second focus is on . Henrik over at DNV highlights a gap between research and the application of methods. With AI becoming an important part of Henrik's department at DNV, it contributes to the ability to apply the actual work being done, providing real value in operational processes. This differentiates from a traditional research department. "Many I have met in research departments, they struggle with a problem that occurs when focusing too much on the research and as a result, eventually misses out as the real benefit originates in the real applications towards the real world. As a result, they miss the problems they attempt to solve" **(Henrik Smith-Meyer, DNV)**.

Finally, the focus will be shifted towards challenges regarding responsibility, explainability, and data governance. As seen through the eyes of Cognite employee Alexander: "I guess it comes back to that whole responsibility part. I mean the value of what we do on the AI side is really only achieved if people make a decision. How do you get the industry on board whose whole purpose of existence has been a very different paradigm? I'm not sure whether controversial is the right word, but it's certainly one of the challenges that I see, where there is a lot of alignment necessary between AI companies and other parts of the industry. Not necessarily even the customer, but other third parties, like an equipment manufacturer" **(Alexander Gleim, Cognite)**. Sindre, also representing Cognite, emphasizes the challenges faced on the customer side, and the complexity which is associated with AI. "In general I would say explainability and complexity is a challenge. It's challenging to convince people to trust a black box, and with complex stuff comes a great deal of maintenance. There is a higher cost associated with building and operating something that is based on ML than to build and operate based on more traditional software. Finally, data governance can pose a challenge as successful AI has a feedback loop. This contradicts the perception of a client whereas their approach to access control is more strict and can rely solely on one person. One-way data flow challenges the feedback loop" **(Sindre Stavseng, Cognite)**.

There is no shortage of experienced challenges resulting from the utilization of AI. Some are more dependent on industry and context than others, but there many different sides of AI-project that should be recognized. From accuracy to privacy to development to maintenance, for only to mention a few, several perceived challenges have been disclosed.

6.2.5 Categorizing an AI-project

AI-technologies and solutions can vary greatly in nature. As such it can be difficult, if not impossible to try to determine a general categorization of an AI-project. In instances where technology or logic are transferable, some categories can recur, but it's still a challenge to highlight a standardized set of categories. As a result, where an opinion has been difficult to extract, the secondary focus has been on what aspects of an AI-project need to be addressed to see if there are certain aspects, areas, or dimensions which can be found across different utilization's.

"I will state that an AI-project for me emphasizes that we are able to uncover and use data containing hidden patterns which we can utilize in order to achieve an advantage or new services," - **Kristian Ramsrud, DNV** Continuing to realize the potential of data is important, and use in a responsible way. Ieva at Telenor Group have suggested two levels of categorization which is

used in her research team. The first level is: ”We do AI alongside a wide spectrum if things: we develop ”Blue Sky” Research on AI where we explore data and build complex ML models; also, we help Telenor commercial units solve problems by deploying some of the AI techniques. The latter may not need complex machine learning models, but rather rely on simpler solutions” **(Ieva Martinkenaite, Telenor)**, and the second level is ”We use AI for automating and running our telecommunications networks smarter. We also do quite a lot on sales marketing and proactive customer care front. The third area is growth beyond connectivity, where we experiment with different types of data (eg IoT) and AI methods to define opportunities for growth” **(Ieva Martinkenaite, Telenor)**. Three domains heavily targeting the operations and work of Telenor Group through the research department, but three domains nonetheless which have always remained. Another categorization is between competence and innovation which has been the case at SINTEF. “We categorize our projects into two main groups; competence and innovation projects. In competence projects we about develop expertise, push state-of-the-art, and publish papers. In innovations projects we utilize our expertise to help companies improve and innovate” **(Anne Marthine Rustad, SINTEF)**.

“For me, a correct categorization emphasizes the different business/application areas, customer segmentation and contact in general, streamlining, automation, and generally better internal processes, intelligent objects, and a level of internal support. AI is a business technology, not an IT technology. The business must see the value realized or it will never be used in production” **(Loek Vredenberg, IBM)**. Loek highlights several important aspects when categorizing an AI-project. Ludvig at Schibsted focuses on the problem at hand. “I believe the most important thing is to focus on which problems you want to solve because the categorization will happen there” **(Ludvig Smedh, Schibsted)**. Explainability is becoming more and more important. For Cognite is has been to the point where one almost purposefully resorts to approach this thought. As such, in the words of Alexander Gleim on what aspects of AI-project should be addressed: “Can provide at least some level of explainability out of the box at the expense of maybe more advanced and potentially more accurate approaches, but if you can’t convince the customer to trust in the outcome that you provide, that ship has sailed, and no value will ever be generated. There are sort of these kinds of distinctions between your modeling world and your physical world, and how you untangle them in a good, transparent way” **(Alexander Gleim, Cognite)**. Familiar with the challenges of working with personalized information and an ethics heavy industry, Karl Aksel at DNB raises another important focus. “I believe one should already early on dare to think about ethics and the legality in these initiatives. It will be more important going forward to see if a particular event can happen or if it will be privacy invasive. As seen also in the research community, one should consider a number of the surrounding effects before starting these solutions” **(Karl Aksel Festø, DNB)**

There are undoubtedly different approaches as to categorize an AI-project, mainly resulting from how one operates in a given industry, given the problems at hand. In spite of different areas of focus, different challenges faced, and expansive portfolio’s amongst other things, some key takeaways and categorizations have been mapped out.

6.2.6 The transformation process

It has been an objective to attempt to map out what will be henceforth known as the ”transformation process.” The word transformation process emphasizes the process or approach of proceeding from a specific need to the actual implementation and later deployment of an AI-solution. What should be the focus when developing an AI-solution, how should one proceed, and can one think of it as a step-by-step approach? While being understood that there is a small chance that either

a company has a more general approach that targets a very diverse portfolio of AI-projects, that they use a more standard train of thought, or are even willing to share internal operations, an effort has been made to consult each partner. A focus remained to see if some more general aspects or approaches can be derived.

It's quite a difficult and general question, to map out if there are qualities such as logic, problem descriptions, and technical details which recurs between AI-projects in terms of implementation and deployment, especially when AI-projects can differ so greatly. In the end, for the theme of the transformation process, the information uncovered during the interviews was not worth following up on or was not in the best interest of the chapter to follow up. The information had a tendency to either follow more standard practices, lack content, or was of a non-shareable nature. As such, despite an effort being made, the information in summation didn't constitute the desired and valuable material to expand upon and to dedicate an entire section to..

6.2.7 AI - a customizable collection of technologies

From contextualization of data to chatbots to a data-driven construction site to autonomous drones and ferries, AI has an ever-larger presence in different solutions, and across industries. The number of different AI-technologies is only matched by the associated number of different applications and areas of use. As such, there has been an interesting opportunity to investigate if the technology or logic from an AI-based solution is transferable, and can be applied to other solutions or to solve entirely different problems.

"We have developed solutions where we see that they are so general, that with small adjustments are suitable for completely different business processes. What we see is that AI-solutions often resemble each other, so if you create something, then others can get inspiration, or we see that we have almost solved a general problem, and then it's important to share it with the AI environment in DNV" **(Kristian Ramsrud, DNV)**. Henrik at DNV is also of the same understanding regarding if the technology from a solution can applied to solve other problems, directing the focus on the importance of the users. "Yes, to the highest degree, and it's often a great direction to go. The most important thing is that the people exposed to an algorithm understand its behavior. If you can achieve this, then these people will be able to take advantage of the algorithm." **(Henrik Smith-Meyer, DNV)**. For IBM, image recognition have been used as an example to show how the same technology can traverse many different use-cases. "The actual technology we're developing and researching, it's generic. When it's done, then we find out that it can actually be used in many different contexts" **(Loek Vredenberg, IBM)**. Generic technology offers a more customizable approach, taking advantage of that some principles recurs across different cases. "We develop generic technology. This means that cases that seem different at first glance, may have similar problem descriptions and hence technical solution. On the other hand, most cases we work with are quite specialized, and off-the-shelf solutions are seldom applicable. It is therefore necessary to make adjustments, or more often, develop specific solutions" **(Anne Marthine Rustad, SINTEF)**

Sindre Stavseng emphasizes the technical challenge as opposed to the learning aspect. "A general challenge with ML at least, is that a technical solution is to a very small degree transferable from one problem to another. So the transfer value is largely the lessons learned at the time. There are a lot of things which can be reused, but one largely starts from scratch for each problem I'm afraid" **(Sindre Stavseng, Cognite)**. A particular solution can take advantage of more standardized "parts", reusable parts or capabilities. "Many capabilities like libraries, data products, and database technologies are reusable for more than one solution. A goal for us involves to not create systems from scratch for each single application/area of use" **(Karl Aksel Festø, DNB)**. A trans-

ferability is undoubtedly there, but it might be more relevant to focus on applicability between domains. "I think that transferability is absolutely there, and we make a lot of use for that. For us, that transferability means between "industrial areas of domain." So things that we do in oilgas in principle have similar applicability in powerutilities even though the industrial domain is very different. However, the conceptual way of attacking a certain problem is certainly comparable" **(Alexander Gleim, Cognite)**. In the end however, the use and subsequent changes resulting from the use of AI, is down to people. "I believe that we as humans define what type of AI we want to have, not the other way around" **(Ieva Martinkenaite, Telenor)**.

Justifications in favor of the transferability and the customizable nature of AI are undoubtedly there, but heavily dependent on the context of the deployment. The technical limitations, especially concerning more specialized solutions, make it difficult to develop more general solutions. As such, in the end it's the need, problem, and use who determines a project and technology, not the other way around.

6.2.8 What is essential to successfully utilize and adopt AI?

In order to implement, deploy, and take advantage of AI, what kinds of infrastructure or foundations needs to in place beforehand? Divided into competence, infrastructure, costs, and the development process, an effort for mapping important factors to consider follow. In order to successfully utilize and adopt AI, such factors need to be accounted for.

Competence

"... AI is just a technology. These are humans who are behind developing, deploying and using AI techniques" **(Ieva Martinkenaite, Telenor)**. When answering what kind of skill, competence, education, or otherwise "talent foundation" which the AI-staff represents at the company or the specific department in question, there has been some repetitive answers across the partner base. While some particular degrees, educations, or fields are strongly represented across the board, the importance of multidisciplinary teams can't be ignored. Some experiences regarding competence targeting utilization of AI, can be summed up as: "I have a good mix of people with various backgrounds. They are educated within engineering cybernetics, mathematics, statistics, physics or computer science, either with a PhD or master's degree. The work we do within AI/machine learning in my group requires that the researchers are well experienced within both mathematics and programming, as well as having the ability to understand new problems fast. For persons with these background and skills, we see that it's possible to learn the rest of the skillset. Besides, AI is a field in fast paced development. It is not possible to know it all. You need to continue to learn, everyday" **(Anne Marthine Rustad, SINTEF)**. "So, it's an advantage if one is a little analytically minded, either through the understanding of mathematics or statistics, or both. I also think industry, that one has an understanding for the industrial issues and that they are suited for the technology. Even though there are or are not any formal educations for it, a certain connection to the industry you work in, that is important" **(Loek Vredenberg, IBM)**. "We are an extremely diverse bunch of people, I would say. Roughly 2/3 of the company have at all times been pure software engineers, typically coming from a computer science background. But also other quantitative fields like mathematics, physics, cybernetics are relevant - fields where you got both a quantitatively rigorous education, but also have some exposure to programming. The other third is then typically people with industrial domain competence. Ideally, you have both parts combined in one person" **(Alexander Gleim, Cognite)**. "We have all our based covered: Many people who are numeric, who are technically competent, but also folks who are ethics-based who can tell us whether what we're doing is right or wrong" **(Elizabeth Traiger, DNV)**.

Summed up, a number of key competences repeat across the spectrum. There is an emphasis on the importance of multidisciplinary teams, and this shines through in the form of different technical-heavy and numerical backgrounds, but also in the form of people with industrial knowledge and who are ethics-based.

Infrastructure

What kind of fundamental facilities and systems is needed to support the sustainable functionality of an AI-solution? From implementation to deployment to maintenance, the focus has been on what kind of necessary infrastructure and foundation is needed for utilizing and supporting AI. The term infrastructure envelops a great deal of different aspects which in a way can even be context-specific. An overview of some industry perceptions regarding important infrastructure ensues.

First off, the focus is on scaling, and how the maintenance or upkeep aspect of AI can still be underestimated when operationalizing working models. "There is AI in the sense of building a model to generate some output, and then there is this massive infrastructure required to actually scale it and put it into production, and that is something that customers continuously underestimate: how much work it actually is to take even a working model into operations and to keep it alive, and making sure that you don't need a large number of software engineers and data scientists to handhold that model all the way until it generates some output consistently. But also, how do you scale it, that is actually apply it from one instance to another" **(Alexander Gleim, Cognite)**. DNV also emphasize the importance of a maintenance aspect and what it involves, from the costs, to the regularity of updates, to a changing nature of the technology, but also highlights the people side. "Technical competence, data compute, and processes for maintenance going forward. The people side, technical competence, needs to be in place beforehand, for understanding. So given the task and the types of methodologies, there has to be sufficient compute for things to be in place, initially for pilot projects. Continuing on, there has to be security and IT protocols, and there has to be processes for maintenance and continuous observation and performance monitoring in place" **(Elizabeth Traiger, DNV)**. With a bigger emphasis on data, Sindre at Cognite highlights the advantage a good infrastructure can provide. "Good infrastructure surrounding data is a great advantage in the sense of easy access to shared datasets, good and versioned metadata so one can easily validate sources and data lineage. An easy way to run experiments and the track results from this is also necessary. That's why it's important with a compute infrastructure which allows for control regarding how a model is trained so all of the results are reproducible" **(Sindre Stavseng, Cognite)**.

Also speaking on behalf of DNV, Kristian have gone a step further as to divide the term infrastructure in three main parts: data, application, and safety. Especially interesting is what's put into application and security. "With infrastructure, one can divide it into data, application, and safety. Application in the form of that you have to have an infrastructure so to easy put things into production, where things scale, where things are monitored, and supported. Safety in the form of having an access control and user management in order to not expose data through the developed solutions. Of course one must also have a team of data scientists, competence where people have responsibility, knowledge, and the opportunity to operate and further develop the productionalized solutions" **(Kristian Ramsrud, DNV)**. As DNB tend to operate with highly personalized data, this also brings along a new set of priority regarding infrastructure. "As a baseline it must be a technical platform for processing, available data, legality assessment (GDPR ++), ethical reviews, competence to build/maintain as well as cultural maturity in the organization, to imple-

ment. A business case helps is of great help" **(Karl Aksel Festø, DNB)**. Finally, the governance dimension or measures required to achieve trustworthy AI, must be addressed. "You have to have well defined governance for accessing, storing, and processing data in a responsible manner. The data has to be easily accessible by many people in the organization" **(Ieva Martinkenaite, Telenor)**.

Infrastructure is a wide term. As such, the different perceptions of what represents infrastructure or otherwise necessary foundations have been the goal to map out. In order to support AI-solutions, important infrastructure aspects involve maintenance, data, application and scaling, and governance among others.

Data

With data at the core, there is a need to facilitate for data management by implementing some sort of data platform to support AI-solutions. Access to enough of the right data in a suitable condition is paramount. When emphasizing the data part as an essential factor, it becomes a highly infrastructure-related question, but as a result of its importance, a separate subsection has been dedicated to it, both in terms of data itself, but also the data platform.

"Of course we must have a modern data and analysis platform" **(Kjersti Wold, SpareBank 1)**. "We have build up a comprehensive data platform, both in terms of service, software, and hardware, and we have had great success with it in the market" **(Loek Vredenberg, IBM)**. "First and foremost: The company must have access to their own data, which I have experienced is unfortunately not always the case. Sensors must measure the right variables and data must be of high enough quality, as resolution and granularity, as well as give time series of considerable length (could be years)" **(Anne Marthine Rustad, SINTEF)**. "DNB invests a great deal in data, and has created a division to govern this effort. A number of different subject areas needs to be in place in order to have the right data available on the right platform. This applies to both technical, legal, and organizational competence" **(Karl Aksel Festø, DNB)**. It's taken for granted that a modern and sufficient data platform is a necessity. As AI and ML is so dependent on data, providing access to the right quality data and enough of it along with the ability to host different AI solutions, are a must. DNV is one organization which have invested heavily in this regard. "We have the Veracity platform, and we also have a recommended practice for data collection and data management. This is an area DNV is very active in. We also have implementations on different cloud computing platforms and our own on-premise compute as well, including data storage , collection and analysis" **(Elizabeth Traiger, DNV)**.

What means access to more, good, and correct data? "Read access to data, and not just point-to-point integrations, but we need to speed up that whole process. You need access to contextualized information, and then you very quickly run into this problem of data quality and how you actually address that, and how you can formulate data quality requirements that your model, your use-case, your project depends on, and they could very well be different from other use cases. So, some concept of talking about data quality and governance around data in the context of a specific use-case, is something that would be very good" **(Alexander Gleim, Cognite)** "Data in the form of having secure access to data, and control over data quality. You need access to explore and control in order to maintain the operation" **(Kristian Ramsrud, DNV)**. The use of data is becoming evermore present all around. "We are seeing all the areas where we work have more to do with sensors, data, and assets. Being an engineering company, we've always valued the information of quantitative results telling about an asset, about its performance and prediction. These ML and AI systems, they need to either be updated with data as it comes, or monitor the

updates that are scheduled" **(Elizabeth Traiger, DNV)**

While the potential of data as a resource still hasn't been fully capitalized, its role can't be downplayed. So, it crucially depends on that whole notion of what data quality, data meaningfulness really are, dependent on what you want to use that data for.

Costs

What kind of expenses or costs are associated with AI? An effort has been made to gain an overview of common, significant, and expected costs when adopting and deploying AI.

"I believe it's the data management, the notion of being data-driven, at least in the implementation phase where it's the driving factor. If a supporting technology is in place along with a good and automated relationship with the processes, then the sheer operation and maintenance remains, as well as sustaining the behavior of the models" **(Loek Vredenberg, IBM)**. Along with focusing the attention a cloud and sharing perspective, Alexander from Cognite also emphasizes the maintenance and upkeep portion. "I mean there is a cloud cost element to it, and that scales with usage data volumes. So if you have a lot of data and a lot of users that want to have access to that data, then it becomes just more expensive than if you have less. And then there is a support and maintenance aspect to it that people often overlook, that these things are really "breathing and living things" that need to be kept alive after the development phase is over, but people haven't really started to grasp this fully yet" **(Alexander Gleim, Cognite)**. Data collection and compute are other experienced costs, but the focus on the technical side should in no way overshadow the people who eventually have to maintain or use it. "On a specific project,t if you look at the total budget of where the money goes, the money goes to the data collection, the compute, but I don't want to discount the cost of people. There's also material costs on training new folks for an AI solution, retraining and educating our workforce" **(Elizabeth Traiger, DNV)**. The human element is significant, not only targeting re-skilling, but also the sheer cost of time used on a project. "The time our developers use is the largest cost" **(Sindre Stavseng, Cognite)**. The data solution used to support the different projects is another cost which should be called attention to. "The data foundation solution of course costs a lot, but has application areas outside of just AI. The costs are generally proportional to the long term business value." - **(Ludvig Smedh, Schibsted)**. Kristian at DNV also provides an important enumeration: "The biggest cost I will say is the initial cost to weed out the uncertainty, to succeed. That is, to explore, take hold of data, test concepts, try and fail, and not least to allow the project to fail. Bigger costs can also occur if the business process changes drastically, if the used model isn't suitable anymore, if the training data needs to be replaced, or if there is a dramatic change in a work process, or the "marked rules. In this context, I believe the costs related to development, platform, time consumption, and business clarifications are the biggest" **(Kristian Ramsrud, DNV)**.

An effort has as such been made to map out the "biggest" or more presents material costs related to AI development and deployment. Standout experiences have been related to management, compute, development, and maintenance of the data, but as well regarding the people side of things, the material costs of people. Finally, a proper infrastructure to support the projects and operations at hand can constitute a significant cost.

6.3 Culmination of the quantitative method

The questionnaire served as a closing act to the entire data and information procurement part of the project. The outcome of the survey has presented the opportunity to assemble an overview or synopsis of differences found in terms of priorities, capabilities, abilities, talent, and strengths of the partners involved. With the intention of comparing and characterizing the partners, the culmination of the quantitative method is included below and represented through several survey-inspired sections.

In concluding the survey and questionnaire, a majority of the contributing representatives and informants have filled out and completed the survey. For different reasons, some have refrained from participating. Before delving into the different outcomes of each part of the questionnaire, a clarification will be made. A different representative from Telenor Group has completed the survey, however, being an appropriate representative working closely with similar activities as Ieva Martinkenaite. Also, one representative from Schibsted has not played a part in completing the survey, and therefore will not represent the final upcoming outcomes of the quantitative method.

A graph, chart, or otherwise visual representation of the outcome of each question is incorporated in each successive section. Each representation is compromised of all the contributors or representatives who have completed the survey.

6.3.1 AI Capabilities - The highest prioritized capabilities to a company

An important aspect has been to investigate what can only be described as important AI-capabilities, regarding how each partner value different capabilities in terms of their day-to-day operations. Given a set of predefined capabilities, each representative has chosen to which degree each relevant option represents their employer's situation. The relevant question reads as follows: "Which AI capabilities are the most important to your company in the next 5 years? Choose a score from 1 (lowest) to 5 (highest)."

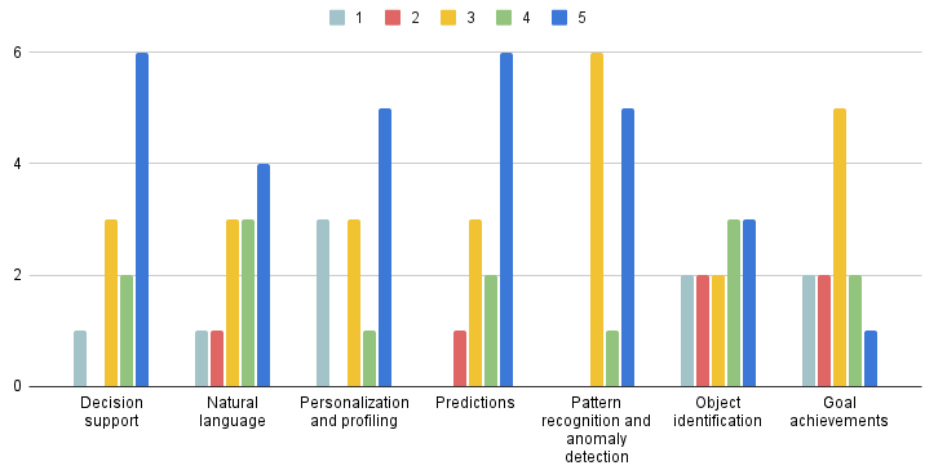

Figure 6.1: Important AI capabilities for a company

6.3.2 AI Capabilities - Where does a company's strongest abilities lie

Speaking of AI-capabilities, this section emphasizes a company's repertoire in the form of most renowned abilities represented through a number of fixed alternatives regarding utilization of AI. The relevant question reads as follows: "Which AI capabilities are the strongest of the company today? Choose a score from 1 (lowest) to 5 (highest)."

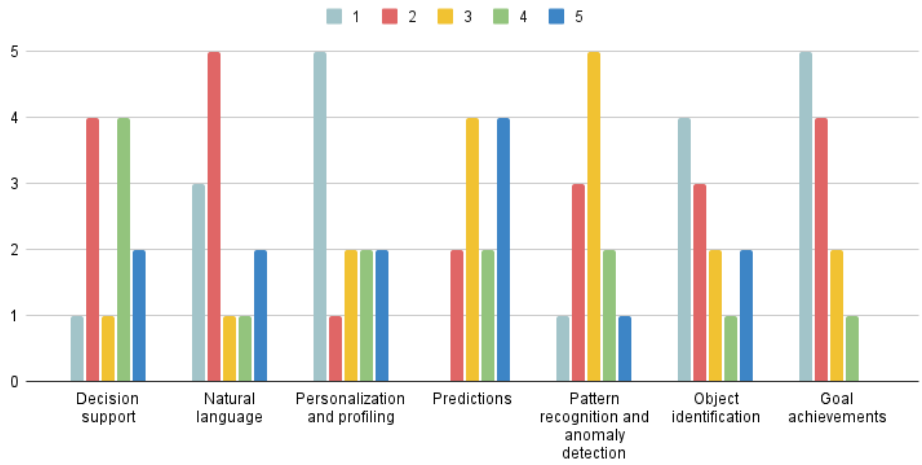

Figure 6.2: Strongest AI capabilities

6.3.3 AI Competences - Critical talent and expertise

An interesting angle involves mapping out different aspects or areas associated with AI, and see within which areas a company has invested in bringing in talent and expertise, and where their competences lie today. The relevant question reads as follows: "What are the company's strongest AI competences today? Choose a score from 1 (lowest) to 5 (highest)"

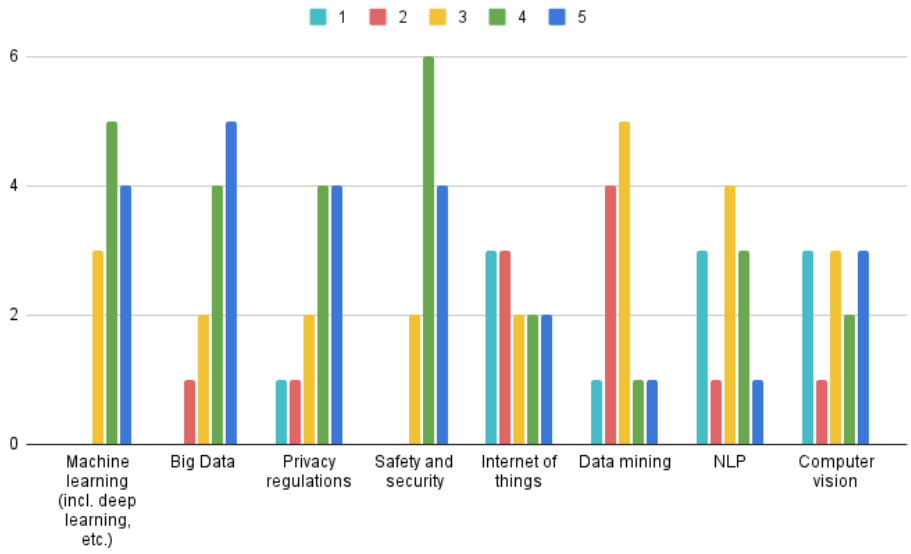

Figure 6.3: Critical AI competences

6.3.4 Data-driven AI - Definitions

Depending on the context and a number of predefined options, what does one put in the term data-driven? The relevant question reads as follows: ”Data-driven” is a commonly used word. In terms of your company as a data-driven organization, how do you define it? Choose one or more options.”

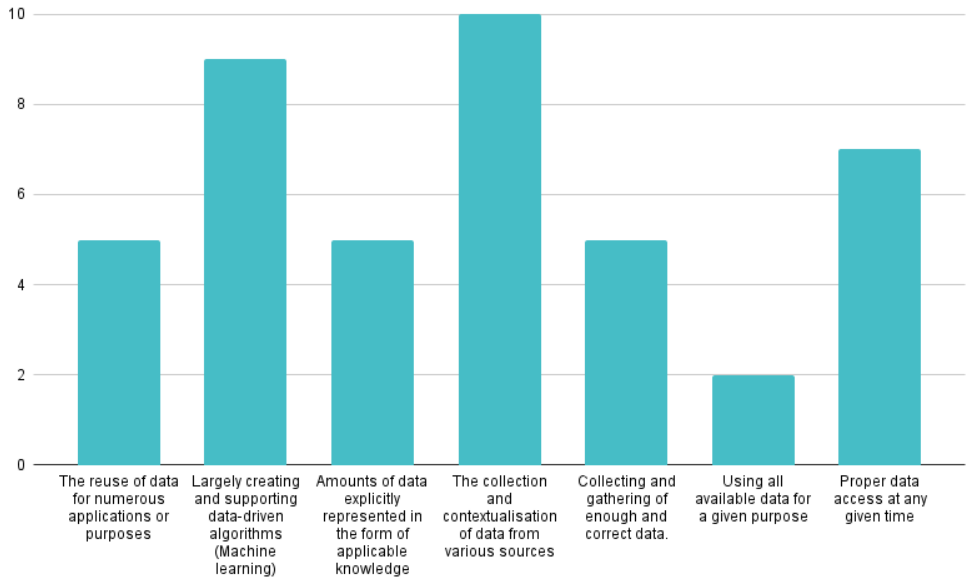

Figure 6.4: The meaning of data-driven AI

6.3.5 Responsible AI

What constitutes ”responsible AI?” Defining it as either meaning explainability, privacy issues, data management including security issues, or trustworthiness, or even all four, an attempt has been made to identify which factors must be taken into consideration or constitutes the notion of responsible AI. The relevant question reads as follows: ”In your definition of responsible AI, which factors must be taken into consideration / What constitutes responsible AI?”

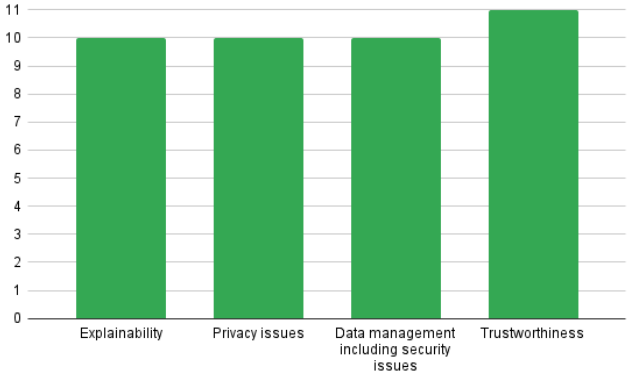

Figure 6.5: The meaning of responsible AI

6.3.6 Data-driven AI - Personal level

For the final part of the questionnaire, there was a desire to see how a representative would characterize both their own experience with AI as well as the parent company. Starting with a personal angle, given a proposed set of data-driven levels: no experience, familiar, competent, and expert, each representative was given the opportunity to choose the alternative which most correctly reflected their own experience level with AI. The relevant question reads as follows: ”Given the pre-determined data-driven levels, choose the one which correctly reflects your own AI-experience level.”

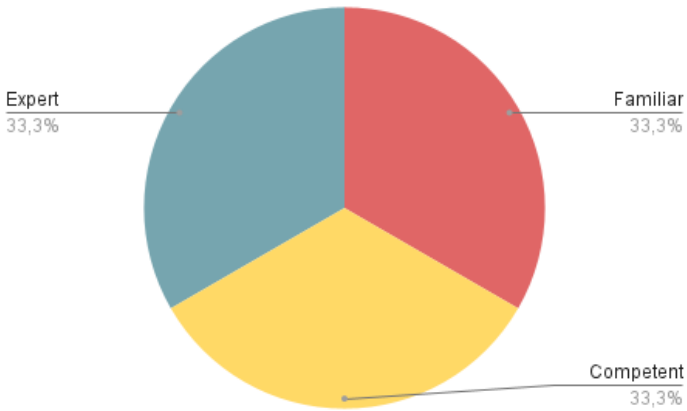

Figure 6.6: Personal experience with AI

6.3.7 Data-driven AI - Company level

For the last question of the survey, it proved interesting to determine how an employee or representative experiences and classifies their employer or parent company’s relationship with AI-technologies. As with the personal level, the same proposed set of data-driven levels ensues. The relevant question reads as follows: ”How would you classify your company’s relationship, ability, and experience with AI-technologies?”

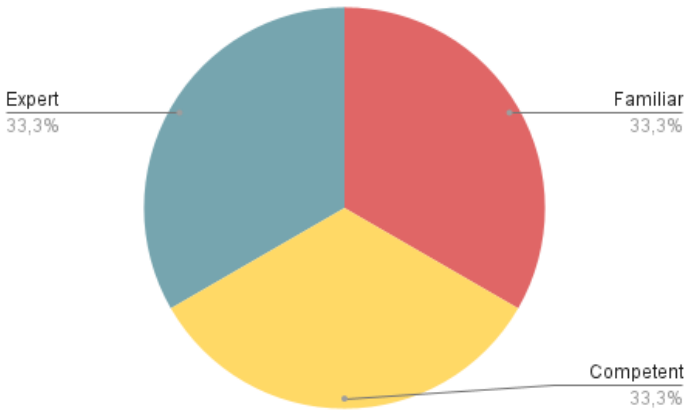

Figure 6.7: Company experience with AI

6.4 Summary of the results

Both through the means of qualitative and quantitative research methodologies, valuable information and data have been gathered and presented throughout this chapter. While additional interesting information was uncovered through the research, only relevant information in relation to the research goals has been included. For each listed topic or theme, a number of confirmations, opinions, and otherwise subjective perspectives in the form of quotes have been provided affirming the validity of the presented data. The graphs and presentation of the numerical data have provided a better overview of distinctive experiences associated with each company, and the comparison and characterizations of the partners in light of each question.

7 Discussion

With the *Discussion* chapter, the goal is to present a discussion of relevant themes obtained during the study and analyze them in light of related work. The themes in question have proved to be purposeful to proceed with and will be expanded upon through evaluation and comparison with state-of-the-art.

7.1 A dimensional approach to enterprise AI

Approaching enterprise AI in a dimensional manner has proved to be a productive way to go. As a part of the qualitative research was dedicated to exploring a set of predetermined themes or aspects regarding an AI project, the first part of the discussion will involve presenting the insights gained. A discussion comparing the research with state-of-the-art is second on the agenda, followed by a finalized version or a dimensional division of AI.

7.1.1 Four aspects of an AI-project

Prior to the start of the actual case study, it was decided that a part of the focus was going to be centered on a number of predetermined aspects or dimensions of an AI-project. Based on the research conducted up to that point, four aspects were decided upon to proceed with. When discussing how to approach an AI-project and how to utilize AI in a good way, a part of the study was dedicated to doing this by focusing on the four following dimensions and aspects: *technical, human, process, and business.*

Technical

In terms of a technical aspect, a more technical heavy approach, what are important drivers or should be included and be taken into consideration when discussing an AI-project?

The data is first. All these things about data access, processing, formats, data labeling. Where is the data placed, how can one access it, what tools does one use to harvest the datasets? Data is a must along with an understanding of the process to be changed. The quality of data ultimately determines the quality of the final solution. Another thing is the IT infrastructure. What is needed to create, deploy and maintain. A big thing is maintenance. What are the costs involved in maintenance? How often will it be continually updated? Will the technology change, given the existing infrastructure and compute agreements with providers? There are sort of many things to it, the fact is that there is so much more to an AI project than just getting a model trained on some data and being able to form a prediction. One needs a whole infrastructure around that actually continuously feeds data into a model, to monitor the generation of these models, and to put in place automatic retraining strategies. Making these models useful on a continuous basis requires a lot of overhead that one needs to address. Be that through own development capacity or through leveraging other services.

Choosing the correct analysis method relative to the area of use or the problem at hand is important. The problem in question determines how one goes about solving it, and the choice of technology. There are several tools in the toolbox, one should use the right tool for the right

purpose. The complexity associated with AI-technologies can have a big impact on time versus value, and force a more pragmatic view. In other words, there is a consensus that a model which performs a little worse is preferred if it can be deployed and gain value faster. There is a trade-off between complexity and value. More advanced technical solutions entail more complexity, and therefore in many cases, an easier solution has been chosen as the complexity of different solutions brings along a real cost in operation. Being the first one to use and adopt a hot new technology is not always a priority. With new solutions popping up it's more important to remain updated on what's happening in the world of AI and striving to be better. It's important to justify the use, and when it comes down to succeeding in an organization, people ultimately care about if one can solve a business problem, and if one has a track record of delivering value or innovation of new services.

So for technical, there are a couple of aspects. Along with the ones already mentioned, there is the repeatability of results, confidence that it's not going to change in time, and an overview of the technical competence in-house. Is it enough to make a change and to maintain it, and being an expert going into the future? A driver for AI to be adopted is to have the right technical competence and find out how much a technical solution in question can be in terms of complexity, and potential accuracy, speed, efficiency, etc. An important question to ask is: "What are the benefits of adding this really technical solution which may be difficult to find the expertise to maintain and may be difficult to explain?" In the end, it's about attempting to find the technology and infrastructure which in turn makes it easier to justify the use and choices made regarding adopting AI.

Human

In terms of a human aspect, what are important drivers or should be included and be taken into consideration when discussing an AI-project?

Speaking of a human element or aspect of AI, a lot of similar perceptions have been noted during the study. Starting with the importance of explainability, account for challenges imposed by a black box. There should be an attempt or even an investment into facilitating for some form of explainability, if the circumstances allow for it. A better understanding of what goes on in these black boxes, why a model behaves as it does, and where the results come from. It's important that responsible humans making the decisions based on such models can trust them. This also brings the focus to the interaction between AI and humans, an interaction that should be facilitated for. There is a personal relationship between the different actors, between the technical staff, domain experts, and perhaps ethical hires. Targeting both use and development, it's important to make sure that there is a joint understanding of the problem and the solution, that the need is rooted in reality. When developing an AI-solution, it's essential that the different parties don't work separately. It has to do with that one should develop an understanding of the business problem at hand, for the complexity of the solution, how to relate to possible outcomes, and not perform hasty or simplistic solutions. In wanting to "change the world," one must understand what a change involves. Practical and personal consequences for people must be considered. It can help to ask "What are the benefits to the humans involved?" To promote its adoption, full disclosure is key. Not only in terms of model outcomes, but more towards getting the entire organization on board. Promoting positive use, and explaining how AI and robots are not here to take over or replace a job. As an aid, AI can remove boring and tiresome processes adding little value. Informing that AI can help people to focus more on the interesting parts of the job, perhaps even dedicating more time to the job they actually signed on for by eliminating unfavorable, but still necessary processes. Show how it's a complimentary service or how it will benefit the people in a way that

perhaps anyone didn't see in the first place. Promote positive change, for example by highlighting the benefits.

Moving on, another point is diverse teams. Not just engineers or data scientists. Domain experts, even ethicists depending on the intended industry. A lot of competence is needed. Include people from both the business side and product side, working together to define success criteria and facilitate for easier communication between the sides or departments. Competence has also been mentioned, how a "reskilling and skilling" of the organization is extremely important, and how it also prevents alienating those not working with the technology up close.

Targeting a human aspect, these are the drivers or main areas of focus when contemplating AI. The human aspect is an important one, in the end how AI is received and used depends on people. AI can help improve the decision-making processes, not to live "isolated lives." Legitimate the AI outcome, and facilitate for trust by emphasizing the interaction between responsible humans and the advice provided by the models, that needs to play well together.

Process

In terms of a process aspect, what are important drivers or should be included and be taken into consideration when discussing an AI-project?

Process can be a quite general term, detailing the process of developing a system to a process that the solution will be a part of, or something else. When thinking of a process aspect, some of the notable answers involved:

1. An agile mindset - Be flexible and adaptive to changes in requirements along the way as well as knowing where the end goal is. Start with clear goals, define expected outcomes and possibilities, and facilitate for a feedback loop. Not develop a solution in isolation, but to expose it to more people, enable feedback during, and involve the users and clients. Also emphasizing a communication process, the importance of communication when one cross specialities.

2. The process of going from investment to value. Cost and usefulness.

3. The process of operating and applying an AI-project. Having a relationship with the process which are to use the solution, no matter the size.

4. Risk and reward for process. What are the benefits and what are the downsides of changing the process? Because process change can imply a mentality and a change of thinking. And many processes are in place because they're either regulated or they've proven to work well in the past, and changing a process isn't an easy task.

5. Prepare for the work ahead targeting a specific process. Focus on the approach, possess the know-how, and have everything in place before starting to address a project or a process. With data, a domain/problem understanding, and a good customer dialogue in place, the basis for performing a good job is in place.

6. Relating the answer back to the human aspect as a process is performed by people. People are the driving force behind how a process is changed through streamlining and quality improvement, and in the end, the human aspect determines how one wishes to work and how a process is being executed.

It's clear that a process aspect targets more than just the process in question. Either emphasizing a work process, a preparation process, or the development process, it's clear that a process view affects many of the aspects of an AI-project, if not all.

Business

In terms of a business aspect, what are important drivers or should be included and be taken into consideration when discussing an AI-project?

The business aspect tends to approach a pure economical focus and emphasizes a value perspective. For example, by finding opportunities that can actually show value immediately or in a rather short-term context of time, and that allows the development of a first MVP. So really the goal is not to just demonstrate technical feasibility, but also that there is a business-relevant outcome at the end of it that people can immediately see the benefit of. This has implications as to which modeling approach for instance, one chooses. Another focus is regarding that not only engineers or technical personnel need to understand the basics. One must understand the bigger directions and the bigger concepts around AI: to understand what a prediction is, why an error is there, etc. From a business perspective, you can't get away from it. With different staff working in different "worlds", good relations to the business side can help understand if there is a good match between what's technically feasible and what is needed on the business side, either internally or for the clients. Also from a business perspective, start small. One doesn't go to state-of-the-art from day one, pack the problem one step at a time and gradually evolve into a more complex solution. It can be business in the form of providing new services, making large investments in different solutions and continuously evaluating the progress to see if it was the correct choice, or the business aspect can emphasize the search for utility value, test and see if machine learning, for example, is appropriate for the situation. The process of approaching a target or goal can require rigorous testing and prototyping replaced by a business evaluation, cost vs value, whether it's worth continuing. Different actors like management and stakeholders all need to have faith in the transformation process.

Business is a very financially charged word. This is also reflective of the common denominator when elaborating on the matter. Profit is the "big regular" when talking of a business aspect. Be it money or reduced man-hours, with savings as a priority the bottom line is profit.

7.1.2 Comparing state-of-the-art

Having published an AI maturity framework as of 2020, Element AI's framework will be used as the preferred target for the comparison. The content of this section will address the four different aspects established through the case study in light of Element AI's model. Element AI's framework presents five organizational dimensions of AI maturity: Strategy, Data, Technology, People, and Governance. Each dimension is integral and lack of progress in one dimension will hold back overall progress on AI, even if other dimensions are further along. An important perspective going forward. Now it will be disclosed how to best use the resources available and compare with the goal to unite or discard information, and hopefully, be left with a better and more representative version of a dimensional structure of AI aspects. Starting off with the comparison of the proposed dimensions and aspects, the section will end with a new and finalized dimensional approach to AI. For the sake of argument, while being emphasized as aspects in the research so far, the different aspects of an AI-project will henceforth be known as dimensions, in line with the AI maturity framework. Also, from this point on Element AI's AI maturity framework will be referred to as "AIMF," while the conducted research of this thesis, namely the four aspects, will

be known as ”the research.”

First off is perhaps a dimension that undoubtedly will be included in any maturity framework or model targeting AI: the technical or technology dimension. While bearing different names, the two dimensions present similar priorities and details. As described in the previous section, AIMF’s technology dimension similarly exhibits the same overall focus: ”Technology for AI maturity refers to the tools, infrastructure and workflows required to support the entire AI solution lifecycle” [5]. The main difference is the involvement of specific details and mentions regarding software frameworks, computing infrastructure, and statistics/metrics, while the research presents a more detailed focus on the different types of general infrastructure, or where a technical focus should be centered. Many different areas can be related to ”technology”, and therefore a great focus should be dedicated to account for these. For instance, the research provides further explanation as to what kinds of priorities an infrastructure should support as well as potential problems which might arise. The must be an infrastructure in place for creating, deploying, and maintaining, for monitoring, for automatic retraining strategies, for analysis methods. There must be an emphasis on using the correct technology for the correct problem, and on addressing a very real technological aspect of AI, namely the complexity. There is clearly a gain from choosing to begin with easier solutions, and increase the focus on complexity as the organization becomes more mature. The trade-off between value and complexity. Finally, the research has uncovered a focus on both technical competence and data as part of a technical aspect. Even with a larger focus on the two through separate dimensions, they’re worth mentioning. Thus, while some of the focus of the technology dimension varied between the AIMF and the research, the overall need and theme remain the same: The need to address the technical side through its own dimension.

Whereas the research has emphasized a human dimension, the AIMF presents a similar people dimension. Across both dimensions, the emphasis is on the value of educating the organization, making sure the people are both on board and ready, and investing in the in-house competence and education targeting the process of designing and deploying AI solutions. AIMF has a big focus on the leadership aspect of the people dimension. As decisions are in the end usually left with management this is important to mention, but the employee side must also be accounted for as the focus should not lie solely on executive leaders. Informing and training the staff, technical and not. A particularly interesting point across both the research and the AIMF is that not every part of the organization needs or even should be concerned and trained to understand every technical aspect or how a particular AI model works. While a necessity for the technical personnel, it’s more important for the remainder of the organization to understand how AI ultimately affects or changes the day-to-day work and how it can be used as an aid, a more general understanding of the field. ”... this is more about separating myths from realities about AI than about upskilling all employees to understand AI algorithms.” [5] An important distinction. When discussing a people dimension, there are three important aspects which the AIMF does not elaborate on, which in regard to the research should be included. These three aspects are diverse teams, the communication between them, and explainability. When presenting a people dimension, the benefit of having diverse teams can not be downplayed. Diverse teams are summed up as benefiting from having domain experts and ethicists as well as engineers and data scientists. The communication between the different departments or sides, such as the product and business side, is integral. Easy communication across the organization should be facilitated for, and establish personal relations between the different actors within a department or a team. A healthy interaction between AI and humans ensuring a realistic understanding of the situation at hand. Finally, there’s the explainability aspect, to bring attention to the challenges which a black box can impose. AI-supported decision-making should make an effort to provide some form of explainability in relation to the

models at hand, if the circumstances allow for it. Highlighted through the presented human aspects, an inclusion of a people dimension speaks for itself.

Moving on to not-shared dimensions, the AIMF has dedicated an entire dimension to data. Explaining the role data has for AI, both how data should influence the design of an AI roadmap, what are the data requirements, to addressing the main data challenge, the AIMF makes a good point of why data can be seen as its own dimension. The culmination of the research up to this point has also emphasized the critical role and importance of data when addressing anything AI-related. The bottom line is that data is so essential and decisive for AI that a separate dimension is justified, and should be included from here on.

Another dimension not shared is process. While the study has emphasized a process aspect of an AI-project, it has in time become clear that process is such a general term and an aspect that is representative in all parts of an organization. When discussing either the technical, human, business or data dimension, the process aspect is included in all of them. Process, represented through different practices, either targeting development, strategy planning, or operations is undeniably a contributing part of each dimension. Either talking about people and reskilling, technical and development processes, processes for ensuring trustworthy and ethical use of AI, processes for data governance, or processes in place to ensure economic and socially beneficial gains, the process aspect in general affects all dimensions. Thus, a decision has been made that ”process” will not be presented as its own dimension. Its presence is ”felt” throughout the rest of the dimensions.

The AIMF also introduces the dimension of strategy, the plan of action to achieve AI maturity in the organization. When emphasizing the choices that a business makes to win, is a separate strategy dimension necessary? Strategy influences and are part of all the other dimensions in one way or another, collectively affecting the progress of the organization. Like process, strategy is a very general aspect, applicable for more than just one dimension. A strategy is needed to decide on the technical, for example a particular technology or a third-party solution. A strategy is needed when recruiting the right competence and talent, as well as updating the current workforce. A strategy is needed to ensure responsible, ethical, and justified use of AI. A strategy is needed to access, use, and maintain the data, facilitate for access to enough of the correct data in a usable state. A strategy is needed to develop and orchestrate an organization's business plan, objectives, and goals, and which role AI will ultimately play in this ecosystem. At the same time, an organization's choice to adopt and apply a maturity model is a strategy in itself. Using a maturity model to approach, compare, and become better in their AI adoption journey can be seen as a business strategy, a strategy for where the organization should invest and how to become more mature. Either talking about a common understanding throughout the organization and culture, the actual applications, different measurement metrics like return on investment, performance, or aiding abilities for the people involved, or the overall business strategy going forward, a strategy aspect is present. A strategy element dependent on so many unique aspects and factors can have the benefit of being decided and added with respect to the dimension in question. In the end, dedicating a dimension to strategy has been argued for to not proceed with as a plan of action should take more specific circumstances into account.

The governance dimension from the AIMF envelops the policies, processes, and technology components ensuring safe, reliable, and trustworthy AI solutions, which are all important. In terms of the research however, while being a big theme throughout the interviews, no aspects were prepared in advance in terms of a governance angle. The idea of dedicating an entire level to the governance angle is a proactive one, but there should be a wider focus. While an argument

can be made that some industries or contexts are more exposed to issues regarding privacy or risk, risk from outcomes of AI models used for decision making, both are important points to be aware of. Especially noticeable in the context of AI is promoting an ethical use. While the AIMF mentions the word AI ethics later on in the level-specific sections, no further explanation is provided. Throughout the research, one of the major themes has been regarding promoting ethical use of AI. It's an essential focus for the reason that if one doesn't trust a technology, then the technology will never be used, and one will not reap any potential rewards which might have been the goal to begin with. While explainability has been mentioned as a relevant aspect for the people dimension, it affects a responsible aspect as well. To promote trustworthiness in how to adopt and utilize AI, explainability is a big driver when wanting to appear honest and transparent. Ethical use, saying this is right and this is not, is difficult as it's context-dependent which is even a greater argument for why it should be "included in the calculation." As previously mentioned, it's a difference between being ethical and legally right. Investing in responsible use can lead to an ethical and sustainable way of doing things. So, refraining from including a technical angle, technology components, the dimension will emphasize a utilization and adoption of AI in an ethical, transparent, and trustworthy way, as opposed to just a legal way.

To have a dimension solely dedicated to ensuring a safe, reliable, and trustworthy utilization of AI is necessary, but should involve a bigger emphasis on ethics and explainability. Therefore, a new dimension should embrace exactly these qualities and in turn facilitate for use characterized as responsible, in the end promoting responsible AI.

Business always represented an important aspect to focus the research towards. As disclosed in the previous section, a business dimension would emphasize value perspectives and involve finding opportunities that can show value in a small amount of time, good communication between the business side and other internal or external parts, as well as informing the different actors present, don't being too ambitious from the start, start small and not attempting to create state-of-the-art early on. There are many things to it, but a business aspect, as stated in the 7.1.1 subsection, can be thought of as "It can be business in the form of providing new services, making large investments in different solutions and continuously evaluating the progress to see if it was the correct choice, or the business aspect can emphasize the search for utility value, test and see if machine learning, for example, is appropriate for the situation. The process of approaching a target or goal can require rigorous testing and prototyping replaced by a business evaluation, cost vs value, whether it's worth continuing." Business is not just a strategy or plan of action, it also envelops outcomes and consequences.

The usefulness, benefits, or utility are naturally a standout when discussing the business aspect, but the utility can be so many things. It can be economical utilities, both costs and growth, but it can also be the utility for the users, for instance, streamlining and an increase in quality. However, then it's no longer just a pure economic aspect, but a societal. The word business is a very economic and financially charged term, and by recognizing the user or client perspective, societal is a more fitting and appropriate term. As such there can still be an economical focus, but at the same time involve other aspects. As AI can be adopted for any number of different usages, for example by affecting sustainability, climate, environment, and more, a business dimension becomes a societal dimension as it extends economical boundaries.

In concluding the discussion of what constitutes important dimensions in relation to AI, it has been demonstrated and clarified that a benefiting and suitable division highlights five dimensions. Namely technical, data, people, societal, and responsible.

7.1.3 The five dimensions of AI maturity

The discussion has resulted in a final version of the dimensions of AI. Through comparing state-of-the-art with the insights and knowledge gained throughout the research, five different dimensions in total have been produced. Deemed most representative when approaching AI adoption, the five dimensions are:

Technical

Dedicating an entire dimension to data, the details of this subject will be left for later. The technical dimension can be summed up as ”What is needed to create, deploy and maintain?” To support the research, development, deployment, and maintenance of AI solutions and projects, an infrastructure must be in place, both in the form of an IT or technical infrastructure (tools, hardware, and software), organizational standards and processes, and competence. A secondary focus involves respecting the increased complexity associated with AI. In terms of technical, a pragmatic view can aid in the question between complexity and value, often followed by a trade-off. In the end, it's about finding the technology, competence, and infrastructure which in turn makes it easier to justify the use and choices made regarding adopting AI.

Data

You can't address the significance, value, or usefulness of AI without mentioning data. Data, and the access to enough of the correct data in a usable quality is integral along with an understanding of the process to be changed. There are many aspects to pay attention to, some are: Do I have the right data? Am I allowed to use the data? Do I have enough data? Is the data mine or is it external data? Of what quality are the data? The quality of data ultimately determines the quality of the final solution.

Utilizing the data requires measures to be in place. Storage is needed for the data to be used, it helps to have some form of active data management when approaching regular use, a technology for handling the data must be in place, one needs compute power, and finally a form of data platform to support AI-solutions. Seeing the opportunities of new sensors and greater data, AI with the right data foundations can be a tool to get the best answer.

People

In the end, there are people who are behind the development and use of AI. It's people who define the type of AI put to use. Some level of internal support is necessary, not just in IT or the technical departments. With a people dimension the focus should as such be on explainability, on informing and educating the entire organization of the journey to come, skilling and reskilling of the workforce, facilitate for diverse and interdisciplinary teams, and enable for strong communication between different business entities. The more people are informed of the direction the organization is heading, the more open will they be towards change. New technologies pose new challenges in terms of competence and skill, with diverse teams one gains new perspectives and competence integral to develop the best solutions. Strong communication along with an understanding of possible consequences is important to not go off track and in the end, create realistic solutions. Of the actors involved, not only strong relationships between the business entities within the organization should be facilitated for, but with potential customers/clients as well.

Societal

The societal dimension emphasizes the usefulness and the benefits which an AI-project can have on an organization, and beyond. Usefulness both in a business regard and user regard. As utility can be of a diverse nature, ”societal” goes beyond just an economic focus. Either denoting value perspectives, providing new services or complementing existing ones, not being too ambitious at the start of the journey to costs and growth, or any other value presented for the business or users, a societal dimension can help put to words what one hopes and eventually achieve with an AI effort. Extending beyond just economical boundaries, the dimension can emphasize usefulness, benefits, and utility targeting different aspects, more representative of the changing and diverse nature of AI.

Responsible

Responsible AI is a dimension that should be a concern and addressed early on, even more as the AI-journey continues. Ensuring a safe, reliable, and trustworthy use of AI is integral with an emphasis on ethics and explainability. Responsible AI will emphasize a utilization and adoption of AI in an ethical, transparent, and trustworthy way, as opposed to just a legal way, and an organization will in return promote responsibility throughout their AI portfolio.

7.2 A leveled division of AI maturity

The second part of the discussion chapter involves addressing AI maturity. Through comparisons, an approach to a leveled division of AI maturity will be under investigation. Like the AI dimensions before, the discussion starts with comparing the research with state-of-the-art and will be proceeded by a final division of the different levels of AI maturity, but the research gained will not constitute its own sub-division this time around. Before delving into the discussion, two different models will be used as the basis when comparing state-of-the-art: The capability maturity model, and the MHC AI maturity model.

7.2.1 Comparing state-of-the-art

The entire case study has been a foundation for new insights and learning. As the study progressed so did the understandings, and helped form a valuable and more clear impression of the themes at hand. In other words, the approach taken facilitated for a new understanding for the discussion ahead. Now with the focus on maturity and maturity levels, what are the lessons learned so far?

From the insights gained, a more clear picture of what kind of different levels of maturity should be representative has come to fruition. First, a recurring opinion across the interviews referred to the need for organizational understanding. While either the technical and/or research departments in an organization tend to be the ones heavily involved in the AI efforts, it’s important to include the other parts of the company as well. Include in the sense that the entire organization should understand what effect AI will have on their daily work life and to which degree. Either through complementary aids or completely new opportunities, ignorance can cause problems. As such, the entire organization should be on board regarding a potential AI journey before starting to adopt, the organization should be a believer. When the adoption has begun, important measures include establishing minimum level efforts. Creating a foundation in terms of infrastructure, data, competence. Introducing AI in a singular form or through more than one process must be able to be supported. As the organization becomes more experienced and comfortable in its use, increasing foundations to facilitate for new possibilities and endeavors come into place. As experienced,

both operating projects and contemplating new ones are realistic. Finally, as a proclaimed expert, neither research, new utilization's or projects will be potentially destructive factors or limitations. Continuous improvement of existing measures while attempting new ones describes the focus going forward. The technology and the societal side coexist and are not limited by embarking on new endeavors. The organization is only limited in the cases or problems it chooses to address.

The capability maturity model

Based on its relevance and prominence in the software world, the capability maturity model (CMM) has been targeted as a means of comparison. Now functioning as a reference for comparing the results against, it will be investigated in there are lessons learned or if any similarities can be drawn between the world of software and the world of AI.

As previously stated, the aim of the CMM is to improve on existing software development processes and contribute to optimization. However, it's the notion of how a maturity model can be observed as a set of structured levels emphasizing how well the practices, behaviors, and processes of an organization can be viewed as a measurement of how an organization is equipped to meet new outcomes, which is a more applicable and interesting angle to follow going forward. How the current measurement can help and be used as aid or benchmark for understanding and comparison. An AI maturity model based on organizational utilization's should be focused on an organization's relationship and experience with the field in a more general sense. As AI-projects can differ greatly, it makes more sense to define a larger context where the influence of AI is evaluated. Therefore the maturity in this sense will describe how capable and mature an organization is in relation to AI, represented through their AI journey and adoption. With this in mind, what knowledge from the CMM is transferable?

The CMM presents 5 different maturity levels. The takeaway from the maturity structure is: Starting at an initial level, the CMM emphasizes a phase with typically undocumented processes in a state of constant change. In other words a chaotic or unstable environment for any process. Adopting a new technology can cause foreseen and unforeseen consequences, and can demand a longer adjustment period. As such it's important to acknowledge the reality of this level. The second level, repeatable, focuses on the occurrence of repeatable processes, possibly with consistent results as the name implies. The possible existence of process discipline can help with ensuring the maintaining of existing processes where it's needed. Especially the mention of disciplines coming into play, and some sort of expectation of consistent results are the key takeaways. These two being aspects wise to address, it remains to be seen if it's beneficial to dedicate an entire level to this "repeatability stage." The third level, defined, is cornered with established sets of defined and documented standard processes subject to some degree of improvement over time. Considered a developmental stage, the use targeting a wider range of conditions and user competence development, is highly relevant regarding how the process can develop to the next level of maturity. Standard processes in place to help users to become competent, or the process to be validated in a range of situations. The defined level provides a great categorization of the progress of the organization as it becomes more experienced. The entire focus of this level is highly transferable, not only developing processes, but using them to strengthen the talent foundation.

Managed is level four of the division, and emphasizes refined and adapted processes through testing in different environments. Competence has been demonstrated by users, processes can adapt to particular projects without measurable losses of quality or deviations from specifications, and process capability is established from this level. Close to optimized qualities, the points raised by this level are relevant for a more general context, detailing how the relationship with a tech-

nology or process matures and becomes managed. The fifth and last level, optimizing, details that the processes have reached a level where optimizing and continuous improvement is the focus, through incremental and innovative technological changes. Process performance is the goal through change by addressing variations in parallel with maintaining and achieving the established quantitative process-improvement objectives. Detailing the highest level of maturity, the organization has reached the level of continuously improving upon existing processes and measures in order to achieve the highest performance and fulfill established goals. This bears strong resembles the previously established last level, being a proclaimed ”expert”.

By delving deeper into the levels proposed by the CMM, it's clear that consistent priorities, definitions, and otherwise important aspects are more than applicable for that of an AI maturity model. While not limiting the focus to a process, a new and improved division of AI maturity can be presented. New and improved in the sense that the comparison between the CMM and the lessons learned throughout the study has given a better indication of both how descriptive the model should be, which levels of maturity it should emphasize, and what needs to be included in a maturity model. Thus, when proposing a learning experience leaning towards a maturity model going forward, the focus will be on five levels. This means introducing a focus on an initial phase, as well as a more representative focus on the later levels of the divisions. More representative as a better understanding of the nature of the levels and maturities involved, and has among other influencing factors affected name conventions, and the progression focus. Optimized instead of expert and managed instead of experienced, and a progression focus, more emphasis on testing and the effect a process has on the users. However, the context of adapting processes to a number of different environments and variations of those environments, will not remain a focus. The same is the case of dedicating an entire level to repeatable processes.

MHC AI maturity model

The MHC AI maturity model will be used as the benchmark and a means in terms of comparing the current effort against a published AI maturity model. With CMM already having been used as an inspiration and influenced the coming solution to a degree, it will now be investigated if a maturity model designed specifically for AI can introduce something new and determine important facts, give an indication as to if the priorities so far have been constructive, or if it provides a different take and understanding altogether.

MHC's model is comprised of four levels of maturity: assessor, tester, believer, and converted. Assessor describes an organization still in assessment mode where the adoption has not begun. Tester describes how the organization has made progress in understanding how AI can be used as an aid to achieve objectives. Potential solutions are being eyed and the organization has perhaps started with some proof of concept projects. Believer is the first section where solid progress has been made in relation to the AI journey. Along with some degree of experience and the know-how to leverage AI for single-use, gaps and limitations still exist before being comfortable with an organization-wide AI acceptance and adoption. Finally, the converted level presents an organization at the most mature level: a good level of AI expertise, the embracing of AI throughout the organization, and can point to a portfolio of use cases and functions.

The first impression is the difference between the CMM and MHC's model in terms of application. While the CMM emphasizes a live process already from the first level, MHC introduces a possible scenario in the second level, and a guaranteed one in the third. The second focus targeting the MHC is a larger amount of time dedicated to preparing for the actual journey as implementation isn't guaranteed until level 3. Due to the challenges and circumstances regard-

ing an AI-project, this should be addressed at an earlier level. With a research that emphasizes organization-wide understanding and communication as a means of success, too much of the actual introduction, implementation, maintenance, and deployment happens in the second part of the model, an aspect which should perhaps be emphasized earlier on. The MHC also lists 4 levels representative of maturity with a first level designated as an assessment mode. While a good idea to include a ”consideration stage”, when only three levels remain to emphasize the actual transformation, adoption, and testing of the journey, and the second level denotes ”the organization has made some progress in understanding how AI can solve/meet some of its strategic objectives” [52], then it becomes more difficult for an organization using the model to put a realistic ”label” on their journey, or determine which level best represents their relationship and maturity with AI. As a last remark, the MHC maturity model lists the believer level as number three on the scale. Contrary to the impressions made through the study, challenges are not limited to technical aspects, business and product development in general, and the organizational factor requires a different approach. Hence, an effort to get the entire organization on board from the beginning, and not only the technical parts, should be prioritized. Understanding and informing about expected and possible outcomes resulting from the adoption of AI should be a priority much earlier on.

Summed up, the main takeaway from the MHC's model is the focus on creating a model where an organization can assess its current AI readiness and capabilities. However, MHC's effort is at most times so general that important aspects, areas, and details are left out. Its business-centric focus has made for a ”surface-level” product that could benefit from a greater investment from technical details to organizational elaborations, even if the main goal was to highlight the importance of an organization assessing its AI maturity level before starting its AI journey.

7.2.2 The five levels of AI maturity

In the end, five levels of maturity have been decided to best represent an AI maturity model. Stretching from no experience to optimized, the model involves everything in between. The five maturity levels are:

1. **Initial** - No measures have been taken. The organization explores and may even have decided to move forward with adopting AI, but as of now, the organization has no experience on the matter.

2. **Believer** - The entire organization, technical and not, are on board and have understood what the introduction of AI can mean for future operations in terms of organizational changes. Plans, strategies, and measures are underway for how to start the AI-journey.

3. **Adopter** - The organization has officially begun its AI journey. AI has been adopted to a small degree in the form of a process/project. While AI has been officially introduced, there is still much work to be done. This is a highly developmental stage.

4. **Managed** - AI has become a standard across the organization. Either through complementing existing processes or creating completely new ones, the different solutions or projects have reached a level where AI is used in the daily operations in one or more instances to achieve organizational objectives. Managed use contributes to fewer instances of loss of quality or deviations.

5. **Optimized** - The AI processes, models, solutions, and supported decisions are continuously improved and updated. New research, utilization's, projects, or endeavors will not be potentially destructive or limiting factors. AI has become an aid for both complementing,

replacing, or creating new possibilities. The technology and the societal side coexist, and the organization is constantly adapting, only limited in the cases or problems it chooses to address.

7.3 Final reflections

Through a discussion of the knowledge and insights gained through the research and state-of-the-art, some final reflections have come to mind. Trying do define what parts and dimensions are most representative and subsequently must be addressed when talking about AI, has turned out to be a difficult task. AI are a field determined by so many different aspects, factors and even context dependent details, so a potential division had to be logical, and make sense in order to proceed. In the end, an approach towards the topic of AI maturity had all the right foundations in place, and eventually constituted the basis for the discussion.

Five dimensions have been experienced to best represent enterprise AI in relation to maturity. In addressing the dimensions of technical, data, people, societal, and responsible, a wholehearted and covering focus is gained to help an organization in its journey to adopt and utilize AI.

Five maturity levels represents the final division of AI maturity. The most representative maturity division have been experienced to emphasise the entire adoption journey, from an initial exploratory level to an optimized level where processes, models, and solutions are constantly improved and updated. Based on progress in the five dimensions of AI, an organization can move up the maturity model/scale and become more mature in the way the adopt and utilize AI.

8 Conclusion and Future Prospects

Has the research goal been achieved? Chapter 8 concludes the research project by addressing the outcomes and answers to the research questions and providing the culmination of the discussion chapter. Finally, future prospects of the research will be explored.

8.1 Towards an AI maturity model

In concluding the research and the subsequent discussion, it has been observed that a great deal of the experiences from the representatives and interviewees can be summarized in a system divided into dimensions and ”state” levels. A maturity model must naturally undergo validations and refinements, in this case with even more collaborating organizations, and both additional in-depth and follow-up interviews with more representatives from each partner. However, the dimensions and levels established and justified with this thesis constitute a good starting point, and are not so different from what is used in an (AI) maturity model, and how it’s organized. In moving towards an AI maturity model, the following organization represents the learning experience gained from this thesis.

8.1.1 Organization

The approach to an AI maturity model has been organized according to two different, but closely related aspects. A dimension aspect and a level aspect. An overview and a short presentation of each aspect follow.

The five dimensions

Five organizational dimensions have been proved to be representative of different aspects associated with an AI-project. A more concise explanation follows.

1. **Technical** - The technical dimension emphasizes what is needed to create, deploy and maintain. To support the research, development, deployment, and maintenance of AI solutions and projects, an infrastructure must be in place, both in the form of an IT or technical infrastructure (tools, hardware, and software), organizational standards and processes, and competence. It’s about finding the right foundations which in turn makes it easier to justify the use and choices made regarding adopting AI, and in what way.

2. **Data** - Data and the access to enough of the correct data in a usable quality are integral to employ AI in a good manner, along with an understanding of the process to be changed. There are many aspects to consider in terms of data, but among the most important ones are storage, active data management, a technology for handling the data, compute power, and a form of a data platform. Seeing the opportunities of new sensors and greater data, AI with the right data foundations can be a tool to get the best answer.

3. **People** - It’s people who define the type of AI put to use. A people dimension focuses on explainability, on informing and educating the entire organization of the journey to come, competence in the form of skilling and reskilling of the workforce, facilitate for diverse and interdisciplinary teams, and enable for strong communication between the different business entities.

4. **Societal** - The societal dimension emphasizes the usefulness and the benefits which an AI-project can have on an organization, and beyond. Usefulness both in a business regard and user regard. Extending beyond just economical boundaries, the dimension can emphasize values targeting different societal aspects in accordance with the changing and diverse nature of AI.

5. **Responsible** - Ensuring a safe, reliable, and trustworthy use of AI from the beginning is integral with an emphasis on ethics and explainability. Responsible AI will emphasize a utilization and adoption of AI in an ethical, transparent, and trustworthy way, as opposed to just a legal way, and an organization will in return promote responsibility throughout their AI portfolio.

The five maturity levels

The five levels of AI maturity documents an organization's relationship and capability with AI. Each level is determined by the progress across the five organizational dimensions. In order to reach a new level, progress is needed in each dimension. Below a presentation of the levels can be found.

1. **Initial** - No measures have been taken. The organization explores and may even have decided to move forward with adopting AI, but as of now, the organization has no experience on the matter.

2. **Believer** - The entire organization, technical and not, are on board and have understood what the introduction of AI can mean for future operations in terms of organizational changes. Plans, strategies, and measures are underway for how to start the AI-journey.

3. **Adopter** - The organization has officially begun its AI journey. AI has been adopted to a small degree in the form of a process/project. While AI has been officially introduced, there is still much work to be done. This is a highly developmental stage.

4. **Managed** - AI has become a standard across the organization. Either through complementing existing processes or creating completely new ones, the different solutions or projects have reached a level where AI is used in daily operations in one or more instances to achieve organizational objectives. Managed use contributes to fewer instances of loss of quality or deviations.

5. **Optimized** - The AI processes, models, solutions, and supported decisions are continuously improved and updated. New research, utilization's, projects, or endeavors will not be potentially destructive or limiting factors. AI has become an aid for both complementing, replacing, or creating new possibilities. The technology and the societal side coexist, and the organization is constantly adapting, only limited in the cases or problems it chooses to address.

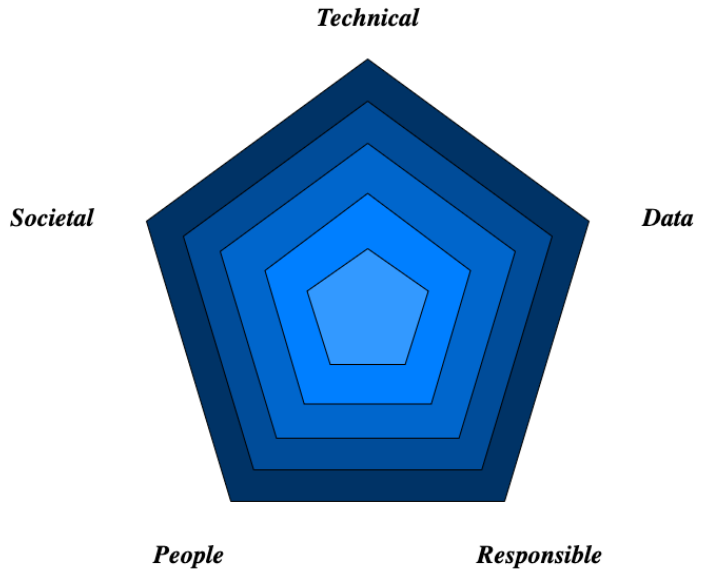

Figure 8.1: AI maturity levels and dimensions

A coarse product

Together, the five dimensions and the five levels of AI maturity constitute a coarse version of an AI maturity model or a more appropriately, an approach. **Figure 8.1** presents the culmination of the two aspects, the maturity dimensions and levels, and highlights a practical and straightforward figure. The figure consists of five different-sized pentagons, each representing a different maturity level where the smallest pentagon in the center of the figure equals level 1 (Initial) and the outermost equals level 5 (Optimized). For each angle of the pentagon, a respective dimension is featured, and each dimension is represented at each level through the angles. This way, an organization can easily determine exactly which dimensions functions as limiting factors, preventing the organization from moving up a maturity level. The model has the goal of providing an academically rooted maturity product with application areas across industries. The model can help an organization to evaluate their maturity and relationship with AI, better understand what an adoption of AI involves, what aspects must be acknowledged when targeting an AI-solution, and in general help the organization to create long-term business value. While a more coarse and rough-cut endeavor, this learning experience is a good starting point for an organizational-focused AI maturity model going forward.

8.2 Conclusion

This thesis has explored if value can be gained from comparing different industrial organizations across industries, and investigate if useful learning experiences and knowledge can be extracted from a standard approach. In addition, the research has also examined if the lessons learned could aid in defining a framework with organizational prospects. The research project has had the

benefit of having an academic foundation, helping provide a more general product without other motivations influencing the progress.

The research has also relied on state-of-the-art as an important means for discussion. Observing what sets the research conducted apart from previous research efforts, and learn from it has been an important focus going forward. Three different research questions have been attempted answered with the thesis.

RQ1 - What are the applications and underlying technologies of AI that generate value among companies?

The research has emphasized a set of different AI-technologies from the beginning, either being machine learning, deep learning, computer vision, or natural language processing. In extracting information from the interviews, the essence of the insights has involved experiences, perceptions, and knowledge based on numerous applications. The culmination of the research has involved a great number of different applications which spans a vast expanse and lacks a form of "red thread" or strong coherence covering all the interviews. Hence, the focus has been on the learning aspect and experience from the different applications, and not the applications themselves. Value can be defined differently, and mean different things to different people. A number of different themes or subject areas have been recognized as important, but for the research partners of this thesis, five stand out as central across the board. Namely *responsible use, profit, competence, explainability,* and *the complementary and aiding nature of AI.*

RQ2 - What characterizes and separates AI adoption and use across companies and across domains?

This research question has been answered through all of the conducted interviews with the different partner representatives, and is addressed through an in-depth discussion in the results and discussion chapters. Common features and differences have been observed between the partners and different organizations, and the survey has provided a synopsis better highlighting the priorities, capabilities, strengths, and understandings across the partner base.

RQ3 - How can a framework for understanding issues relevant to organizations' adoption of AI technologies be defined?

A framework emphasizing an organization's adoption of AI-technologies and how it develops over time is best represented by focusing the framework on two different, but closely related aspects. These aspects take the form of *dimensions* and *maturity levels*, the first emphasizing five unique dimensions of an AI-project, and the latter denoting five different levels of AI maturity. The details have been accounted for earlier in this chapter.

The conclusion to the research has been three-fold. First, "a coarse product" or a starting point for an AI maturity model has been developed, providing suitable foundations to build on. Second, the research has shown that it's suitable and valuable to compare organizations and businesses across industries, and third, what aspects and parts a framework targeting organizational adoption of AI should include. As stated in *RQ3*, the focus has been on defining a form of framework. The interviews and qualitative method have proved that a suitable framework in relation to RQ3 must define a set of dimensions emphasizing the important aspects, priorities, and noticeable parts of an AI-project. Hence, an approach towards an maturity model has been experienced to best represent a suitable tool to summarize the results.

8.3 Future work and prospects

In concluding the research and finalizing the thesis, new and innovative ways of continuing the research or additional research efforts spanning from the foundation established by this thesis will be presented here. The future prospects, different interesting avenues based on the accumulated results of this research can be found below.

1. **Expand on the work of this thesis**
    - Continue to research and investigate potential value perspectives and gains from comparing different industry segments.
    - Include new partners.
    - Include more representatives from current partners.
    - Continue along the same lines through the means of in-depth and follow-up interviews, and additional surveys.
2. **Develop a refined version of the AI maturity model**
    - Continue to build on the current AI maturity model by providing a more detailed and technical-emphasized version.
    - Include more partners and more representatives of each partner.
    - A testing and try-out period of the model with appropriate recipients.
3. **Provide an even more specific approach and deep-dive**
    - Narrow down the project specification and emphasize a specific approach rather than a general one. For example, through a heavy technical aspect, focusing on one AI-technology rather than the field in general, or by focusing on one industry rather than several.
4. **Expand on the work in the form of an AI framework**
    - Create detailed technical organizational guidelines and checklists for leveraging AI-based solutions to create long-term business value.

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A Interview template for the in-depth interview in Norwegian

Introduksjon
Takk, og velkommen til master intervju. Som representant for ... er det en stor mulighet og veldig spennende å kunne få inkludere akkurat ... i forskningsoppgaven. Dette intervjuet blir gjort i relasjon til et case-study i samarbeid med NTNU, som en del av Masteroppgave ved studieprogrammet Datateknologi. Denne oppgaven presenterer en forskningsmulighet hvor det er ønskelig å undersøke både verdien og innflytelsen AI kan ha i industrien, og om det er mulig å fastsette denne i en stegvis form. Med andre ord er det ønskelig å analysere transformasjonen og reisen til ... i møtet med AI, og konsekvensen det har fått for bedriften.

Del 1: Generelle inntrykk

- *Intervjuet tas opp for transkriberings-årsaker. Er du fortrolig med at intervjuet i form av lyd og video, lagres for å skape en skriftlig versjon og transkribering av intervjuet i etterkant? Alt av filer, både lyd og video, vil slettes etter at transkriberingen er ferdig.*

- *Aksepterer du, og er du fortrolig med at navn, posisjon og din tilknytning med ... vil bli inkludert og senere publisert i den kommende masteroppgaven, et produkt av NTNU og NorwAI?*

- *Hvor lenge har du jobbet i DNB, hva er nåværende stillingstittel/rolle, og hvilken avdeling tilhører du?*

- *Hvilken kompetanse innenfor AI sitter du på selv?*

- *Hvilken betydning har AI hatt for deg og din avdeling?*

- *Hvilken betydning har AI hatt for selskapet i den store sammenheng?*

  - *Litt generelt om konsekvenser?*

- *Har dere et forhold til maturity models, og er det er noe som anvendes mtp rigging for en organisasjon?*

Del 2: Fordeler, utfordringer, og fallgruver relatert til AI og selskapets historie (Generelt om AI)

- *Hvilke konkrete AI prosjekter har du vært involvert i? Ønsker å få et kort innblikk i alt fra varighet, størrelse, sluttprodukt til kostnader.*

- *Hva er merkbare endringer etter implementering av et AI-prosjekt? Både negative og positive opplevelser. Flott å ta utgangspunkt i noen spesifikke caser eller flere.*

- *Hva er opplevde eller eventuelt oppfattede fordeler som en implementasjon av et AI-prosjekt kan føre med seg på bedriftens nåværende operasjoner?*

- *Hva er opplevde eller eventuelt oppfattede ulemper du ser med det nåværende fokuset på AI i ...? Selv utenfor din avdeling?*

    - Bør et fremtidig fokus prioriteres annerledes?

- *Fortell om ... sin nåværende bruk av spesifikke og forberedte AI-teknologier, både i organisasjonen og avdelingen. Fra introduksjon til implementasjon til fungerende prosess, gjerne i form av spesifikke caser.*

- *Kan ... sin historie, erfaring, bakgrunn og "readiness" ha hatt noe å si for opplevd møte og effekt av AI, og hvordan?*

- *Hva er generell forskjell før og etter for Selskapet etter AI? Kan gjerne ta utgangspunkt i ulike avdelinger.*

    - Finnes det noen tilgjengelig data selskapet har om opplevd effekt?

- *Har verdikjeden eller BM blitt endret etter implementasjon? Er verdigrunnlaget nå et annet sted?*

- *Hvordan innså dere at dere burde ta i bruk og adoptere AI? Har det vært pga konkurrenter, nyheter eller annet. Hva var motivasjon for å bruke AI over andre ting/løsninger.*

Del 3: Et typisk AI-prosjekt
Med utgangspunkt i spesifikke cases:

- *Hva slags type AI-prosjekter holder dere på med? (Noe mer å legge til fra forrige del?)*

    - Hvilke AI-teknologier har dere vært innom?

- *Hva skal til for at et prosjekt skal ses på som "vellykket"? Altså hvor mye eller hva må prosjektet oppfylle?*

- *Hvordan kategoriserer dere et AI prosjekt, og hvilke aspekter ved et AI prosjekt må tas hensyn til?*

- *Hvilke gevinster har dere forventet og håpet på å få, og hvordan har dere gått frem for å oppnå disse? Hvilken business verdi ønsker dere å realisere og hvorfor. (Utover bare det å være kostnadsbesparende)*

- *Hvilke metoder brukes for å evaluere et AI-prosjekt? Er det en standard dere bruker?*

- *Hvilken utdanning og kompetanse-pakke sitter AI-personalet hos ... idag med?*

- *Hvilke deler av AI er mest interessant for utnyttelse, eller hvilke anser dere som mest nyttig for dere og hvorfor? Altså er det læringsapesktet, språk eller beslutnings støtte, personalisering, mønster kjennkjenning aller noe annet som er av størst interesse?*

  - Jeg vil nå introdusere noen aspekter, kunne du gitt en score fra 1 til 5(høyest), utifra opplevd nyttighetsgrad/behov i ...'s bruk av AI?

  Læreaspekt:
  Beslutnings-taknings aspekt:
  Språk aspekt:
  Personalisering:
  Klassifisering:
  Innsikt i komplekse systemer og problemer:
  Tidsserieanalyse:
  Analyse generelt:
  Etikk og ansvarlig AI:

- *Hvilke aspekt ved AI er mest utfordrende. Dette kan gå på personvern, store datavern, sanntids overvåkning, kontroversiell automatisering, filterbobler/ecokammer ved personanlisering, biased AI, sammenkobling av data osv.*

Del 4: Spørsmål relatert til "transformasjonsprosessen" . Finne ut fundament, krav og andre nødvendigheter. Hva må være på plass?
Nå er det ønskelig å få en oversikt over ulike nødvendigheter som både må og bør være på plass når det er snakk om å ta i bruk AI, og da på en god måte. Altså hvilke behov må være oppfylt. Dette ønskes gjerne sett ut ifra større "områder", vi kan dele disse inn i prosess, business, teknisk og menneskelig.

- *Hva er typisk for prosesser som både har blitt endret og er utsatt for effektivisering/endring, i denne sammenheng med AI. Både mer "åpenbare" og de ikke.*

- *Hvordan går dere frem for finne aktuelle prosesser?*

- *Hvordan går dere frem for å transformere?*

  - Er det en sjekkliste dere bruker? Gjerne ved ulike trinn i "transformasjonsprosessen"?

- *Med utgangspunkt i det menneskelige aspektet, hva er viktige pådrivere eller tilfeller, og hva bør inkluderes/involveres når det omhandler et AI-prosjekt?*

- *Med utgangspunkt i det teknologiske aspektet, et mer tungt teknologisk fokus, hva er viktige pådrivere eller tilfeller, og hva bør inkluderes/involveres når det omhandler et AI-prosjekt?*

- *Med utgangspunkt i det prosess-aktige aspektet,hva er viktige pådrivere eller tilfeller, og hva bør inkluderes/involveres når det omhandler et AI-prosjekt?*

- *Med utgangspunkt i business aspektet, hva er viktige pådrivere eller tilfeller, og hva bør inkluderes/involveres når det omhandler et AI-prosjekt?*

- *Hva er fokuset deres når et nytt AI-initiativ og innsats skal vurderes og implementeres. Er det et IT fokus eller flere/andre?*

- *Ser dere at teknologien fra en egen AI-basert løsning kan anvendes i andre løsninger etterpå? Har dere eksempler hvor dere har opplevd at teknologien kan brukes i andre løsninger og løse andre problemer?*

Kostnader, aktører, infrastruktur, og personvern:

- *For å kunne implementere relevante og aktuelle AI-teknologier, hva er nødvendige tiltak, infrastruktur eller grunnlag som må være på plass? Eks. mtp GDPR*

- *Ved implementasjon og bruk av AI, tyr DNB til samarbeid med faste aktører, tredje-parts åpne løsninger, eller utlysning ved anbud etter behov, eller er løsningen forbeholdt inhouse-utvikling?*

  - Er det typiske deler som er mer utsatt for utlysning?

  - Hvordan bestemmes det for hvilket nivå av outsourcing er nødvendig?

- *Hva er generelt de største kostnadene relatert til AI?*

- *Data er viktig, hvordan har dere bygget opp en tilstrekkelig dataplattform for å understøtte AI-løsninger? Tilgang til god, riktig, og nok data*

Del 5: Avslutning
Til slutt er det ønskelig å høre om intervjuobjektet har noe nytt eller noen endelige spørsmål/tanker eller bare meninger å komme med. Takke for tiden det har tatt, og nevne at et potensielt oppfølgingsintervju som følge av avdekkede muligheter kan forekomme.

- *Noen andre avsluttende tanker eller noe utover det vi har dekket idag?*

B Interview template for the in-depth interview in English

Introduction
Thank you, and welcome to an in-depth master interview. As a representative for ... it's a big opportunity and of great excitement to include ... in the thesis. This interview is being conducted in relation to a case-study in collaboration with NTNU as part of a master thesis at the study program of Computer science. This research project presents an opportunity to research both the value and impact of AI across industries represented through a given company's experience and history with the technology.

Part 1: General impressions

- *The interview will be recorded for transcription-purposes. Are you comfortable with the case that the interview in the form of recorded sound and video files, will be stored in order to create a written version and transcription afterwards? All of the files in question, video and sound files, will be deleted after the transcribing are completed.*

- *Do you agree to have your name, position and affiliation with the company included and published in the coming master thesis, a product of NTNU and NorwAI?*

- *For how long have you been working at ..., what are your current role/job title, and which department do you belong to?*

- *How do you classify your own background/competence or relationship with AI?*

- *What impact and significance have AI had for you and your department?*

- *What impact and significance have AI had for the company on a grander scale?*

  - *and what about general experienced consequences?*

- *Are you familiar with maturity models, and are they subsequently applied to rig for the organization?*

Part 2: Improvements, challenges, and pitfalls regarding AI and the company

- *Which specific AI-projects have you been a part of? A brief insight into duration, size, end product to costs.*

- *What are noticeable changes after implementation of an AI-project? Both positive and negatively-oriented experiences regarding one or more cases.*

- *Focusing on the improvements or perks from the implementation of an AI-project, can you mention some regarding their impact on the current operations of the company?*

- *Are there specific disadvantages or challenges resulting from the current focus on AI in ...?*

    - Should a future focus be prioritized any differently?

- *Can you provide a quick overview of ...'s current use of specific and prepared AI-technologies, preferably in the form of specific cases?*

- *What factors have been instrumental for the experienced effect and introduction with AI, and how? For example Schibsted 's history, experience, background and readiness and how they have affected the adoption of AI.*

- *What are experienced differences before and after AI? Great to focus on specific departments within the company*

    - Is there any available data regarding experienced effects which the company can provide?

- *Has the value chain or business model been altered or changed after implementation? Does the "value base" or core values now lie somewhere else?*

- *How did you realise that you should use and adopt AI? Were competition or a new technical potential deciding factors when you decided to use AI instead of other solutions?*

Part 3: A typical AI-project and its subsequent evaluation/rating
Based on specific cases:

- *What kind of AI-projects are you currently doing?*

    - What AI-technologies have you used or introduced?

- *What does it take for a project to be deemed "successful"? What must a project fulfill or achieve?*

- *How do you categorize an AI-project, and what aspects of an AI-project needs to be addressed?*

- *What profits or improvements have you expected and hoped to achieve with AI, and how have you proceeded in order to achieve them? What kind of business value have been the goal to realise, and why? (Besides being cost-saving)*

- *Which methods do you use to evaluate an AI-project? Are there a standard or set of rules you like to use?*

- *What kind of skill, competence and education, talent foundation or "package/collection" are represented at ... today?*

- *What parts of AI are most interesting for utilization, or what do you consider as most practical and useful, and why? That is, is a learning aspect, language, decision support among others, most interesting?*

  - Now I will introduce some aspects, could you give a ranking, 1 - 5, in terms of their degree of usefulness and use, based on ... use of AI? Any thoughts on this?

  Learning aspect:
  Decision making aspect:
  Language aspect:
  Personalization:
  Classification:
  Insight into complex systems and problems:
  Time series analysis:
  Analysis in general/ images, sounds etc:
  Ethics and responsible AI:

- *What aspects of AI are most challenging? Everything from GDPR, big data, protection, real time monitoring, controversial automation (weapon systems, coordination of data from multiple sources), filters from personalization (exposed to news you already agree with), biased AI and more.*

  - Should a future focus be prioritized any differently?

Part 4: Questions related to the "transformation process". Discover information regarding the foundation, demands, and other necessities. What must be in place to leverage AI?
Now it's interesting to acquire an overview of different necessities which needs and should be in

place when talking about how to leverage AI, and to do so in a good manner. This will be done by focusing on some larger "areas", namely: process, business, technical, and human.

- *What are typical or more common for processes which have been changed and which have been exposed to streamlining/improvement by the means of AI? Both more obvious processes and more discreet.*

- *How do you approach the process of finding relevant and "appropriate or susceptible" processes, operations or cases?*

- *How do you actually proceed and perform the transformation process?*

  - Do you use a checklist? Or experience a "number of steps" in the transformation process?

- *Based in the "human aspect" of leveraging AI, what are important drivers or cases, and what should be included/involved when talking of an AI-project?*

- *Based in the "business aspect" of leveraging AI, what are important drivers or cases, and what should be included/involved when talking of an AI-project?*

- *Based in the "process aspect" of leveraging AI, what are important drivers or cases, and what should be included/involved when talking of an AI-project?*

- *Based in the "technical aspect", a more technical heavy focus, of leveraging AI, what are important drivers or cases, and what should be included/involved when talking of an AI-project?*

- *What remains as the focus when a new AI-initiative and effort are to be evaluated and implemented? Is it an (IT) focus or others (revenue vs cost)*

- *Have you experienced that the technology from an AI-based solution can be applied in or for other solutions later on? Do you have examples where you have seen that the technology can be used for other solutions and to solve other problems?*

  Costs, actors, infrastructure and privacy:

- *In order to implement relevant and current AI-technologies, what are the necessary measures, infrastructure or foundations which need to be in place beforehand? For example in terms of GDPR*

- *Regarding the implementation and use of AI, does DNV tend to cooperate with standard actors, use third-party solutions or call for tenders depending on the need, or is the solution reserved for in-house development?*

    - Are some parts typically more exposed to cooperation or consulting?

    - How do you decide on the level of outsourcing which is necessary?

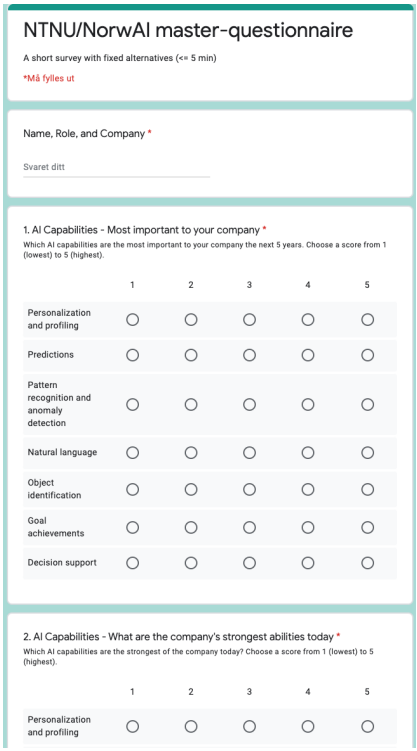
- *What are generally the biggest material costs related to AI?*

- *Data is important, how have you implemented a sufficient data-platform to support AI-solutions?*

Part 5: Ending
In the final part we listen if the interview-object has anything new or any final questions/thoughts or opinions to add as well as thanking the interviewee for participating.

- *Any final thoughts or relevant information besides what we have covered so far?*

C Questionnaire and survey



NTNU/NorwAI master-questionnaire

A short survey with fixed alternatives (<= 5 min)

*Må fylles ut

Name, Role, and Company *

Svaret ditt

1. AI Capabilities - Most important to your company *

Which AI capabilities are the most important to your company the next 5 years. Choose a score from 1 (lowest) to 5 (highest).

	1	2	3	4	5
Personalization and profiling	○	○	○	○	○
Predictions	○	○	○	○	○
Pattern recognition and anomaly detection	○	○	○	○	○
Natural language	○	○	○	○	○
Object identification	○	○	○	○	○
Goal achievements	○	○	○	○	○
Decision support	○	○	○	○	○

2. AI Capabilities - What are the company's strongest abilities today *

Which AI capabilities are the strongest of the company today? Choose a score from 1 (lowest) to 5 (highest).

	1	2	3	4	5
Personalization and profiling	○	○	○	○	○

(a)

Predictions	○	○	○	○	○
Pattern recognition and anomaly detection	○	○	○	○	○
Natural language	○	○	○	○	○
Object identification	○	○	○	○	○
Goal achievements	○	○	○	○	○
Decision support	○	○	○	○	○

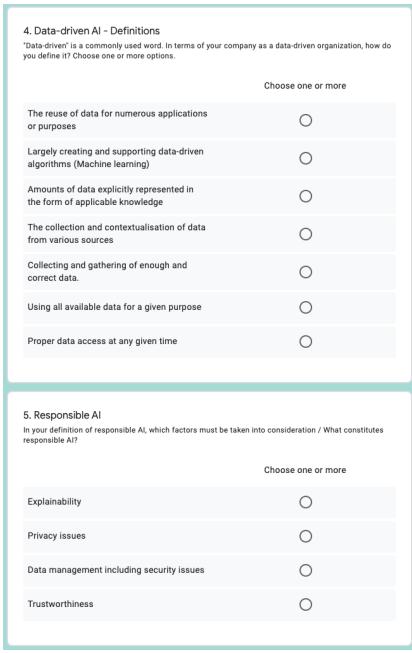
3. Critical AI Competences - Strongest areas *

What are the company's strongest AI competences today? Choose a score from 1 (lowest) to 5 (highest)

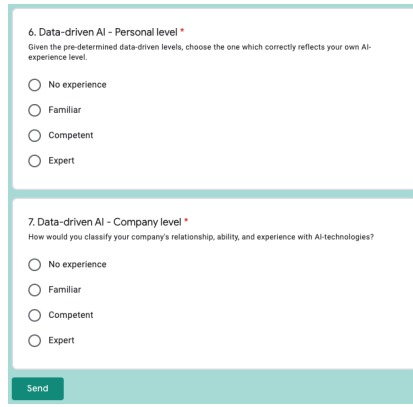
	1	2	3	4	5
Machine learning (incl. deep learning, etc.)	○	○	○	○	○
Big Data	○	○	○	○	○
Privacy regulations	○	○	○	○	○
Safety and security	○	○	○	○	○
Internet of things	○	○	○	○	○
Data mining	○	○	○	○	○
NLP	○	○	○	○	○
Computer vision	○	○	○	○	○

(b)

Figure C.1: The first and second part of the survey split into four parts



(a)



(b)

Figure C.2: The third and fourth part of the survey split into four parts

Theodor L. Holmsen

Understanding Organizations' Adoption of AI Technologies: Challenges, Opportunities and Impact

NTNU
Norwegian University of
Science and Technology