

# The Impact of AI on the Banking Industry

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## ABSTRACT

Technological innovations are emerging at a rapid pace. Throughout history, these technological advancements have increased productivity within businesses. The latest advancements within businesses consist of automation, industrial robots and artificial intelligence. The usage of the latter is on the rise in the last few years and is transforming the way of working in a wide variety of different industries. One of these industries is the banking industry. Over the years banks have always improved their methods, by applying FinTech solutions, to differentiate themselves and to stay ahead of their competitors. Currently, the new FinTech solution to which banks have to adapt is artificial intelligence, also known as AI. It has the potential to improve most operations of the banks. In this research, a systematic literature review will be performed to find the effect that AI has had on the banking industry. The findings of the systematic literature review will then be analysed.

Additional Key Words and Phrases: Artificial Intelligence, Banking Industry, FinTech, Impact, Algorithms

## 1 INTRODUCTION

With the start of the new industrial revolution, industry 4.0, in 2011 sectors shifted their priorities to advanced digitalisation [14]. A big part of the new technologies that were getting implemented was AI. John McCarthy, one of the founders of AI, once defined it as "getting a computer to do things which, when done by people, are said to involve intelligence" [45]. Even though the idea of AI has been around for more than half a century, with the paper of John McCarthy being published in 1958 [29], only recently it is changing the job market at an unprecedented pace. The integration of AI by a company in at least one function was only 20% in 2017 but has increased to 50% in 2022 [13]. This shows the scale at which AI is transforming companies.

The recent rise in the usage of AI within companies is due to an increase in the possibilities of the different techniques of AI. The field of AI includes several techniques such as robotics, computer vision, natural language processing, deep learning and machine learning. These techniques in general can be described as simulating the thought processes of a human by a computer. The computer uses algorithms that allow the computer to make decisions. The decision making of the computer is based on processing vast amounts of data and learning to recognize patterns within the data sets. This has the potential to improve and take over a wide variety of functions. Among others, AI can help by automating repetitive tasks, making business decisions and enhancing customer experience. This ultimately will help a business grow.

These forms of integration of AI can be found in nearly every industry. The banking industry is no exception to this. Banks have

always kept improving throughout the years. Keeping up with the newest innovations. These new innovations within the financial sector are often called FinTech. This stands for financial technology and can be seen as the new technologies that improve and automate the financial services. Artificial Intelligence, Block Chain, Cloud Computing and Big Data (ABCD) constitute the core of FinTech [26]. Banks have integrated these innovative solutions as early as the 1960s by introducing ATMs [8]. Adapting to online banking in the 2000s and introducing mobile based banking in the 2010s [8]. Now banks are innovating through the implementation of AI. The use of AI can potentially improve efficiency, reduce cost, reduce errors and many more within a bank. The integration in the financial services sector, of which banks are a big part, is one of the sectors that is furthest advanced with a high percentage of integration of AI within the companies. AI is integrated by more than 60% of the companies within the financial services sector [11]. With the capabilities of AI still improving, the banks that already have integrated it into one or more processes still have a lot of growth potential using newer and better forms of AI.

In order to deeply understand the impact of AI in the banking industry a systematic literature review is conducted in this research. The main research question to be answered is then as follows:

*What is the impact of Artificial Intelligence on the banking industry?*

The primary research question is answered by considering the following sub-research questions:

**SRQ1:** What are the potential different use cases for AI in the banking industry?

**SRQ2:** What negative impacts can the implementation of AI in the banking industry have?

**SRQ3:** What methods of AI are used in the Banking Industry?

The analysis towards these questions can be found later in the paper. The remainder of the paper is structured as follows. Section two presents the methodology of the systematic literature review. The results of this systematic literature review are presented in section three. Section four presents the literature review itself. Lastly, sections five and six are respectively the discussion and the conclusion.

## 2 METHODOLOGY

To perform this systematic literature review the methodology as described below is used. The methodology explains the way this research is carried out. It is a systematic plan of collecting, critically evaluating, integrating, and presenting findings with as final goal to answer the main research question with its sub-research questions [36]. Explaining how the data is collected and analysed through the use of this methodology helps to ensure the reliability of this research. To start this methodology an overview is given of the databases that have been used during this research including a short description of the characteristics of these specific databases.

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Databases with a broad search field are used to capture as many relevant articles as possible.

Overview of the databases:

- Google Scholar<sup>1</sup>: a database used for broad searches that shows scholarly articles from different publishers.
- Web of Science<sup>2</sup>: a large database suitable for searching articles from high-impact research journals.
- Scopus<sup>3</sup>: a database for searching research literature in the science and technology field.

## 2.1 Procedure

By using a specific set of keywords to search in these databases, this literature review was conducted. The procedure used for this is described in this section.

In their study Xiao and Watson [59] established eight common steps to conduct a systematic literature review. These steps are as follows:

- (1) formulating the research problem;
- (2) developing and validating the review protocol;
- (3) searching the literature;
- (4) screening for inclusion;
- (5) assessing quality;
- (6) extracting data;
- (7) analyzing and synthesizing data;
- (8) reporting the findings.

Using these steps this procedure is established. A list of studies was retrieved by entering a specific search string in each of the databases. This was done for each of the research questions. The initial search string consisted of a combination of keywords to find specific results. The initial search strings for every research question per database and the number of papers that it produced can be found in tables 1, 2, 3 and 4 for the research questions 1, 2, 3 and 4 respectively. Not all papers were found using the initial search string. After using the initial search string further papers were found by refining the initial search string or by using the reference list from initially found papers. This method of using the reference list of papers to find new papers is called snowballing [58].

To find relevant research the databases were scanned based on the titles of the research. In case the title seemed to be relevant to the topic, the abstract of the research and the keywords were read. After reading the abstract the conclusion was read in case the research still seemed to be relevant. The relevant studies are included in this literature review. A database shows the research that is the most closely related to the search terms first. At a certain point the relevancy of the research presented by the database drops. Therefore, it was decided to stop the search using a specific search string after around ten unrelated studies in a row had been found. This was done when a combination of the search string and a specific database gave more than a few hundred results. After finding a sufficient amount of studies to answer and substantiate the findings the search towards this topic was ended. After finishing the search

<sup>1</sup>Google Scholar: <https://scholar.google.com/>

<sup>2</sup>Web of Science: <https://www.webofknowledge.com/>

<sup>3</sup>Scopus: <https://www.scopus.com/>

Table 1. Results of the initial search strings SRQ1

Database	Search String	Results
Google Scholar	AI Banking Industry Use Cases (2014-2023)	17,900
	AI Banking Industry Possibilities (2014-2023)	17,400
	AI Banking Industry Applications (2014-2023)	17,100
Web of Science	TS=((AI AND Banking AND Industry) AND ( Possibilities OR Use Cases OR Applications)) AND PUBYEAR AFT 2013	33
Scopus	TITLE-ABS-KEY(ai* AND banking AND industry AND (possibilities* OR (use AND cases) OR applications*)) AND PUBYEAR > 2013	458

Table 2. Results of the initial search strings SRQ2

Database	Search String	Results
Google Scholar	negative impact artificial intelligence (2014-2023)	18,500
	limitations artificial intelligence (2014-2023)	17,900
	disadvantage artificial intelligence (2014-2023)	121,200
Web of Science	TS=((negative AND impact) OR limitations OR disadvantage) AND Artificial AND Intelligence) AND PUBYEAR AFT 2013	6,747
Scopus	TITLE-ABS-KEY(((negative AND impact) OR limitations OR disadvantage) AND artificial AND intelligence) AND PUBYEAR > 2013	14,032

Table 3. Results of the initial search strings SRQ3

Database	Search String	Results
Google Scholar	Artificial Intelligence methods banking (2014-2023)	16,600
	Artificial Intelligence techniques banking (2014-2023)	18,000
Web of Science	TS=((Artificial AND Intelligence) OR AI) AND (methods OR techniques) AND banking) AND PUBYEAR AFT 2013	448
Scopus	TITLE-ABS-KEY(((artificial AND intelligence) OR ai) AND (methods OR techniques) AND banking) AND PUBYEAR > 2013	446

Table 4. Results of the initial search strings RQ

Database	Search String	Results
Google Scholar	Impact of AI Bank (2014-2023)	18,300
	Impact of AI Banking Industry (2014-2023)	18,400
Web of Science	TS=(AI AND Impact AND Bank) AND PUBYEAR AFT 2013	101
	TS=(AI AND Impact AND Banking AND Industry) AND PUBYEAR AFT 2013	24
Scopus	TITLE-ABS-KEY(ai AND impact AND bank) AND PUBYEAR > 2013	103
	TITLE-ABS-KEY(ai AND impact AND banking AND industry) AND PUBYEAR > 2013	41

towards all the sub-research questions, the main research question was answered.

### 2.2 Screening Procedure

For the screening procedure of the studies, the best practices proposed by Kitchenham [21] were used, to the extent that was possible for this study. Rules to include and exclude studies help to filter unwanted studies from the vast amount of studies. The inclusion criteria that were applied during the literature review were:

- Research Alignment
  - Studies that explore the different use cases of AI in banking.
  - Studies that focuses on the negative impacts of AI in banking.
  - Studies that researched the effectiveness of different AI methods for different use cases in banking.
  - Studies that directly address the impact of AI in banking.
- Publication Type
  - The studies should be peer-reviewed.
  - The studies should be a research paper, article or other scholarly document.
- Study Design
  - Qualitative studies addressing one of the research questions, for example a case study or systematic literature review.
  - Quantitative studies addressing one of the research questions, for example a benchmarking study, statistical analysis, experiment or survey.
  - Qualitative studies addressing one of the research questions.
  - Studies that make use of both techniques.
- Time Frame
  - The publication date of the studies is after 2013.
- Language
  - Studies that are written in English.

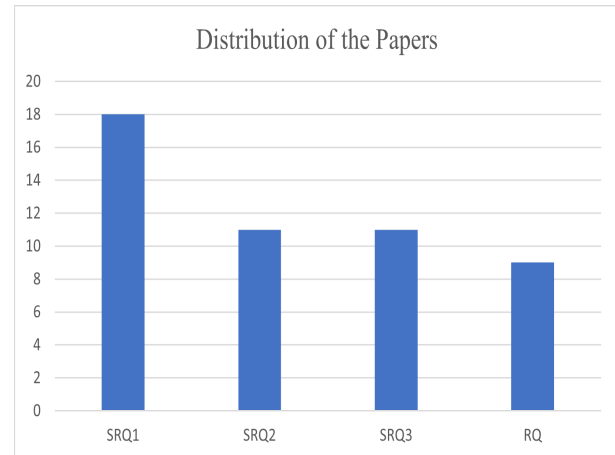


Fig. 1. The distribution of the papers over the research questions

From the inclusion criteria, the following exclusion criteria follow logically:

- Studies that do not directly address one of the research questions.
- Opinion pieces or other forms of subjective articles.
- Studies that do not meet the inclusion criteria.

### 3 RESULTS SYSTEMATIC LITERATURE REVIEW

The search phase of the systematic literature review resulted in many papers. Most of the papers were not considered relevant for this research. The number of papers that were considered relevant was 49, these were found either by the initial search strings or by snowballing. The paper selection mechanism can be found in Figure 2.

Using Google Scholar 24 relevant papers of good quality were found.

Web of Science contained 19 relevant papers. Among these papers were 5 duplicates of what was found using Google Scholar. The other papers were considered to have new added value.

Scopus contained 12 relevant papers. One of these papers was already found using the other databases the rest of the papers were new relevant papers.

The papers that were found helped to answer the research questions. The way the papers are distributed over the different research questions can be found in Figure 1.

### 4 FINDINGS

By following the methodology the information to answer the research questions was found. In this section, these findings of the systematic literature review are synthesized. It provides a summary of the current state of knowledge on this topic.

#### 4.1 Use Cases for AI in the Banking Industry

A wide variety of use cases for which AI can potentially be adopted in the banking industry was found [1, 28, 51, 56]. It was chosen to describe here the applications of AI that have or can have a

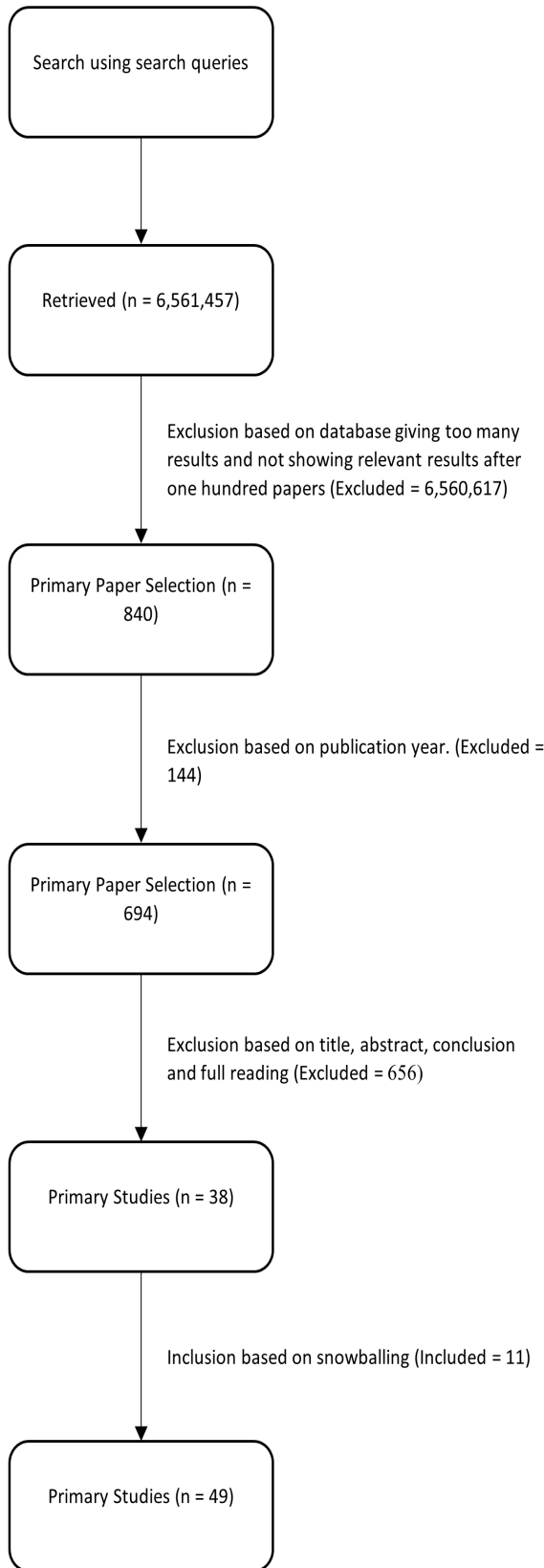


Fig. 2. paper selection mechanism

substantial role in the daily banking industry. Since these use cases are spread over a wide variety of different tasks they need to be classified. It was found that in most studies the different tasks can be classified into the following four broad categories [1, 22, 51]:

- Customer Services
- Financial management
- Fraud Detection
- Compliance with Regulations

#### 4.1.1 Customer Services.

##### Chatbot

A number of potential tasks that can be fulfilled by the use of AI can be classified in the customer service category. The most obvious is the use of chatbots. A chatbot is a computer program that helps a customer by answering questions a customer has in a human-like way through a chatting format, using AI techniques such as Natural Language Processing (NLP) [5]. The introduction of chatbots by a bank helps ease the banking process for the employee [43]. A chatbot advisor has multiple advantages over a human advisor. So has a chatbot the advantage on the factors of price, convenience, efficiency and 24/7 access [32, 37]. By being available round the clock giving instant answers to customers the use of a chatbot reduces the turnaround time (TAT) and increases the efficiency within the customer service process [32]. Still, human advice is preferred when it comes to accountability and effectiveness [37]. For this reason in case a chatbot does not provide the answers a customer wants, the customer can in most cases still be redirected to someone from customer service.

##### Customer Onboarding

Another important process in which AI can play an important role is the customer onboarding process. This process includes all activities that are involved in introducing a new customer to the bank. This includes among others data and document collection, identification checks and know your customer (KYC) procedures. This can be a time consuming process, which can take up to twelve weeks [20]. The steps taken in this process are crucial as they can make or break the ongoing relationship with the customer. Introducing AI can speed up this process and increase the security to start the new relationship with the customer on good terms.

#### 4.1.2 Financial management.

##### Credit Risk Management

Credit risk management is one of the cornerstones of the banking industry. In this process, the creditworthiness of the customer is determined. This is a prediction of the possibility that the customer will pay back the loan. By determining this creditworthiness the bank can based on the results decide if credit should be extended to the customer. These decisions that are made by bank staff are predominantly based on financial information, as was found by Trönberg and Hemlin [52]. Even though decisions were predominantly based on financial information, they also found that decisions were also regularly intuitive based. In the traditional credit risk management methods mainly the experience and the judgment level of

the employee determine the outcome [19]. Using a set of variables and past data these predictions can also be made by an algorithm. For this AI can be used. In recent studies is already been found that AI models are performing better than the traditional models [55]. One of the main obstacles to the wider adoption of AI models in credit risk management is the lack of transparency of the models [18].

#### *Asset Management*

An asset manager of a bank is responsible for managing the investments of a client, with the goal to increase the client's assets. This is done by making investment decisions based on analyses and research of the market. The decisions that are made are based on the objectives of the client. Instead of an asset manager, AI can be used to make these decisions. AI can automate the process of asset management by analysing the data and making trading decisions based on this. The use of AI in asset management does not mean that asset managers are unnecessary. Asset managers are still needed to monitor the AI to make sure that it is in line with the objectives of the client [10].

#### *Document Processing*

Another process that AI can potentially automate within banks is that of document processing. This is the process of scanning a document to find important information that can be used for further business processes. Alhaddad [31] defines two possible methods for this in his study. In the first method, this process is executed by an employee, reading through these documents and then manually inputting the important information into the bank's individual portals. The second method represents the use of AI to automatically extract important data from the documents that are then forwarded to the bank's portals. The use of AI as mentioned in the second method is more efficient compared to the first method.

#### *4.1.3 Fraud Detection.*

AI technologies also have possibilities in the financial crime section for banks. So can AI be used in the fraud detection, tracking down credit card fraud and money laundering. AI can be used to identify and block these fraudulent activities in real-time and predicting future possible suspicious actions [47]. The data set consisting of the vast amount of credit card transactions that have been made helps to train the algorithm. These transactions can then be used to categorize the credit card holder in fraudulent usage or normal usage. Where the usage of AI to detect credit card fraud has matured over the last years, still a lot of profit can be made in the detection of money laundering and terrorism financing [54].

#### *4.1.4 Compliance with Regulations.*

The use of technology in this area is often called RegTech which is a portmanteau of Regulatory Technology. RegTech helps a bank by managing regulatory requirements by using automated processes, which improves the reporting capabilities, increases compliance and reduces costs [57]. Further, using AI in the area of RegTech can help by monitoring the bank's processes [3]. Banks need to adapt their processes to the changes in regulations and since the regulations are changing frequently banks are constantly adapting. AI can be used

to read the new compliance requirements and adapt the processes accordingly.

#### *4.2 Limitations of the use cases*

While the banking industry can benefit from AI in the different use cases mentioned above it can also impact a bank negatively. AI has its limitations and disadvantages. It is important for a bank to understand this so a proper infrastructure can be set up for the implementation of AI. This way a bank gets the most out of the functionalities of the implemented AI.

Some general disadvantages were found that apply to all implementations of AI that are applicable in the banking industry [7, 12, 35]. These disadvantages are:

- The high costs of the implementation;
- the high costs of maintenance and repair;
- potential bugs in the system;
- the requirement of technical expertise.

Looking at the four earlier mentioned categories there are also some specific disadvantages of AI. A specific disadvantage of the use of chatbots is the potential inaccuracy of some answers. The chatbots are trained with a specific data set, if this contains data that is not accurate the chatbot will provide inaccurate answers [30]. Further, chatbots have difficulties with handling complex queries [30]. Therefore customer service should still have employees since AI cannot be expected to handle all possible queries of the customers.

Using AI in asset management also has its limitations and potential risks. When using AI in the asset management these should be taken into account. A big potential risk of using AI when making trading investments is over-fitting, using too much known information to create the algorithm [34]. In more dept, this concept of over-fitting means that the algorithm is trained to exactly match the training data, with the result that the algorithm is not accurate for unseen data. If this happens the AI is useless for making trading decisions. Using historical data to train these algorithms also makes them particularly ineffective during a crisis [6]. The reason for a crisis cannot always be traced back to historical data. The rise of the crisis can be quite sudden. This makes the market more volatile and more unpredictable than normal.

Risks of the implementation of AI can also be found in financial crime protection. A big risk is that a bank can lose its credibility when customers are mistakenly seen as fraudsters [39]. This type of mistake is also known as a type one error or a false positive. This mistake can be made by the system due to a racial bias within the algorithm. A type two error can also happen when a fraudster is not detected [39]. The risk of bias is not only relevant for fraud detection systems. This can also happen when AI is used to give credit risk scores, to determine if credit should be extended to the customer.

Also for the use of AI for regulatory requirements, the general disadvantages apply. Further, the implementation of these RegTech solutions brings multiple challenges. One of these challenges is the inconsistency in regulations between different national and international regulators [49]. Another challenge is that of replacing legacy systems that do not integrate with the new technologies [49]. The implementation of RegTech is often delayed due to these legacy

systems. The replacement of these systems is often expensive and time consuming.

There is also an important risk of using AI that needs to be considered when implementing AI in the processes. That is the risk of the AI becoming a black box. This means that the way the AI operates gets so complex that humans, even data scientists, are unable to understand the decision making process. Edelman [2] found that the lack of transparency is the main reason people do not feel comfortable with technology. In case of these opaque technologies, the trustworthiness is mostly dependent on our trust in the expert. A second problem with black box AI raises when there are flaws in the decision making process. These flaws are difficult to fix since it is not easy to understand what is going on [38].

### 4.3 AI methods used in the Banking Industry

AI is one of the major fields of computer science and can be seen as an umbrella term for all the computer programs that act as an intelligence. A bank that has implemented AI makes use of multiple AI methods. The methods offer different approaches to solving the problems. By understanding and utilising these methods, banks can take advantage of the possibilities of these AI methods. The most popular techniques for banks are neural networks, natural language processing and support vector machines.

**4.3.1 Neural Networks.** Neural Networks (NN) are inspired by the way biological neurons signal to one another in the human brain. The NN consists of multiple layers. These layers are an input layer, one or multiple hidden layers and an output layer. Each layer consists of nodes which are the artificial neurons. These nodes are connected with the nodes of the following layer by edges. All nodes in the input layer get a particular value assigned. Weights are used in the network to control the strength of the signal that is transmitted between two nodes. The nodes in each layer processes the information and feeds the processed information to the next layer. The NN learns by comparing the predicted output with the actual output. This information is used to reduce the error by transferring the information back into the network and adjusting the weights. This process is performed until the NN has a certain accuracy. For this process, a large number of data is needed to train the NN to make more accurate decisions. NNs can be used for multiple functions. It can be used for credit assessment, making trading decisions and fraud detection.

Lessmann et al. [25] concluded that NNs were the most effective individual classifier for credit assessment. They also found that individual classifiers, including NNs, were outperformed by ensemble classifiers, which make use of various classification algorithms.

Asset managers can also benefit greatly from NNs. Shihao et al. [17] compared different AI methods for trading. They found that NNs were the best performing method. Lam [24] compared the performance of NNs with that of the overall market average return, the minimum benchmark, and that of the top one-third returns, the maximum benchmark. Here the minimum benchmark represents the highly recommended strategy of diversified portfolios. The results showed that NNs were able to consistently and significantly outperform the minimum benchmark. However NNs were not able to significantly outperform the maximum benchmark.

In the field of fraud detection, NNs have proven to be very successful. Multiple studies researched the use of NNs when it comes to fraudulent transactions [41, 44, 48]. By using NNs all achieved an accuracy of approximately 100%, while still showing great results on other performance metrics such as precision, recall and f-score.

**4.3.2 Natural Language Processing.** Natural language processing (NLP) is used to analyse the way humans speak or write. It ingests unstructured data in the form of spoken words or text and converts this data into structured data that can be used. This process consists of several steps. Starting with preprocessing the text by breaking it apart into separate sentences. These sentences are then broken apart into words. Next, the words are brought back to their root form and the meaning in the text is learned. After preprocessing the computer can process the text dependent on the task NLP has to fulfill. The most significant use of NLP is in the implementation of chatbots. Further, NLP also gets used for credit scoring, trading and fraud detection where it gets combined with a deep learning method. Kulkarni et al. [23] have developed a chatbot for banks using NLP. The chatbot can be asked all bank related questions, such as information about loans, pension, account, mobile banking etc. The questions can be asked in different ways. The chatbot then uses NLP to understand this question and to accurately respond to give the user the intended information.

**4.3.3 Support Vector Machine.** A support vector machine (SVM) is a learning algorithm that is mainly used for classification problems. SVM tries to find the optimal decision boundary between different categories. This boundary is called the hyperplane. The SVM goal is to maximise the margin between the points of the categories closest to the hyperplane. The SVM is trained by using a training set with each example belonging to one of the given categories. An SVM requires a lot less input data than a neural network to perform accurately. SVM can be used for the same problems as neural networks in the banking industry. So, it can be used for credit assessment, making trading decisions and fraud detection.

Baesens et al. [4] studied various classification techniques for credit scoring. They found the best performances with SVM and neural network techniques. However, they also stated that simpler techniques also showed very good results. These simpler techniques' performances were in most cases not statistically different from SVM and neural networks. This was later further investigated by Lessmann et al. [25] who also found good performances for SVM, but not as good as neural networks or ensemble classifiers.

By reviewing machine learning techniques Strader et al. [46] concluded that neural networks are best used for predicting numerical stock market index values, but SVM best fits for predicting a rise or fall of the stock market. In Nti et al. [33] extensive literature review showed that neural networks and SVM are the most used algorithms for stock market predictions. They also found that they are better performing than other machine learning algorithms. Similar results were found by the review of Kumbure et al. [27].

Raghavan and Gayar [40] compared various machine learning techniques to detect fraudulent transactions, to find insight into which methods companies can best use. They found similar results for SVM and neural network methods. While the results of these

methods were close, they significantly outperformed other methods. The best results were found by combining SVM with neural networks. In other research done by Ryman-Tubb et al. [42], in which they undertook a complete survey of key published work, they found neural networks in the top ranked methods, but did not find sufficient evidence to conclude that neural networks were the best performer.

#### 4.4 The impact of AI on banks

AI has already impacted a wide variety of operations within the banking industry. Changing operations such as customer services, credit risk management, asset management, document processing and fraud detection. The impact of AI offers new opportunities to the banking industry. Within this industry, a great number of banks are already benefiting from this new technology.

AI has impacted the customer service department of banks in a positive way. According to customers AI already has greater problem solving capabilities than humans when it comes to less complex tasks [60]. Still, human customer service is needed since human customer service exceeds AI capabilities when it comes to the more complex tasks [60]. Further, Boustani [9] found, regarding customer service, that even though customers are satisfied with their experience with AI and accept AI technologies, they do not accept it equally as human customer service. Instead of replacing human customer service, AI will be more of an assistance. AI can help the employee with organizing and increasing the efficiency of the processes, which increases the employee's productivity. Also, fewer employees will be needed when AI gets integrated into the process. The savings in 2019 for these front office tasks were estimated at \$199 billion [15].

AI and specifically machine learning is used by banks for making predictions. Making predictions is important for tasks like credit risk assessment and fraud detection. To evaluate the functionality of these machine learning models metrics such as accuracy, precision, recall and F-measure are used. Van Thiel and van Raai [53] found for their credit risk prediction model the following scores for the aforementioned metrics: accuracy 0.95, precision 0.96, recall 0.88 and F-measure 0.92. Ryman-Tubb et al. [42] found similar results in their survey of published work about fraud detection models. These high values cannot be achieved by a human employee alone. Therefore the implementation of these AI models will enhance the accuracy, reduce the false positives and increase the efficiency. This ultimately will reduce the costs of the credit risk management and fraud detection. Human supervision will still be needed for tasks such as training the model and reviewing the decisions that are made by the model. The savings for the year 2019 by implementing AI for fraud detection and anti-money laundering were estimated at \$217 billion and for credit risk management at \$31 billion [15].

The use of AI in the asset management has three main goals: achieving higher portfolio returns, lowering the cost of asset management and enhancing the customer experience [10]. AI can help to achieve higher portfolio returns by optimizing the investment process. Often these investments are investments in stocks. This trading process has been digitised over the years. This has resulted in a large quantity of data sets that can be analysed by the trader.

An AI can help with analysing this vast amount of data. Based on these analyses and the trading preferences of the asset manager, for example, risk tolerance and preferred investment sector, the AI can make recommendations. AI can also be used to further reduce the need for human labour. This can be done by taking over the entire trading process, from making decisions to actually performing the transaction [10]. By increasing the efficiency of the processes AI can lower the cost of asset management. The vast amount of data that needs to be processed needs to be checked on quality. Improving the quality of the data reduces risks and costs. A main AI technique to improve the quality of the data is NLP. This is done by transferring the relevant information into a more understandable report. This has led to a 60% reduction in the report-making [16]. When it comes to the customer experience Byrom [10] mentioned several benefits for the use of AI. First of all, AI cuts customer fees by reducing the costs of asset management. A disadvantage of this is that the customer is liable for its own portfolio. AI can also be used for customization. AI helps to invest based on customer settings, such as risk tolerance, preferred investment sector, income etc. The investments of the customer can then be displayed in an AI-based interface.

For compliance with regulations, banks can benefit from RegTech solutions. These solutions improve the reporting capabilities, increase compliance and reduce costs [57]. The need for these solutions to reduce compliance costs is high. In 2022 the RegTech spending's for the year were estimated at \$68 billion and are expected to exceed \$204 billion in 2026 [50]. Further, it is estimated that in 2026, 50% of the compliance of regulations is done by RegTech [50].

## 5 DISCUSSION

This systematic literature review showed the impact of AI on the banking industry. To broaden the knowledge on this subject the review was started by investigating the different use cases for AI in the banking industry. This was done by identifying the different possibilities of AI for banks. This resulted in multiple papers that classified the different use cases. These papers seem to generally classify the use cases in customer service, financial management, fraud detection and compliance with regulations. Then the different use cases were researched to get a better understanding of the role that AI can play here. Papers were not included if it seemed that they would not add new knowledge to the topic. By firstly understanding the possibilities of AI in the banking industry the topic could be further investigated.

It is further important for a bank to understand the limitations or possible negative impacts of AI before implementing AI in the different processes. This was done by first searching the negative impacts of AI on banks. This resulted in some general disadvantages of AI applications such as the high cost of implementation and maintenance, the possibility of bugs in the system and the requirement for technical expertise. Making use of the snowballing technique the risk of the black box effect was also found. After having a general overview of these disadvantages, the various use cases for AI in banking were investigated for negative impacts. This research only stated the different negative impacts of AI on the various processes

in banking. Future research can be conducted to investigate to what matter this negatively influences the processes within banking.

Since AI contains various techniques, research was conducted on these techniques and their performances. Most of the investigated studies showed high popularity and good performances of neural networks, NLP and SVM. Therefore these were researched in more depth. Literature reviews or benchmarking studies were deemed more relevant than studies on a single AI technique. The studies showed slightly better results for neural networks than most other methods. Other techniques exist and can be researched in future more specific studies.

With the knowledge gained from researching the sub-research questions, the main research question was investigated. Based on the different use cases it was investigated how AI has made its impact on the banking industry.

## 6 CONCLUSION

Even though AI is at the root of innovation it already made a significant impact on the banking industry. Providing improvements in the processes of client services, credit risk assessment, asset management, crime detection and regulatory compliance's. AI has helped these different departments by the decision making, automating the processes and streamlining the operations. Hereby banks achieved higher efficiencies, lower costs, better customer experience and better decision making. While these benefits outweigh the limitations of AI, they still need to be considered. These can be the high costs of AI, potential bugs and the requirement for technical expertise. Specific advantages and disadvantages are dependent on the way AI is used.

In the client services sector, the main impact that is made by AI is the integration of chatbots. The 24/7 availability of chatbots has significantly reduced the turnaround time and increased the customer services processes. The advantages are mainly visible for the less complex queries, since chatbots struggle with handling complex queries. These are often still fulfilled by an employee. The main AI method for chatbots is NLP, to process the textual data.

In the financial management, the prediction capabilities of AI have taken over a large part of the processes. In the credit risk assessment, AI has made its impact by analysing vast amounts of data in a very short time, to gain insight into the creditworthiness of the customer. Hereby achieving higher accuracies than traditional methods. For asset management, the decision making skills of AI are mostly used to predict stock market trends, to advice which investments to be made. AI helps the asset manager by achieving higher returns, lowering operational costs and enhancing the customer experience. These prediction models mainly use neural networks or SVM methods to make a decision. Neural networks show the best results of the individual methods, but combining methods gets even better results. These significant benefits of AI can only be achieved if the risk of over-fitting is avoided. Over-fitting can make the algorithm useless for making accurate decisions.

The fraud detection can benefit from similar methods as the financial management department. By using deep learning methods such as neural networks or SVM, fraudulent transactions can be correctly classified. While banks can benefit greatly from AI fraud detection

methods, the risk of AI here is that customers can mistakenly be seen as fraudsters, due to for example racial bias.

AI in the regulatory compliance's can be seen in the form of RegTech. By using RegTech banks can monitor and streamline regulatory processes. The difficulty of using RegTech is due to the inconsistency in regulations. This needs to be considered when implementing RegTech. When implemented correctly RegTech can improve the reporting capabilities, increasing compliance and reducing cost. By using NLP to process the frequently changing textual regulations, RegTech can adapt the processes of the bank accordingly.

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