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DEVELOPING AI STRATEGY FOR HIGH-TECH INDUSTRIAL COMPANY

Master's Thesis in Technology
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ABSTRACT

Mikko Kopra: Developing AI strategy for high-tech industrial company
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A successful utilization of Artificial Intelligence (AI) technologies is closely linked to the development and implementation of an effective AI strategy. A well-defined AI strategy helps to identify and prioritize the most suitable AI use cases. This thesis is conducted as a case study for IONCOR, a high-tech industrial company in the battery manufacturing industry. It operates in a data-intensive environment that is highly promising for utilizing AI.

The objective of this thesis is to study: What factors should be considered when creating an AI strategy for a high-tech industrial company? The thesis establishes a theoretical foundation for AI strategy development with a literature review. Based on the literature review results, a seven-step AI strategy development framework was established. Main themes in the AI strategy development framework are: 1. Setting AI goals, 2. Use case identification and success metrics, 3. Data, 4. People and Skills, 5. Technology selection, 6. Risk analysis and Mitigation plan, and 7. Implementation.

To validate and improve the created AI strategy development framework, the empirical research was conducted in a case company. Data were collected through semi-structured interviews, and the results were compared with the framework that was created. Interview themes and key questions were derived from the AI strategy development framework, and the interview data were analysed using thematic qualitative data analysis. A total of eight participants were interviewed in the case company based on their experience in relevant areas. Interview results aligned well with the developed AI strategy development framework. The following are the main empirical findings combined with theory.

As the first step in developing an AI strategy, it is essential to establish AI strategic objectives in collaboration with a cross-functional team and align these objectives with the company's overall strategic goals and vision. The next step is to identify use cases that are feasible to implement and have clear business value. AI use cases should be prioritized based on value, Return On Investment (ROI), criticality, and complexity. The interview result emphasizes a focus on business value, business-critical topics, and solving business problems. The highest priority use cases should have low complexity and high value. The interview also suggested exploring whether AI presents new business opportunities. Thirdly, you need to identify the available data sources and ensure that the data is of high quality. Data must be clean, well-integrated, and easily accessible. Data security was emphasized in the interview results, along with the importance of privacy, legal, and ethical requirements. The fourth step is to evaluate the organization's current capabilities, maturity, and needed roles. Enhance the organization's AI capabilities through training and workshops. The fifth step is to do a technology selection with the help of AI experts. The main principle in selecting technology is to select off-the-shelf solutions whenever possible, as there was a clear consensus among interviewees. AI solutions should be flexible, scalable, secure, interoperable with existing systems, and upgradable to accommodate future tasks. The sixth step is to do a risk analysis. Consider the technical, security, operational and financial risks, as well as reputational, ethical and regulatory risks. The latter ones are easy to forget based on interview feedback. The final step is to create an implementation roadmap and plan how to monitor progress. An agile and iterative approach in development should always be preferred when possible.

In conclusion, this study successfully addressed the research question by providing a practical framework for AI strategy development that can be applied in the high-tech manufacturing industry.

Keywords: AI strategy, Artificial Intelligence, High-tech industry

TIIVISTELMÄ

Mikko Kopra: Tekoälystrategian kehittäminen korkean teknologian teollisuusyritykselle
Diplomityö
Tampereen yliopisto
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Tekoälyteknologioiden onnistunut hyödyntäminen on läheisesti sidoksissa tehokkaan tekoälystrategian kehittämiseen ja toteuttamiseen. Hyvin määritelty tekoälystrategia auttaa tunnistamaan ja priorisoimaan sopivimmat tekoälyn käyttötapaukset. Tämä opinnäytetyö on tehty tapaustutkimuksena IONCORille, akkuvalmistusalan korkean teknologian teollisuusyritykselle. Yritys toimii dataintensiivisessä ympäristössä, joka on erittäin lupaava tekoälyn hyödyntämisen kannalta.

Opinnäytetyön tavoitteena on tutkia: Mitä tekijöitä tulisi ottaa huomioon tekoälystrategiaa luotaessa korkean teknologian teollisuusyritykselle? Opinnäytetyö luo teoreettisen perustan tekoälystrategian kehittämiselle kirjallisuuskatsauksen avulla. Kirjallisuuskatsauksen tulosten perusteella luotiin seitsemänvaiheinen tekoälystrategian kehityskehys. Tekoälystrategian kehityskehyksen pääteemat ovat: 1. Tekoälytavoitteiden asettaminen, 2. Käyttötapausten tunnistaminen ja onnistumisen mittarit, 3. Data, 4. Ihmiset ja taidot, 5. Teknologian valinta, 6. Riskianalyysi ja hallintasuunnitelma sekä 7. Toteutus.

Luodun tekoälystrategian kehittämiskehyksen validoimiseksi ja parantamiseksi tehtiin empiirinen tutkimus tapausyrityksessä. Data kerättiin puolistrukturoiduilla haastatteluilla ja tuloksia verrattiin luotuun kehykseen. Haastatteluteemat ja keskeiset kysymykset johdettiin tekoälystrategian kehityskehyksestä, ja haastatteluaineistoa analysoitiin temaattisella kvalitatiivisella data-analyysillä. Yhteensä kahdeksaa osallistujaa haastateltiin yrityksessä heidän kokemuksensa perusteella asiaankuuluvilla aloilla. Haastattelutulokset olivat hyvin linjassa kehitetyn tekoälystrategian kehityskehyksen kanssa. Seuraavat päähavainnot olivat empiirisiä havaintoja yhdistettynä teoriaan.

Ensimmäinen askel tekoälystrategian kehitystyössä on asettaa tekoälyn strategiset tavoitteet monialaisen tiimin kanssa ja yhdenmukaistaa tekoälyn tavoitteet yrityksen strategisten tavoitteiden ja vision kanssa. Seuraava vaihe on tunnistaa käyttötapaukset, jotka ovat toteuttamiskelpoisia ja joilla on selkeä liiketoiminta-arvo. Tekoälyn käyttötapaukset tulisi priorisoida arvon, sijoitetun pääoman tuoton, kriittisyyden ja monimutkaisuuden perusteella. Haastattelutuloksissa korostettiin keskittymistä liiketoiminta-arvoon, liiketoimintakriittisiin aiheisiin ja liiketoimintaongelmien ratkaisemiseen. Korkeimman prioriteetin käyttötapausten tulisi olla monimutkaisuudeltaan mahdollisimman helppoja ja korkean arvon omaavia. Haastattelussa ehdotettiin myös, että tarkastellaan, avaako tekoäly uusia liiketoimintamahdollisuuksia. Kolmanneksi on tunnistettava käytettävissä olevat tietolähteet ja varmistettava, että data on korkealaatuista. Datan on oltava puhdasta, hyvin integroitua ja helposti saatavilla. Haastattelutuloksissa korostettiin tietoturvaa, eikä pidä unohtaa yksityisyyden, lakisääteisten ja eettisten vaatimusten merkitystä. Neljäs vaihe on arvioida organisaation nykyisiä valmiuksia, kypsyyttä ja tarvittavia rooleja. Kasvattaa organisaation tekoälytaitoja koulutuksen ja työpajojen avulla. Viides vaihe on teknologian valinta tekoälyasiantuntijoiden avulla. Teknologian valinnan pääperiaatteena voidaan pitää valmiiden ratkaisujen valitsemista aina kun mahdollista, tästä oli selkeä yksimielisyys haastateltavien keskuudessa. Tekoälyratkaisujen tulisi olla joustavia, skaalautuvia, turvallisia, yhteensopivia nykyisten järjestelmien kanssa ja päivitettävissä myös tulevaisuuden tehtäviin. Kuudes vaihe on riskianalyysin tekeminen, jossa tulee huomioida tekniset-, turvallisuus-, operatiiviset- ja taloudelliset riskit sekä maine-, eettiset- ja sääntelyyn liittyvät riskit. Kolme viimeksi mainittua riskiä jää helposti huomiotta haastattelupalautteen perusteella. Viimeinen seitsemäs vaihe on laatia käyttöönottosuunnitelma ja suunnitella, miten edistymistä seurataan. Tekoälyratkaisuja kehittäessä tulisi suosia ketterää ja iteratiivista lähestymistapaa aina kun se on mahdollista. Yhteenvetona voidaan todeta, että tämä tutkimus vastasi tutkimuskysymykseen tarjoamalla käytännöllisen tekoälystrategian kehityskehyksen, jota voidaan käyttää korkean teknologian valmistavassa teollisuudessa.

Avainsanat: Tekoälystrategia, Tekoäly, AI, Korkean teknologian teollisuus

USE OF AI IN THESIS

I have utilised AI tools in my thesis:

☐ No
☒ Yes

The AI tools utilised in my thesis and their purposes are described below:

Names and versions of AI tools: Microsoft 365 Copilot, Version 3.3.8.

Purpose of using AI tools: Microsoft 365 Copilot was used in summarizing the interview results in addition to traditional automatic transcription in Microsoft Teams application.

Sections where AI tools were used: Microsoft 365 Copilot was used for interview data collection only.

I acknowledge that I am fully responsible for the entire content of my thesis, including the parts generated by AI, and accept accountability for any violations of ethical standards in publications.

PREFACE

I want to express my gratitude to my employer, IONCOR, for making this thesis possible and for serving as the research subject for my case study. From the university side I would like to thank examiner Krista Sorri for her encouragement and guidance during the writing process. I would also like to thank my family and wife, Anu, for their support during my studies.

Pori, 15 June 2025

Mikko Kopra

CONTENTS

LIST OF FIGURES AND TABLES

LIST OF SYMBOLS AND ABBREVIATIONS

AI	Artificial Intelligence
ANI	Artificial Narrow Intelligence
CNN	Convolutional Neural Network
DL	Deep Learning
FCL	Fully Connected Layer
GAN	Generative Adversarial Network
GenAI	Generative AI
GPT	General Pre-Trained Transformer
ICT	Information and Communications Technology
IT	Information Technology
KPIs	Key Performance Indicators
LLMs	Large Language Models
LSTM	Long Short-Term Memory
ML	Machine Learning
MVS	Minimum Viable Solution
NLP	Natural Language Processing
NN	Neural Networks
OGTM	Objectives Goals Tactics Measures
OKRs	Objectives and Key Results
POC	Proof of Concept
POV	Poof of Value
RAG	Retrieval Augmented Generation
RNN	Recurrent Neural Networks
ROI	Return on Investment
SaaS	Software as a Service
SMART	Specific Measurable Actionable Realistic Time-constrained
SWOT	Strengths Weaknesses Opportunities Threats

1. INTRODUCTION

Recently, there has been considerable interest in businesses utilizing Artificial Intelligence (AI) in various applications. Particularly, the recent boom around generative AI has increased pressure on Information and Communications Technology (ICT) departments to support organizations in adopting and utilizing artificial intelligence. The industrial environment is very promising for utilizing AI because manufacturing lines and the systems that control those produce a lot of sensor and process data, which can then be utilized, for example, to optimize and improve process efficiency or quality. Several expert tasks in a company could also benefit from the use of AI. For example, how to find relevant information from ever-increasing data volumes, how to increase efficiency, and how to speed up product development are topics to which AI could provide solutions.

1.1 Background of the Research

As previously stated, there is a pull for implementing AI solutions in various organizations, but how to start your AI implementation journey in the right direction? Jumping straight into individual AI solutions is unlikely to lead to the best outcome, but it leads to fragmentation of the IT architecture, compatibility issues, an increase in support costs, and the solutions do not necessarily address the most important goals that the company is having. Getting a comprehensive picture of which areas should be invested in now and in the coming years, what things to consider, what risks to avoid, and how to get the most out of AI requires a plan. That plan is called an AI strategy.

The aim of this study is to find out how to start leveraging AI in a high-tech manufacturing company. According to Rackspace Technology (2021), to overcome pitfalls and harvest the potential benefits from AI, there is a need to put an AI strategy in place first. (Rackspace Technology, 2021, p. 8) Also, Miyamoto's (2023) research on AI governance and AI adoption suggests that the successful adaptation and utilization of AI technologies are closely linked to the development and implementation of an effective AI strategy. A well-defined AI strategy helps organizations to identify the most suitable AI applications, allocate resources optimally, and maximize the benefits from AI applications. (Miyamoto, 2023, pp. 649, 656)

1.2 Research objectives, questions and scope

AI strategy is guiding the organization to the right direction for the development and implementation of AI projects. How then to ensure that the AI strategy is focusing on the right things and it is creating an optimal business value? The objective of this study is to investigate what elements a good strategy includes in a high-tech industrial company

environment. This leads to **a research question for the thesis: What factors should be considered when creating an AI strategy for a high-tech industrial company?**

The thesis establishes a theoretical foundation for AI strategy development with a literature review. Based on the literature review results, an AI strategy development framework is proposed. The empirical research aims to validate and improve the developed AI strategy development framework in the case company. Data is collected through interviews, and the results are compared against the created framework. By combining theory and empirical findings from interviews, the aim is to find differences that might arise between theory and practice in the case company environment.

1.3 Structure of the Thesis

This first chapter of the thesis introduces the research, its objectives, and justifies the research question and the research scope. The second chapter explains what strategy is, its purpose, and the different strategy levels that typically exist within a company. Additionally, the development of strategy is discussed, with a focus on IT strategy. The elements of an IT strategy are reviewed, and two strategy implementation models are explained. The third chapter introduces the history of AI and what AI means. After this, different AI technologies, their strengths, weaknesses, and applications are reviewed. The fourth chapter presents the approach taken in conducting empirical research. The research philosophy and theory development approach are first explained. After that, the methodological choices and research strategy are reasoned. The data collection method - semi-structured interview is explained. Interview themes and key questions are presented, which are derived from the AI strategy development model. At the end of the chapter, the methodological choices used in qualitative data analysis are justified. The fifth chapter examines the actual research topic using a literature review: what factors should be considered when creating an AI strategy for a high-tech industrial company. A new AI strategy development framework will be made using a table of common factors compiled from various AI strategy development models and guides. The sixth chapter presents the results from the interview and compares them to the previously proposed theoretical framework. Finally, the seventh chapter presents the main findings and conclusions from the research topic. It states whether the research objectives have been achieved, evaluates the content of the work and its limitations, and finally, identifies any further research topics that have emerged.

2. WHAT IS STRATEGY

Strategy exists to answer the question: What is the best way for us to succeed in our chosen business in the future? (Sutinen and Haapakorva, 2021a, p. 37) Strategy defines how the company is planning to compete in its markets and what the competitive advantages are against competitors. A good strategy creates a unique value for the selected customer segment. Unique value proposition is the basis of a sound business strategy, while just targeting to be the best in the industry "*is a dangerous mindset that leads to zero-sum competition where no one can win*".(Harvard Business School, 2024) Competing to be unique means focusing on profits, meeting the diverse needs of the target customer, and competing through innovation. Competing to be the best focuses on being number one, having the greatest market share, and competing by imitation. (Harvard Business School, 2024)

There are multiple levels of strategy, including corporate, business unit, and functional levels. Corporate strategy defines which businesses to compete in, and a business unit strategy defines how to compete in each distinct industry or business. Since business units typically generate 90% or more of economic performance, their strategy is central. (Harvard Business School, 2024) The business unit consists of various functions, so the strategic direction and tasks need to be linked between functions and strategic levels. (Hill, 2017, p. 2)

Objectives are a key part of the strategy. Objectives are the targets that are achieved with a strategy. In other words, the strategy tells how the business objectives can be achieved. (Hill, 2017, p. 2)

The basis of the strategy is an understanding of one's competitiveness and the vision, how the competitive landscape, operating environment, and customers are changing in the future. (Sutinen and Haapakorva, 2021b, p. 46) In business unit strategy planning, the different options and forecasted outcomes are discussed. In addition, investments and timescales related to different objectives are also considered. The same applies to functional level strategy planning, which needs to meet the business unit objectives too. (Hill, 2017, p. 3)

Strategy is a tool for management and prioritization. Strategy should prioritize our work at the daily level. Basically, everyone has several alternative things to do in every hour than we have time to do. The task of strategy is to prioritize and focus our choices on making the most essential. Without the guiding influence of strategy, we end up doing mainly things that have an externally set deadline, instead of doing potentially more important tasks that advance strategic change. (Sutinen and Haapakorva, 2021b, p. 41)

Strategy is a decision about a certain set of changes that improves company competitiveness and takes it in the desired direction. The point is not to change everything, only selected parts, when compared to the current state. By making significant changes, the risk level increases, and accordingly, the probability of failure. (Sutinen and Haapakorva, 2021b, pp. 42–43)

2.1 Strategy development

Strategy defines the direction and implementation plan. Direction concerns the selection of markets in which to compete, understanding the competitive drivers in these markets, and how the company can influence its market position. The implementation plan responds to how the business can meet or exceed the competitive drivers, and it prioritizes where to focus its key resources: time and money. (Hill, 2017, pp. 10–11)

An organization’s mission statement clarifies its reason for existence; it defines the business in which the organization operates. Vision tells the aspiration of the organization’s future position. (David Cannon, 2023, p. 6) Sutinen and Haapakorva describe in their book two different approaches for strategy target setting: vision-driven target setting and potential-based target setting. (Sutinen and Haapakorva, 2021, pp. 51–53) A vision-driven target setting often looks for disruptive growth, and the willingness to take risks is also greater. Vision can be based on a dream to achieve or win something. Potential based target setting is more formal process with four phases: 1. understanding the current state of own competitiveness, 2. what is the future operating and competitive environment, 3. what are the choices and actions to succeed in future regarding customer segments and value proposition and 4. how to implement the selected changes and strategic projects. (Sutinen and Haapakorva, 2021a, pp. 53–59)

Business strategy describes an organization's vision, objectives, and business model, aligning the different parts of the organization to common goals, defining courses of action and resource allocation, and also outlining what the organization will not do. The success of a strategy depends on a cohesive and clearly communicated strategy. (David Cannon, 2023, p. 25) The whole organization must understand the strategy. The benefit of a good strategy is relatively scant if only the top management understands it. That is why it is important to have interactive dialogue with different organizational levels during the strategy work. The core of the strategy must be clear and simple, especially in the initial round of a new strategy; complexity and details can be introduced in later rounds. The wider the group you can connect to strategy work, the more likely the strategy will be adopted and the more likely the strategy will happen.(Sutinen and Haapakorva, 2021b, pp. 64–66)

In the strategy work, alternative scenarios should be built from the selected options. Based on different scenarios, the most probable future scenario should be identified and how it will affect the customer experience, competitiveness, and shareholder value. Secondly, different choices should be considered from the perspective of risk management. (Sutinen and Haapakorva, 2021b, pp. 117–119)

2.2 IT strategy

IT strategy must support and reflect the organization's purpose, vision, and business line strategy. The digital and IT strategy should not be considered only as the IT department's strategy, because it cannot be achieved alone without collaboration with multiple stakeholders. When the vision is defined and scoped by a team, it should be documented in the strategy. Vision should be communicated multiple times and in a variety of ways. It should be ensured that everyone understands their role within the big picture and how they contribute to it. (David Cannon, 2023, p. 6-7)

Elements of the strategy document consist of seven different topics, which are described next. In the case of functional strategy, the vision and purpose statements must show how they support the enterprise-level vision and purpose**.** In the scope and authority part, it should be clearly stated which parts of the organization are included or excluded. The context should summarize the findings and recommendations of strategic assessments. It should describe the internal and external environments, target state, the opportunities it seeks, and the challenges to overcome. Objectives and Key Results (OKRs) are listed, which the strategy aims to achieve. Budget and investment should show the total investment expected for the strategy, and possible conditions and constraints. The principles used should be written down, which were used when the strategy was defined; this also forms the basis for decisions when implementing the strategy. The strategy document should give an overview of the key organizational capabilities and current maturity. A roadmap defines the strategic objective, the major milestones, and the initiatives involved in implementing the strategy. And lastly, the initiative overviews are described in the strategy document, but detailed plans are not presented here. (David Cannon, 2023, pp. 9–10)

The IT strategy describes how the IT department supports the organization's business goals. It defines which technology will be used in operations and how the technology outlined in the strategy can be utilized. The IT strategy describes the introduction of new technology and takes a position on the role of technology and service providers.(David Cannon, 2023, p. 27)

IT function should know what other business functions intend at a strategic level. One way to do this is to start a discussion with other functions about the most important business needs and opportunities that they have identified. Discussion between the IT and other divisions should focus on actual business needs rather than IT technology aspects. IT can then determine how other functions' needs can be addressed. A good way to get feedback for strategic objectives is to use SWOT analysis (Strengths, Weaknesses, Opportunities, Threats), which is used to identify the strategic themes that have the potential for strategic objectives. In SWOT analysis, the first two dimensions evaluate the current Strengths and Weaknesses of the company or function, so the focus is on internal issues. In SWOT analysis, the third and fourth dimensions look externally and toward the future: what are the Opportunities the company or function may exploit, and what are the Threats that could cause problems to the company in the future. When SWOT is ready, it gives input for creating objectives and Key Performance Indicators (KPIs) for them. (High, 2014, chap. 4)

2.3 Strategy implementation models

There are many different strategy models that can be used, but it is essential that within an organization, the same format is in use. A consistent format makes comparison easy between the plans. The more inconsistent these plans are, the more difficult it is for the IT leadership team to interpret these plans and prioritize the IT activities. (High, 2014, chap. 2)

2.3.1 OGTM model

The OGTM strategy model comes from the words of Objectives, Goals, Tactics, and Measures. In this model, the objective is any of the organization's or function’s major objectives for the strategy period. These objectives are developed with a long-term horizon in mind. There should not be too many objectives because those objectives should focus the organization's activities. Goals in the OGTM model are metrics that measure the success of the set objective. Each goal should meet the SMART-criteria (Specific, Measurable, Actionable, Realistic and Time-constrained). Tactics are the actions to execute the objective and goal. There can be several tactics that help the organization to reach its goals. M-letter from OGTM comes from the word Measures. Measures are the metrics that qualify success in achieving the tactics. So, both Goals and Metrics are the KPIs for objectives or Tactics. Ideally, each division head should have their own OGMTs, which are aligned with corporate or business line-level OGTMs. IT can then make their own OGTMs, which align with the tactics and measures of the other divisions. (High, 2014, chap. 2)

2.3.2 OKR model

The Objectives and Key Results model is another tool for strategy development, especially in the implementation phase. In the OKR model, the Objective means a qualitative and inspiring goal. Key Results are measurements for objectives; those are quantitative and measure whether the objective is achieved or not. One objective can have multiple key results activities. Objectives can be active for more than one quarter, but they need to be evaluated quarterly and related key results reformulated if needed. There should not be more than a maximum of five objectives at the same time to keep focus and priorities correct. Objectives should be goal-oriented, transparent, and relevant. Often, the objectives and especially the key results are set by the team. This also strengthens everyone's commitment to the goals. (Sutinen and Haapakorva, 2021, pp. 185–188)

When objectives are defining the direction, the key results are measuring the progress of the target. Key results should be achievable during one quarter to keep it dynamic and interesting. It's recommended that one objective is to have at maximum five key results. The key results must meet the SMART-criteria (Specific, Measurable, Achievable, Relevant and Time-bound), as is the case with the objectives of the OGTM model. (Sutinen and Haapakorva, 2021, pp. 188–189)

What is specific in OKR, it's very time focused and it effectively structures what is important to be done in a goal-oriented and measurable way. OKR brings the strategy closer to daily work, it is highlighting what is important just now and how different initiatives or actions are connected to common objective. (Sutinen and Haapakorva, 2021, pp. 185, 190)

3. ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is defined by the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) organizations as follows: "*AI is a technical and scientific field devoted to the engineered system that generates outputs such as content, forecasts, recommendations, or decisions for a given set of human-defined objectives."*(ISO/IEC, 2022, p. 7) Through interdisciplinary efforts, AI systems are developed to handle tasks that conventionally require human intelligence. AI uses techniques from different fields like computer science, mathematics, linguistics, economics, philosophy, and cognitive science. Typically, the AI system has some of the following characteristics: it's interactive based on input, it can utilize multiple data sources contextually, AI systems should operate under human oversight, and it can utilize dynamic, real-time data and update its operations based on new data. (ISO/IEC, 2022, p. 17) From a technological point of view, AI is programming, mathematics, and statistics. From mathematics and statistics, it uses matrices, vectors, derivatives, and probability calculations. This knowledge helps to understand which kind of problem can be solved with AI. The fundamentals of AI are straightforward mathematical concepts; however, understanding them becomes complicated once they are applied in practice. Computers are quick to calculate multi-level and multi-dimensional variables. For humans, it's difficult to understand more than three-dimensional space, but for AI, there can be an unlimited number of dimensions in theory. (Kananen, 2019, p. 27)

3.1 History of AI

The first use of the term AI goes back to 1956 when John McCarthy, assistant professor of mathematics at Dartmouth College, hosted a research project on Artificial Intelligence. The eight-week conference focused on evaluating the limits of computer performance, flexibility, and capabilities in comparison to the human mind. Covered topics included natural language processing, neural networks, abstraction, creativity and the theory of computation. A total of 20 of the nation's leading computer and behavioural scientists participated in the conference. (Sahota and Ashley, 2019, chap. 2)

In the 1960s, the U.S. Department of Defence created the Advanced Research Projects Agency (ARPA) to direct and fund cutting-edge scientific research projects related to AI, but also computer technology and networking, like Advanced Research Projects Agency Network (ARPANET), the predecessor of the internet. This group, which was later renamed as the Defence Advanced Research Projects Agency (DARPA), became a major supporter of artificial intelligence research. However, in the mid-1970s, the funding for AI

was reduced due to the failure to put theories into practice, due to the limitations of computer technology. This was the beginning of the so-called first AI winter. (ISO, 2024; Sahota and Ashley, 2019, chap. 2)

In the 1980s, when computing power was rising and costs were decreasing, the most remarkable progress was seen in expert system software, which was a decision-making tool based on large datasets. Banks, manufacturers, financiers, and other companies were making decisions and forecasts based on data stored in mainframe computers. By the late 1990s, due to increased computational power, AI was spreading into many different areas like data mining, marketing, logistics, and medical diagnosis. (Sahota and Ashley, 2019, chap. 2) The second AI winter occurred in the late 1980s and lasted until the mid-1990s. But the AI boom was recovered by the arrival of the internet and the rise of big data. (Herremans, 2021, p. 2)

One of the most visible AI milestones of the 90s was the victory of IBM's Deep Blue chess computer against world chess champion Garry Kasparov. This was a significant demonstration of the potential of artificial intelligence systems. Next time when the AI was beating the human in television was in 2011 in one of the most famous answer and question game, Jeopardy! This was done by IBM's Watson AI program, which was showcasing how the AI can understand natural language. In 2012, the deep learning AI boom started, which was based on a neural network idea that mimics the functioning of the human brain. (ISO, 2024) Something more impressive happened in 2016 when the AI program AlphaGo won against the legendary Go player Lee Sedol. Go is said to be a much more complex board game than Chess. In the Deep Blue case, the AI program was taught to play chess, and the AlphaGo program learned to play Go. This self-learning was possible with a deep learning neural network approach. (Sahota and Ashley, 2019, chap. 3)

From 2017 onwards, with the help of deep learning and increased computing power, there has been rapid development in Natural Language Processing (NLP), machine vision, robotics, and autonomous systems. 2023 was the year of the rise of Large Language Models like General Pre-Trained Transformer 4 (GPT), which demonstrated AI's ability to communicate with natural language via a chatbot-type user interface and assist with a wide range of tasks. In 2024, new multimodal AI systems enabled the handling of various kinds of data, including text, audio, images, and video. AI assistants can assist in a wide variety of tasks and are capable of contextual conversations. (ISO, 2024)

3.2 Operating principle of AI programming

Traditional rule-based programming works with inputs given to the program and rules define how the data is processed. A computer program, after that, produces output or

answers based on set rules. In certain cases, like in simulating natural language, it has been found that it is practically impossible to write the necessary number of rules. So, more efficient ways to handle big amounts of data have been developed. In AI-based programming, rules are not pre-set, but an AI algorithm finds the rules based on given data and already known answer pairs. The AI algorithm will be trained so that it gives a correct answer from new data with the help of already generated rules. AI gives answers with probabilities, and the more data there is, the more accurate the forecast. Because AI is based on statistical probabilities, it can also give a wrong answer in a single case. AI can handle a massive amount of data quickly. In the real world, the observed data is often non-linear, which AI can handle too, in addition to linear data. The AI specialty is that it can find properties from non-linear data that are not obvious to humans. Deep neural networks are cost-efficient when compared to other systems for dealing with non-linear data. (Kananen, 2019, pp. 29–34)

3.3 Strong and weak AI

Current artificial intelligence algorithms are programmed by humans. If something changes in AI's operating environment, it causes problems for the machine, and it needs retraining and guidance. Machines are good at finding regularities and patterns in data and making predictions based on them. However, it is difficult or even impossible for the AI to understand the contexts and entities. This is why the current AI systems are called weak or Artificial Narrow Intelligence (ANI). It is only able to do precise and clearly defined tasks. AI could be called a strong AI if it were able to describe the relationship between cause and effect unambiguously. It should be able to independently answer the question "why", not only "what" or "how", as ANI is capable. Strong AI is also known as Artificial General Intelligence (AGI). Theoretically, it would be able to do a broad range of tasks with good enough performance. A strong AI is still purely speculative, and it remains the goal of researchers and developers on the horizon. (ISO, 2024; Kananen, 2019, pp. 40–41)

3.4 Different AI Technologies

AI consists of multiple different technologies, and there is no single general AI technology that can solve all problems. Figure 1 presents a holistic view of the artificial intelligence (AI) landscape. (Hanassab et al., 2024, p. 2)

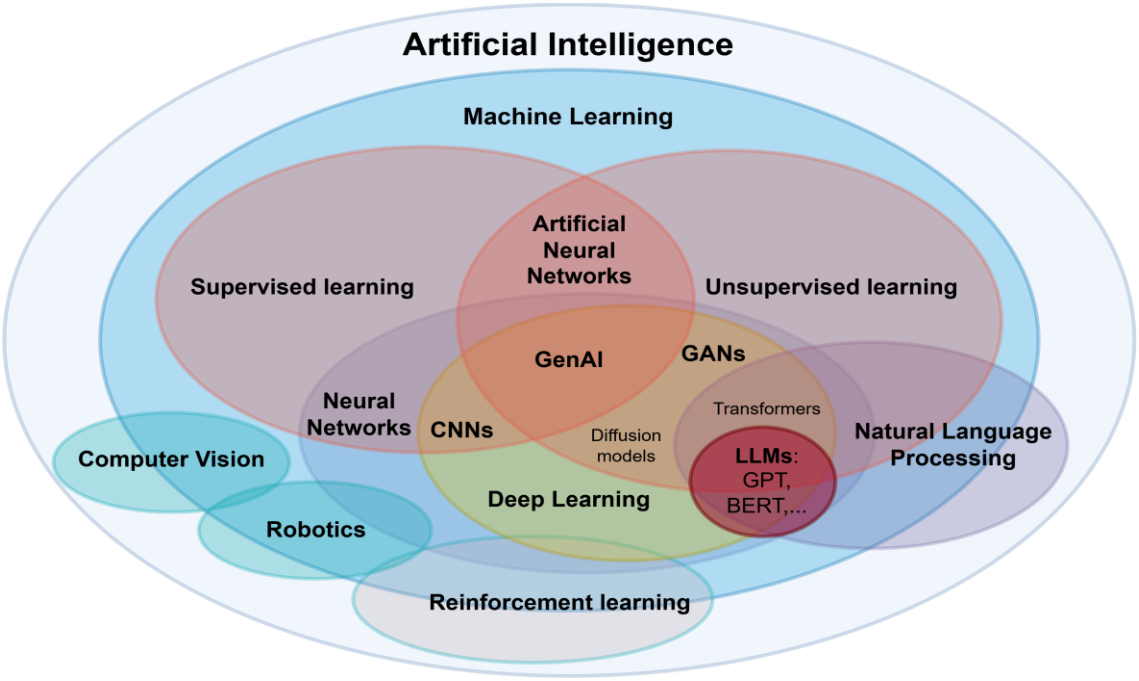

Figure 1. *Artificial Intelligence landscape (adapted from Hanassab et al., 2024, p. 2; Samala et al., 2024, p. 4)*

One way to structure the AI technologies is to look at how the AI is taught. Machine Learning (ML) algorithms can be taught with supervised learning, unsupervised learning, or reinforcement learning. In supervised learning, neural networks and machine learning methods are used. Unsupervised learning typically uses machine learning methods. It is also common to use multiple methods together when it is called semi-supervised learning. Figure 2 on the next page presents different artificial intelligence teaching methods and typical applications.

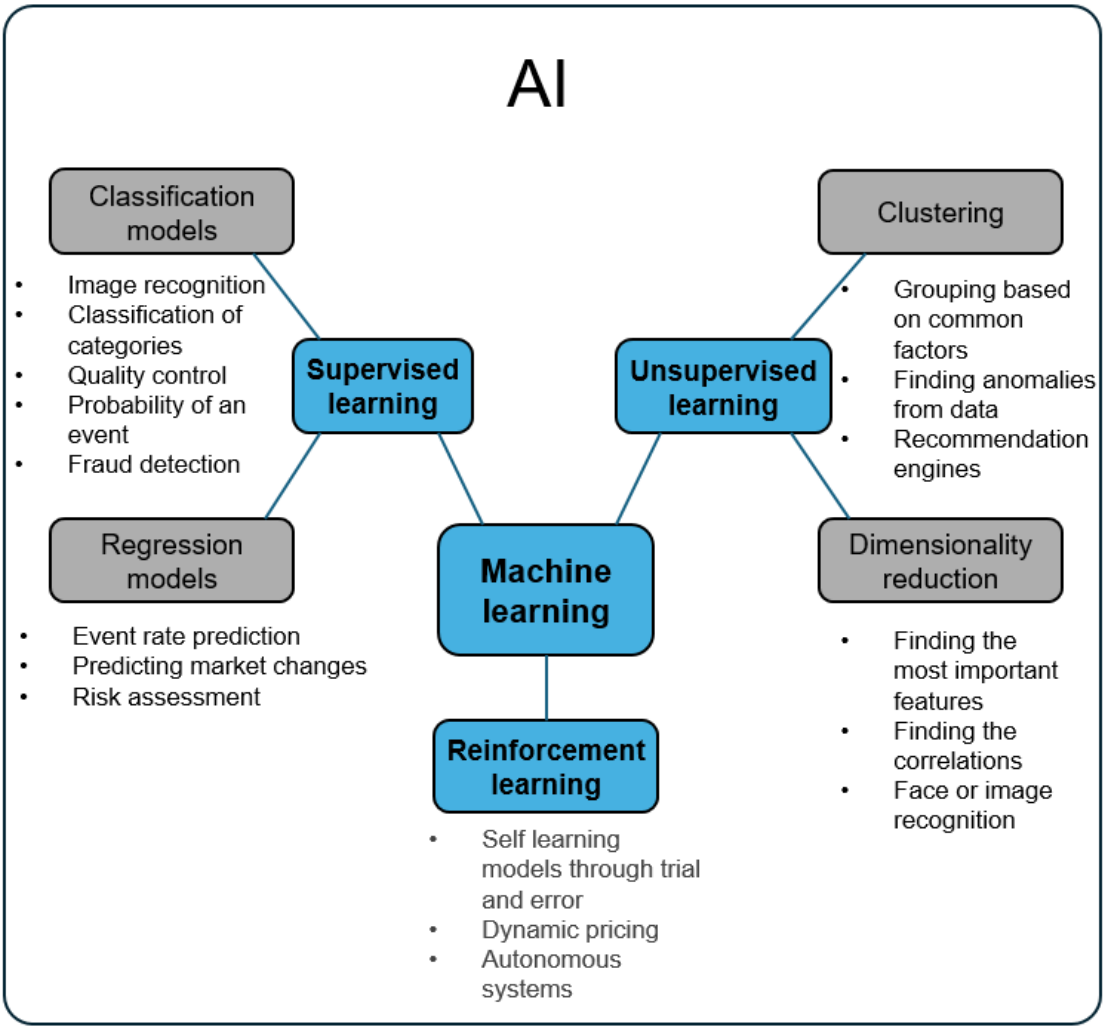

Figure 2. *Three ways to teach AI and typical use cases (adapted from Kananen, 2019; Mishra, 2024, p. 128)*

Both supervised and unsupervised learning need significant amounts of data, unlike reinforcement learning, because it can learn by doing with the trial-and-error method. Although no data is needed for reinforcement learning, the operating environment needs to be modelled. (Kananen, 2019, pp. 43–44)

3.4.1 Machine Learning

As stated earlier, there are three different kinds of machine learning algorithms groups based on their teaching methods and purpose. In supervised learning, the algorithm learns from example data and related target responses, such as classes, tags, or numeric values. Based on the patterns in the training data, the algorithm then tries to predict the classifications of new data. Examples of supervised learning techniques are regression analysis, logistic regression, decision trees, random forest, and support vector machines. (K. and Rodriguez, 2024, chap. 1)

Supervised learning can be divided into classification models and regression models. Classification models predict the probability of a certain event and often answer whether

something will happen or not. A classification model can also predict classes, such as customer age groups. (Kananen, 2019, chap. 3) A regression model target is a numeric value. An example of this is the average prices of houses in a particular area. Some real-world applications of supervised learning include recommender systems, image detection and recognition, chatbots, machine language translation, speech recognition, and autonomous driving. (Mueller and Massaron, 2022, chap. 9)

In unsupervised learning, there is no right answer to what the model is trying to represent. Data is given to AI, and then the ML algorithm detects patterns i.e. regularities, from it without any human intervention. This is useful for providing insights from original data and inputting into supervised ML algorithms. AI can detect patterns or connections in data that may not be easy for humans to see. Examples of unsupervised learning methods include grouping, anomaly detection, clustering, autoencoders (which are used in neural networks), and principal component analysis (a linear dimensionality reduction technique to find main components from data). (K. and Rodriguez, 2024, chap. 1; Kananen, 2019, p. 51; Mueller and Massaron, 2022, chap. 9)

In reinforcement learning, the algorithm gets the data without correct answers or labels, like in unsupervised learning, but the ML model gets positive or negative feedback from the result the algorithm proposes. The ML model is learning by the trial-and-error method. The algorithm is trying to get as many positive points as possible from success and avoid negative points from errors. One example of reinforcement learning is that computers can learn to play video games by themselves. (Mueller and Massaron, 2022, chap. 9)

It’s essential to understand in what kind of situations specific ML techniques are suitable and what kinds of business problems they can solve. From a business point of view, machine learning can be utilized for five different use cases. 1. Regression analysis – the relation between two variables, what happens to one variable when the other changes. Forecast based on a linear regression model. 2. Classification– into which category a single observation belongs. Classification problems can be used to address, for example, “yes or no” questions. 3. Clustering – an algorithm looks for independent groups and similarities in sample data. 4. Ranking – the relative importance of an issue or observation in relation to others. It can be used in search engine optimization or in recommendation services. 5. Generative algorithms are utilized to create content such as text, images, and music. (Kananen, 2019, pp. 113–117)

3.4.2 Neural networks

Neural Networks (NN) derive their inspiration from how the brain works. Neural networks are effective in analysing non-linear data with large amounts of different terms, which are

difficult to solve with traditional mathematical methods. (Kananen, 2019, pp. 127–128) Deep Learning (DL) utilizes multilayered neural networks to analyse data, and it is a subtype of machine learning. It is good at detecting patterns, recognizing images, doing machine translation, and speech recognition. One benefit of DL networks is that it is learning from data, which increases DL algorithms' accuracy and efficiency over time. The other benefit is its flexibility to be reused for different object recognition problems, you can reuse the majority of layers and modify only the final output layers. (K. and Rodriguez, 2024, chap. 1; Mueller and Massaron, 2022, chap. 11)

A neuron, also known as a unit, is the core of a neural network algorithm. Neurons form an interconnected structure that makes up a neural network. Neurons get input from other neurons, and neurons' output works as an input for neurons in the next layer. There are no connections between the neurons in the same layer, only with the next layer. (Mueller and Massaron, 2022, chap. 11) In Figure 3 below, there is a schematic representation of a simple neural network. (Kananen, 2019, p. 129)

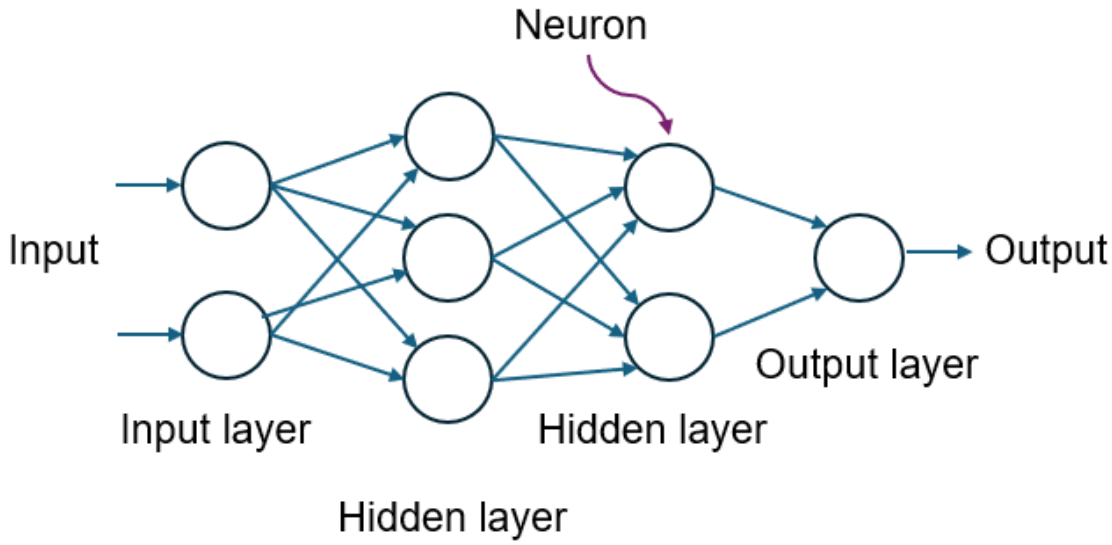

Figure 3. *Neural network architecture (adapted from Kananen, 2019, p. 129; Mueller and Massaron, 2022, chap. 11)*

In advanced neural networks, the types of layers and the number of parameters must be determined. The best architecture of a neural network cannot be determined, and the development of a neural network requires experiments with different solutions to test whether the output data matches the target values. In the training phase of the NN, the values of the weighting factors are changed so that the known value and the calculated value are as close as possible. (Kananen, 2019, p. 136; Mueller and Massaron, 2022, chap. 11)

The so-called intelligence of the neural network comes from the weighting coefficient values of neurons. The higher the weighting factor is between the neurons, the more the property in question affects the phenomenon under study. (Kananen, 2019, p. 129)

Weight is a measure of connection strength between the neurons. If the weight of the connection is weak and the signal goes through it, the signal is likely to be dumped and not affect the result or prediction of the model. Neural networks consist of activation functions, which are key components in deep learning networks. Activation function in each neuron decides if a certain threshold is exceeded to send the output. If the threshold is not achieved, the signal is attenuated. Neural networks learn with the trial-and-error method. When the algorithm gets an example and doesn't get the right answer, it tries to solve the problem by changing the existing weights of the system using backpropagation. The same calculation process is performed several iterations until the network is correctly weighted and the neural network learns to give the correct answers. (Mueller and Massaron, 2022, chap. 11)

It is important to note that a deep learning network does not understand anything. It uses mathematical principles and a massive number of examples to derive statistical pattern matching. NN can give a wrong answer if the investigated data object differs remarkably from the training data, but NN can also be taught to detect these cases. Deep learning networks can be seen as a way to memorize data and then retrieve relevant info from it by using the similarity between the actual problem and the memorized one. (Kananen, 2019, p. 140; Mueller and Massaron, 2022, chap. 11)

3.5 Generative AI

Generative AI (GenAI) refers to a subset of AI technologies that uses natural language processing, machine learning, and deep learning models to generate unique content like text, audio, images, or video. Examples of GenAI technologies and models are Natural Language Processing (NLP), Large Language Models (LLMs) like Generative Pre-trained Transformer (GPT) and Bidirectional Encoder Representation from Transformers (BERT), Convolutional Neural Network (CNN), Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM) and Generative Adversarial Networks (GANs). (Baker, 2025, chap. 1; Mueller and Massaron, 2022, chap. 11) Generative AI models learn from huge amounts of training data by identifying the patterns, structures and relationships. (Baker, 2025, chap. 1; Stryker and Scapicchio, 2024) By using knowledge of the statistical distribution of data, it is possible to create new content that is statistically similar to the training data. (Hagos et al., 2024, p. 3) According to Baker (2024) "*a GenAI output is the model's best prediction of what you are seeking*" and the "*GenAI predicts what letters, words, or images are likely to follow those that are in your prompt.*" The model's prediction is based on comparison to patterns that exist in its training dataset. (Baker, 2025, chap. 1)

Convolutional Neural Networks are specialized to detect edges and shapes from images. CNN algorithms can handle the object variation in images like different sizes, distortions and positions. (Mueller and Massaron, 2022, chap. 11) CNN uses convolutional calculations where the image matrix is multiplied by a filter, also known as a feature detector matrix, which is then slid over the image to get a feature map of the image as output. Various filters can identify distinct features within an image, such as edges, lines, or curves. The more filters are used, the more image features are extracted. Next steps in CNN image processing are non-linearity operations, which remove negative pixels from the feature map and pooling, which reduces the dimensionality of each feature map. First, the previous steps can be run again on the output of the first pooling layer and that way extracting the useful features and reducing the dimensions of the input image. The last step in this process, in a Fully Connected Layer (FCL), is to classify the found image features into various classes based on the training data. If a CNN is trained to find four different objects in an image, the outputs of the FCL are the probabilities of each object appearing in the image. (Ujjwal, 2016) In the year 2017, the best algorithms had 97,3% accuracy in predicting images, which surpasses human capabilities, because humans make mistakes in classification work. With CNN, you need to remember that the result can be changed significantly by adding certain noise to the image or changing a single pixel in it. Hence, you cannot fully trust it. (Mueller and Massaron, 2022, chap. 11) CNN networks can be used in many image-analysis tasks like face recognition or handwriting reading. Image processing programs can delimit objects from the image. In industry, surface quality controls are a very common application. Training of CNN networks requires a massive amount of image data, but there is a possibility to buy ready-trained CNN networks as a SaaS service from the internet. (Kananen, 2019, p. 154)

CNNs are good at recognizing patterns but they cannot recognize the sequence in which patterns appear. For sequence recognition you need to use Recurrent Neural Networks. A few examples of RNN applications are text autocompletion and digital assistants. RNN's limitation is that it needs a large amount of data to learn, and it cannot remember information that appeared earlier in a phrase. To solve memory limitations and multiple relations of words in a phrase, the Long Short-Term Memory and the Gated Recurrent Unit (GRU) neural units have been developed. (Mueller and Massaron, 2022, chap. 11)

Generative Adversarial Networks represent another kind of deep learning technology that relies on using previous examples for rule-making. GAN can create a new image based on the dataset it has with the help of two competing neural networks. Another neural network called Generator takes random input and generates an output image. Another neural network called Discriminator, tries to correctly distinguish the fake images of the generator. Generator learns from mistakes and improves to avoid detection by the

discriminator. Applications for GANs are creating photo-realistic images of objects, modifying existing images or generating movement from static photos. (Mueller and Massaron, 2022, chap. 11) GAN-networks can be used for instance to circuit board design, visual design of computer games or image generation based on text. (Kananen, 2019, p. 156)

Natural Language Processing is a combination of machine learning and deep learning. NLP refers to the machine processing of both written and spoken language, along with text categorization, creation and discussion. Since language processing with traditional machine learning has too many different grammar rules and exceptions to consider, statistical methods have been sought to help with the situation. With a classification problem approach, the text is converted into vectors. The algorithm calculates the position of each word, the distance between them and how many times a certain word occurs. Based on this information, the machine can generate or translate language. It needs to be remembered that for machines, reading comprehension, double meanings and dialogue are still difficult. A machine cannot understand the cause-and-effect relationships, but it is extremely efficient at handling large masses of text and searching for information from them. The best results are achieved when the machine is trained with contextual data; if it has been trained with data from different domains, the results may not be as good. NLP is not faultless, and you should always consider the benefits vs. risks of using it. NLP models are often taught with supervised learning, and the data needs to be annotated. Also, one challenge is that the amount of required training data is large. That's why the data collection and annotation is the most laborious work phase in NLP development. (Kananen, 2019, pp. 141–145)

The development **Large Language Models** in recent years has marked a new era in NLP in terms of new capabilities and wide-ranging applications of it. LMMs have a significant role in generative AI due to their ability to understand and generate human language. LLMs are capable to process and analyse a large amount of data to solve problems. Applications of LLMs are, for example, Natural Language Understanding (NLU), text summarization, text translation, question answering, code generation, chatbots and even Automatic Speech Recognition (ASR). The growth of computing power and the explosive growth of the amount of available data have enabled the rapid development of large language models and Generative AI. The more training data available, the better the performance of the LLM is. The latest LLMs, such as Generative Pre-trained Transformers (GPTs), use a transformer architecture that surpasses the capabilities of RNN or LSTM architectures in being able to learn long-range dependencies from text and generate consistent and meaningful output. Also, training of transformer models is much faster due to its innovations. (Hagos et al., 2024, pp. 1–2)

In 2017, Ashish Vaswani described the first time a transformer model in the paper “Attention is All You Need”. This paper is considered as a major milestone in the training of LLMs because the transformer model has quickly become a fundamental method in natural language processing (NLP). Transformer models are used in most of the modern generative AI tools like OpenAI’s ChatGPT, Microsoft’s Copilot and Google’s Gemini. Transformer models use an attention concept to determine the most relevant parts of data within a sequence. Self-attention mechanisms calculate weights for every word or token in a sequence, indicating how they are related to every other word. This enables the model to predict which words are likely to be used in a sentence (IBM, 2023) Self-attention mechanics allow the model to handle long-range dependencies between distant words in a sentence, which is important in text summarization and translation. (Hagos et al., 2024, p. 9) Another major innovation in transformer models is positional encoding. In positional encoding, a unique number is assigned to each word in a sentence. This enables the model to process entire sequences of data rather than individual words. So, with the help of transformer architecture, the GPT model can predict the next word in a sequence and learn how words are typically used in language.

All this is possible after training the foundation model with huge volumes of raw data, tuning, fine-tuning and using Reinforcement Learning with Human Feedback (RLHF). Training of foundation models is time-consuming and computationally intensive, which can cost millions of dollars. Therefore, the tech giants are mainly developing the LLMs. Developers and experts are focusing on choosing best fitting GenAI model, fine-tuning the model or improving the AI model performance with the Retrieval Augmented Generation (RAG) method. (Stryker and Scapicchio, 2024) RAG framework is a tactic to improve foundation model output accuracy, relevancy and reliability. It extends the GenAI model to use the most relevant data source for the organization in addition to training data. GenAI models are typically trained on broad data sets, and additional data sources might be needed when operating within specialized, highly technical subjects, and when there is a need for high-quality data. (Baker, 2025, chap. 1,8)

3.6 GenAI common limitations, problems and flaws

Even the latest GPT models have similar flaws to earlier GPT models. GPT models can hallucinate facts and generate false information. Hallucination in this context means that the GPT output seems plausible, but it is nonsensical or inaccurate. OpenAI claims that, in their internally adversarial-designed factuality evaluation, the GPT-4 model scores on average a little under 80% accuracy, where 100% means complete agreement with human ideal responses. (OpenAI, 2023) Sometimes, GPT can create an entirely fictional report, reference or statement as an answer. One way to mitigate inaccurate output is to set preventive measures like guardrails, which restrict the model to trusted data sources.

A continuous model evaluation and fine-tuning can reduce this problem, too. This is one reason why, in critical operations, there should always be a human in the loop for output validation when GPT is used. Another challenge is the inconsistent outputs resulting from the probabilistic nature of GenAI models. With the same input, you can get different outputs from GenAI. The generative model can give biased, unfair or offensive content as a result due to the potentially biased training data the model is taught. Focusing on high-quality training data is preventing this challenge. (Stryker and Scapicchio, 2024)

Generative AI can potentially be misused by creating fake identities, phishing emails and AI-manipulated images, video or audio content for criminal purposes. An AI model can also leak private or sensitive information from a massive training dataset, or the prompt data can leak to other users if that is not technically prevented. One challenge is also GenAI explainability, because many AI models are “black box” models. It’s impossible to provide a meaningful explanation of how a deep learning neural network arrives at a decision due to the complexity of the system. (ISO/IEC, 2022, pp. 29–30; Stryker and Scapicchio, 2024)

The following flaws are typical for GenAI models. 1. Models are working well with data that is of a similar type to training data, but they can struggle with generalization in unseen scenarios. One example is that the model cannot generate a picture of a fox because it was trained only with images of cats and dogs. 2. GenAI can also be very sensitive to input. A minor change in input can make a big change in output. 3. Models can overfit, which means that they are too tailored to the training dataset. This leads to a poor performance with new data because it can detect false patterns from noise. 4. GenAI models lack proper comprehension, which can lead to nonsensical responses. (Baker, 2025, chap. 6)

3.7 Different applications of Artificial Intelligence in manufacturing

Sahota and Ashley (2019) state that no matter which industry you are in, there are possibilities to take advantage of AI. Why the AI has not been a breakthrough in small businesses is mostly due to money. The minimum price to get started can be as high as 100 000$ to develop a dedicated AI, but SaaS services with monthly fees are making deployments cheaper. A few examples where AI can be applied in manufacturing are supply chain planning and logistics - to estimate demand & supply and optimize inventory turnover, predictive maintenance – with the help of sensor and process data to plan preventive maintenance, and business intelligence to detect data anomalies and analyse key metrics. (Sahota and Ashley, 2019, chap. 13) Rashidi (2024) lists manufacturing use cases, in addition to predictive maintenance, including AI-powered robotics and AI-assisted quality control and visual inspection. In the Environment Health and Safety (EHS)

area, the potential places for AI are hazard identification and monitoring: AI models can leverage data from various sources like workplace cameras and air quality sensors. The procurement department can utilize AI for contract analysis, and human resources can utilize Chatbots for employee questions. IT service desk or customer service can faster solve customer problems by utilizing the knowledge databases with GTP models. Sales can also save a lot of time with GenAI tools in customer calls and follow-ups, sales presentations and personalized sales messages. The list basically continues to any function in the company. (Rashidi, 2024, chap. 7)

Gartner (2013) studied generative AI use cases for manufacturing. A total of 21 prominent use cases for GenAI were evaluated against use case value and feasibility, and five use cases got the best rating with high value and feasibility. In order of preference, the use cases were data insights (from internal and external data), AI image generation (product design, content management and package design), material processing efficiency in production (Overall Equipment Effectiveness), avatar generation (for marketing) and mechanical design optimization. (Eichhorn and Aggarwal, 2023)

When thinking of an AI solution, it needs to address a real need that businesses are willing to spend money to obtain. To be cost-effective, the solution must either cost the same or less than current alternatives unless it offers superior benefits. Results of an AI application must be reproducible, even if the circumstances change − people often expect that AI can adapt to changes, which is not always the case. The AI solution needs to be resource efficient and fully address the need, because business is extremely focused on performing tasks with the fewest possible resources. Additionally, the solution must provide a practical benefit that the end user requires. It is a good idea to look for the simple solution when developing AI applications and follow the “Keep It Simple, Stupid” (KISS) principle. This is because the complexity is more likely to lead to failure. (Mueller and Massaron, 2022, chap. 15)

4. RESEARCH METHODOLOGY

In this chapter, the research methodology of the empirical part of this thesis is described according to the research onion model of Saunders et al. (2019). First, the research's philosophical and theoretical development approach is explained. Next, the methodological choice, research strategy, and selection of time horizon are reasoned. These three layers focus on the research design process, which defines the methods used in a research project. The following sections describe the data collection method and data analysis. (Saunders, 2019, pp. 172–173)

4.1 Research Design and Strategy

In chapters 2 and 3, the basics of strategy development and AI technologies were presented to the reader. Building on this knowledge and based on the findings from the literature review in Chapter 5 regarding AI strategy development, a new framework for AI strategy development was presented. How the literature was selected is explained in the next subchapter 4.2. The empirical research in this thesis aims to obtain answers to the research question "what factors should be considered when creating an artificial intelligence strategy for a high-tech industrial company" and to ensure the applicability of the developed model to the case company by collecting views from selected personnel. Pragmatism as a research philosophy fits well with this study, as it focuses on practical solutions for problems. A practical effect of ideas and knowledge is valued because they enable practical solutions and outcomes. (Saunders, 2019, p. 151) According to Saunders et. al (2019), "*Pragmatism strives to reconcile both objectivism and subjectivism, facts and values, accurate and rigorous knowledge and different contextualised experiences*"(Saunders, 2019, p. 151).

This research aims to develop a new conceptual framework, and it is done by collecting data to explore a phenomenon and identifying the common themes from it. Established premises are utilised to derive untested conclusions within an AI strategy framework. This approach is described as an inductive theory development. (Saunders, 2019, pp. 152–153) An inductive approach also supports the view that the strategy framework is connected at the end with the organisation, its personnel and their subjective interpretations of reality. (Saunders, 2019, p. 155)

The data collected in this empirical research are planned to be non-numeric, qualitative data. This is needed to evaluate and improve an AI strategy framework model developed based on a literature review. Qualitative interview data are collected with a semi—structured interview from persons in the case organisation having a good view of operations, strategy development and data handling (Saunders, 2019, p. 179). Therefore, based on

the above factors, the most suitable methodological choice is a mono-method qualitative study. (Saunders, 2019, p. 179)

A research strategy can be defined as a plan for how a researcher will answer the research question. It serves as a methodological bridge between the research philosophy and the selection of methods for data collection and analysis. Research questions and objectives are, therefore, also guiding the choice of research strategy. (Saunders, 2019, p. 189-190)

A case study is often used for an exploratory purpose that uses open-ended questions to gain insights into the subject being studied. Exploratory research questions typically start with 'What' or 'How', as well as questions that are used during the data collection phase to explore a problem. An exploratory study is practical when you want to have more understanding of an issue. Because of the exploratory nature, the interviews can be relatively unstructured. A single case study is used due to access to a specific organisation and because it can be seen as a typical case. (Saunders, 2019, pp. 186–187) In this thesis, the selected research strategy is a case study, which is one of the typical strategies used in qualitative research. The case in this case study is a modern battery manufacturing company that has highly automated production processes and digitalised data collection. It represents a typical and modern high-tech manufacturing company. A characteristic of a case study is that it aims to understand the dynamics of the topic being studied within its context. Just this real-life setting and understanding the impact of context are what distinguish a case study from other research strategies. (Saunders, 2019, pp. 196–197)

Data collection for this research via interviews will be happening over a short period of time. In this case, the change or development of a phenomenon over time that occurs in longitudinal studies does not need to be studied. It’s enough to collect data at a particular time in a time horizon, which is called a cross-sectional time horizon. (Saunders, 2019, p. 212)

4.2 Literature review

The thesis establishes a theoretical foundation for AI strategy development with a literature review. According to Snyder (2019), “*building our research on and relating it to existing knowledge is the building block of all academic research activities, regardless of discipline*”. A literature review is generally defined as a structured approach to gathering and synthesizing existing research. (Snyder, 2019, pp. 333) The outcome of a literature review must advance the field through building new knowledge and not be just an integrated summary of the articles reviewed. (Dodgson, 2021, p. 27) According to Dodgson (2021), the research process for a critical analysis literature review can be divided into

three phases. The first step is to break down the reviewed studies into separate, discrete data points that are congruent with the research question. The second phase of analysis is a within-case examination and a cross-case comparison regarding article methodological congruence. Methodological congruence means a determination of how the elements of the study, like question, design, sampling, measurement, and analysis, fit together. When an incongruence has been detected within the study, it is taken out of the sample and not included in the rest of the analysis. Typically, only the cross-case comparison among the categorized variables is reported with descriptive frequency distributions. The final phase of a literature review is the reconstruction of individual data points into a form of synthesis that answers the research question. (Dodgson, 2021, pp. 27–31) In this research, a literature review methodology is between semi-systematic and integrative. (Saunders, 2019, pp. 78–79)

The aim is to get an overview of the research area and synthesize information for a new AI strategy development framework. The used literature samples were research articles and journals but also books and internet articles from international IT companies. Literature analysis and evaluation method is qualitative. The main database for the searching process is the Andor information search portal, which is in use at Tampere University. A search strategy to identify relevant literature is to search for data related to AI in conjunction with strategy, business strategy, or deployment of AI. The literature related to artificial intelligence includes articles published within the last 5 years, but most of the literature is from 2023 and 2024. The language of the articles is selected as Finnish or English. References from selected articles are also used when identified as potentially relevant.

4.3 Data Collection

Data collection in the empirical part of this research is done with qualitative research interviews. This selection is derived from the research strategy and the need to explore and gain a deeper understanding of the issue within the organisation’s environment. The approach to qualitative interviews is a semi-structured interview, as the plan is to use a predetermined list of themes and related key questions to steer the direction of the interview. Themes are drawn from the drafted AI strategy development framework introduced in Chapter 5 (Saunders, 2019, pp. 436–438). With semi-structured interviews, it is possible to collect rich and detailed data. This interview method helps the interviewer to understand participants' reasons for the decisions, attitudes and opinions. (Saunders, 2019, pp. 444–445) The interview is conducted in a semi-flexible manner, allowing the order of questions to be adjusted based on the flow of the discussion, but keeping the key questions the same through all interviews. Additional time will be allocated to explore new themes that the interviewee considers important and keeping the possibility to open

a more detailed discussion of relevant topics. However, all predefined themes are covered with each participant. Semi-structured and unstructured interview types are commonly used in exploratory studies as well as in the previously chosen inductive approach, for theory development too. (Saunders, 2019, pp. 438–443) One-to-one interviews will be conducted in person through a one-hour face-to-face interview session or over video teleconference using Microsoft Teams. Data is recorded with the Teams transcribing feature and content summarisation with Microsoft 365 Copilot AI. A positive aspect of face-to-face interviews is that they can foster open discussion, result in rich and unbiased data, as they offer the possibility to ask for clarification during the interview. (Saunders, 2019, pp. 441–442)

In Table 1, the selected interviewees are presented.

Table 1. *The list of participants in the interview and their role in the case organization*

Interviewee	Role	Related expertise
I1	ICT Project Manager	IT Project management, IT Strategy development
I2	ICT Specialist	BI-report development, data engineering
I3	Data Analyst	Robotic Process Automation, GenAI, data engineering
I4	SCM System Specialist	Supply Chain Management System specialist, AI and data engineering
I5	ICT Director	Business line management team member, strategy development, head of ICT
I6	Managing Director Battery Plant 1	Operations management, lean manufacturing, strategy development
I7	Production Director	Production and quality management expertise.
I8	Managing Director Battery Plant 2	Operations management, board member work, strategy and business development

Interviewees are selected based on their experience in relevant areas like strategy development, operations management, system development and data engineering. This

means a purposive and typical case sampling technique where the research population sample is non-probabilistic, and subjective judgment is used to select the participants. (Saunders, 2019, pp. 295–296, 321–322)

4.4 Interview themes and key questions

As mentioned earlier, themes covered in the semi-structured interview are picked up from the drafted AI strategy development framework, introduced in Chapter 4. Interview themes will be shared with interviewees beforehand. This has three positive effects: firstly, it demonstrates the interviewer's competence and credibility, thereby gaining the confidence of interviewees; and secondly, it helps the interviewer assess the accuracy of responses. Thirdly, pre-shared themes provide the possibility for interviewees to prepare for interview topics. (Saunders, 2019, pp. 451–452)

The interview begins by thanking the interviewee for participating and giving his/her time for the interview, and after that, the research topic is explained. Used data collection methods in the interview session and agreed and explained how the data would be handled afterwards. The anonymity of the respondent's comments is also guaranteed, encouraging the interviewee to be more open about the information they are willing to provide. To minimise interview bias, open-ended questions are utilised instead of those that might lead the interviewee. Open questions are followed by probing questions to explore the responses in more detail that are significant to the research topic. (Saunders, 2019, pp. 456–459)

Warm-up questions include asking the interviewee his/her views on which business areas artificial intelligence should be implemented in first place and whether he/she have any good use cases in mind. Next, the conversation is steered towards research topics focused on developing an AI strategy. About the goal setting in AI strategy work, the interviewee is asked what the important factors are when making goals for an AI program or strategy. Topics that would support earlier literature review findings are setting clear goals and metrics, focusing on how to create value with AI and identifying the business problems. The next question to this theme is about what kind of working group should be selected to create an artificial intelligence strategy. Various sources present that the strategy development team should be a cross-functional team having both business domain as well as AI technology knowledge. A third question is about different strategy levels in the company and how the AI strategy should be aligned with those. Outcomes of this question could be based on literature: understanding the strategic choices at the enterprise level, the company goals and its vision.

The second theme is about identifying AI use cases and success metrics. The questions deal with which kind of skillset is needed from a team defining the AI use cases, and

when selecting the AI use cases, based on which criteria should those be selected. Regarding needed skillset, various sources are highlighting the knowledge of fundamental principles of the AI technology, understanding business processes, customer expectations and markets. Approaches to selecting and evaluating the AI use case importance can be the linkage to business goals, value they provide to the business, technical feasibility or complexity, available data, risk level, internal and external readiness, and criticality for the company's targets. Success metrics for selected use cases are important too.

The third theme in the AI framework is about data, which is a prerequisite for AI. Interviewees are asked about what aspects of data handling they see as important when considering AI strategy or AI use cases implementation. Various sources suggest that important aspects are data quality, data availability, data governance, identifying data sources and taking care of data security, privacy, legal and ethical requirements. Also, alignment with the data strategy is essential.

The fourth theme is people and skills, which is one of the most important factors for a successful AI project. The aim is to explore the various approaches to addressing this resource and competence challenge. Literature suggests that evaluating organizational capabilities and determining the needed roles is important. With correct technology partner selection, it’s possible to fill competence gaps, too. The entire organization needs to be trained or at least be aware of AI capabilities.

The fifth theme is technology selection; in addition to technological choices, it's about a make-or-buy decision. The interviewee is presented with three methods to approach technology selection: whether to build a custom solution, buy an off-the-shelf solution, or something in between, which is off-the-model development, where existing AI models are complemented with their own data to better meet the organization's AI needs. Custom solutions have a high cost, technical talents are needed, and development takes more time than off-the-shelf solutions, but the opportunity is to get fully customized AI solutions for the organization. Off-the-shelf solutions, on the other hand, have lower cost, no technical AI talent needed, and implementation is fast, but no customization is possible. Interviewee is asked which of the three options fits best for our business and for the high-tech manufacturing industry in general. Also, the more open question is what other topics should be taken into consideration in technology selection. According to a literature review on technology selection, the available data and model training should be taken into consideration. The correct approach needs to be selected, whether to build a custom solution, buy an off-the-shelf solution or use an off-the-shelf model. It's advisable to use off-the-shelf solutions whenever possible. A flexible technology should be selected that is interoperable with the current IT architecture and is upgradable. When selecting technology, it should be flexible enough to handle both current and future needs. It

should be interoperable with the current IT architecture and be integrable with existing systems. It should be scalable and upgradable. Security should also be considered to ensure compliance with relevant security standards and legislation.

The sixth theme deals with risk analysis and a mitigation plan. At first, it is discussed what risks the interviewee sees with AI solutions and how to mitigate those risks. Secondly, the human-in-the-loop concept is presented, where a human judgement is incorporated into the final decision-making and how certain AI technologies like neural networks or GPT models are not always giving the same answer, but the result is based on probabilities. It is asked that, considering this uncertainty, which kind of use cases are such that human-in-the-loop is necessary and when it's not needed. Based on the literature review, there are topics like: doing a risk analysis and mitigation plan for a planned AI solution. Should be considered technical-, operative-, reputational-, ethical-, financial- and regulatory risks. Human-in-the-loop needs to be considered in the AI decision-making process.

The last theme in the AI strategy framework is the AI implementation roadmap. Different software development approaches are presented to the interviewee: the iterative agile approach and the waterfall-type sequential methodology. Characteristics of these development approaches are explained, and after that, the question is raised which approach would be preferred in AI projects. Next, it is asked what key elements should be included in the AI strategy implementation roadmap. According to the literature, the key elements are timeline, objectives, deliverables, resources and integrations to existing systems. Also, considering the needed competencies, change management and any limitations is important to be taken care of. The final question in this theme is how the AI strategy implementation should be followed up.

After discussing the various themes from the AI strategy framework, the interviewee is asked if they would like to add anything important that is still missing from it.

4.5 Data Analysis

Interview data is analysed with qualitative data analysis. Interview data is typically rich with many details, and it collects the participants' experiences and perceptions of the research topic. Data collection and analysis is an interactive process, where possible new themes, patterns and relationships are recognized and it can affect data categorising and coding during the process. (Saunders, 2019, pp. 638–641) Methodological choice for interview data analysis is thematic analysis, which is referred to as a foundational method for qualitative analysis, as the same type of process can be used with several qualitative research strategies. Thematic analysis is searching for patterns and

themes that occur in collected data, which can then be used for developing and testing explanations and theories. Thematic analysis can be used for all three different theory development approaches: inductive, deductive and abductive. In the used inductive approach, themes that are derived both from interview data and the earlier developed AI strategy development framework are compared. New themes can be raised based on interview data and are not limited to the existing framework. (Saunders, 2019, pp. 651–652)

Analysis starts with reading through the interview transcripts and seeking recurring themes and patterns at the same time. The next step is to use coding to categorize data, which helps in the later phase to regroup and find the data with similar meanings. All AI strategy framework's different themes and their characteristics will be coded in data, and all other new recurring themes will be coded in data. Research questions can also be used to help select which data should be coded. So the coding is both data driven and theory driven. (Saunders, 2019, pp. 652–653, 655)

The third step after the coding is searching for themes, recognising patterns and relationships. A theme is a higher-level category that contains multiple codes that have some relationship. A theme should also be important for the research question. When creating themes, it should be consider how the themes are related to each other. Which are the possible main themes, and which are the related sub-themes. When examining the data and selected themes, it's highly likely that some themes need to be refined, combined, discarded or made into a new one. (Saunders, 2019, pp. 656–658)

When seeking the patterns in data and recognizing relationships between themes, the found connections should be evaluated. These connections or propositions can be tested by seeking alternative explanations for findings. By doing so, it is possible to develop credible and well-grounded conclusions. Finding negative cases that do not fit with propositions helps to refine the research explanations. This helps to avoid unreliable interpretations which can happen if a researcher sees only evidence that supports his/her opinion. (Saunders, 2019, pp. 658–660)

In Table 2 below, there is a summarised list of all the research methodological choices used in this research.

Table 2. *Research methodological choices*

Methodological selections	**Approach**
Philosophy	Pragmatism
Approach to theory development	Induction
Methodological choice	Mono method qualitative
Research strategy	Case study
Time horizon	Cross-sectional
Data collection	Semi-structured interviews
Data analysis	Qualitative thematic analysis

5. AI STRATEGY DEVELOPMENT

Although AI and machine learning have been around for a long time, the latest AI boom of GenAI and Large Language Models has increased the pressure for companies to adopt AI solutions and applications everywhere and to do everything. Fear of missing out is driving companies to implement, for example, GenAI solutions even if they don't necessarily fit every purpose. (Baker, 2025, chap. 6)

Rackspace Technology conducted a global survey of 1,870 IT leaders across industries in 2021 on the use and adoption of AI and machine learning. One of the significant findings from the study, to overcome pitfalls and harvest the potential benefits from AI, was the need to put an AI strategy in place first. "*Without a solid destination and organisational buy-in, your AI and machine learning journey could waste a lot of money and resources and never become production-ready*."(Rackspace Technology, 2021, p. 8) According to Proksch et al. (2024), "*the most organisations lack a well-defined strategy for AI implementation*". Without a good alignment between AI strategy and enterprise strategy, the risk of unrealistic expectations, organisational challenges and adoption problems at the executive level are possible. AI strategy offers a clear vision and direction for AI usage, and it aligns with the company's business operations. It provides a planning framework, transparency and knowledge-sharing to create value. AI strategy is critical in identifying the necessary value-driving capabilities and in establishing a support system. (Proksch et al., 2024a, chap. 9) Miyamoto (2023) measured the level of AI governance, AI adoption and AI strategy of Japanese companies. The study found that the successful adaptation and utilisation of AI technologies are closely linked to the development and implementation of an effective AI strategy. A well-defined AI strategy helps organisations to identify the most suitable AI applications, allocate resources optimally and to maximise the benefits from AI applications. (Miyamoto, 2023, pp. 649, 656) Ruokonen and Ritala (2023) describe how large companies are already saving millions through machine learning, for example by optimising debts and receivables. Generative AI is expected to significantly accelerate productivity growth and help automate manual tasks in their business processes. Forward-looking managers should consider putting the AI into a very important role and at the forefront of the company's strategy. (Ruokonen and Ritala, 2023, p. 1) Companies can be divided into three different AI strategy archetypes based on their starting point and characteristics: digital tycoon strategy, niche carver strategy and asset augmenter strategy. Digital tycoon strategy is for companies like Google, Amazon and Spotify, whose business is based on data and software-platform-based services. They utilise their continuously growing data sets to make AI-based predictions to improve their services. The niche carve strategy is suitable for companies which build AI algorithms with superior performance in their domain, like machine vision and speech

recognition. The last type of AI strategy we will focus on in this work is the asset growth strategy. It is for companies like Siemens or John Deere, who can use the sensor and process data in closely controlled physical environments. Data is fed to AI algorithms, and value is captured by optimising processes and augmenting their product service portfolios. (Ruokonen and Ritala, 2023, pp. 2–3) Asset augmenter companies operate in traditional sectors such as industry, retail or grocery. They typically aim first for gradual implementation by trying specific AI solutions in different operations before scaling up for a more holistic approach across the company. The key is not only to implement standard AI algorithms that their competitors might use, but they also need to deploy AI in smarter ways by developing company-specific technology and reinventing traditional industrial business models. Challenge for the AI asset augmenter companies are incompatible legacy systems, functional silos, fear of AI and to break free from old ways of working. Asset augmenters often use platforms and general AI capabilities provided by digital tycoons, and they may buy specialised AI solutions from niche carvers rather than developing their own solutions. But building their unique AI advantage and services should be focused on their access to specific assets, processes and customer data, while the AI capabilities and tools may be sourced from vendors. (Ruokonen and Ritala, 2023, p. 7)

5.1 Issues that should be considered when creating an AI strategy for a high-tech industrial company

Herremans (2021) discusses the development of AI strategy quite extensively in his study about a roadmap for developing a successful AI strategy. His roadmap consists of the following pieces: goals, data, AI team, AI in the company, technologies, KPIs, risk level and cultural shift. (Herremans, 2021, p. 4) Garner's (2023) "GenAI planning workbook" has many elements similar to Herremans' AI strategy roadmap, but in goal setting, it focuses more on aligning AI goals with the corporate vision and business goals with appropriate success metrics. Also, the AI project ranking against one another is done in a more systematic way by scoring different factors from a technical and business point of view. (Gartner, 2023, pp. 4–10) In Sippola's (2024) ten-step model for a successful artificial intelligence strategy, the importance of identifying and prioritising AI use cases is the cornerstone of an AI strategy. Setting clear success metrics is stressed too for goals. A fresh view in Sippola's model is the advice to develop guidelines and policies on how to use AI responsibly and ethically within an organisation. (Sippola, 2024)

Proksch et al. (2024) present Lafley and Martin's (2013) strategy framework, which has been found effective for integrating AI into enterprises. It was first used by US government agencies like the Department of Defence and the Department of Energy for shaping AI strategies. Based on this framework, the strategy is coordinated and integrated by a

set of five choices: "*a winning aspiration, where to play, how to win, core capabilities and management systems*".(Proksch et al., 2024, chap. 9) Proksch et al. (2024) applied the strategy framework in the field of AI as follows. Aspiration is about defining the role and AI ambition level within an organisation: what AI is intended to accomplish and what is not. The focus is on areas of an AI initiative. Focusing on certain business opportunities in specific business areas. How to win is about defining how AI is going to create value in specified business opportunities. Capabilities focus on resources that are needed to create value with AI, including talent, partners, data and technical requirements. Lastly, the management systems mean the identification and definition of organisational systems that support the AI strategy. (Proksch et al., 2024a, chap. 9) Organisation's technical and non-technical capabilities can significantly limit the possibilities to implement industry AI use cases, and that should be taken into account when setting the AI strategy or project ambition level. (Proksch et al., 2024a, chap. 2)

Related to AI strategy work in general, Proksch et al. (2014) also remind that, like any business strategy, an AI strategy requires updates and evolution as technology and business requirements progress. (Proksch et al., 2024a, chap. 9)

5.2 AI Goals & metrics

For successful AI strategy implementation, the importance of setting clear goals and metrics is highlighted in multiple articles and studies. (Gartner, 2023; Herremans, 2021; Sippola, 2024) Understanding where AI should be applied to and how to create value with it is key to securing AI's long-term business impact. An enterprise-level strategy should be understood and aligned with an AI strategy, as understanding the strategic choices at the enterprise level enables the identification of areas where AI can effectively be applied. (Proksch et al., 2024a, chap. 9)

Gartner suggests that the first step should be to clearly state how GenAI objectives link to the company's goals and support its vision. It should be evaluated what value is expected from AI solutions towards business goals and how to measure success. In addition to understand, how AI support the business goals, clear AI goals help to fund the right use cases, which have a clear return on investment (ROI) and lead to further innovation. (Gartner, 2023, pp. 3–7) Kananen (2019) states that the application of AI begins with identifying business problems. First, you need to define what specific business problem artificial intelligence should solve. The organisation should understand what added value AI brings and how it affects business processes and the organisation. Support from senior management is also needed for the necessary changes. The most important thing is to identify the business benefit from AI. To identify it, you need to know the company's data-generating and management systems. (Kananen, 2019, pp. 54–55) Herremans' AI roadmap recommends starting by listing potential goals and problem

statements that an AI system can address. Listed items are then possible projects with a clear task definition and different requirements. When the list is ready, the top projects should be selected, typically 3 to 5. (Herremans, 2021, p. 155828) Projects can be ranked based on technical feasibility factors and business value factors. Items to consider in technical feasibility are access to labelled data, architecture, technology feasibility and skills & resources. Business value factors contain alignment with mission & values, sponsor support and is project measurable. (Gartner, 2023)

The team that is defining the goals, use cases, and metrics should consist of both domain and AI knowledge professionals. Knowledge of fundamental principles of the AI technology is needed to avoid misleading or invalid solutions, but also a real understanding of business needs is necessary to avoid misaligned solutions to business objectives. (Bergman, 2024) You need to understand business processes, customer expectations and markets, to improve processes and customer experience. With AI solutions, it is possible to improve current operations, innovate new services using data and utilise information obtained from data to support business management decision making. (Kananen, 2019, pp. 199–200)

5.2.1 Identifying use cases and metrics

An AI use case definition starts with listing the business goals and thinking about how AI enables those. Then, how to measure the success of the goal and what use cases could maximise the value should be considered. (Gartner, 2023) A few examples of business goals are: improving customer satisfaction, improving efficiency or automating processes. A good success metric could be, for example, a change in customer satisfaction score, growth in processing volumes or an increasing degree of automation. (Sippola, 2024) AI use cases can be evaluated based on their value and feasibility. Eichhorn & Aggarwal's (2023) value and feasibility scoring method helps leaders in investment decisions for different AI solutions. Use cases are scored against four value dimensions: increased revenue, increased efficiency, managed risk, and non-financial value; and against three feasibility dimensions: technical feasibility, internal readiness, and external readiness. Ratings are from 0 to 4 in both categories, and the higher the value, the greater the priority. In value ratings, the low score means low or negligible value that can be gained, and a high score means that the use case results in a significant revenue increase, cost savings or enables new ways of doing business. In feasibility rating, zero means that the use case is almost impossible to implement, and 4 means that the implementation effort is easy.

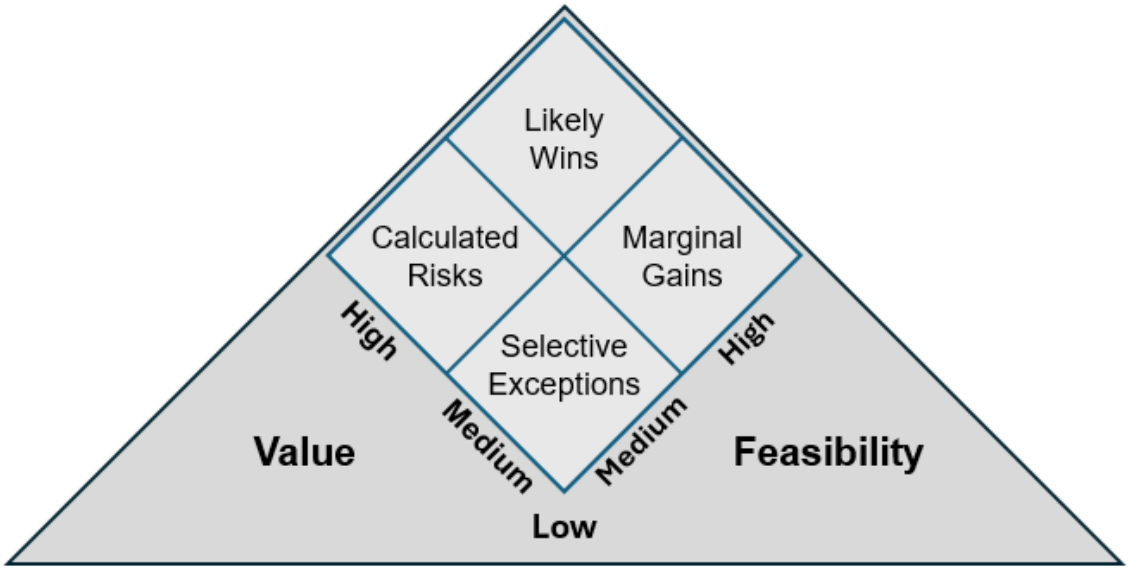

Figure 4. *Use-Case Prism (adapted from Eichhorn and Aggarwal, 2023)*

In Figure 4, Eichhorn & Aggarwal's (2023) use case prism, the winning use cases at the top of the prism are the ones which combine high feasibility and high value. (Eichhorn and Aggarwal, 2023, pp. 1–11)

Rashidi (2024) suggests that the use case ideation phase should be done with a team which suits that purpose. An effective team consist of strategic thinkers, innovators, discerners, business partners or anyone else who has a growth-based mind set and can help to ideate. First, the team should just generate ideas and start capturing all the use cases that come to mind. The aim is to list use cases which should align with the AI strategy, but considering also the organisation's capabilities, available data and risk level after the ideation phase comes use case selection. (Rashidi, 2024, chap. 4) Rashidi (2024) does not emphasise the business value in use case selection as it much depends on the viewpoint, objective and KPI's used to define the business value. Rashidi's approach is a so-called quantitative Criticality vs. Complexity evaluation quadrant. Each use case is rated on a scale from 1 to 5 based on how critical it is to the longevity, perseverance and growth of the company. The complexity dimension is also evaluated on a scale from 1 to 5 about how difficult the deployment of the selected use case is when compared to another use case. There are three questions for criticality and three for complexity. Questions for criticality are: "Does it impact sales and growth?", "Does it impact operations?" and "Does it impact company culture and public perception?" (rating 1= this has zero impact on us, rating 5= it's a critical issue for our organisation). Question for complexity are: "Does it impact bandwidth for other project?" (rating 1= minor, rating 5= major), "What is the degree of change management is needed" and "Do we have clear ownership of this use case?" (rating 1= clear owner, rating 5= no idea who can own this). After scoring each question for use cases and adding the sum for Criticality and

Complexity, use case sums can be compared in the Complexity vs. Criticality quadrant shown in Figure 5. (Rashidi, 2024, chap. 4)

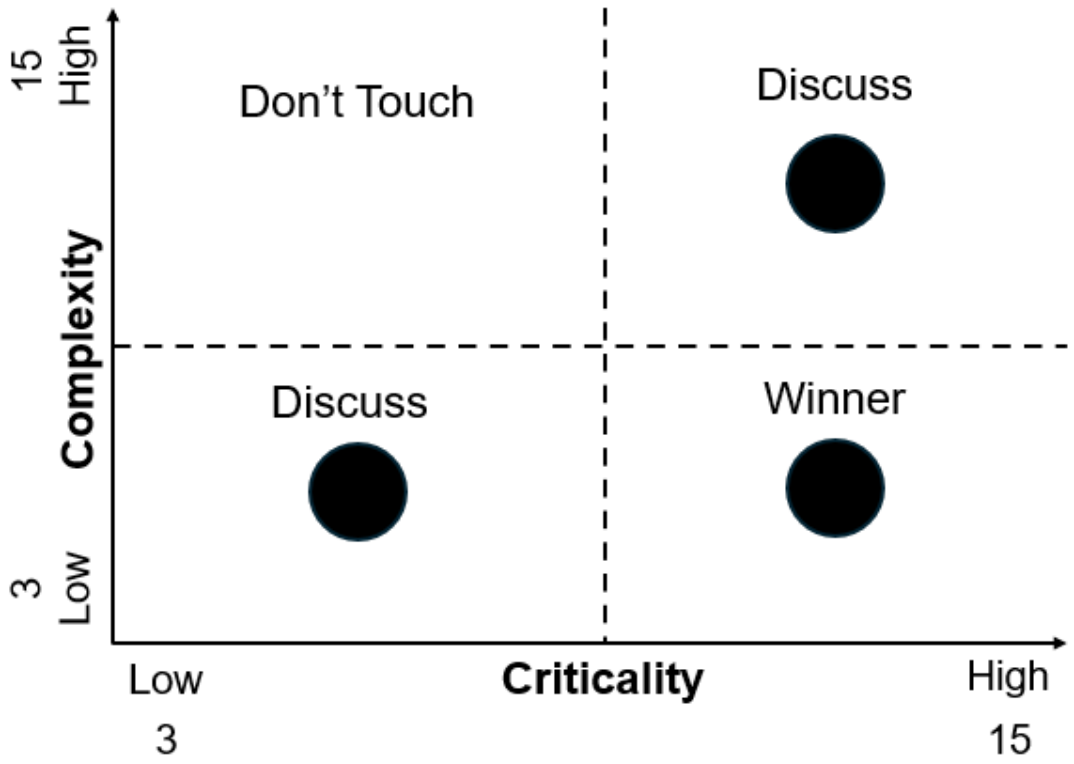

Figure 5. *Complexity vs. Criticality use case quadrant (adapted from Rashidi, 2024, chap. 4)*

Rashidi (2024) recommends focusing on use cases with high criticality but low complexity. For beginners, it's advisable to leverage off-the-shelf AI tools built for consumer or enterprise use, which accelerate time to market and make deployment easier. (Rashidi, 2024, chap. 4)

Proksch et al. (2024) suggest considering AI feasibility risk and AI adoption risk when evaluating the AI business opportunity use cases. Feasibility risks are related to technological capabilities and adoption risk, which are costs which occur if stakeholders resist adopting the AI solution or do not collaborate with the initiative in its creation. (Proksch et al., 2024a, chap. 2) Other risk that affects AI business value are presented in the following Risk analysis subchapter 4.1.6.

When comparing previously presented AI use case prioritisation methods, we can see that it is recommended to focus on the following types of use cases. From a complexity and feasibility perspective, the use cases should not be too technically complex. The organisation should be able and willing to incorporate the use case, and the organisation's change management effort should not be too high. There should also be clear ownership of the use case. From a criticality and value perspective, the use cases should

have a major impact on revenue, operational efficiency, secure the company's future performance, and have a positive effect on company culture or public perception.

5.2.2 People and skills

One of the possible organisational barriers to capturing value from AI is people & skills. (Gartner, 2023) AI value creation will require a diverse set of skills and competencies, ranging from technical and non-technical to soft skills. (Proksch et al., 2024a, chap. 14) When starting to develop an AI strategy or an AI project, you need first to evaluate your organisation's current capabilities, maturity and AI strategy ambition level. (Rashidi, 2024, chap. 3) It's important to assess the competencies and skills needed and train current employees in those, but also to delegate roles that can effectively deliver them. (Proksch et al., 2024a, chap. 14) That will directly affect the selection of an AI technology partner. If the ambition level is anything more than just buying a ready AI Software as a Service (SaaS) service, you will need AI and data experts during the implementation journey. In technology partner selection, it is important that the company you select is eager to do great work and has a strong development team. Company size should also be right when compared to your budget and ambition level, and it should have a good cultural fit with our company, as your team needs to work with someone they trust. (Rashidi, 2024, chap. 3)

Sippola (2024) states that it is paramount to identify and ensure the availability of the different skills and required roles for the project in an organisation. Key skills are, for example, prompt engineering, data management, information security expertise, project management, change management and expert collaboration. (Sippola, 2024) Herremans (2021) lists also other skills needed for AI strategy implementation: 1. data mining skills - to detect patterns in large data sets and find out what data may be useful, 2. software engineering skills - to develop models with optimised, scalable and secure ways and 3. deep understanding of mathematics and statistics - to understand the neural network technologies and build novel solutions. (Herremans, 2021, p. 155831) In addition to employees directly involved with the AI implementation, the rest of the organisation also needs to be aware of AI possibilities. When employees are educated, they can better contribute to brainstorming workshops to think about how to utilise AI technologies. (Herremans, 2021, pp. 155835–155836) According to Rackspace Technology's (2021) study, 27% of responders say that the most significant barrier to AI and machine learning adoption is a lack of skilled people. Additionally, 34% of respondents reported that AI and ML research and development project failures were due to a lack of expertise within the organisation. This was the most common reason for project failures, along with the lack of data quality. Solutions for the skill gap are either training people in workshops and courses or relying on a competent service provider. (Rackspace Technology, 2021)

5.2.3 Data

"*Without proper data, there is no workable AI*." Ruokonen's & Ritala's (2023) AI-first strategy approach highlights the importance of data quality as data is the basis for AI algorithm predictions, which then create a concrete business value. (Ruokonen and Ritala, 2023, p. 2) Data quality refers to the consistency, accuracy, and unambiguousness of data. (Kananen, 2019, p. 74) One of the three major recommendations in Rackspace Technology's AI & machine learning study is to address the data quality. Data must be clean, well-integrated and data silos should be avoided. (Rackspace Technology, 2021, p. 8)

According to Herremans (2021), the AI strategy should be aligned with the company's data strategy. Data strategy refers to a plan for how an organisation manage its information assets. Different data sources should be identified, and a plan should be made for how data is stored, updated and used. (Herremans, 2021) Data and data life cycle management are crucial elements for AI value creation. Data management activities consist of tasks like data sourcing, data governance, data preparation, data consumption, understanding the infrastructure requirements for AI data, data archiving and deletion. Data sourcing means collecting the data from internal and external sources. Internal data sources refer to the organisation's internal data, which is generated from different IT systems like enterprise resource planning applications or manufacturing devices. External data sources comprise data which is generated outside of the organisation and can be, for example, from an open data source or a public dataset. The origin of data plays a crucial role in determining its quality, reliability, accuracy and overall usefulness. (Proksch et al., 2024a, chap. 13)

Maintaining a centralised overview of all data assets in an organisation, also known as a data catalogue, helps data engineers to identify which data might be useful for AI model development. A common belief is that the more data is input for the ML algorithm, the better the results. This might not always be the case for the best predictive models. (Herremans, 2021, p. 155829) For example, high-dimensional data causes an exponential increase in the necessary data processing power needed to analyse the data. It also increases the amount of training data required. Data are said to be high-dimensional when the number of features (p) in the dataset is greater than the number of observations (N). This ($p >> N$) leads to the 'curse of dimensionality', coined by mathematician Richard E. Bellman. The curse of dimensionality can lead to AI model overfitting if there is not enough training data. Overfitting means the produced model could be very good at predicting with the training dataset, but it fails when facing new data. The way to avoid overfitting is to keep the AI models simple, but at the same time, you need to be careful of the risk of underfitting. (Shetty, 2022)

In addition to securing the data quality, the data strategy should address the data analytics use cases and how to make data available efficiently. Not to be forgotten are the data security, privacy and ethical requirements. (Heiskanen, 2022) Having the data widely and easily available allows data engineers to invent ideas and develop new applications more quickly. On the other hand, this increases the risk of data breaches and privacy issues. The organisation needs to find the right balance between quick access to data and adequate data security. When handling and storing the data, legal requirements should be considered, related to local privacy laws like the European Union's (EU) General Data Protection Regulation (GDPR) or the California Consumer Privacy Act (CCPA). (Herremans, 2021, p. 155830) The topics described above about data privacy, regulatory compliance, ensuring data security, confidentiality, integrity, and availability belong under the data governance umbrella, which should establish the needed processes for these. (Proksch et al., 2024a, chap. 13)

5.2.4 Technology selection

According to Rashidi (2024), a few decisions are required when selecting an AI solution. First, you need to decide whether to build a custom solution or to buy an off-the-shelf solution. Next, you need to research the technical options and then think about how the options align with your objectives. As in recent years, the AI solution offering has expanded exponentially, finding a proper solution and adoption of AI should be easier than ever. The strengths of the off-the-shelf products are that they are low cost, no technical AI talent is required, and implementation is fast. The limitation of the off-the-shelf products is that the customisation level is minimal or non-existent. Developing and training a new foundation model to meet the specific needs of an organisation, on the other hand, has high costs, high dependency on tech talent, and a slower time to market, but it offers high possibilities for customisation and differentiation. Between these two extremes lies off-the-model development, where existing AI models are complemented with their own data to meet an organisation's AI needs better. One example of this is improving the AI model performance with the Retrieval Augmented Generation (RAG) method. (Rashidi, 2024, chap. 4)

In technology selection, the company needs to consider whether a black-box type of decision-making is an acceptable approach or if an explainable model is needed. The downside of explainable models is that they are not typically as accurate as deep neural networks. (Herremans, 2021, p. 155833) Rashidi (2024) recommends using off-the-shelf solutions whenever it's possible and especially when the use case is about analysing a larger set of data for insights, summarising contracts and documents, recap online meetings, translating from one language to another, creating decks for presentations and when editing photos or other content. Taking off-the-shelf solutions is not necessarily so

easy as it sounds, even the off-the-shelf solutions are not plug-and-play type. They require brainstorming, redesigning existing processes, governance, development iterations, outlining the new standard operating procedure and quality control. (Rashidi, 2024, chap. 4) Herremans (2021) states that the option to build AI systems within the organisation, the adage ‘do not reinvent the wheel’ applies well here. There are specialised AI companies which might have already developed the needed AI model, so it’s worth considering a Software as a Service (SaaS) approach. (Herremans, 2021, p. 155832)

Sippola (2024) states It is important to select those AI technologies and platforms which best fit the organisation’s needs and objectives. You need to determine whether the AI solution offers the necessary features and performance for your business needs. Technology must be flexible enough to handle both current and future tasks. It should be interoperable with the current IT architecture and well-integrated with existing systems, which makes it easier to move to new technologies. The chosen technology should be cost-effective for the value it brings. Scalability and upgradability help to accommodate business growth and stay current with the latest technological innovations. Security is also a critical factor. It’s important to ensure that the technology complies with industry security standards and legislation. (Sippola, 2024)

Training AI models requires a significant amount of processing power, and there are few approaches for companies to get it. It’s possible to rent cloud capacity or buy equipment and run the models in-house. It is also possible to take a hybrid approach where the AI model is trained in the cloud and then run it on in-house servers. Having in-house servers comes with two types of costs: capital expenses and operating expenses. There are major investments, maintenance and running costs in in-house servers, so cloud services may offer a quick, cost-efficient and scalable way to have the needed Graphic Processing Unit (GPU) power for developing or running the AI models. (Herremans, 2021, p. 155833) Biggest IT houses provide scalable, cost-effective and easy-to-use cloud services without the need for expensive on-premises IT infrastructure. They enable scaling up or down computing resources on demand, which is often a cost-effective solution for AI operations. In addition to cloud capacity, Amazon Web Services (AWS), Google Cloud Platform (GCP), and Microsoft Azure offer pre-built AI algorithms, ready tools and AI frameworks for training and deploying the AI solutions. (Proksch et al., 2024a, chap. 12)

In technology selection, the available data affects which AI technology can be used. If there is labelled data available for model training and testing, supervised learning can be used. When the labelled data is scarce, semi-supervised or self-supervised learning is used. Reinforcement learning can be used by putting the ‘human in the loop”, and that way, new labelled data is added to the model while it is in production. One point to consider is whether the AI solution is to replace humans or just be a copilot. A latter approach

is more popular, that AI is just augmenting human performance. (Herremans, 2021, p. 155833) There is also often a point to keep a human in the loop for quality control reasons. Humans can make a final evaluation of AI output, as there is no guarantee that the model will always work the same way, especially in the case of neural networks. Another thing to consider is which one makes more mistakes - the human or the prediction model.

5.2.5 Risk analysis

It is important to do a risk analysis for a planned AI solution. Risk analysis should consider technical risks like malfunction and security; operative risks like process inefficiency or wrong decisions; reputational risks like loss of customer trust; ethical risks such as model biases which affecting fairness in decisions or lack of transparency what data is collected; regulatory risks like handling of personal information; and financial risks like unexpected cost and lack of return of investment. All major risks should be written down, assessed, and a risk mitigation plan should be developed. (Sippola, 2024)

One way to mitigate AI risks is by using a human-in-the-loop. Human-in-the-loop refers to a concept where human judgment is incorporated into the AI decision-making process. It ensures that human oversight is happening to secure that ethics, values and context are considered according to human norms. According to Rashidi (2024), human-in-the-loop is a must-have process in any AI deployment. (Rashidi, 2024, chap. 6)

5.2.6 Implementation roadmap

As an approach for AI projects, Rashidi (2024) suggests" *think big, start small and scale quickly*". It's good to think about possibilities without restraints like resources and funding, which hold us back. Starting small is typically done with small pilots called POC (Proof of Concept) to assess the technical feasibility. (Rashidi, 2024, chap. 3) In POC, the process description and data sources are defined. The AI model is trained, tested and evaluated to determine if the developed model could work as a solution for the problem. POC is the fast and inexpensive way to test the functionality of an idea. With the help on testing, it is possible to gain an understanding of AI performance and set targets for actual implementation. After a successful POC, the model often needs further training to improve its accuracy for production purposes. The last step is to build system integrations into place between the production environment and the AI solution. (Kananen, 2019, pp. 59–60) According to Proksch et al. (2024), the agile and iterative approach is common for AI projects, especially when requirements and risk are not fully known up front. Iterative development means that the project is developed through incremental steps, and steering feedback is collected after every iteration. In an iterative approach,

there are usually many development stages like POC, Poof of Value (POV), pilot, Minimum Viable Solution (MVS) and final solution. After PoC, the POV validates the solution's business value proposition, and in the pilot phase, the solution is tested in real-world settings. MVS contains only essential features that are needed for going into production. In certain cases, a waterfall type of software development is justified. If all deliverables are well known up front, a predictive approach can be the most optimal choice. But if dealing with innovative solutions or services, the adaptive and iterative approach becomes more favourable. (Proksch et al., 2024a, chap. 10)

Change management is an one important factor in ensuring a smooth AI deployment into an organisation. Common pitfalls are unclear ownership and roles for change management, insufficient resources and unclear understanding of what change management is. Rashidi (2024) lists the top 10 change management topics that are critical to AI projects. 1. Make a concise statement that clearly describes the vision, mission and rationale of the transformation. 2. Ensure that you have a leadership alignment with active support. 3. Make a transition plan for people, processes and technology while maintaining business continuity. 4. Establish frequent and consistent communication of the anticipated changes in the ways of working. 5. Involve employees in the change process. 6. Plan to celebrate small victories to prevent fatigue. 7. Make a correct expectation level for an organisation about progress and the iterative approach. 8. Keep retrospectives to align the project team and stakeholders' understanding about progress, issues and risks. 9. Continuously monitor progress, team morale and impact to be able to adjust strategies. 10. Make changes when necessary and communicate the reason why the changes are made. (Rashidi, 2024, chap. 5)

To secure the successful implementation of the AI strategy and AI projects, the planning of the implementation roadmap is crucial. The scope of the implementation roadmap encompasses the entire project, from planning and prototyping to testing, implementation, and continuous improvement processes. Key elements for the AI roadmap are planned timeline, objectives, deliverables, resources and integrations to existing systems. Furthermore, considering the needed competencies and any limitations is important. The roadmap should have checkpoints and assessment methods to be able to follow up on the progress of implementation. (Sippola, 2024) One way to follow up the progress regularly and ensure alignment with the AI strategy is to use the earlier presented Objectives and Key Results method and synchronize the roadmap deliverables to the OKR's Key Results.

5.3 A summary of different AI strategy development steps

Table 3 describes the focus areas of different research sources regarding the development of an AI strategy or AI deployment strategy. All selected sources emphasise the

following areas: AI goals and problem statements should be linked to business goals; when implementing an AI solution, attention must be paid to the business value it generates and its essential to measure and show the progress of the AI initiative; data availability and even full data governance should be taken care; organisation resources and skills are key for success; right technology selection is essential. Other commonly mentioned areas are risk analysis and related mitigation plan, use case identification and prioritisation, implementation roadmap, evaluating use case complexity, and measures for AI monitoring and change management.

Table 3. *Focus areas on the development of an AI strategy*

	(Gartner, 2023)	(Sippola, 2024)	(Herremans, 2021)	(Rashidi, 2024)	(Kananen, 2019)	(Proksch et al., 2024a)
Evaluate organisation readiness				x	x	
AI goals & problem statements linked to business goals	x	x	x	x	x	x
Use case identification and prioritisation	x	x		x		
Success metrics	x	x	x	x	x	x
Business value	x	x	x	x	x	x
Consider feasibility/ complexity in selection	x		x	x		x
Remove organisational barriers	x					x
Data governance or strategy		x	x			x
Data sources & data quality	x		x	x	x	x
People and skills	x	x	x	x	x	x
Technology selection & Solution selection	x	x	x	x	x	x
Develop guidelines for the responsible and ethical use of AI		x		x		
Risk analysis & mitigation plan	x	x	x	x	x	
Implementation roadmap		x		x	x	x
Change management	x			x		x
Set measures to monitor AI performance		x			x	x

Based on the above-discussed AI strategy focus areas and discussion in chapter 4.1 and its sub-chapters, in Figure 6 below, I have gathered a seven-step AI strategy development framework. Selected themes appeared most frequently in various sources and can be considered the main themes.

Figure 6. *AI strategy development framework*

As a first step in AI strategy development, the work is to set AI strategic goals with a cross-functional team and align AI objectives with the company's strategic goals and vision. The next step is to identify use cases that are feasible to implement and have a clear business value. AI use cases should be prioritised based on value, criticality and

complexity. It’s essential to set success metrics too for use cases. Thirdly, you need to consider what kind of data is available in different sources and ensure that it’s high quality. There might be a need to collect the data or source the data from external sources, too. Take care of data security, privacy, legal and ethical requirements. The fourth step is to secure project human resources along with the needed skills. Grow your organisation's AI skills with training and workshops. Organisation readiness also affects AI technology partner selection. An expert-level AI development know-how can be outsourced too. The fifth step is to do a technology selection with the help of AI experts. Aspects that affect technology selection are available data, budget, organisation readiness for AI and IT architecture. The sixth step is to do a risk analysis and a mitigation plan. The last step is to do an implementation roadmap and plan how to monitor the project progress.

6. RESULTS AND DISCUSSION OF FINDINGS

This chapter presents findings of semi-structured interviews and compares the collected information with the AI strategy development framework. Similarities and differences are highlighted, and the reasons behind those are discussed. As a result, the AI strategy development framework is enhanced to match the needs of the case company.

6.1 Analysis of interview data

Semi-structured interview data were collected from one-to-one interviews using Microsoft Teams video recording, automatic transcription in Teams, and the Microsoft Copilot GenAI tool to summarize the discussion. After the interview, the transcript and Copilot summary records were compared, and relevant data were collected from each interview into a master data document for further analysis. The collected data was then analysed with the thematic analysis method. A hierarchical coding structure was established first, based on themes identified from the literature review and the AI strategy framework. After that, the interview data in the master data document was read through, and the coding structure was improved to gather all themes or meanings of the data. So coding was both theory and data driven. After the coding structure was ready, the master data was labelled with codes. Thematic analysis was then conducted by comparing content marked with codes from the same hierarchy or topic and identifying relationships between them. The main findings from the interview data were then summarized and compared with the theory.

6.2 Goal setting for AI strategy

Interviewees were first asked to provide a brief overview of their background in strategy development and their experiences with AI. Five of the eight interviewees had a sound experience in strategy development at the company, business line and functional strategy level; the rest of the interviewees had more knowledge on the AI side, and experience from strategy development was at the functional strategy level. All participants had experience at least from an end-user point of view, with GenAI tools and had thoughts on where AI could be implemented.

Interviewees were asked their views on good use cases where AI could be implemented. Most frequently mentioned AI use cases were production quality control by detecting anomalies in data or automatic visual quality monitoring, getting data insights from large amounts of data and streamlining the data searching. Also, logistics and production process optimizations, predictive maintenance, market- and contract analysis, GenAI chat bots and utilization of GenAI solutions got mentions. These are all examples that are

very typical and realistic use cases for AI, although they need multiple approaches and AI technologies to be realized.

The next questions focused on goal setting in the AI strategy framework. The first question was about what the important factors are when making goals for an AI program or project. The most important factor was identified as the strategic business value or business value of AI. AI strategy should be thought out, considering what is important and critical to business, and what produces significant value for the organization. One interesting perspective was also to investigate whether AI could have an impact on the company's business environment or its service offering. As Interviewee 8 stated:

"*An external sparring partner could help the company to test the AI-strategy and to see if artificial intelligence is changing something significantly in our company's business that we ourselves don't see and easily become blind to the potential changes in the business environment*" "*And those old assumptions about how we do business may change quite radically*."

Importance of defining for which purpose, what kind of uses and to whom AI is developed was mentioned.

The next question was: What kind of working group should be used to create an AI strategy? There was a clear consensus that the working group should be cross-functional: in addition to IT experts, strong business domain knowledge is needed from different functions. Interviewee 2 emphasized the importance of the business voice:

"The challenges and areas for development are specifically on the business side, so that's the essence of it, that there's business telling us what they need help with."

It was said that it is important for business departments to be involved in developing an AI strategy from the beginning. This ensures that the development has real use cases and benefits the company.

The third topic in AI strategy goal setting was how AI strategy should be aligned with other strategies. Based on interview data, AI strategy should be part of the company's larger business strategy. This clarifies the implementation of the AI strategy, and one should avoid running it as a separate matter. AI strategy should be synchronized with other strategies and aligned with the company's business targets and functional goals. Every function could have its own AI strategy. Interviewee 8 stated about the need for strategic thinking:

"AI cannot be just an operational response but must be part of the business strategy. This means that the implementation of AI must have a clear direction and understanding of how it supports the business in the long term.".

What was missing from interview responses was the emphasis on setting clear AI goals and metrics for the AI strategy that also align with corporate vision and enterprise strategy. This is essential in any successful IT strategy. (Gartner, 2023; Herremans, 2021; Sippola, 2024) According to Proksch et al. (2024) Companies that have succeeded in creating value with AI have demonstrated the importance of aligning the AI strategy with the enterprise strategy. (Proksch et al., 2024b, chap. 9) However, in the responses, the focus on business value, business critical topics and solving business problems was something that very well aligned with the literature. Approach to work with a cross-functional team, both with business and IT experts, when defining AI strategy and goals, is something that theory also supports. One thing to highlight, as Interviewee 8 pointed out, is that it's also important to look at whether AI changes the business radically and opens new business opportunities. This is something which should also be highlighted.

6.3 AI use case identification

The second theme was AI use case identification. What kind of skill set is needed from a team defining the AI uses was discussed first. Based on interview feedback, the skills required are from technical to business expertise. It would be good if everyone had some basic knowledge about AI technologies so they could think about what they could be used for. IT and AI experts are needed to bring knowledge about the possibilities and limitations of available data, technologies and IT systems. Knowledge of typical AI use cases and tools is beneficial when thinking about AI opportunities and low-hanging fruits. This could be done, for example, by collecting and analysing user experiences of utilizing AI in different industries. Naturally, understanding of business needs, processes and problems is key in defining AI use cases.

Interviewees' expectations of the AI working team matched those suggested in the literature review: both the domain and AI experts are needed to get correct solutions that align with the business's objectives and to avoid misleading or invalid solutions. (Bergman, 2024)

The next topic around AI use cases was to discuss based on which criteria the AI use cases should be selected for development. Clearly, the common view was to prioritize and select the use cases based on expected returns, i.e. where there is clear business potential in relation to the investment. A good metric to measure this would be ROI. Few interviewees also connected the complexity of the solution to business value evaluation and as Interviewee 7 said:

"It's the cost-benefit analysis. So where do we get the most value gained for the least amount of effort, and that's how I would prioritize it."

Depending on how far the company is in its AI implementation journey, this should also affect the selection of use cases. If the company is just starting to develop its first AI solutions, the best approach might be to select and try different small-scale pilot cases and not run into large, possibly overambitious projects, which need too much time and money. When the organization is progressing with multiple feasible projects in different functions, it is at the same time learning by doing and building a data-driven AI culture. This can help others get excited and understand what artificial intelligence can be used for. Bigger investments are justified when there is a big reward expected. If an AI use case is related, for example, to a production process, the expected cost savings can be so huge that also bigger investments for development are justified.

When selecting the AI use cases, the strategic objectives should always be borne in mind, and how the use case fits into business- and functional-level strategies. Available resources also affect the use case selection, whether the limiting factor is time, money or human resources.

The principles for selecting AI use cases showed similarities between theory and interview results in focusing on business value and expected return on investment. Also, favouring cases where the most value was expected to be obtained with the least effort fits the theory, but it did not delve into how this "least effort" should be evaluated. In chapter 5.2.1, Rashidi's approach (2024) was presented. There use cases were selected based on their criticality to company longevity and growth, and non-complexity of deployment based on available resources, change management effort and clear ownership of the use case. (Rashidi, 2024, chap. 5) Therefore, this complexity versus criticality quadrant viewpoint should be considered when prioritizing AI use cases. To name a few additional individual factors, the available data and the project's risk level are also considerations that should be considered in the AI use case assessment, which was not mentioned in the interview.

6.4 Data

The third theme in the interview was about what aspects of data handling are seen as important when considering an AI strategy or AI use case implementation. Almost all interviewees raised the importance of data quality. As Interviewee 1 said:

"Data must be reliable and intact for AI to function properly."

According to Interviewee 6:

"The data sources should be mapped, and the data chain should be examined carefully to be sure where the system gets data and whether the data is really OK and see if there are any risks or uncertainties to wrong conclusions".

Interviewee 7 stressed that:

"The effectiveness of AI goals depends on the quality of data fed into the system, as AI's output is directly influenced by the input data".

Few interviewees highlighted that data governance is important, because it defines the owners for data, who should monitor its quality.

Data security was much highlighted too, securing data confidentiality was a main concern both externally and internally. Used data should not be leaked out of the company, and internal users should have access only to the data to which they have access rights. Data availability was a common topic that was brought up. Data should be centralized from different sources to ease its utilization. When developing AI, the data integrations between systems should be taken care of and ensure that the data is up to date. As Interviewee 5 said:

"The data should be as fresh and real-time as possible, especially for process and quality control purposes".

Interview responses covered well the different points of data management, like handling the data quality, securing it, mapping the data sources and making data available. Maintaining a centralized overview of all data assets was mentioned too. According to Herremans (2021), the organization should align the AI strategy with data strategy, and this is something that organizations should really think about, whether a separate data strategy is needed, which plans how the organization is managing its information asset now and in the future. (Herremans, 2021) As said, the security was often mentioned, but the privacy and ethical requirements were not brought up, even though those are the topics that need to be considered in AI projects. In the interview comments, there was a good and important point that you really need to understand the source data and its quality when using AI for decision making.

6.5 People and skills

The fourth theme discussed was people and skills, focusing on how to overcome this barrier to capturing value from AI. Many different approaches have been suggested to increase the capabilities of the organisation. It was stated that employee training is important, so that they can participate in AI projects effectively and utilize new technologies. When employees have a basic knowledge of AI, they are better able to find potential uses for it. AI training programs should be developed to enhance employees' skills in using AI tools effectively. Training programs can also be e-learning courses, which are widely available and are available for self-study, which help people get started with using

artificial intelligence. Other learning methods discussed were self-training, internal workshops and train the trainer approach. Interviewee 7 suggested personal targets for engineers and managers for self-training:

"Encouraged to self-training by setting personal goals for engineers and managers to spend, for example, 10 hours this year on learning AI prompt writing."

Learning-by-doing workshops were suggested by two interviewees. Interviewee 6 said that:

"You could organize small workshops and think concretely about what AI can be used for and encourage people to use it."

Small workshops, proof of concept testing and demos is one way to get the whole organization to learn utilizing AI. The train-the-trainer approach was said to be an effective method, too, where colleagues are teaching each other how AI is used. Having a support system or team in place for employees, where the AI expert can assist employees in integrating AI into their work process, was seen as important.

Depending on the size of the organization and its capabilities, one solution to bridge the skills gap is to use external vendors. Interviewees 5 and 2 pointed out that:

I5: *"In the initial stages, you should use a competent partner who is familiar with the AI area and its possibilities. With the help of a partner, you can increase your own expertise."*

I2: *"External service providers can help implement AI projects, especially when specialized expertise or resources are needed."*

One view was also to designate an AI expert or manager to drive AI initiatives and provide training to employees as Interviewee 7 suggested:

"Should we hire, or should we train somebody and say you're gonna be the AI guru, and we want you to go through and you focus only on AI. How can we use it every day? What is the right AI for us? What data sets can we use it for? And then you know, how can we maximise our benefit? I would say that'd be the first thing is to designate a kind of leader in that sense."

Both theory and interview results suggest training the whole organization to be able to identify AI possibilities. In addition, the employees directly involved in the project should be trained with workshops and courses when needed. Theory also brings a new point, the need to assess the organization's current competencies and skills. This enables the planning of which training is required and which expertise should be sourced from a technology partner. (Proksch et al., 2024b, chap. 14) As suggested by interviewees, using

the train-the-trainer approach and encouraging people to self-learn are also possible approaches to increase AI competencies.

6.6 Technology selection

The fifth theme in the interview was technology selection. Interviewees were first asked about the development approach to AI technology, which fits best for our business and the high-tech manufacturing industry overall. Off-the-shelf, custom solution and off-the-model development models discussed what the pros and cons are. Other aspects about technology and vendor selection were also inquired about. Off-the-shelf and off-the-model solutions was clearly seen as the most suitable approaches in terms of resource, cost effectiveness and implementation speed point of view. As Interviewee 5 said:

“We should look specifically at what tools are available on the market, what we need, and how we could utilize those tools.”

This approach was seen as best in the early stages of the AI journey. The use of off-the-shelf solutions might be needed when implementing AI to oversee the production process. These solutions can be purchased from major vendors, but some configuration is required to tailor them to a production-specific environment. As Interviewee 5 stated:

"The ideal situation would be that we could modify it on our own so that it better serves our needs and develop it so that it wouldn't have to constantly take on external support for its development, but the foundation would still be there, so to speak, from a major player."

Developing one's own custom AI model was said to be reasonable when it enables a new service offering or brings a clear competitive advantage, and no suitable AI solution is available on the market.

Other important aspects discussed around technology selection were security, avoiding so-called vendor lock and how the solution fits in the compatibility and architecture point of view to the current IT landscape. Although a security evaluation is part of the technology selection process, it is discussed in the next subchapter, Risks and Mitigation. Technology continuity and compatibility are important to consider, and it would be good for the solution or technology to be open, not tied to a single supplier. This helps to avoid vendor lock, and it allows changing the supplier if necessary. From a compatibility point of view, it should be ensured that the solution is compatible with existing systems like the company data warehouse or ERP systems. Taking care of the overall IT architecture was seen as important, as Interviewee 3 commented:

“We should keep the whole picture in mind, meaning if we are on a Microsoft platform, we should build on top of that, which helps with tool integration. And we should not just

randomly adopt different technologies that meet current needs but think about future needs."

Interviewees had the same preference as the theory to select off-the-shelf solutions whenever possible. This saves time, ready solutions typically have a lower implementation cost, and no own AI talents are necessary. (Rashidi, 2024) Both theory and empirical feedback recommend that the selected solution should be flexible, scalable, secure, interoperable with current systems and upgradable to future tasks too. What was new in empirical feedback was the recommendation to avoid so-called vendor lock. This is important because it enables competitive bidding for the service and allows for better control over running costs. Another emphasized factor from interviewees was the architectural planning, that the new solution fits the current ICT landscape.

6.7 AI risks and mitigation of those

In the sixth theme, the AI risks and ways to mitigate those were first discussed, and then in which use cases, human decisions are still needed in the decision-making process. Almost all interviewees mentioned operational risks as one of the risks when implementing AI. It was said that you need to understand that a Generative AI does not always give the correct answer, and there should be a human decision in uncertain situations. One idea to improve the reliability of AI is to enable querying of the source data used in the decision-making process. Another important aspect is that the accuracy of the data used by AI had to be ensured. This ensures that AI solutions can work reliably. Blindly believing that AI will always work perfectly can also lead to high costs, so this financial risk should be taken into account by monitoring how the AI model is working. In certain machine learning models and use cases, the AI can outperform humans, as Interviewee 2 commented:

"At some point, the AI will probably be ninety-nine-point ninety-nine percent right, so at some point, you just trust it to be right. When a machine learning model has been trained on a huge amount of data, trusting it is better than trusting a human."

On the technical risks side, it was said that the authorization needs to be taken care of and make sure that users can access only the data they are supposed to. In the technology selection phase, the security needs to be thought through so that the data is protected and ensured that it does not end up in the wrong hands. The obsolescence of solutions can be seen as a risk in the use of artificial intelligence, because the field is developing rapidly, and solutions can become obsolete. With technical solutions also comes a person risk. If know-how is only in the hands of one or two people, there is always a risk too. A good documentation of the AI solution mitigates this risk. Related to person or know-how risk, it was said by Interviewee 3 that:

"If AI causes problems, it is important that the company has people who understand how AI works and can fix the problems quickly."

It should be considered what harm can be done if AI makes incorrect decisions. Interviewee 7 pointed out that:

"I see a chance or a risk of being overly reliant on AI. I've seen this already with people in school, for example." "A human should be somewhere in the loop to make sure that AI is going to the right direction" and "monitoring it and kind of giving it guidance because I think AI, at least the current AI is they're very much like children."

AI can support in decision-making, but the final responsibility is on humans. People should have a general understanding of the logic behind the AI before they can decide where it can be used and where it cannot.

The interviews highlighted the technical, security, operational, and financial risks, which were mentioned in the literature review too. Other risk types, like reputational, ethical, and regulatory risk, did not get attention, which gives rise to a formal process where risks should be considered in AI projects. A person risk emerged as a new perspective from an interview when thinking about AI solutions. It's important to secure the necessary internal know-how when AI solutions are implemented or make sure a support agreement is in place with the vendor. The need to have human oversight in critical tasks was also identified.

6.8 Implementation of AI

The last theme in the interview was the AI implementation roadmap. It was discussed which kind of development approach would fit best for the case company AI projects. The different approaches can be seen as agile or a waterfall type of methodology. Also, different elements that should be included in the AI implementation roadmap were discussed and how the progress should be followed.

The agile approach as a development model was preferred because of its ability to adapt to changes more easily, and it is also suitable for a pilot testing approach. It was seen as a quick way to make the first testable version and find possible problems early on, allowing early fixes. As Interviewee 7 said:

"Obviously, anything we do, we should always try to be agile and adjustable. I think that is the key. The challenge with AI, we have to do a project in an agile way because as we go forward, AI is moving at such an advanced rate that we may make a plan today that we implement something next year and then six months from now, the whole world may shift, and we do something else and so."

An iterative way of development was seen as important, although in some cases there is a place for the waterfall method too, when it is very clear what the project scope and requirements are.

Regarding key elements of the AI strategy implementation roadmap, three interviewees mentioned the timeline and objectives. It was said to be important to have an owner who drives the implementation. One way to enhance the implementation of AI was mentioned to hire an AI manager to lead AI initiatives and provide training and support to employees in utilizing AI effectively. In responses, there was emphasis on resource planning: budgeting, competencies and IT infrastructure. Also, the training plan was proposed to be part of the implementation plan. To implement an AI strategy, it should be clearly communicated with support from the Chief Executive Officer (CEO) level. Having a long roadmap was seen as a challenge in areas like AI because of the speed of technology development. The roadmap must be flexible and ready to take advantage of future opportunities. As stated by Interviewee 8:

"When it comes to artificial intelligence, you may have to be a bit of a visionary and think about what all the things are likely to be possible in 5 years and start developing something like that now."

How the AI strategy implementation should be followed up was seen to be done via agreed metrics. Metrics like AI solution usage rate, gathered benefits, and improved performance were suggested. The progress of the strategy should be monitored regularly, and the indicators should be clear and easy to follow. Metrics should be defined in collaboration with the business and aiming at continuous improvement.

Interview feedback about AI implementation was much following the literature review findings. In most cases, the agile and iterative development approach was seen as the preferred method as it is adaptable to changes. (Proksch et al., 2024b, chap. 10) Also, different elements needed in the implementation roadmap were well aligned with theory, but one topic, the change management process, did not get much attention. According to Rashidi (2024), change management is one of the common pitfalls in AI deployment. (Rashidi, 2024, chap. 5)

7. CONCLUSIONS

The aim of this study was to find out how to start leveraging AI in a high-tech manufacturing company. According to Rackspace Technology (2021), to overcome pitfalls and harvest the potential benefits from AI, there is a need to put an AI strategy in place first. (Rackspace Technology, 2021, p. 8) Also, Miyamoto's (2023) research on AI governance and AI adoption suggests that the successful adaptation and utilization of AI technologies are closely linked to the development and implementation of an effective AI strategy. A well-defined AI strategy helps organizations to identify the most suitable AI applications, allocate resources optimally and maximize the benefits from AI applications. (Miyamoto, 2023, pp. 649, 656) So, AI strategy is guiding the organization in the right direction for the development and implementation of AI projects. How then to ensure that the AI strategy is focusing on the right things, and is it creating an optimal business value? This leads to **a research question for the thesis: What factors should be considered when developing an AI strategy for a high-tech industrial company?**

The thesis established a theoretical foundation for AI strategy development with a literature review. Focus areas of AI strategy development were gathered by comparing common factors from six different publications on AI strategy development and implementation. Based on the selected AI strategy focus areas and the results of the literature review, a seven-step AI strategy development framework was established in Chapter 5.3. "Figure 6. AI strategy development framework." **The top-level factors in the AI strategy development framework are: 1. Setting AI goals, 2. Use case identification and success metrics, 3. Data, 4. People & Skills, 5. Technology Selection, 6. Risk Analysis & Mitigation plan and 7. Implementation**.

The empirical research of this thesis aimed to answer the same question as a literature review and, in this way, also to give confirmation that the developed AI strategy development framework was relevant in the case of the company environment, too, which is car and off-highway battery manufacturing. The research was done as a case study with a semi-structured interview method. Interview themes and key questions were derived from the AI strategy development framework, and interview data were analysed with thematic qualitative data analysis. A total of eight participants were interviewed in the case company based on their experience in relevant areas. Interview results aligned well with the developed AI strategy development framework. The following main findings were empirical findings combined with theory.

As a first step in AI strategy development, the work is to set AI strategic objectives with a cross-functional team and align AI goals with the company's strategic goals and vision. The next step is to identify use cases that are feasible to implement and have a clear business value. AI use cases should be prioritized based on value, ROI, criticality and

complexity. It’s important to set success metrics for use cases too. Interview result emphasizes a focus on business value, business-critical topics and solving business problems. Highest priority use cases should be with low complexity and high value. The interview also suggested looking into whether AI opens new business opportunities. The interviews did not address the assessment of the risk level of use cases, which is considered important in the literature to remember.

Thirdly, identify the available data sources and ensure that the data is of high quality. Data must be clean, well-integrated and easily accessible. Data security was emphasized in the interview results, but privacy, legal and ethical requirements were not mentioned, although these are mandatory to include in the design.

The fourth step is to evaluate the organization's current capabilities, maturity and needed roles. Grow your organization's AI skills with training and workshops. Train the whole organization to be able to identify AI possibilities. Choose an AI technology partner that fits your organization and fills the organization's competence gaps.

The fifth step is to do a technology selection with the help of AI experts. The main principle in choosing technology is to select off-the-shelf solutions whenever it’s possible; there was a clear consensus on this. AI solutions should be flexible, scalable, secure, interoperable with current systems and upgradable to future tasks too. The interview results raised an important aspect in technology selection. It should always avoid a vendor lock situation in technology selection.

The sixth step is to do a risk analysis. Consider the technical-, security-, operational- and financial risks, but also reputational-, ethical-, and regulatory risks. The latter ones are easy to forget based on interview feedback. It was suggested to also secure the internal know-how of AI solutions implemented and review the need for human oversight.

The last step is to do an implementation roadmap and plan how to monitor the progress. An agile and iterative approach should always be preferred when possible. Change management was not brought up in the interview, but it should be coordinated as it is one of the common pitfalls in AI deployments.

In conclusion, this study successfully addressed the research question by developing an AI strategy development framework, which is summarized in Chapter 5.3. “Figure 6. AI strategy development framework”. Based on the evaluation, the empirical research results were aligned with the main points in the framework. This practical framework can be applied in the high-tech manufacturing industry to develop a good AI strategy.

7.1 Evaluation of the research and limitations

The study approached the empirical semi-structured interview research with themes derived from the literature review. Literature samples used to develop the AI strategy development framework were sourced from multiple sources, including peer-reviewed research articles and journals, as well as books and internet articles from international IT companies. There was a scarcity of academic research sources for the research topic.

The quality of this qualitative empirical research is reviewed through Tracy's (2010) 'Eight "Big-Tent" criteria for excellent qualitative research' model. The model consists of eight key markers of quality in qualitative research, which are Worthy topic, Rich rigor, Sincerity, Credibility, Resonance, Significant contribution, Ethics and Meaningful coherence. (Tracy, 2010)

This research can be considered a valuable topic because developing an artificial intelligence strategy is a very relevant, timely and interesting topic, as we are currently living in the midst of an artificial intelligence boom that is not temporary but will have a significant impact on many business areas as it enables productivity and business growth. (Rashidi, 2024, chap. 1; Tracy, 2010, p. 841)

The second key marker of good quality research is rich rigor, which means that there is enough data to support significant claims, the researcher has spent enough time to gather significant data, and the data collection and analysis processes are appropriate. (Tracy, 2010, p. 841) The research methodology used was the Saunders et al. (2019) research onion model, which follows best practices in academic research. Interviewees were selected based on their experience. The sample size is considered suitable for this type of qualitative study, where non-probabilistic sampling can be used to select participants. (Saunders, 2019, pp. 295–296, 315–317) Interview data was collected with automatic transcription and reviewed after the interview. There was enough time (1h) allocated for every one-to-one interview. The thematic data analysis process was done systematically, and the results were compared to the literature review results. All common themes from the data were highlighted and new, valuable viewpoints were raised too. Some single comments that were not supported by literature or did not bring value were not taken into the study paper. So, there is always some risk for incorrect interpretations of what is relevant and what is not.

Sincerity as a criterion for quality means researcher self-reflexivity and transparency about methods and challenges. (Tracy, 2010, p. 241) Data was collected with open questions, and leading discussion was avoided. Data was analysed objectively without adding the researcher's own predilections or opinions. How data collection and analysis were done was described transparently and in detail.

Credibility is about for example, a thick description, concrete details and using triangulation, which means using two or more data sources, the researcher converges on the same conclusion, which is then more credible. (Tracy, 2010, p. 843) Interviewee responses were directly quoted to bring more credibility, and similarities and differences compared to the theory were highlighted. In conclusion, it was noted that semi-structured interview results were very well aligned with the AI strategy development framework derived from theory.

Resonance criteria are about research influence. Research must be presented with clarity, be comprehensible to the target audience, and it should have transferability. (Tracy, 2010, p. 845) Developed an AI strategy development framework that is summarized into seven different themes in Chapter 5.3. “Figure 6. AI strategy development framework” to have clarity and easy utilization. The framework should be transferable to other high-tech industrial companies; however, more research is needed if it is to be applied to another type of business environment.

According to Tracy (2010), the research should provide a significant contribution theoretically, practically, morally, methodologically or heuristically. (Tracy, 2010, pp. 845–846) This research has clear practical significance because it provides a tool for designing an effective AI strategy.

Research ethics is about procedural, situational, relational and exiting ethics. (Tracy, 2010, p. 847) When doing the research, the participants' interview data were coded and not shared further. The research topic was explained to participants, and participation was voluntary. Situational ethics was considered when direct quotes were included in the research results. Relational ethics was followed in interaction with interviewees, and exit ethics was addressed in this study by writing the research in a way that it could not be misread or misused.

The last qualitative research criterion, meaningful coherence, means that “*meaningfully coherent studies rather clearly link research design, data collection, and analysis to their theoretical framework and situational goals.*” (Tracy, 2010, p. 848) The study achieved coherence by first developing an AI strategy development framework based on a literature review, which was then used as a basis for semi-structured interviews. Interview results also supported the focus points in the created framework.

7.2 Future research

For further research, a semi-structured interview study with the same set of questions could be done with another high-tech industrial company from a different business area or with a company that is not in the early stages of AI adoption. This could open new perspectives on the research topic. On the other hand, as the research material related to AI development and implementation can be expected to grow at an increasing pace, a complementary literature review conducted after some time could provide even greater assurance that the AI strategy development framework includes all the necessary elements.

Once this AI strategy development framework has been implemented in a company, it would be interesting to understand through evaluative research how well and effectively the framework works.

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APPENDIX A: INTERVIEW GUIDE

Thank you for taking the time to participate in this interview. This research is related to my master's thesis, which examines the development of an AI strategy for a high-tech industrial company, focusing on what factors should be considered when creating an AI strategy.

The interview will be recorded and transcribed using Microsoft Teams and Microsoft Co-pilot. Respondents' comments and other interview data will be treated anonymously.

Based on the literature review, I have created an AI strategy development framework that gives themes to this interview research. The main themes discussed around the AI strategy development model are:

- AI goals and link to other strategies
- AI use case identification
- Data
- People and skills
- Technology selection
- Risk analysis
- Implementation

First, we could discuss AI use cases in practice.

Opening questions:

- **Which business areas should the AI be applied to in the first place?**
- **How do you see what could be a good use case for the utilization of artificial intelligence?**

Then, about **goal setting in AI strategy:**

- **When thinking about AI strategy development, what do you see as an important factor when making goals for an AI program or project?**
- **What kind of working group should be used to create an artificial intelligence strategy?**
- **Regarding different strategy levels in the company, how should the AI strategy be aligned?**

The next theme is about identifying **AI use cases and success metrics.** Questions for this research theme are:

- “**What do you think is the kind of skillset needed from a team defining the AI use cases?”**
- “**When selecting AI use cases to be implemented, based on which criteria should those be selected**”?

The third theme in the AI framework is about data, which is a prerequisite for AI.

- **What aspects of data handling do you see as important when considering AI strategy or AI use cases implementation?**

The fourth theme is people and skills, and their effect on successful AI projects.

- **People and skills are seen as one of the major barriers to capturing value from AI, according to Gartner’s and Rackspace Technology’s studies. What would be your approach to solving this problem?** (Gartner, 2023; Rackspace Technology, 2021)

The fifth theme is **technology selection**; in addition to technological choices, it's about a make-or-buy decision.

- “One of the first steps in technology selection is to make a decision, whether to build a custom solution, buy an off-the-shelf solution, or something in between, which is off-the-model development, where existing AI models are complemented with their own data to better meet the organization's AI needs. Custom solutions have excessive cost, technical talents are needed, and development takes more time than off-the-shelf solutions, but the opportunity is to get fully customized AI solutions for the organization. Off-the-shelf solutions, on the other hand, have a lower cost, no technical AI talent is needed, and implementation is fast; however, customization is not possible. **How do you see these three options: off-the-shelf, off-the-model and own custom AI solution, which option or options fit best for our business and high-tech manufacturing industry?**
- **Regarding technology selection, what other topics do you see as important factors to be taken into consideration?**

The sixth theme deals with risk analysis and a mitigation plan.

- **What risks do you see with AI solutions, and how can you mitigate those?**
- The concept of human-in-the-loop means that there is a human judgment incorporated into the final AI decision-making. Certain AI technologies, like neural networks or GPT models, do not always give the same answer, but the result is based on probabilities. **Considering this uncertainty, which kind of use cases are such that human-in-the-loop is necessary and when it’s not needed?**

The last theme in the AI strategy framework is the **AI implementation roadmap**.

- The approach for an AI project can be either agile and iterative or a waterfall-type sequential methodology, where the first step is requirement analysis, followed by system design, implementation, integration, testing, and finally deployment and maintenance.

Waterfall methodology can be seen as a more predictive way, but it cannot adapt to changes easily. In agile, you first do a small pilot called Proof of Concept to assess the technical feasibility, and after that, start to proceed towards a minimum viable solution with only necessary features, and then towards a full, feature-rich final AI solution. **Which approach would you prefer in AI projects?**

- **What key elements would you include in an AI strategy implementation roadmap?**
- **How should the AI strategy implementation be followed up?**

We have now discussed the following themes: AI goal setting, use case identification, data, people & skills, technology selection, risk analysis & mitigation plan and implementation roadmap.

- **Do you feel that there are still some areas totally missing in this AI strategy development framework, or should some of the discussed topics or areas be highlighted more as very important factors?**