Challenges and Opportunities of Artificial Intelligence in Digital Transformation

A Systematic Literature Review

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Abstract

In the era of exponential development of technology, new technologies like artificial intelligence (AI) have great impacts on organizations. By applying digital transformation, companies are creating new practices or updating existing applications to stay competitive in the market. Digital technologies have gotten to the top position in organizations' business strategies. Artificial intelligence technologies can create a competitive advantage through digital strategy. To fulfill changed customer expectations, companies use artificial intelligence technology in their products and services. Artificial intelligence technologies provide some great opportunities. On the other hand, they are bringing out some serious challenges to organizations. Understanding the opportunities and challenges that AI provides is critical for organizations and society. There is a lack of knowledge about the challenges and opportunities of AI in digital transformation. This research addresses the challenges and opportunities by a comprehensive documentation about the insights derived from the existing literature. The research question was formulated as follows: What are the challenges and opportunities of artificial intelligence in digital transformation? As the research strategy, the systematic literature review method was selected. Data was retrieved by using Web of Science and Scopus databases, which enable the researcher to reach several databases like ScienceDirect, ResearchGate, etc. PRISMA framework was followed to reach the final number of articles to analyze. After reading all the studies, the data retrieved from 32 studies were analyzed through the content analysis method, and common themes were identified with the challenges and opportunities of artificial intelligence in digital transformation. The research results can be useful for organizations that wish to know the challenges and opportunities of using artificial intelligence in digital transformation and the actions to take to use these challenges and opportunities.

Keywords: Artificial intelligence, digital transformation, challenges, opportunities, digital transformation strategy, digital strategy

Synopsis

Background

Digital technologies are entering our lives more and more every day. Digital transformation is becoming a must for companies to be competitive in the market. Artificial intelligence, as a revolutionary technology, is a candidate to become an indispensable part of digital transformation. In this study, the challenges, and opportunities of artificial intelligence in digital transformation are examined through a systematic literature review. Reviewing existing literature on this topic helped address and categorize the main topics of this research area. The findings of this study can be useful for companies undergoing digital transformation, in understanding the opportunities provided by AI, such as improving strategic decision-making and competitiveness, and challenges, such as data privacy issues.

Problem

Artificial intelligence is seen as a revolutionary technology and its adoption is increasing. Companies can use artificial intelligence to improve their decision-making and increase their competitiveness in the market. Artificial intelligence technologies provide some great opportunities besides bringing out some serious challenges. Understanding these challenges and opportunities will be critical for organizations and society. There is a lack of knowledge about the challenges and opportunities of artificial intelligence in digital transformation. This research aims to conduct a systematic literature review to investigate these challenges and opportunities.

Research Question

The research question of this study is: ‘What are the challenges and opportunities of artificial intelligence in digital transformation?’

Method

The chosen research strategy for this research is the systematic literature review. Web of Science and Scopus databases were used for data collection in the literature search. Also, for data collection, the PRISMA framework was followed. The search strings were formulated and without time restriction all the studies focusing on artificial intelligence and digital transformation together were retrieved. After applying certain inclusion and exclusion criteria, final papers were chosen for the data analysis. For data analysis, the content analysis method was applied.

Result

The challenges of AI in digital transformation identified in this study are; in the *cost category* high cost of AI technology; in the *technology category* data collection and data accessibility challenges, poor data quality, and technical blockages; in the *human category* lack of skills/knowledge, top management support, employees' lack of trust for AI and resistance to change, over dependency on technology, and lack of empathy; in the *ethics category* high possibility of bias, data privacy considerations, transparency, and explainability, responsible use of predictive analytics, data governance, and intellectual property; and in the *security category* cyber security risks. According to article distribution, the most frequently mentioned topics were ethical issues; ‘high possibility of bias’, ‘data privacy considerations’, and ‘transparency and explainability’.

The opportunities of AI in digital transformation identified in this study are; in the *cost category* of cost-effectiveness, gaining competitive advantage, enhanced productivity, and saving time and labor costs;

in the *technology, category* increased efficiency, better decision-making, optimization of processes and sources, support innovation, automate mundane tasks, and improve product and service quality; in *human category* flexible and personalized products and services, increase customer engagement and loyalty, increase accessibility of products and services, and reduce human error; in *environment, category* improve sustainability; and in *security category* foresee potential challenges and risks. According to article distribution, the most frequently mentioned topics were technology-related issues; 'increase efficiency', 'better decision-making', and 'automate mundane tasks.

Discussion

This study provides comprehensive research in literature focusing on the challenges and opportunities of AI in digital transformation without using limitations such as specific sector applications or specific concepts like the role of AI in business model innovation. From manufacturing to education, many sectors' applications and several literature reviews were investigated, and as a result, a wider list of challenges and opportunities was created. In this way, this study contributes to the literature. Among the most frequently mentioned topics in terms of challenges, ethics-related issues stood out, especially the categories of 'high possibility of bias', 'data privacy considerations', and 'transparency and explainability'. Among the most frequently mentioned topics in terms of opportunities, technology-related issues stood out, especially the categories of 'increase efficiency', 'better decision-making', and 'automate mundane tasks. The challenges of AI in digital transformation are changing depending on what stage the AI implementation is or what sector the organization is in. The opportunities of AI in digital transformation are changing depending on the companies' needs or what sector the company is in. This study can guide organizations about the challenges and opportunities of AI in digital transformation and even each department in the organization can make useful inferences with the information provided here. This research provides key challenges to consider for companies and they could take suitable actions against these challenges. In addition, companies can benefit from the identified opportunities.

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List of Abbreviations

AI: Artificial Intelligence
CSR: Corporate Social Responsibility
EU: European Union
GDPR: General Data Protection Regulation
GPT: Generative-Pretrained Transformer
IoT: Internet of Things
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

1 Introduction

This chapter provides fundamental information related to artificial intelligence and digital transformation. Research problem, research question, and limitations are also included in this chapter.

1.1 Background

The contribution of digital technologies to our lives is rapidly increasing. In the face of the exponential development of technology, companies' need for digital transformation is increasing to keep up with these developments. “Digital transformation is the use of new digital technologies, such as social media, mobile, analytics or embedded devices, to enable major business improvements like enhancing customer experience, streamlining operations or creating new business models” (Horlacher and Hess, 2016, p 1). Digital transformation is the process of creating new practices or updating existing ones by using digital technologies to be better at fulfilling changing customer and business needs (Abasaheb & Subashini, 2023). As part of the digital transformation, to improve efficiency and customer experience, businesses are using digital innovations in their processes, procedures, products, etc. (Hinings et al., 2018, as cited in Hajishirzi & Costa, 2021).

Artificial intelligence (AI), the use of which has increased in recent years, has a great impact on the digitalization process of companies (Rittelmeyer & Sandkuhl, 2021, as cited in Hein-Pensel et al., 2023). “AI is the technology that allows machines to interact with humans, data, and the entire ecosystem and learn from this such that they can perform more than what either humans or machines can on their own” (Maheshwari, 2019, p 141). According to Holmström (2022), it is agreed that new technologies like AI technology have major effects on organizations, especially in large-scale transformations. Digital technologies such as cloud computing, big data, and (AI) nourish digital transformation and redesign the competitive arena (Magistretti et al., 2019). Kraus et al. (2021) show the strong relationship between digital transformation and the technologies that are mentioned above and describe technology as a key driver to enable competitiveness in digital transformation.

In the past few decades, we have seen tremendous advancements in AI methods that were made open-source and that increased its accessibility by people. The decline in computer hardware and AI chip design costs has made the extensive and complex computation needs in AI applications more feasible for organizations (Collins et al., 2021). Also, improvements in cloud-based services made AI more attainable by organizations (Collins et al., 2021). AI is used in decision-making, creating value from data-related decisions, and improving companies’ operations of products and services (Bughin, et al., 2017). The utilization of AI provides many benefits for organizations; it enables process automation and helps develop new products and services (Borges et al., 2021). AI technologies help organizations improve performance by providing speed, flexibility, customization, and innovation (Venkatraman, 2017; Wilson & Daugherty, 2018 as cited in Borges et al., 2021).

Borges et al. (2021) state that AI technologies can create a competitive advantage through digital strategy by improving customer experience and engagement, as one of their research opportunity suggestions. AI will play a significant part in roles involving strategic decision-making, cognitive processing, and data-related decisions, such as analyzing team performance and improving production and service-based operations (Bughin, et al., 2017). According to our new reality, technologies and customer behaviors are rapidly changing and companies need to adapt to these circumstances quickly. Zaki (2019) claims that digital service transformation will be companies’ strategic focus in different sectors. To be competitive companies are building a digital service strategy. In addition to designing the

right experience for their customers, and rewriting business models to become more data-driven in the way they work, at the same time, companies must deal with digital transformation challenges in leadership, culture, etc. (Zaki, 2019).

Digitalization's consequences are affecting all sectors. Companies need to evolve according to changing technologies and customer behaviors. Audio, video and text processing, machine learning, knowledge representation, and robotic processes are some of the AI components that help companies increase productivity, reduce costs, improve quality, and enable them to be competitive in this highly digital world (Maheshwari, 2019). Customer needs and expectations have changed, and companies use AI in product and service improvements according to these changes. With the help of real-time data companies derive insights and create value for their customers. Google identifies images by using deep learning, one of the subfields of AI. The self-driving car industry is using AI to make correct adjustments to the sensors' data. Many companies use AI-powered chatbots to be faster in responding to their customers.

1.2 Research Problem

For organizations, AI can be seen as a key driver of digital transformations today. Although AI technologies have advanced significantly, their adoption is still in its early stages (Bughin, et al., 2017). The adoption of AI accelerated during the Covid-19 pandemic. Ayoko (2021) claims that modern organizations will be increasingly adopting digital transformation, robotics, and AI. AI is helping companies in cost reduction, increasing the quality of the services they provide, and enhancing coordination, and productivity (Iansiti & Lakhani, 2020; Kittur et al., 2019, as cited in Ayoko, 2021). Companies can use AI to improve their decision-making and increase their competitiveness in the market.

Brock & von Wangenheim (2019) suggests that, although AI is seen as a revolutionary technology, there is not much empirical advice for managers on how to use AI and/or prepare for it at this stage. Holmström (2022) claims that AI technologies provide some great opportunities besides bringing out some serious challenges; however, many leaders do not know how to deal with these challenges. Paul et al. (2024) investigate digital transformation from a multidisciplinary point of view and recommend investigating a comprehensive understanding of AI's impact for responsible and beneficial implementations. According to Lemieux (2023) exploring current and emerging opportunities and challenges that AI provides is critical for organizations and society which will be affected by these AI developments. Therefore, the problem this thesis seeks to address is the lack of knowledge on the challenges and opportunities of AI in digital transformation. This research aims to conduct a systematic literature review to investigate the challenges and opportunities that companies might encounter in their digital transformation journey.

1.3 Research Question

To investigate the impact of AI on digital transformation a clear and comprehensive research question was formulated. The research question to be answered in this thesis is: 'What are the challenges and opportunities of artificial intelligence in digital transformation?'

1.4 Delimitations

This study is limited to investigating challenges and opportunities of AI technologies in digital transformation. This study does not focus on the other technologies that are mentioned in digital

transformation, such as IoT, cloud technology, etc. Only the articles and journals which are written in English were used in this research. This study is not limited to any time limit, geographical region, or sector. Only open-access articles were examined in terms of accessibility limitations.

2 Extended Background

This chapter introduces artificial intelligence, digital transformation, and how AI is located as part of the organizations' business and digital transformation strategies.

2.1 Artificial Intelligence

The term "artificial intelligence (AI)" was first used in 1955 by John McCarthy and his colleagues in a research paper (McCarthy, Minsky, Rochester, & Shannon, 1955, as cited in Caner & Bhatti, 2020). Being established as an academic discipline in the 1950s, AI did not get too much interest in the following fifty years (Haenlein & Kaplan, 2019, p5). On the other hand, some remarkable times made the world astonished by AI, like IBM's Deep Blue's defeat of World Chess Champion Gary Kasparov in 1997 (Caner & Bhatti, 2020).

With new developments in technology, the importance and use of artificial intelligence has increased considerably recently. According to Maheswari (2019, p 145), three factors made AI technology feasible: the availability of huge data, deep learning algorithms, and an increase in computational power. Huang et al. (2019) explain AI systems in three categories; "mechanically intelligent" systems which do repetitive tasks for consistent performance, systems that are "thinking-intelligent" which can autonomously learn and adapt from data, and future systems that will be "feeling intelligent to interact with people in the way humans do. Mechanical AI is being used widely nowadays, thinking AI is expected to be advancing rapidly, and feeling AI is assumed to be used in most practical applications shortly (Huang et. al, 2019).

AI is involved in many sectors such as healthcare, finance, marketing, e-commerce, education, etc. AI technology has the potential to change how business functions perform, and AI can affect many business functions like production, marketing, process management, etc. (Caner & Bhatti, 2020). We can see many examples in the marketing sector. AI is used in designing personalized products and services. Recommendation engines use AI algorithms to provide personalized offers to customers who have similar interests. Using historical data AI applications match the customers with the best possible products, and as a conclusion of this, marketers improve the return on investments. With machine learning, one of the specialized areas of AI, computers can learn through experience (historical, transactional data). Deep learning, one of the subfields of machine learning, uses much more complex algorithms called artificial neural networks. Image processing, and natural language processing applications help to diagnose illnesses in the healthcare sector. It is expected that AI's impacts will be seen in all sectors in the following ten years (Caner & Bhatti, 2020).

2.2 Digital Transformation

As digital technology spreads across all industries and society, it is beneficial to distinguish the differences between digitization, digitalization, and digital transformation. "*Digitization* is the technical process of converting analog signals to digital signals" (Saarikko et al., 2020, p 828). This process is a basic prerequisite for recent technological improvements from smartphones to artificial intelligence. Schallmo & Williams (2018, p 6) define *digitalization* as "fundamental changes made to business operations and business models based on newly acquired knowledge gained via value-added digitization initiatives".

"Digitization" and "digitalization" have conceptual differences. Digitization expresses the technology and digitalization is about why this technology is used in a specific process (Saarikko et al., 2020). Businesses created new products and services through digitalization. For instance, banks developed online banking systems to enable real-time transfers without going to the bank. Customers' bank account details are digitized and easy transfers between different accounts are made possible.

Reis et al. (2018, p 418) define *digital transformation* as "the use of new digital technologies that enables major business improvements and influences all aspects of customers' life". Digital transformation improves an entity by triggering significant changes (Vial, 2019). The development of e-commerce and e-business after the Internet began to spread in the 1990s can be seen as the foundation for today's digitalization (Chalons & Dufft, 2017, p 13). The use of smart devices and social media platforms began to increase from 2000 to 2015, the way customers communicate with businesses changed drastically and customer expectations for businesses' response times and multi-channel availability of the businesses have evolved (Schallmo & Williams, 2018, p 4).

Business operations and business models are revised or newly created in digital transformation through value-added digitization initiatives, and this results in profit improvement (Schallmo & Williams, 2018, p 4). Through digital channels, businesses began to communicate with their customers one-on-one, in real-time. At first information technology was mostly supporting existing processes, now it is used to develop new business models and create new products and services (Chalons & Dufft, 2017, p 13).

2.3 AI's Importance in Digital Transformation

The digital transformation path differs according to industry, customer adoption, and the organization's environment, but every organization needs a change plan (Berman, 2012). Organizations that use digital transformation as part of their digital business strategy are advantageous in remaining in the market. Using multiple strategies in combination with digital business strategy provides companies with different capabilities, knowledge, and resources (Kraus et al., 2021). Leading companies focus on reshaping their customer value propositions and transforming their operations to succeed in digital transformation (Berman, 2012).

Lately, in business strategies digital technologies have gotten to the top position. Kim & Kim (2022) claim that for a successful digital transformation strategy, companies are using AI technology in constructing new business models. By learning on its own and imitating human performance AI technologies can present cognition ability. Due to their functions, some new-generation AI tools can be categorized as cognitive technologies, which are assumed to be part of the organizations' cognitive strategy (Davenport & Mahidhar, 2018, Borges et al., 2021).

AI's benefits are changing between industries and departments (Paul et al., 2024). Aldoseri et al. (2024) claim that with the capability of processing and analyzing the data, companies that embrace AI in digital transformation can have limitless possibilities in terms of growth and competitiveness. According to Perifanis & Kitsios (2023), integrating AI solutions into business strategies provides companies with remarkable benefits such as improved decision-making and efficiency increase. Integrating data analytics, predictive analytics, performance monitoring, and innovative product development into organizational strategies constructs the AI-powered innovation framework (Aldoseri et al., 2024).

2.4 Challenges and Opportunities of AI in Digital Transformation

Challenges and opportunities of AI in digital transformation were investigated in different categories. The findings are presented below.

2.4.1 Challenges of AI in Digital Transformation

The themes encountered in the first research on the challenges of artificial intelligence in digital transformation are given in Table 1.

Table 1 - List of challenges of AI in digital transformation

Challenges	References
High cost of AI technology	Golab-Andrzejak, 2023 (Research sector: Marketing); Ahmad et al., 2023 (Research sector: Manufacturing); Klopov et al., 2023 (Research sector: Education)
Challenges in data collection	Aldoseri et al., 2024 (Research sector: Not specific)
Poor data quality	Aldoseri et al., 2024 (Research sector: Not specific)
Cyber security risks	Lemieux, 2023 (Research sector: Not specific)
Lack of empathy	Mhlanga, 2023 (Research sector: Education)
Over-dependence on technology	Mhlanga, 2023 (Research sector: Education)
Lack of skills/knowledge	Ahmad et al., 2022 (Research sector: Manufacturing)
Data privacy considerations	Aldoseri et al., 2024 (Research sector: Not specific)
High possibility of bias	Aldoseri et al., 2024 (Research sector: Not specific); Mhlanga, 2023 (Research sector: Education)

The challenges of AI in digital transformation that were identified in the initial research are explained in detail below.

High cost of AI technology: Golab-Andrzejak (2023) investigated the barriers and challenges of AI-powered digital transformation in the context of marketing on the Polish market. One of the main challenges that is mentioned in this research is the lack of willingness to endure the high costs of AI technology. In another research on AI in digital transformation, Ahmad et al. (2023) show that cost is among the most important challenges in the implementation of AI in manufacturing firms in Malaysia. Klopov et al. (2023) state that cost is a disadvantage in AI applications in digital transformation. It is stated that the cost is too high for ordinary companies.

Challenges in data collection: According to Aldoseri et al. (2024) businesses have challenges in accessing relevant data. Data sources are fragmented, data comes in inconsistent formats or there is a vast amount of data to access and analyze. Data silos and integration complexities are other challenges related to this issue and there should be data collection strategies in organizations.

Poor data quality: For effective data analysis, the quality of data is very important (Aldoseri et al., 2024). Poor data quality which comes from inaccurate, incomplete, or inconsistent data can cause erroneous insights and wrong decision-making. To ensure data reliability companies should invest in effective data management tools (Aldoseri et al., 2024).

Cyber security risks: Lemieux, F. (2023) draws attention to the subject that AI tools can be used by hackers in the misdirection of a program or application. There are several examples of this, like malicious AI can be hidden in applications and when people download them, these malicious applications can cause harm to the computers.

Lack of empathy: Mhlanga (2023) investigates the challenges and opportunities of ChatGPT, an AI-powered technology, which has several capabilities such as answering queries and generating texts. ChatGPT is used in educational institutions to enhance education. Empathy is important when providing education to kids. Due to ChatGPT's lack of empathy, it can't provide a personal connection with students. As a result of this lack of empathy, students' motivation and overall school achievement might be affected.

Over-dependence on technology: Mhlanga (2023) shows that in the education sector in developing economies, dependence of ChatGPT technology may cause a decrease in the critical thinking and problem-solving skills of the students.

Lack of skills/knowledge: Ahmad et al. (2022) investigate the lack of skills/knowledge and human capital in AI, robotics, and IoT as a challenge, and states that this leads to the adoption of AI slower in companies.

Data privacy considerations: According to Aldoseri et al. (2024), there are increasing concerns on data privacy issues of AI technology use and there are developments in protection regulations like GDPR. Data privacy issues should be addressed by organizations, and they should be complying with the regulations.

High possibility of bias: AI algorithms are dependent on historical data and the discriminatory practices and social biases of these data can affect the outcomes of AI applications (Aldoseri et al., 2024). Organizations should avoid bias in data analysis and ensure not to harm or to create a disadvantage on any group. Mhlanga (2023) also mentions bias in outputs and misuse of data as a challenge of AI.

2.4.2 Opportunities of AI in Digital Transformation

The themes encountered in the first research on the opportunities of artificial intelligence in digital transformation are given in Table 2.

Table 2 - List of opportunities of AI in digital transformation

Opportunities	References
Cost-effectiveness	Aldoseri et al., 2024 (Research sector: Not specific)
Gain competitive advantage	Kitsios&Kamariotou, 2021 (Research sector: Not specific)
Enhance productivity	Aldoseri et al., 2024 (Research sector: Not specific)
Save time and labor costs	Klopov et al., 2023 (Research sector: Education)
Increase in efficiency of operations	Golab-Andrzejak, 2023 (Research sector: Marketing)
Better decision-making	Aldoseri et al., 2024 (Research sector: Not specific)
Optimization of processes	Golab-Andrzejak, 2023 (Research sector: Marketing)
Support innovation	Aldoseri et al., 2024 (Research sector: Not specific)
Automate mundane tasks	Aldoseri et al., 2024 (Research sector: Not specific)
Foresee potential challenges and risks	Aldoseri et al., 2024 (Research sector: Not specific)
Increase customer engagement and loyalty	Aldoseri et al., 2024 (Research sector: Not specific)
Increase in accessibility of customer service	Golab-Andrzejak, 2023 (Research sector: Marketing); Mhlanga, 2023 (Research sector: Education)
Flexible and individualized products and services	Mhlanga, 2023 (Research sector: Education); Aldoseri et al., 2024 (Research sector: Not specific)
Reduce human error	Klopov et al., 2023 (Research sector: Education)
Improve sustainability	Aldoseri et al., 2024 (Research sector: Not specific)

The opportunities of AI in digital transformation that were identified in the initial research are explained in detail below.

Cost-effectiveness: Aldoseri et al. (2024) show in many ways that AI is useful in cost saving. For example, AI can analyze sensor data from machinery, and foresee maintenance needs. This reduces problems and unexpected downtimes. AI-powered systems can reduce vehicle travel time by selecting optimal traffic conditions. This also can help to decrease emissions and improve environmental sustainability.

Gain a competitive advantage: According to Kitsios & Kamariotou (2021), AI helps organizations in knowledge management, decision-making processes, and advanced analytics, which provides a competitive advantage by enhancing customer experience, innovation of applications, and new product development.

Enhance productivity: AI-driven innovations enhance productivity (Aldoseri et al., 2024).

Save time and labor costs: Klopov et al. (2023) state that in the long run the cost of AI is relatively low, and this can help save time and labor costs.

Increase in efficiency of operations: Golab-Andrzejak (2023) investigates AI applications and shows how a second-generation chatbot increases the efficiency of customer service.

Better decision-making: Data analytics can provide reliable data-driven insights for leaders to use in strategic decision-making. It reduces the risk of intuition-based decision-making (Aldoseri et al., 2024). Organizations can decide a better path by looking at various scenarios simulated by AI tools.

Optimization of processes: Golab-Andrzejak (2023) states the benefits of AI tools used in process optimization, showing that it provide reliability increase and cost reduction.

Support innovation: Aldoseri et al. (2024) claim that by processing and analyzing the data AI applications can enable organizations to make innovative and transformative changes.

Automate mundane tasks: Automation of mundane tasks can help increase efficiency and allow users to focus on more high-value activities (Aldoseri et al., 2024).

Foresee potential challenges and risks: AI algorithms can process real-time data and foresee potential risks (Aldoseri et al., 2024). Organizations can use insights that AI provides and take precautions to prevent undesirable consequences.

Increase customer engagement and loyalty: By anticipating customer behaviors companies can produce tailored products and services, which leads to an increase in customer satisfaction and in the end customer loyalty (Aldoseri et al., 2024).

Increase in accessibility of customer service: Golab-Andrzejak (2023) shows the benefits of a chatbot which increases the accessibility of customer service. Mhlanga (2023) states that ChatGPT helps expand participation in high-quality education and deliver good education without creating a language barrier because it provides language support.

Flexible and individualized products and services: By analyzing various data, AI offers insights into customer needs and expectations which leads to an increase in customer satisfaction. With this knowledge, companies can produce new products and services (Aldoseri et al., 2024). In personalized learning, ChatGPT interacts with more users and improves its understanding of their learning style. This way it can provide personalized recommendations (Mhlanga, 2023).

Reduce human error: AI technologies help in processing vast amounts of information, and that leads to fewer errors in decisions and reduces human-related errors (Klopov et al., 2023)

Improve sustainability: AI-powered systems can be cost-efficient, help reduce fuel consumption, and contribute to the environment (Aldoseri et al., 2024). Technology-driven efficiency can increase sustainability, for example by providing advantages in agricultural practices.

3 Research Methodology

This section includes the research strategy and the alternatives, the data collection method and the alternatives, the PRISMA framework application, the data analysis method, and the alternatives, and the ethical consideration parts.

3.1 Research Strategy & Alternative

For a research project, one of the biggest concerns is how to do the research in a scientific way to get the best results that fulfill the research goal. There are many alternative ways to do the research. To reach a specific goal, a strategic plan should be designed (Denscombe, 2014). The strategy should be feasible for the researcher to reach the appropriate sources in the research subject, for instance, the right people to interview or the documents for the research should be accessible. Time constraint is an important factor to be considered to decide the research strategy. Moreover, ethical risks should be well assessed at the beginning of the research (Denscombe, 2014). In addition, the knowledge can be in different places or maybe even biased.

This thesis aims to get an objective overview of the challenges and opportunities of AI in companies' digital transformation processes. To reach the most comprehensive point of view about the research subject, the systematic literature review method was chosen. The systematic literature review method was suitable to examine several studies. Also, the research question in this study is clear, which makes this study suitable for a literature review. Systematic reviews are used to reach a reliable and objective outcome on a specific topic (Denscombe, 2014). Relevant literature is skimmed systematically and rigorously. By analyzing the data summoned in the light of the chosen criteria, an objective conclusion is reached at the end of the systematic literature review (Denscombe, 2014). In a literature review, a higher-level synthesis is needed which integrates concepts across domains to come up with a holistic solution (Watson & Webster, 2020). The researcher must identify the ideas that matter. After identification, the researcher finds a way to connect the ideas in a way that is consistent with a clear and explanatory flow (Watson & Webster, 2020).

One of the strategies that could be used to reach this research's goal is to conduct case studies with companies that are using AI in their digital transformation processes. In case study strategy the goal is to reach a general conclusion with the help of specific applications (Denscombe, 2014). With case studies, there is a good opportunity to find great insights from detailed interviews with the people who use the specific tools related to the research subject. However, the breadth of the study is less important than the depth of the study in case studies (Denscombe, 2014). Case studies are suitable for small-scale research and in a case study, different research methods can be used. On the other hand, the credibility of the generalization of the findings can be an issue that should be demonstrated by the researcher (Denscombe, 2014). One of the disadvantages of the case study mentioned by Denscombe (2014) is that it doesn't focus on the outcomes, however case study focuses on processes. To be able to conduct more comprehensive results rather than a deeper investigation, the case study method was not chosen. In addition, it was thought that the generalizability of the results, which is one of the weak points of the case study method, may limit this study.

Another alternative strategy for this study could have been the surveys. According to Denscombe (2014), surveys can be in various forms and the most common of these is to ask people questions. The survey process can be done face-to-face, online, by phone, or by postal service. With a survey, the subject can be investigated in detail. They are considered empirical research because it involves seeking necessary information from relevant people. Surveys mostly provide the current situation. Their coverage is wide and comprehensive. Quantitative and statistical analysis can be used to analyze survey results. Surveys can provide cost and time advantages. Results can be retrieved in a short time. Surveys provide real-life

experiences from the people who are concerned about the research topic. It can be used in both small-scale and large-scale research. Both quantitative and qualitative data can be collected by surveys. Surveys including interviews can provide rich data. However, there can be low response rates in surveys which can cause biased results (Denscombe, 2014). When the research population is hard to contact, the survey strategy can be very time-consuming. This method was not used because the researcher couldn't reach a sufficient number of participants for a survey. Additionally, it would be very hard to reach enough participants, since this study focuses on digital transformation and AI together. It would be hard to reach suitable organizations that are using AI in their digital transformation journey.

3.2 Data Collection Method & Alternative

Although the same subject is investigated in different research projects, there can be different results (Denscombe, 2014). In a systematic literature review keywords and search terms should be carefully considered (Denscombe, 2014). It is recommended that in the small-scale research process, the search can concentrate on published works (Denscombe, 2014). The evaluation of the quality of the sources is done by the researcher. The reason why the articles were excluded, the chosen articles' relevance with the research subject, quality assessment criteria that were used should be covered explicitly in the research (Denscombe, 2014).

PRISMA framework was applied to collect the relevant data from databases. The articles are screened according to PRISMA procedures. PRISMA statement was published in 2009, and it was designed to help create transparent systematic reviews (Page et al.,2021). The renewed version of it is called PRISMA 2000 and it includes guidance reflecting advances in reporting. There is a 27-item checklist to guide the preparation of a systematic literature review. Page et al. (2021) state that familiarity with PRISMA 2020 helps the researcher in planning and conducting systematic reviews.

The systematic review process stages in PRISMA are (1) identification; (2) screening; and (3) inclusion. In the identification stage, relevant records are identified and retrieved from databases and registers. All duplicates are removed. In the screening stage, records are screened, and irrelevant records are excluded. Then the records are retrieved and assessed for eligibility using inclusion and exclusion criteria. Excluded records are again reported in this stage. In the final stage, including studies and reports are finalized.

According to Denscombe (2014) interviews, questionnaires, observation, and documents are used as data collection methods. These methods have different strengths and weaknesses. Usefulness is a criterion to decide which method is suitable for the research. Combining these methods and using a mixed methods approach can also be useful when no other method is found better than others (Denscombe, 2014).

Questionnaires can be an alternative data collection method for this research. There are three criteria for questionnaires (Denscombe, 2014). First, the collected data can be used subsequently for data analysis. Second, they include a written list of questions, which should be consistent and precise. Third, in questionnaires, the information needed is asked directly to the participants. The cost of materials, the money, and the time consumed is relatively low in questionnaires. The same questions are asked of every participant. On the other hand, questionnaires can impose a structure on participants, reflecting the way of thinking of the researcher. This study aims to reach all the relevant aspects of the challenges and opportunities of AI in digital transformation. Questionnaires prepared by the researcher may be missing some aspects of the research subject. On the other hand, for the researcher, it would take more time to find suitable participants meaning organizations that use AI technology as part of their digital transformation processes. In addition, in questionnaires, pre-coded questions can lead the respondent which may end up with a biased finding (Denscombe, 2014). Because of these reasons, this method has not been chosen for this study.

Another alternative data collection method is interviews. The source is the answers of people in this method. People give consent to participate in the research. The agenda of the discussion is decided by the researcher in this method (Denscombe, 2014). Opinions, feelings, emotions, complex issues and privileged information can be understood by interviews. Topics can be investigated in depth in interviews. Researchers can gain valuable insights. Validity of the data is provided in face-to-face interviews which enable direct contact with the informant. On the other hand, what people say might not be what people do. Moreover, interviewers can be affected by the researcher. Because of these disadvantages and being very time-consuming this method was not chosen in this study. In addition, using the interview method will narrow the possibility of finding new challenges and opportunities of artificial intelligence in digital transformation, as the scope of this research will be narrowed to a few interviews and a small number of different sectors, etc.

3.2.1 Keywords & Motivation

The keywords that were searched alone or in combination with the others are as follows: 'artificial intelligence', 'machine learning', 'deep learning', 'AI', 'digital transformation', 'digital transformation strategy', and 'digital strategy'. To reach more relevant studies on the subject, the words 'machine learning' and 'deep learning', which are sub-themes of artificial intelligence that are mostly encountered in artificial intelligence technologies, were used in the keyword search. In addition to the term 'digital transformation strategy', the term 'digital strategy' is also used within the scope of technology-focused organizational strategies. On the other hand, special care was taken to ensure that the terms digital transformation and artificial intelligence were mentioned together in the articles. The search string formulation which was used in the scientific database search is given in Table 3.

Table 3 – Search strings for each database

Database	Search strings
Web of Science	TS= ("artificial intelligence" OR "machine learning" OR "deep learning" OR "AI") AND TS= ("digital transformation" OR "digital transformation*" OR "digital transformation strateg*" OR " digital strateg *")
Scopus	TITLE-ABS-KEY ("artificial intelligence" OR "machine learning" OR "deep learning" OR "AI") AND TITLE-ABS-KEY ("digital transformation" OR "digital transformation*" OR "digital transformation strateg*" OR " digital strateg*")

3.2.2 Inclusion/Exclusion Criteria & Motivation

The search was performed by looking for the search strings in abstracts, titles, and keywords of the articles. The author, title, abstract, and DOI information were exported and saved on Microsoft Excel spreadsheets. Then the duplicated studies were eliminated.

The screening phase for the selection of articles and studies was guided by the inclusion and exclusion criteria that are given in Table 4.

Table 4 – Inclusion and exclusion criteria

Inclusion criteria	Motivation
No time restriction	To ensure more comprehensive research
Articles and journals	To ensure high-quality data
Studies written in English	To understand the content of the article clearly
Studies that clearly state they focus on AI	To ensure the data address this study's aim
Studies that clearly state they focus on digital transformation	To ensure the data address this study's aim

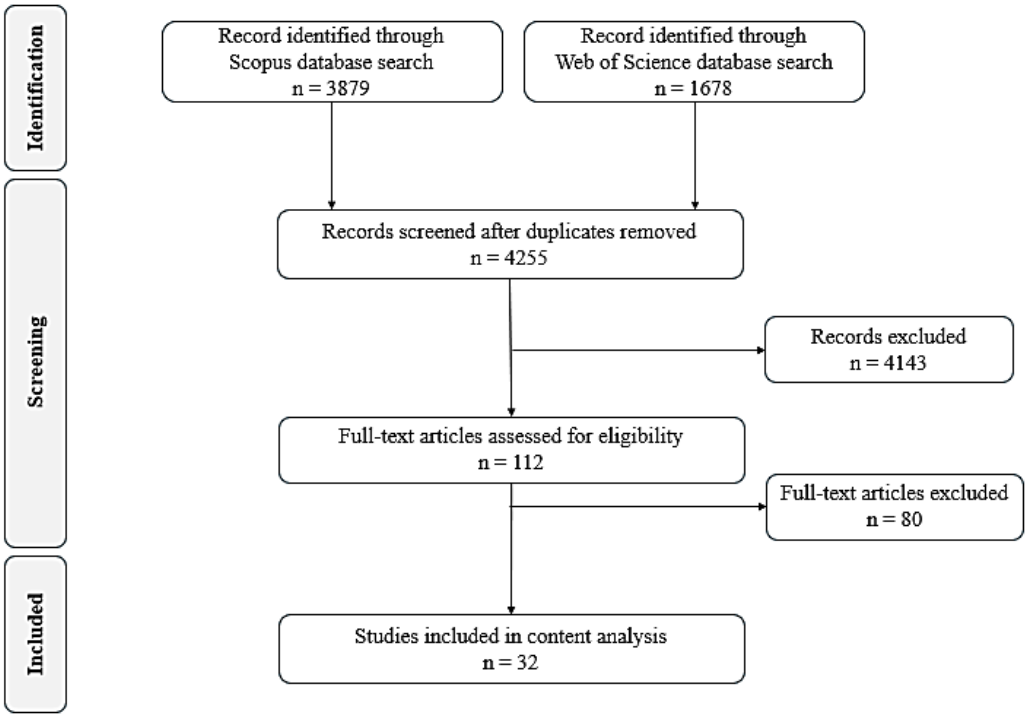
Open access publications	To enable the accessibility of the articles
Full text availability	To investigate the text in detail
Exclusion criterion	**Motivation**
Duplicate articles	To reduce redundant work

3.2.3 Data sources

Web of Science and Scopus are known to be some of the largest citation databases and are used in several research in literature. Scopus is claimed to be the largest database of abstracts and citations (Kitchenham & Charters, 2007). Web of Science and Scopus platforms were used to reach relevant studies in literature. These platforms enable the researcher to reach several databases like ScienceDirect, ResearchGate, etc.

3.3 PRISMA Framework Application

The process of removing duplicated records, applying inclusion and exclusion criteria, and evaluating the eligibility of articles are followed. Applying the PRISMA framework and the article selection process is illustrated in Figure 1.



** Figure 1 – PRISMA flow diagram*

After removing duplicate records, 4255 records remained for review. Next, open access records were selected, and it was investigated whether the articles were focused on artificial intelligence and digital transformation by looking at abstracts and keywords. 112 articles were evaluated by full-text review. In conclusion, 32 studies were found suitable for data analysis. The list of articles including the article ID, title, year, author(s), research method, and the source of the article is given in Appendix A.

3.4 Data Analysis Method & Alternative

According to Denscombe (2014), qualitative data need to be prepared before starting the data analysis. First, the original data should be protected. Secondly, data should be cataloged. Without using any reference system, researchers cannot navigate on the data back and forth. One of the advantages of qualitative analysis is that data is rich and in detail. The findings are based on evidence and there can be alternative explanations. One of the disadvantages of qualitative analysis is that data analysis generally takes longer compared with quantitative analysis. Moreover, the findings in qualitative analysis are more objective because researcher's background and beliefs have a role in data analysis.

The content analysis method was chosen for data analysis. According to Denscombe (2014) content analysis stages are given as follows:

1- Choosing an appropriate sample of text.
2- Breaking down the text into smaller units.
3- Developing relevant categories.
4- Coding the units according to the categories.
5- Counting the frequency of these codes.
6- Analyzing the units' frequency and the relationship among them.

Content analysis can be applied to any text. The main strength of content analysis is that it helps to quantify the content (Denscombe, 2014). The main limitation of content analysis is the tendency to dislocate units and meanings from the context. Another limitation is the difficulty in understanding the implied meanings of the terms or what is not said and missing. Content analysis is good for addressing the more straightforward and simple aspects (Denscombe, 2014).

As the first step, the suitable parts in the full text were identified as the challenges or the opportunities. This text was broken down into smaller units, and the relevant themes were gathered in an Excel file. After the duplicates' removal, the remaining units were grouped into categories, and in this step, the category names were decided. In the next step, units were separated according to these determined categories. All the articles were examined according to the usage of these codes and categories. The frequency of these codes was counted, and the related articles were reported according to the determined categories in the results. If the code was mentioned in more than one article, this code was counted as a sub-theme to be included in the final report. In the last step, the relationships of the units were analyzed, and the categories and sub-themes were finalized.

An alternative for data analysis is the thematic analysis method. Braun & Clarke (2006) claim that thematic analysis is a foundational method in qualitative analysis and researchers should learn this method. Flexibility is an important benefit of thematic analysis. A theme shows a relation between the data and the research question, and it gives a level of patterned meaning (Braun & Clarke, 2006). There are generally several instances of this theme in the data. The researcher judges what is a theme in that analysis. Themes can capture an important relation with the research question. The themes should accurately reflect the content of the whole data set. Themes can be identified in two ways, in an inductive (bottom-up) or in a deductive (theoretical, top-down) way. In the inductive approach, the researcher codes the data without trying to make the data fit in some existing frame. In the deductive approach, the theoretical or analytical interest of the researcher affects the analysis. This way focus on some aspects of the data. In thematic analysis, the level of the themes is a decision to make. There are two options, semantic level and latent level. At the semantic level, the explicit meaning of the theme is identified, and the researcher is not interested beyond the written data. Data is organized as patterns in a semantic way. In latent-level analysis, the underlying ideas and assumptions are identified. It is an interpretative work; the themes are theorized. The researcher was interested in the occurrence of relevant themes in relevant articles. Because of this research's scope, content analysis, which generally tends to quantify (Braun & Clarke, 2006) was preferred for this study.

Another alternative for data analysis is computer assisted data analysis. There are software packages to analyze qualitative data, one of the best known is NVivo (Denscombe, 2014). These packages can help in preparation, organization, and storage of data. Baugh et al. (2010) states that these software packages help the researcher in managing raw data and this way researcher saves time to delve into deeper analysis. On the other hand, learning to use these packages is complex and it may take time to learn it initially (Hwang, 2008; Baugh et al., 2010). In the end the analysis is done by the researcher, the codes and their connections are decided by the researcher. Time constraints are a disadvantage for using these kinds of software packages. The researcher had neither sufficient experience nor enough time to use these software packages.

3.5 Ethical Considerations

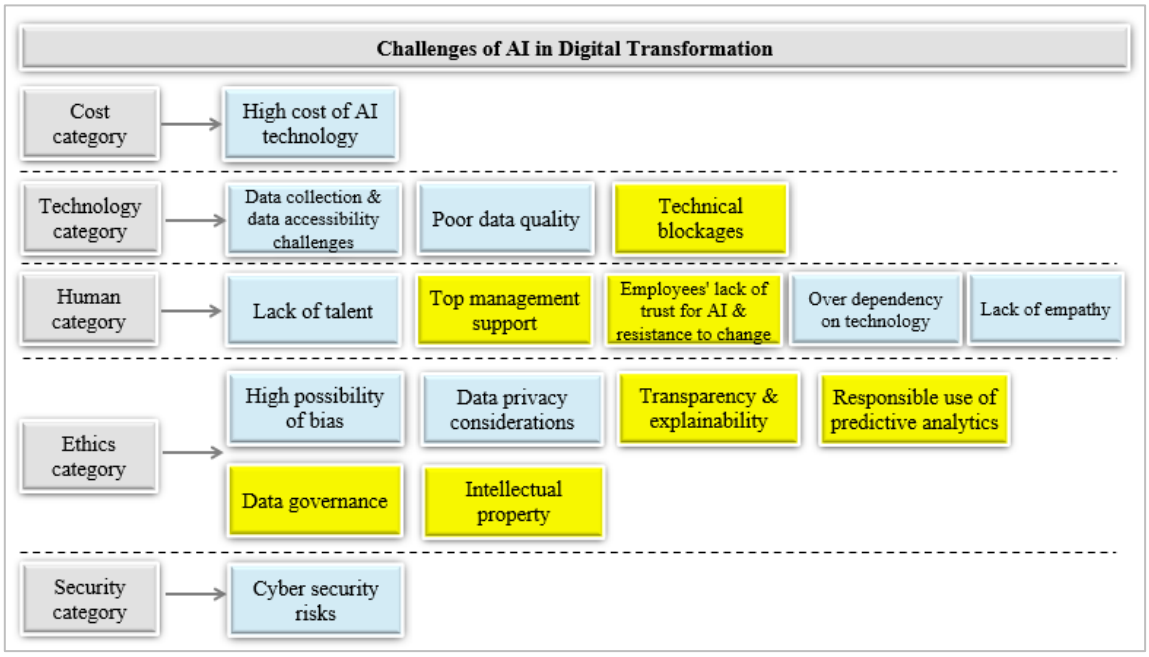
In systematic reviews, deeply personal or confidential information from participants is not collected. (Suri, 2019). However, lately, systematic reviews have become more methodologically inclusive and influence public perception, policies, and other research (Suri, 2019). Suri (2019) claims that there is an assumption that systematic review findings are representative of the larger picture; however, when the systematic review is biased, serious ethical implications can arise. In this thesis, the impact of search biases has been carefully evaluated and a general screening has been attempted. Diversity was considered important in the selection process of the articles.

4 Results and Analysis

Section 4 is structured as follows. In section 4.1 the challenges of AI in digital transformation and in section 4.2 the opportunities of AI in digital transformation were explained in detail.

4.1 Challenges of AI in Digital Transformation

After examining the literature with the systematic literature review methodology, the results regarding the challenges of artificial intelligence in digital transformation were categorized according to the field and the scope of the topic they fall under. The determined categories are as follows: *cost*, *technology*, *human*, *ethics*, and *security*. The sub-categories that were identified in this research about the challenges of AI in digital transformation are illustrated below (Figure 2). The new challenges identified after systematic literature review, which are not included in Table 1, are highlighted in yellow.



** Figure 2 - Map of challenges of AI in digital transformation*

The identified sub-categories as challenges of AI in digital transformation and the article distribution is shown in Table 5. According to these results it can be said that the most frequently mentioned topics were ethical issues; 'high possibility of bias', 'data privacy considerations', and 'transparency and explainability'.

Table 5 - Sub-categories as challenges of AI in digital transformation and article distribution of these challenges

Category	Challenges of AI in Digital Transformation	Related Article IDs	Number of Articles
Cost	High cost of AI technology	1, 9, 11, 13, 24, 27	6
Technology	Data collection & data accessibility challenges	3, 4, 29	3
	Poor data quality	3, 4, 6, 9, 12, 20, 24, 29	8

	Technical blockages	4, 9, 19, 20, 27	5
Human	Lack of skills/knowledge	1, 4, 18, 19, 23, 29, 31	7
	Top management support	4, 9, 20, 23, 32	5
	Employees' lack of trust for AI & resistance to change	4, 8, 10, 13, 20, 23, 24, 25, 32	9
	Over dependency on technology	8, 15, 32	3
	Lack of empathy	5, 8, 15	3
Ethics	High possibility of bias	2, 3, 4, 5, 6, 8, 15, 16, 19, 22, 25, 29, 31, 32	14
	Data privacy considerations	1, 2, 3, 4, 6, 8, 16, 19, 25, 27, 31, 32	12
	Transparency & explainability	3, 6, 8, 18, 19, 22, 23, 25, 29, 32	10
	Responsible use of predictive analytics	2, 3, 15, 22, 26	5
	Data governance	2, 4, 19	3
	Intellectual property	8, 22	2
Security	Cyber security risks	1, 4, 12, 16, 24, 29, 31	7

The challenges of AI in digital transformation that were identified in this research are explained in detail below.

4.1.1 Cost Category

High cost of AI technology: Implementation, research, and development of AI technology needs large amount of capital. Cost is a reason for the organizations to reject the implementation of AI if the future benefits cannot be seen and evaluated correctly by the management (Ahmad et al., 2022). Gołąb-Andrzejak (2023) also mentions the reluctance to invest money as a challenge in AI-based projects. For small-scale companies, the cost of implementation and maintenance of AI can be too high (Klopov et al., 2023).

4.1.2 Technology Category

Data collection and data accessibility challenges: Accessing relevant data is a challenge (Aldoseri et al., 2024). Generally, data formats are inconsistent and data sources are fragmented. “Data deluge”, the volume of the data is too much, and traditional storage architectures can fail to deal with intensive AI workloads (Aldoseri et al., 2024).

Poor data quality: One of the reasons for failure in some AI implementation cases is poor data quality (Philippart, 2022). The quality of data is very important for effective data analysis. Inaccurate, incomplete, or inconsistent data can cause erroneous insights and lead to wrong decision-making (Aldoseri et al., 2024).

Technical blockages: The compatibility of the systems and AI’s integration into existing systems are challenges to deal with (Thokal & Patil, 2024). System integration requires meticulous planning and implementation for the systems to work harmoniously together (Aldoseri et al., 2024).

4.1.3 Human Category

Lack of skills/knowledge: AI implementation requires IT expertise and skilled human talent (Peretz-Andersson et al., 2024). Lack of skills/knowledge leads to the adoption of AI taking place slower in companies (Ahmad et al., 2022). The scarcity of skilled professionals specialized in AI technologies amplifies the challenges for AI-based digital transformation, and the technical skills and expertise within the organizations need to be assessed (Aldoseri et al., 2024). (Reier-Forradellas & Garay-Gallastegui, 2021) also states that insufficient existence of AI talent like data scientists, machine learning experts, etc, is a significant challenge for the adoption of AI in companies.

Top management support: Top management support is a critical subject for AI implementations, and it is mentioned as an internal pressure element in AI implementation (Peretz-Andersson et al., 2024). Active support from top management helps the success of AI adoptions (Zhang et al., 2024). Misunderstanding of AI technology and the benefits of this technology might provide by the management is stated as one of the main difficulties in AI-based projects (Gołąb-Andrzejak, 2023). Unrealistic expectations from these transformations also might cloud the potential of AI technologies (Aldoseri et al., 2024).

Employees' lack of trust for AI and resistance to change: When people do not understand how AI operates, they are less prone to trust an AI application (Reim et al., 2020; Li et al., 2023). Resistance to change is a challenge for the success of AI projects (Aldoseri et al., 2024). Employees might fear losing their jobs or being replaced by AI and this causes reluctance in AI technology adoption (Li et al., 2023; Athota et al. 2023).

Over-dependence on technology: With the new AI developments in education sector, dependence of ChatGPT (Chat Generative-Pretrained Transformer) technology may affect critical thinking and problem-solving skills of the students in a negative way (Mhlanga, 2023).

Lack of empathy: The use of ChatGPT in educational institutions can enhance education. However, due to ChatGPT's lack of empathy, it can't establish empathetic connections with students. This situation might affect the students' motivation and overall school achievement (Mhlanga, 2023).

4.1.4 Ethics Category

High possibility of bias: Success of the AI algorithms dependent on the historical data (training data). Discriminatory practices and social biases of these historical data can affect the outcomes of AI applications (Aldoseri et al., 2024). Biased data can result in unfair outcomes and discrimination (George & Wooden, 2023). Because of the algorithms that AI use, biases are impossible to eliminate completely but minimizing them is important (Reier-Forradellas & Garay-Gallastegui, 2021). Organizations should avoid bias in data analysis and ensure not to harm or to create a disadvantage on any group.

Data privacy considerations: Data privacy issues arise in the use of AI technology and these concerns are increasing (Aldoseri et al.,2024). How personal data are collected, stored and used by AI systems are important issues (Pislaru et al., 2024). The risk of breaches and exposure to sensitive information is increasing with more data (Aldoseri et al.,2024). There are developments in protection regulations like GDPR. Data privacy issues should be addressed by organizations, and they should be complying with the regulations.

Transparency and explainability: AI systems are complex and understanding and explaining how it works can be difficult. Mechanism of algorithms can lead to black boxes and reduce the users' understanding of data and predictions (Böhmer&Schinnenburg,2023). AI systems should be transparent and explainable (George & Wooden, 2023).

Responsible use of predictive analytics: Misuse of predictive analytics is a risk that can be encountered in AI applications which can lead to a violation of individual privacy or autonomy (Aldoseri et al., 2024).

It is crucial to implement reliable AI applications that abide by the law and are moral. The protection of ethical principles and values should also be ensured (Perifanis & Kitsios, 2023).

Data governance: It is important to implement an organization-wide perspective on the value and importance of data for accountable data management. Data governance involves the data policies, standards, and responsibilities related to data management, moreover data privacy, and compliance issues (Aldoseri et al., 2024). Data governance is the management of the availability, integrity, usability, and security of data (Aldoseri et al., 2024). Data stewards play an important role in data governance (Aldoseri et al., 2024). Businesses need to embrace good data ecosystem with data governance (Akter et al., 2020).

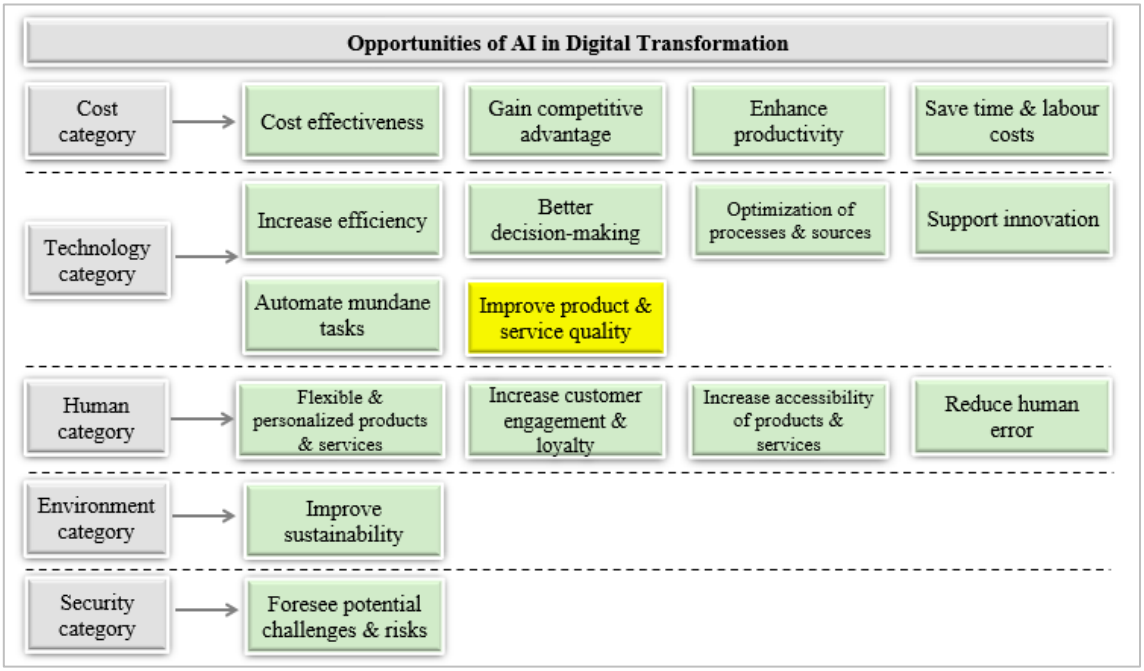
Intellectual property: On the creation of new intellectual property there are some concerns, such as ownership, authorship, and licensing. For an Artificial Intelligence Law, the European Commission launched a proposal in April 2021, aiming to regulate the prohibited uses of AI (Reier-Forradellas & Garay-Gallastegui, 2021). However, this regulation does not contain issues such as liability or intellectual (Reier-Forradellas & Garay-Gallastegui, 2021).

4.1.5 Security Category

Cyber security risks: Inadequately secured AI frameworks can be targets for cyber-attacks, which can lead to severe breaches of sensitive information and data (Aldoseri et al., 2024). Because all databases are mutually connected cyber threats are an important risk for AI systems (Kovačić et al., 2022). Organizations should implement robust cybersecurity protocols.

4.2 Opportunities of AI in Digital Transformation

After examining the literature with the systematic literature review methodology, the results regarding the opportunities of artificial intelligence in digital transformation were categorized according to the field and the scope of the topic they fall under. The determined categories are as follows: *cost, technology, human, environment*, and *security*. The sub-categories that were identified in this research about the opportunities of AI in digital transformation are illustrated below (Figure 3). The new opportunity identified after systematic literature review, which is not included in Table 2, is highlighted in yellow.



** Figure 3 - Map of opportunities of AI in digital transformation*

Identified sub-categories as opportunities of AI in digital transformation and the article distribution is shown in Table 6. According to these results it can be said that the most frequently mentioned topics were technology related issues; 'increase efficiency', 'better decision-making', and 'automate mundane tasks'.

Table 6 - Sub-categories as opportunities of AI in digital transformation and article distribution of these opportunities

Category	Opportunities of AI in Digital Transformation	Related Article IDs	Number of Articles
Cost	Cost effectiveness	3, 8, 9, 12, 13, 15, 26, 27	8
	Gain competitive advantage	2, 12, 13, 14, 17, 18, 22, 24	8
	Enhance productivity	3, 7, 13, 15, 18, 26	6
	Save time and labor costs	8, 11, 13, 14, 15, 19, 27, 29, 32	9
Technology	Increase efficiency	3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 18, 19, 21, 22, 26, 27, 28, 29, 32	21
	Better decision-making	3, 5, 8, 10, 11, 12, 13, 14, 17, 18, 19, 21, 22, 26, 27, 32	16
	Optimization of processes & resources	3, 6, 13, 16, 19, 24, 28, 29, 32	9
	Support innovation	3, 10, 13, 14, 18, 19, 23, 24, 26, 27, 29, 30, 31, 32	14
	Automate mundane tasks	2, 4, 6, 7, 8, 9, 13, 16, 17, 19, 22, 25, 26, 27, 29	15
	Improve product & service quality	8, 10, 13, 17, 19, 26, 27, 30, 32	9
Human	Flexible & personalized products & services	2, 3, 8, 11, 15, 17, 19, 22, 27	9
	Increase customer engagement & loyalty	2, 3, 8, 17, 22, 26, 27	7
	Increase accessibility of products & services	8, 15, 16, 17, 27, 29, 31	7
	Reduce human error	4, 11, 13, 22, 26, 27, 29	7
Environment	Improve sustainability	3, 4, 8, 18, 19, 21, 23, 28, 29	9
Security	Foresee potential challenges & risks	2, 3, 26, 27, 32	5

The sub-categories as opportunities of AI in digital transformation that were identified in this research are explained in detail below.

4.2.1 Cost Category

Cost effectiveness: In many ways AI is useful in cost saving (Aldoseri et al., 2024). For example, AI can analyze sensor data from machines and predict maintenance needs. Proactive maintenance extends equipment life, reduces downtime, and enhances overall operational efficiency (Aldoseri et al., 2024). Despite the high cost of these technologies, because of the decreased workforce and headcount volume,

the return on investment is high (Li et al., 2023). Intelligent automation of data-driven repetitive tasks reduces costs and increases revenues (Gołąb-Andrzejak, 2023).

Gain competitive advantage: AI applications in knowledge management, decision-making processes, and advanced analytics provide a competitive advantage by enhancing customer experience, innovation and new product development (Kitsios & Kamariotou, 2021). Machine learning has deeply changed the way we create and imagine new products (Magistretti et. al, 2019). Being at the forefront of AI advancements provides companies with a significant competitive advantage (Aldoseri et al., 2024).

Enhance productivity: AI-driven innovations enhance productivity (Aldoseri et al., 2024). By transforming strategies and operating models AI provides significant improvements in productivity (Reier-Forradellas & Garay-Gallastegui, 2021). By introducing AI technologies into business processes and reassessing tasks, optimal productivity can be achieved (Svetlana et al., 2022).

Save time and labor costs: The cost of AI is relatively low in the long run, because AI can help save time and labor costs by making the labor less physical and more intellectual (Klopov et al., 2023). Automation of various tasks saves time in accessing services (Thokal & Patil, 2024). AI helps in standardized processes which enables people to spend more time on creative tasks (Weber-Lewerenz, 2021).

4.2.2 Technology Category

Increase efficiency: Chatbots increase the efficiency of customer service (Golab-Andrzejak, 2023). AI helps in improving efficiency, especially in academic research. It helps in automating tasks, enabling collaboration, and providing new insights (George & Wooden, 2023). Identifying the most suitable expert for a patient by AI increases the efficiency in healthcare systems (Paul et al., 2024). Online order processing improves efficiency without compromising the quality of the products (Golab-Andrzejak, 2023). To increase efficiency AI can support human capabilities, however, this could lead to human being replaced by AI (Böhmer & Schinnenburg, 2023).

Better decision-making: Data analytics can provide reliable data-driven insights for leaders to use in strategic decision-making. AI reduces the risk of intuition-based decision-making (Aldoseri et al., 2024). The volume of information available can increase the efficiency of decision-making process progressively (Magistretti et. al, 2019). AI has advanced analytical capabilities and can process large amounts of data; thus, AI helps in improving the quality of decision-making, in addition it provides real-time information to decision-makers about people's preferences and needs (Pislaru et al., 2024). Using AI tools for various scenarios simulation can help organizations to decide the better path to proceed (Kovačić et al., 2022). Some findings indicate that in decision-making remains human authority is widely intact (Fritzsche & Gölzer, 2021). In order to optimize decision-making and be proactive to shifting market conditions and demands, it is recommended that businesses should invest in AI skills (Perifanis & Kitsios, 2023).

Optimization of processes and resources: AI tools have benefits in process optimization and provide cost reduction (Golab-Andrzejak, 2023). Resource allocation and cost optimization is very important in healthcare management (Li et al., 2023). AI helps to optimize resource allocation by getting insights from operational data and identifying bottlenecks and inefficiencies of operations (Aldoseri et al., 2024).

Support innovation: AI applications can enable organizations to make transformative changes by processing and analyzing the data (Aldoseri et al., 2024). AI promotes incremental innovation products and services (Perifanis & Kitsios, 2023). AI is becoming a significant source for innovation (Kitsios & Kamariotou, 2021). Innovation helps to provide better financial performance and maintain the balance between cost and quality of care in healthcare facilities (Li et al., 2023). General-purpose technology is a new way of creating and can potentially change the structure of research and development processes, consequently changing the nature of innovation processes (Perifanis & Kitsios, 2023). AI stimulates innovation and enables us to create innovative products (Svetlana et al., 2022).

Automate mundane tasks: Automation of the mundane tasks can help in increasing efficiency and, as a result, employees can focus on more high-value activities (Aldoseri et al., 2024). In AI implementations generally many tasks are automated (Fritzsche & Gölzer, 2021). AI technologies provide great solutions to automate tasks particularly in management or personnel recruitment (Mihai et al., 2023).

Improve product and service quality: AI technology improves product quality (Kitsios & Kamariotou, 2021). AI can enhance product quality through analytics (Paul et al., 2024). AI can revolutionize higher education and improve the quality of education (George & Wooden, 2023).

4.2.3 Human Category

Flexible and individualized products and services: AI offers insights into customer needs and expectations which lead to increase in customer satisfaction by analyzing various data. This knowledge helps companies in new product and service creation (Aldoseri et al., 2024). One example of AI in personalized learning is ChatGPT. ChatGPT interacts with more users and improves its understanding of their learning style. This way it can provide personalized recommendations (Mhlanga, 2023). Some companies use machine learning to predict their customers' emotions and provide personalized services (Akter et al., 2020). Universities are exploring AI capabilities to personalize student experiences by analyzing student's learning styles, giving customized feedback, and enhancing their learning outcomes (George & Wooden, 2023). AI algorithms provide personalized experiences for customers, recommending them individualized products to enhance their shopping experience (Paul et al., 2024). With AI all customer segments can be targeted in a personalized way (Reier-Forradellas, & Garay-Gallastegui, 2021).

Increase customer engagement and loyalty: With the help of AI technology organizations provide better service to their customers, and customer satisfaction and retention increase (Svetlana et al., 2022). By predicting customer behaviors, companies produce tailored products and services, and this leads to an increase in customer satisfaction and customer loyalty (Aldoseri et al., 2024). Enhanced experience provided through AI applications fosters customer satisfaction and loyalty, and as a result increases the revenue (Thokal & Patil, 2024). Many companies set up remote data monitoring centers to provide real-time support of customers and internal operations, resulting in more data-driven customer engagement (Sjödin et al., 2021).

Increase in accessibility: Golab-Andrzejak (2023) shows the benefits of a chatbot which increases the accessibility of customer service. Mhlanga (2023) states that ChatGPT helps expand in the participation in high-quality education and deliver good education without creating a language barrier because it provides language support. One of the advantages of AI-centered smart university is accessibility (George & Wooden, 2023). AI provides accessibility by letting people access information any time (Pislaru et al., 2024). AI also makes government more accessible to communities by facilitating dialogue (Pislaru et al., 2024).

Reduce human error: AI technologies help in processing vast amounts of information, and that leads to fewer errors in decisions and reduces human related errors (Klopov et al., 2023). Repetitive tasks can be automated because they are time consuming and prone to human error, and this will help to reduce human error (Aldoseri et al., 2024; Svetlana et al., 2022). AI structures help in minimization or prevention of human errors (Weber-Lewerenz, 2021).

4.2.4 Environment Category

Improve sustainability: Due to organizations' focus on corporate social responsibility (CSR) and the increasing awareness of climate change, ecological and environmental considerations are becoming important (Perifanis & Kitsios, 2023). AI enhances sustainability by increasing the energy efficiency of the activities and reducing waste (Pislaru et al., 2024). AI-powered systems can be cost efficient, by selecting optimal traffic conditions help in decreasing fuel consumption and contributing to the environment (Aldoseri et al., 2024). Technology-driven efficiency can increase sustainability, for

example by providing advantages in agricultural practices. Artificial intelligence technologies have enabled companies to explore more environmental materials, facilitating more sustainable use of material resources (Peretz-Andersson et al., 2024).

4.2.5 Security Category

Foresee potential challenges and risks: AI algorithms can process real-time data and foresee potential risks (Aldoseri et al., 2024). Organizations can use insights that AI provides and take precautions to prevent undesirable consequences. With AI technical advancements can be tracked and any important technological changes can be foreseen (Perifanis & Kitsios, 2023). For example, Deep Instinct company helps firms protect themselves from cyber threats using AI algorithms (Akter et al., 2020). AI is more reliable and faster in detecting fraud and inconsistencies in information security issues (Svetlana et al., 2022). AI improves project monitoring and risk management abilities. Project's progress is monitored in real-time and potential issues can be identified with AI technology (Zhang et al., 2024).

5 Discussion

In this chapter, the results of the systematic literature review concerning the challenges and opportunities of AI in digital transformation will be discussed. Section 5.1 is about the discussion of the sub-categories that were identified as challenges of AI in digital transformation, section 5.2 is about the discussion of the sub-categories that were identified as opportunities of AI in digital transformation, and section 5.3 is about the article distribution by sectors and research methods.

5.1 Challenges of AI in Digital Transformation

After applying the systematic literature review, 7 new challenges were identified. These new challenges are the 'technical blockages', 'top management support', 'employees' lack of trust for AI and resistance to change', 'transparency and explainability', 'responsible use of predictive analytics', 'data governance', and 'intellectual property'. The discussion about the identified challenges of AI in digital transformation is given in detail below.

Cost Category

Especially in the initial stage and at different stages of AI implementations, the *high cost of AI technology* has a major effect and plays a decisive role. When the future benefits are not well understood, high costs can be a rejection reason for AI projects. Several studies mention that the high cost of AI technology can affect the willingness to invest money in AI projects and consequently cost is still one of the top challenges of AI. It is useful to add that for small companies AI solutions are still not affordable.

Technology Category

As for the *data collection and data accessibility challenges* it can be said that the algorithms that are used in AI applications need a large number of data to train the algorithms and provide better predictions and results. The volume of data nowadays is huge, and data comes from different resources with different formats. Also, huge data increases workflows and overwhelms data infrastructures. *Poor data quality* is also a concern that it can cause wrong assumptions and erroneous insights. Inconsistent, inaccurate data can be a failure for AI implementation in some cases. Data heterogeneity and effective data management have become crucial, and organizations should implement robust strategies to deal with these circumstances. Technical integration of the AI and current systems can be another problematic issue in AI implementations. Ensuring harmonious co-existence requires meticulous planning and is useful for dealing with *technical blockages*.

Human Category

This category was determined as 'human' by considering the impact of humans in digital transformation and the direct impact of AI on humans. The scarcity of skilled employees to manage AI implementations and when using AI technology is a big challenge for companies. *Lack of skills/knowledge* causes the adoption of AI to be slower. Organizations need to assess the level of their employees who have AI knowledge and expertise. In some cases, external consultants help companies to deal with this challenge. Accumulating AI resources, recruiting skilled AI experts, and collaborating with educational institutions to increase their employees' knowledge and expertise on AI technologies and systems can be beneficial. *Top management support* is another challenge for AI implementations. It is seen that active support from top management helps for successful AI adoptions. On the other hand, misunderstanding AI technology and misevaluating its future benefits can be a deterrent to AI adoption. Organizations must navigate the potential pitfalls and create executable digital transformation strategies. *Employees' lack of trust in AI and resistance to change* are concerns in organizations' AI adoptions. Employees might not understand how AI operates and what benefits it will provide to them and sometimes they can be resistant to changes that come with digital transformation. In some cases, they fear that they will be rendered useless by AI

technology and may fear losing their jobs due to AI replacing their jobs. This challenge can be overcome through a culture change that makes the employees feel included in this transformation process.

Especially in the education sector, there are different kinds of challenges encountered. Although artificial intelligence has many contributions to students in education, *over-dependency on technology* can be a potential disadvantage to learning as it reduces students' critical thinking and problem-solving skills. *Over-dependency on technology* is a challenge that was only mentioned in research on educational applications of AI. However, this subject also can be a challenge for organizations since their employees' creativity and innovativeness might be affected by AI technology. It is thought that it would be useful to further investigate the issue of *over-dependence on technology* in the human resources management practices of organizations.

Chatbots that are used in education can provide quick and efficient responses, on the other hand, they lack empathy. Chatbots cannot provide emotional assistance to students who have problems or need extra help that a teacher could provide. *Lack of empathy* is seen as a challenge in educational AI applications, however, this can also be a challenge in other sectors, for example in the hospitality or healthcare sector, where a customer needs an emotional response in some cases. In organizations, *lack of empathy* can be considered as a challenge that may be appropriate to examine in terms of chatbots which is a channel of interaction with customers or human resources management applications where lack of empathy can be a problem when your co-worker is an AI-related technology.

Ethics Category

AI algorithms achieve the best results when there is enough historical data to train. When the training data includes some biases such as gender, race, or other biases, the inference of that algorithm will also include these biases. This means biased data results in biased predictions. Organizations must avoid unfair outcomes and discriminatory practices. AI applications due to their nature and their way of work are prone to *high possibility of bias*. *Data privacy considerations* have increased recently. There are protection regulations such as GDPR (General Data Protection Regulation) in the EU. GDPR regulates the protection of individuals regarding their data processing. Data privacy issues should be addressed by organizations. Developments in regulations should be followed and organizations should comply with these regulations.

AI systems *transparency and explainability* is another issue to be counted in the ethics category. People do not properly understand how AI technology works. In one respect, in most applications, it cannot be clearly explained how AI performs calculations in the background. This is sometimes called a black box. If AI models can be explained clearly, it will increase their reliability. On the other hand, the failures can be detected if we can clearly understand how the model works. *Transparency and explainability* are a ways to build trust in AI applications by organizations. Ethical principles and values should be considered, and r*esponsible use of predictive analytics* is to be ensured by the organizations from social and technical perspectives. Misuse of predictive analytics can lead to a violation of individuals' privacy. *Data governance* is an ethical issue to be considered by organizations. It involves data policies, standards, and responsibilities related to data management. Data privacy and compliance with regulations are maintained by good data governance applications. AI creates new intellectual property using publicly available text, video, and image data. However, there are some concerns about *intellectual property* issues such as ownership, authorship, and licensing. Organizations should be cautious and follow the regulations about i*ntellectual property.*

Security Category

Cybersecurity risks are an important challenge for AI in digital transformation. The security of AI frameworks is crucial because they may be targets for cyber-attacks. If there are cyber-attacks on mutually connected databases that AI systems use, all data will be endangered. Organizations should take necessary measures to protect their data. There should be robust cybersecurity protocols in the organizations.

5.2 Opportunities of AI in Digital Transformation

After applying the systematic literature review, 'improve product and service quality' was identified as a new opportunity. The discussion about the opportunities of AI in digital transformation is shown below.

Cost Category

Artificial intelligence reduces the labor force by automating tasks, which naturally reduces costs. *Cost-effectiveness* leads to improved return on investment. Also, there are other ways AI can help reduce costs. For example, by analyzing data and predicting maintenance needs AI can help increase equipment life and reduce downtime, and this leads to overall efficiency. With the help of AI, organizations gain a competitive advantage. Companies that follow the latest developments in new technologies and apply them in their processes will be one step ahead of other companies that are not catching up with the latest developments. AI changes the way the work is done. With AI-related strategies and operating models, companies can gain significant productivity improvements. AI technology *enhances productivity* and optimal productivity can be achieved by the companies. AI helps save time and lower labor costs. Automation of various tasks both saves *time and labor costs*.

Technology Category

Many examples show AI *increases efficiency.* For example, chatbots are very useful in answering simple questions and increasing the efficiency of customer service. In the healthcare sector, identifying the most suitable expert for a patient provides efficiency. AI can improve production planning decisions. AI also provides good insights to provide better decision-making. Managers can make use of these insights and improve their organizations' capabilities. AI also can provide real-time data to help managers to make better decisions. AI simulation tools can show possible results of the selected routes, and this helps managers to decide the most suitable way. It also helps us to easily adapt to shifting market conditions. More data-driven decisions are possible with AI. However, some research shows that AI's suggestions are not always accepted immediately, humans are still the last ones to make strategic decisions. AI technology is beneficial in resource allocation and process optimization. *Optimization of processes and resources* is done by analyzing data and identifying bottlenecks and inefficiencies of operations.

Optimization of resources leads to a reduction in cost, and it also provides a positive impact on the environment. AI enhances the innovation capability of organizations. It is becoming an important source of innovation. AI *supports innovation* by creating new ways to do things, changing structures of research and development processes, and helping in the creation of innovative products and services. Automation is another advantage of AI. By *automating mundane tasks* AI provides efficiency in the operations, additionally, employees can have more time for more creative and high-value activities. Automation is useful in human resources activities, for example when identifying suitable candidates for job positions and automating the recruitment processes, etc. AI applications are useful to *improve product and service quality* through analytics. Especially in the education area, by providing personalized education opportunities AI can improve the quality of education.

Human Category

One of the most valuable benefits of AI is the possibility of providing *flexible and individualized products and services*. Companies can produce new products and services with the help of insights about customer needs and expectations that AI provides. This leads to an increase in customer satisfaction. Personalized learning in the education sector is a strong example of the personalized usage of products. By interacting with users and understanding their learning style ChatGPT provides personalized recommendations and personalized learning opportunities. AI has changed the way marketing practices work. AI algorithms are also used in providing personalized experiences for customers, for example, Amazon is using algorithms to recommend to its customers the products that they might need by investigating the customers' previous behaviors. With the help of AI, it is possible to treat each customer in a personalized way. Providing better service to customers leads to *an increase in customer*

engagement and loyalty. Customer satisfaction and retention are positively impacted with the help of new AI applications. An increase in customer satisfaction and loyalty eventually leads to an increase in revenue. AI technology has improved customer experience by enabling an omnichannel world; for example, chatbots are used as another channel in customer service to increase customer engagement. To provide more data-driven customer engagement and real-time support for customers and internal operations, organizations started to invest in setting up remote data monitoring centers.

AI technology provides an *increase in accessibility of products and services*. Chatbots are used to increase the accessibility of customer service. In education, ChatGPT expands the possibility of participation in high-quality education. With its language support, ChatGPT overcomes the language barrier for education. AI applications also help to access information at any time. Traditional working hours are no longer an obstacle, especially in public administration applications. AI technologies *reduce human error* due to using large amounts of information. The probability of making mistakes decreases. By using AI in operations human related errors will be lessened. Especially in time-consuming repetitive tasks, processes can be automated, and the error possibility will be decreased.

Environment Category

Organizations considerably increased their social responsibility activities. Ecological and environmental considerations are on most of the organization's agenda. AI helps to *improve sustainability* in many ways. AI enhances sustainability by increasing the energy efficiency of the activities, helping in the optimization of the resources, and providing predictive analysis like in sustainable agricultural practices.

Security Category

Another opportunity that AI provides is to *foresee potential challenges and risks*. The insight that AI provides is valuable for organizations. With this knowledge, organizations can prevent undesirable consequences. Technical advancements can be tracked, and important changes can be foreseen beforehand. Using real-time AI helps organizations with project monitoring and risk management activities. Organizations should use AI to improve their processes and activities.

5.3 Article Distribution by Sectors and Research Methodology

Of the articles examined in this study, 20 articles used a literature review (62,5%), 10 articles used case studies (31,3%), and 2 articles used a questionnaire (6,2%) as research method. This research covers articles that focus on many sectors. The article distribution by sectors and research methods is given in Table 7.

Table 7 - Article distribution by sectors and research methods

Sectors	Literature reviews Article IDs	Case studies Article IDs	Questionnaires' Article ID
Construction	-	29	-
Education	8, 11, 15, 31	-	-
Finance	-	5	-
Healthcare	-	13	-
Human resources	6	-	-
IT	-	14	-
Manufacturing	-	18, 24	1
Marketing	-	9	-
Not specific	2, 3, 4, 10, 12, 16, 17, 19, 22, 23, 26, 28, 30, 32	20	-
Public administration	-	25	21
Several industries	-	7	-
Telecom	27	-	-

Grand Total	20	10	2

Most of the articles shown in Table 7, that have a research method literature review have been presented without any sectoral distinction, and they are shown under the not specific category. In total 12.5% of the articles were about the education sector and 9,4% of them were focused on the manufacturing sector.

The research scopes of the articles that used case studies and questionnaire methods are provided below in Table 8.

Table 8 – The research scope of the articles that used case study and questionnaire methods

Methods	Sectors	Research Scopes	Article IDs
Case study	Construction	50 leading experts from research, transfer institutions, and other associations have participated in this research.	29
Case study, interviews, questionnaire	Finance	Interview data from 31 financial planners and advisors in Australia were investigated.	5
Case study	Healthcare	An examination was conducted in a healthcare institution operating in the United Arab Emirates.	13
Case study	IT	IBM Watson application as a case was examined.	14
Questionnaire	Manufacturing	The questionnaire was conducted with 93 manufacturing sector companies in Malaysia.	1
Case study, interviews	Manufacturing	Five manufacturing SMEs which were owned by a large Swedish Holding Company were examined.	18
Case study	Manufacturing	A total of 6 companies, including globally active Swedish B2B providers and digital partners, were examined.	24
Case study	Marketing	A Polish clothing company LPP was investigated. LPP operates a chain of stores overseas and uses AI-based tools in its marketing activities.	9
Case study	Not specific	An AI solution provider firm called Vekia's 2 years period's projects were investigated.	20
Questionnaire	Public administration	The questionnaire was conducted by 507 respondents.	21
Case study, interviews	Public administration	14 publicly known experts from Spain were interviewed. Experts come from different public administrations.	25
Case study	Several industries	82 implementation projects from Automotive, Chemicals/ Pharma, Consumer Goods, Energy, Industrial Goods, Retail, Services, and Transport/Traffic industries were examined.	7

Although no year limit was applied in this research, the articles that were selected in this research study have been published in the last 5 years. Therefore, it can be assumed that research focusing on AI and digital transformation emerged about five years ago.

6 Conclusion

This chapter includes the conclusion, ethical and societal consequences, originality and significance, research quality, limitations, and future research.

6.1 Conclusion

Recently, research addressing artificial intelligence and digital transformation issues together has begun to increase. Comprehensive research in literature focusing on the challenges and opportunities of AI in digital transformation was needed. Some research examined specific sectors and sectoral applications while others investigated literature for specific concepts, such as business model innovation, knowledge management, etc. This research aimed to include the most comprehensive perspective on the challenges and opportunities of AI in digital transformation. From manufacturing to education, many sectors' applications and several literature reviews were investigated, and as a result, a wider list of challenges and opportunities was created. In this study, the findings were categorized according to the field and the scope of the topic they fall under.

The challenges of AI in digital transformation identified in this study are; in the cost category high cost of AI technology; in the technology category data collection and data accessibility challenges, poor data quality, and technical blockages; in the human category lack of skills/knowledge, top management support, employees' lack of trust for AI and resistance to change, over dependency on technology, and lack of empathy; in ethics category high possibility of bias, data privacy considerations, transparency and explainability, responsible use of predictive analytics, data governance, and intellectual property; and in security category cyber security risks.

When the article distribution is examined, for the challenges it was seen that the most frequently mentioned topics were ethical issues; 'high possibility of bias', 'data privacy considerations', and 'transparency and explainability'. After applying the systematic literature review, 7 new challenges were identified. These new challenges are the 'technical blockages', 'top management support', 'employees' lack of trust for AI and resistance to change', 'transparency and explainability', 'responsible use of predictive analytics', 'data governance', and 'intellectual property'.

The opportunities of AI in digital transformation identified in this study are; in the cost category cost effectiveness, gaining competitive advantage, enhanced productivity, and saving time and labor costs; in the technology category increase efficiency, better decision-making, optimization of processes and sources, support innovation, automate mundane tasks, and improve product and service quality; in human category flexible and personalized products and services, increase customer engagement and loyalty, increase accessibility of products and services, and reduce human error; in environment category improve sustainability; and in security category foresee potential challenges and risks.

When the article distribution is examined, for the opportunities it was seen that the most frequently mentioned topics were technology-related issues; 'increase efficiency', 'better decision-making', and 'automate mundane tasks'. After applying the systematic literature review, 'improve product and service quality' was identified as a new opportunity.

This study can guide what organizations can focus on. Companies could use the results of this study to better understand the challenges and opportunities of AI in digital transformation. Every organization will need to assess their specific needs and expectations from AI, and also their level of AI readiness. Ethics-related issues will be a concern for law departments, or customer-facing departments such as marketing, sales, customer service, etc. Technology-related issues can be important for IT-related departments, enterprise architecture departments, or research and development departments. Cost-

related issues are vital for finance departments or the top management. Issues in the human category can guide human resources departments and customer-facing departments.

This research provides key challenges to consider for companies and they could take suitable actions against these challenges while integrating AI through their transformation journey. In addition, companies could evaluate the opportunities presented here to enhance their capabilities. Table 9 displays the challenges and opportunities of AI in digital transformation. The new challenges and opportunities that were identified after the systematic literature review are highlighted in gray.

Table 9 - The challenges and opportunities of AI in digital transformation (created by the author)

Category	**Challenges of AI in Digital Transformation**
Cost	High cost of AI technology
Technology	Data collection and data accessibility challenges
	Poor data quality
	Technical blockages
Human	Lack of skills/knowledge
	Top management support
	Employees' lack of trust in AI and resistance to change
	Over-dependency on technology
	Lack of empathy
Ethics	High possibility of bias
	Data privacy considerations
	Transparency and explainability
	Responsible use of predictive analytics
	Data governance
	Intellectual property
Security	Cyber security risks
Category	**Opportunities of AI in Digital Transformation**
Cost	Cost-effectiveness
	Gain competitive advantage
	Enhance productivity
	Save time and labor costs
Technology	Increase efficiency
	Better decision-making
	Optimization of processes and sources
	Support innovation
	Automate mundane tasks
	Improve product and service quality
Human	Flexible and personalized products and services
	Increase customer engagement and loyalty
	Increase accessibility of products and services
	Reduce human error
Environment	Improve sustainability
Security	Foresee potential challenges and risks

To sum up, the challenges are changing depending on what stage the AI implementation is. In addition, the way companies benefit from these identified opportunities will vary depending on the sector. It is worth noting the importance of understanding the challenges and opportunities of AI in digital

transformation. Finally, companies can take appropriate measures based on their specific needs and use the information provided in this study to improve their strategies.

6.2 Ethical and Societal Consequences

The ethical and societal consequences were mitigated by utilizing a systematic literature review approach. The findings of the studied data were considered thoroughly and reflected transparently. Legitimate and authorized literature sources were taken into account in this study. This study provides a transparent and systematic review of the articles. It is thought that there are neither ethical nor societal consequences of this research.

6.3 Originality and Significance

6.3.1 Implications for Theory

Previous research about the challenges and opportunities of AI in digital transformation was separately provided in the literature. There was not any article that included all of the sub-categories together, which were presented in this study. When viewed from this angle this research provides a wider list of challenges and opportunities of AI in a digital transformation perspective. Since AI applications from many sectors have been examined with case studies involving companies of different types and sizes, it can be said that the scope of this study is broader than previous studies.

6.3.2 Implications for Practice

The findings of this study present the challenges and opportunities of AI in digital transformation. Being aware of these challenges and opportunities will provide insights to managers who manage or are part of digital transformation in their companies and aim to make the most of AI technology. Furthermore, these findings will be useful for companies to plan, execute, and align their AI-related digital business strategies throughout their digital transformation journey.

6.4 Research Quality

According to Denscombe (2014), for research to be credible, the findings should be based on some basic practices that are known as good. These bases can be listed as follows, *validity, reliability, generalizability,* and *objectivity*.

Validity includes the accuracy and precision of data, and also the appropriateness of the data and the research question being investigated (Denscombe, 2014). Published articles that used case studies or literature review methods from well-known journals were selected as data for the analysis to fulfill the validity criteria. Selected articles examined related issues to this study's research question. The literature review method was applied systematically and transparently. It was aimed at providing a valid presentation of the results.

For *reliability*, the neutrality of the research instrument and its consistent usability on multiple occasions are being considered (Denscombe, 2014). In this research PRISMA framework as a research methodology and content analysis method for data analysis was applied. Similar and most used contents were extracted from the articles and shown as sub-categories.

Generalizability, which is also external validity, can be explained as the ability of the research findings to be not suitable for that particular case but also suitable for other cases, such as being at a universal level (Denscombe, 2014). Not all the results apply to every organization. This study provides alternative perspectives by using several case studies from different sectors. Every organization can apply this knowledge following their specific needs.

Objectivity means that the research does not include bias, and also the data collection and data analysis processes are fair (Denscombe, 2014). In this study, when selecting the appropriate articles to extract data only the given inclusion and exclusion criteria were applied. Also, in the data analysis, the findings that are given in the articles were reported.

6.5 Limitations and Future Research

The number of databases that were used for the research is a limitation in this study. Additionally, only the research written in English could be used. The limited sample size is another limitation of this study. Although the sub-categories identified in this research are mostly clearly shown and explained in the articles, the interpretation of some data may have been affected by the researcher's background, and some hidden inferences contained in the articles may not have been captured. Although there are some limitations, it is thought that this study will contribute to the existing literature.

Opportunities and challenges of AI in digital transformation vary according to sector. Future research could explore differences in the challenges and opportunities of AI in different sectors. It will be insightful for organizations in different sectors to make better use of this information.

Based on one of the identified challenges of AI in the education sector, ‘lack of empathy’ can be investigated more thoroughly. Human resources management or healthcare sector applications can be examined from a human-AI interaction perspective.

One of the challenges detected ‘employees' lack of trust for AI and resistance to change’ can be a future research subject to deeply investigate. Employees' lack of trust in AI and resistance to change can be thoroughly examined from a change management perspective.

As a challenge ‘over-dependency on technology category’, it can be investigated how it will affect the way people work in the workplace environment, especially when they need to work with an artificial intelligence tool as a colleague, and how it can change the perspective of human resources.

In addition, a more detailed study on sustainability issues that considers both challenges and opportunities will be useful, especially in this period when climate change awareness and concerns are increasing, and organizations are starting to create strategies for sustainable solutions.

Finally, the challenges and opportunities that were detected in this study can be used with a case study methodology to investigate the validity and effectiveness of these challenges and opportunities that were detected.

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Appendix A – The List of Articles

Article ID	Title	Year	Author(s)	Method	Sector	Research Scope	Source
1	Digital Transformation: An Exploring Barriers and Challenges Practice of Artificial Intelligence in Manufacturing Firms in Malaysia	2022	Ahmad M.F.; Husin N.A.A.; Ahmad A.N.A.; Abdullah H.; Wei C.S.; Nawi M.N.M.	Questionnaire	Manufacturing	The questionnaire was conducted with 93 manufacturing sector companies in Malaysia.	Journal of Advanced Research in Applied Sciences and Engineering Technology, 29(1), pp. 110–117
2	Transforming business using digital innovations: the application of AI, blockchain, cloud and data analytics	2020	Akter S.; Michael K.; Uddin M.R.; McCarthy G.; Rahman M.	Literature review	Not specific	In addition to the literature review, several digital transformation cases of AI, Machine Learning, and Deep Learning were presented as examples.	Annals of Operations Research, 308(1–2), pp. 7–39
3	AI-Powered Innovation in Digital Transformation: Key Pillars and Industry Impact	2024	Aldoseri A.; Al-Khalifa K.N.; Hamouda A.M.	Literature review, experience-driven methodology	Not specific	In addition to the literature review, first-hand experiences and observations in real-world contexts were investigated.	Sustainability (Switzerland), 16(5), p. 1790
4	Methodological Approach to Assessing the Current State of Organizations for AI-Based Digital Transformation	2024	Aldoseri A.; Al-Khalifa K.N.; Hamouda A.M.	Literature review, experience-driven methodology	Not specific	In addition to the literature review, with experience-driven aspect; knowledge provided from actual situations and direct observation were included.	Applied System Innovation, 7(1), p. 14
5	Overcoming financial planners' cognitive biases through digitalization: A qualitative study	2023	Athota, VS; Pereira, V; Hasan, Z; Vaz, D; Laker, B; Reppas, D	Case study, interviews, questionnaire	Finance	Interview data from 31 financial planners and advisors in Australia were investigated.	Journal Of Business Research, 154
6	Critical exploration of AI-driven HRM to build up organizational capabilities	2023	Böhmer N.; Schinnenburg H.	Systematic literature review	Human resources	62 international journals across different disciplines were examined by a systematic literature review.	Employee Relations: The International Journal, 45(5), pp. 1057–1082
7	Industrial Applications of Artificial Intelligence: From Grand Stories of Digital Disruption to Actual Progress	2021	Fritzsche A.; Gölzer P.	Case study	Several industries	82 implementation projects from Automotive, Chemicals/ Pharma, Consumer Goods, Energy, Industrial Goods, Retail,	Procedia CIRP, 104, pp. 683–688

						Services, Transport/Traffic industries were examined.	
8	Managing the Strategic Transformation of Higher Education through Artificial Intelligence	2023	George B.; Wooden O.	Systematic literature review, meta-analysis, and narrative review	Education	The number of articles reviewed is not stated.	Administrative Sciences, 13(9), p. 196
9	AI-powered Digital Transformation: Tools, Benefits and Challenges for Marketers – Case Study of LPP	2023	Golab-Andrzejak E.G.	Case study	Marketing	A Polish clothing company LPP were investigated. LPP operates a chain of stores overseas and uses AI-based tools in its marketing activities.	Procedia Computer Science, 219, pp. 397–404
10	Artificial intelligence and business strategy towards digital transformation: A research agenda	2021	Kitsios F.; Kamariotou M.	Literature review	Not specific	81 articles were investigated.	Sustainability (Switzerland), 13(4), 2025
11	Digital Transformation of Education Based on Artificial Intelligence	2023	Klopov I.; Shapurov O.; Voronkova V.; Nikitenko V.; Oleksenko R.; Khavina I.; Chebakova Y.	Literature review, meta-analysis	Education	The number of articles reviewed is not stated.	TEM Journal, pp. 2625–2634
12	Using Artificial Intelligence for Creating and Managing Organizational Knowledge	2022	Kovačić M.; Mutavdžija M.; Buntak K.; Pus I.	Literature review	Not specific	The number of articles reviewed is not stated.	Tehnicki Vjesnik--Technical Gazette, 29(4)
13	How does artificial intelligence impact human resources performance. evidence from a healthcare institution in the United Arab Emirates	2023	Li, P.; Bastone, A; Mohamad, T. A.; Schiavone, F.	Case study	Healthcare	An examination was conducted in a healthcare institution operating in the United Arab Emirates.	Journal of Innovation & Knowledge, 8(2), p. 100340
14	How intelligent is Watson? Enabling digital transformation through artificial intelligence	2019	Magistretti S.; Dell'Era C.; Messeni Petruzzelli A.	Case study	IT	IBM Watson application as a case was examined.	Business Horizons, 62(6), pp. 819-829
15	Digital Transformation Education, Opportunities, and Challenges of the Application of ChatGPT to Emerging Economies	2023	Mhlanga D.	Systematic literature review	Education	25 publications were included in the research.	Education Research International, 2023, pp. 1–13
16	Digital Transformation Based on AI Technologies in European Union Organizations	2023	Mihai F.; Aleca O.E.; Gheorghe M.	Scientific literature review	Not specific	The number of articles reviewed is not stated. By literature review 18 indicators were identified and examined in 27 EU countries.	Electronics (Switzerland), 12(11), p. 2386.

17	Digital transformation: A multidisciplinary perspective and future research agenda	2024	Paul J.; Ueno A.; Dennis C.; Alamanos E.; Curtis L.; Foroudi P.; Kacprzak A.; Kunz W.H.; Liu J.; Marvi R.; Nair S.L.S.; Ozdemir O.; Pantano E.; Papadopoulos T.; Petit O.; Tyagi S.; Wirtz J.	Literature review	Not specific	The number of articles reviewed is not stated.	International Journal of Consumer Studies, 48(2)
18	Artificial intelligence implementation in manufacturing SMEs: A resource orchestration approach	2024	Peretz-Andersson E.; Tabares S.; Mikalef P.; Parida V.	Case study, interviews	Manufacturing	Five manufacturing SMEs which were owned by a large Swedish Holding Company were examined.	International Journal of Information Management, 77, 102781
19	Investigating the Influence of Artificial Intelligence on Business Value in the Digital Era of Strategy: A Literature Review	2023	Perifanis N.-A.; Kitsios F.	Systematic literature review	Not specific	139 articles were discussed.	Information (Switzerland), 14(2), p. 85
20	Success Factors to Deliver Organizational Digital Transformation: A Framework for Transformation Leadership	2022	Philippart, MH	Case study	Not specific	An AI solution provider firm called Vekia's 2 years period's projects were investigated.	Journal of Global Information Management, 30(8), pp. 1–17
21	Citizen-Centric Governance: Enhancing Citizen Engagement through Artificial Intelligence Tools	2024	Pislaru M.; Vlad C.S.; Ivascu L.; Mircea I.I.	Questionnaire	Public administration	The questionnaire was conducted by 507 respondents.	Sustainability (Switzerland), 16(7), 2686
22	Digital Transformation and Artificial Intelligence Applied to Business: Legal Regulations, Economic Impact and Perspective	2021	Reier-Forradellas R.F.; Garay-Gallastegui L.M.	Literature review	Not specific	The number of articles reviewed is not stated.	Laws, 10(3), 70
23	Implementation of Artificial Intelligence (AI): A Roadmap for Business Model Innovation	2020	Reim, W; Åström, J; Eriksson, O	Systematic literature review	Not specific	79 papers were investigated.	AI, 1(2)
24	How AI capabilities enable business model innovation: Scaling AI through co-evolutionary processes and feedback loops	2021	Sjödin D.; Parida V.; Palmié M.; Wincent J.	Case study	Manufacturing	A total of 6 companies, including globally active Swedish B2B providers and digital partners, were examined.	Journal of Business Research, 134, pp. 574–587
25	Artificial Intelligence Risks and Challenges in the Spanish Public Administration: An Exploratory Analysis through Expert Judgements	2021	Sobrino-García I.	Case study, interviews	Public administration	14 publicly known experts from Spain were interviewed. Experts come from different public administrations.	Administrative Sciences, 11(3), p. 102
26	Artificial intelligence as a driver of business process transformation	2022	Svetlana N.; Anna N.; Svetlana M.; Tatiana G.; Olga M.	Literature review, theoretical analysis	Not specific	The number of articles reviewed is not stated.	Procedia Computer Science, 213, pp. 276–284

27	Review and Analysis of the Literature: Artificial Intelligence-Based Digital Transformation of Automated Customer Onboarding	2023	Thokal V.; Patil P.R.	Literature review	Telecom	The number of articles reviewed is not stated.	Engineering Proceedings, 59(1), 234
28	Towards the eco-design of Artificial Intelligence and Big Data applications: A bibliometric analysis of related research	2020	Wang Z.; Liao H.-T.	Literature review, bibliometric analysis	Not specific	236 articles were investigated.	IOP Conference Series: Materials Science and Engineering, 806(1), 012039
29	Corporate digital responsibility (CDR) in construction engineering—ethical guidelines for the application of digital transformation and artificial intelligence (AI) in user practice	2021	Weber-Lewerenz B.	Case study	Construction	50 leading experts from research, transfer institutions and other associations were participated in this research.	Springer Nature-Applied Sciences, 3(10)
30	Unraveling the capabilities that enable digital transformation: A data-driven methodology and the case of artificial intelligence	2021	Wu M.; Kozanoglu D.C.; Min C.; Zhang Y.	Literature review, bibliometric approach	Not specific	10,179 scientific papers and 9,454 AI patents were examined.	Advanced Engineering Informatics, 50, p. 101368
31	Educational Missions and Tactics in the EU Artificial Intelligence Strategy in the Era of Digital Transformation: A Policy Analysis Based on EU Documents Published During 2018-2022	2023	Xiong Y.; Ling Q.; Liu J.	Literature review	Education	Published policy documents regarding the EU Artificial Intelligence Strategy for the period 2018-2022 were examined.	Advances in Transdisciplinary Engineering
32	The Impact of Artificial Intelligence on Organizational Justice and Project Performance: A Systematic Literature and Science Mapping Review	2024	Zhang X.; Antwi-Afari M.F.; Zhang Y.; Xing X.	Systematic literature review	Not specific	47 bibliographic records were analyzed.	Buildings, 14(1), p. 259

Appendix B – Reflection Document

How does your study correspond to the goals of the thesis course? Why? Focus on the goals that were achieved especially well and those that were not well achieved.

The primary objective of the thesis was to find out the challenges and opportunities of AI in digital transformation. Relevant literature was investigated systematically. The main reason for me to investigate AI-related improvements was that I can see the way we do things change rapidly. I believe that artificial intelligence is a great breakthrough that will change many things, shortly. Due to the time limitation of this study, not all of the articles could be examined, and open-access articles criteria were applied. Nevertheless, the scope of this thesis meets comprehensive expectations. Many case studies including different sectors and literature reviews were examined. I think that more articles could be investigated. Additionally, a case study could be used to evaluate the findings of this study.

How did the planning of your study work? What could you have done better?

In the beginning, I did an effective time planning by preparing a good schedule plan for this thesis. However, due to special circumstances, the time goals couldn't be reached in the first months. Also, in the research phase, I had to change the research question and narrow it down to the challenges and opportunities of AI in digital transformation, since the literature was huge in digital transformation topics. On the other hand, the pace of my studies in the last month was good and I managed to finish the thesis on time. In addition, doing the thesis with another student would have made some things easier, and in this case, the relevant literature could have been examined more comprehensively. The support and helpful suggestions of my supervisor were very valuable to reach in a more focused way in the final stage of the thesis.

How does the thesis work relate to your education? Which courses and areas have been most relevant for your thesis work?

This master's program's name is Strategic Information Systems Management. In many courses, we examined how knowledge is used through information systems in organizations. Also, I took a course that teaches us how to do our research systematically. This course's name was Scientific Communication and Research Methodology. Other relevant courses were Data Mining in Computer and Systems Sciences, Management of Global IT Resources, Open and Big Data Management, Research Methodology for Computer and System Sciences, and finally Systems Theory, Organizations and IT.

How valuable is the thesis for your future work and/or studies?

The thesis is very valuable for my future work. I am a data analyst and I want to improve my AI skills. The future lies in gaining new capabilities. Investigating such a topic will give me precious insight to foresee what the future will be about. This new knowledge improves my focus on finding more valid professions. In addition, the thesis will be helpful in organizations, and I will use this master's degree and my thesis topic in my future job search. Researching such a current issue is also an advantage in terms of gaining more detailed information and perspective on this subject before anyone else.

How satisfied are you with your thesis work and its results? Why?

I'm satisfied with my thesis work and the results that I found out. I think I worked meticulously and created well-designed research. The results will be most helpful in providing great insights for organizations that are in the digital transformation process and wish to learn the challenges and opportunities of AI. When I first started my research, I saw that there weren't many studies that

investigated this topic comprehensively. The results of this study will, in a way, contribute to everyone who wants to learn about this subject.

What AI tools and similar tools did you use in the thesis process and how did you use them? Give some examples.

I didn't use any AI tools in this research. If that counts, "The Google Translate" program was helpful when I needed a better translation.