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Artificial Intelligence in Banking

– The Future of The Banking Work Environment



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Artificial Intelligence in Banking

- The Future of The Banking Work Environment

This thesis explores the current state of Artificial Intelligence (AI) technology, its capabilities and applications in the banking industry, as well as its potential to improve banking processes. The study also examines the current and future adoption of Artificial Intelligence in banking and the challenges that financial institutions face in implementing this technology. Moreover, the thesis makes use of an Artificial Intelligent model, Azure Machine Learning, to conduct a sentiment analysis on interviews conducted with key stakeholders involved in the banking sector. The aim of the sentiment analysis is to capture the opinions and perceptions towards the current and future role of AI in banking. Overall, the research findings suggest a positive outlook towards the use of Artificial Intelligence in the banking industry, with many experts anticipating substantial benefits to the sector. However, as Artificial Intelligence technology is still at a nascent stage, there is a degree of uncertainty around the specific future applications and the full extent of its adoption in banking. Moreover, the sentiment analysis reveals mixed feelings regarding the future competitiveness of banks with the rise of Artificial Intelligence and new Fintech entrants to the financial sector who are better equipped at leveraging this technology than traditional banks.

Keywords:

Artificial Intelligence, Machine Learning, Natural Language Processing, Banking, Finance, Fintech

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Tekoäly pankkialalla

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Tämä opinnäytetyö tutkii tekoälyteknologian nykytilaa, sen kykyjä ja sovellusmahdollisuuksia pankkialalla sekä sen potentiaalia parantaa pankkitoimintoja. Tutkielma tarkastelee myös tekoälyn nykyistä ja tulevaa käyttöönottoa pankkialalla ja rahoituslaitosten kohtaamia haasteita tämän teknologian käyttöönotossa. Lisäksi se hyödyntää tekoälymallia, Azure Machine Learningia, suorittaakseen tunneanalyysin pankkialaan liittyvistä keskeisten sidosryhmien haastatteluista. Tunnepohjaisen analyysin tavoitteena on tallentaa mielipiteet ja näkemykset tekoälyn nykyisestä ja tulevasta roolista pankkialalla. Yleisesti tutkimustulokset osoittavat myönteistä suhtautumista tekoälyn käyttöön pankkialalla ja, että monet asiantuntijat odottavat sen tarjoavan merkittäviä etuja alalle. Koska tekoälyteknologia on kuitenkin vielä alkuvaiheessaan, sen tulevista sovelluskohteista ja sen käytön laajuudesta pankkialalla on epävarmuutta. Lisäksi tunneanalyysi paljastaa ristiriitaisia tunteita pankkien tulevasta kilpailukyvystä tekoälyn nousun ja uusien rahoitusteknologia-toimijoiden myötä, jotka ovat paremmin varustautuneita hyödyntämään tätä teknologiaa kuin perinteiset pankit.

Asiasanat:

Tekoäly, koneoppiminen, luonnollisen kielen käsittely, pankkiala, rahoitus, rahoitusteknologia

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List of abbreviations

Abbreviation	Explanation of abbreviation (Source)
AI	Artificial Intelligence
AML	Anti-Money Laundering
API	Application Programming Interface
Fintech	Financial Technology
IS	Information Systems
IoT	Internet of Things
KPI	Key Performance Indicator
ML	Machine Learning
NLU	Natural Language Understanding
NLP	Natural Language Processing
OCR	Optical Character Recognition
PWC	PricewaterhouseCoopers
RPA	Robotic Process Automation
SME	Small Medium Enterprise

1 Introduction

1.1 Background

In the beginning of the 21st century, the idea of artificially intelligent robots was introduced to the world through science fiction. Later, during the 1950s, the concept of artificial intelligence (AI) started to concretize in the minds of scientists, mathematicians and philosophers, among which was the famous mathematician Alan Turing who delved into the realm of mathematics to explore the possibility of artificial intelligence. (Rockwell, 2017.) In his influential paper “Computing Machinery and Intelligence”, Turing proposed to consider the question “can machine think?” on the basis that if humans could utilize available information and reason to solve problems and make decisions, machines should be capable of doing the same (Turing, 1950). Since then, Artificial Intelligence started flourishing and was able to expand within the limits of the computing power at the time (Rockwell, 2017). Nevertheless, for more than half a century, AI existed in a state of scientific obscurity and gathered limited practical interest. It was only up till recently that the popularity of AI started to gain traction and catch the audience’s interest, partly due to a boom in data flow and improved computing power. (Kaplan & Haenlein, 2019a.) The number of publications around AI doubled compared to ten years ago (Hu, 2022). Through internet usage and the increase of connected devices, information is now circulating at tremendous speed and there is an abundance of collected data that logs our interests, tastes, behaviour by following our every click on the internet and elsewhere. (Bryson, 2018; Greatedon, 2019). On the other hand, the drop in cost of production of sensors, cameras, storage space, powerful processors and cloud computing systems, has paved the way for AI and computers to extract meaning out of chaotic data by identifying images, recognizing trends, organizing data and retrieving information in a meaningful matter. (Verganti, Vendraminelli, & Iansiti, 2020.) Former Cisco CEO John Chambers mentioned at the BoxWorks 2015 conference that at least 40% of all businesses will cease to exist after a decade if they do not transform

themselves and incorporate the new arising technologies within their business (Ross, 2015). Banks are no different. They need to keep up to date and integrate the latest technological advancements to remain in the competition.

According to a research report published in 2019 by Wells Fargo, one of the largest banks in the US, the coming decade will see robots and AI replacing 200,000 jobs in the banking sector (J. Kelly, 2019). The reason is many external factors like a decade-long of low interest rate squeezing the banks margins, geopolitical uncertainties, fear of recession, and other tensions, weighing on the banks profitability and forcing them to cut costs and adapt to a changing landscape. Unlike other industries the banks cost is concentrated in their employees and not in factories or manufacturing plants like other industries. Therefore, significant economies can be achieved by properly managing their human capital and replacing people with robots and AI that can handle complex tasks more efficiently while working round the clock, not needing lunch breaks, vacations, sick leaves, health insurance, promotions, etc. (J. Kelly, 2019.)

It is fairly known that banks possess a large amount of customers' data at their disposal (Mhlanga, 2020). It is by capitalizing on this information that banks can predict the customers' needs before they become aware of them and go beyond just predicting their consumer behaviour and aim at customizing the banking experiences of each customer, through various channels and creating a tailored personal experience for every client. (McKinsey & Company, 2020.) Hence, through AI technology, banks can leverage the big data, a term coined to describe large hard-to-manage volumes of data – both structured and unstructured – that inundate businesses on a day-to-day basis, to recommend customized and tailored products and services based on each customer's taste and personal behaviour. To be able to complete the large personalization projects, banks are seeking help from technological and software development companies to assist them in establishing technological ecosystems that exceed their technical abilities. (Ragotham, 2019.)

1.2 Purpose of the research and research questions

The banking industry is an early adopter of AI compared to other industries and is willing to explore these new technologies (Vijai, 2019). Hence, a number of applications related to Artificial Intelligence (AI) and Machine Learning (ML) in finance have been developed (G. D. Sharma, A. Yadav, & R. Chopra, 2020). Traders, wealth managers, bankers, and insurers have become familiar and more knowledgeable with these applications than other workforces (Columbus, 2020).

In order to understand how AI is unfolding in the financial sector, it is important to shed light on the basics of AI, its different types, characteristics, assets, areas of use and benefits in the banking sector. This thesis will address as well, the challenges to adoption that comes with the implementation of these technological advancements within the banking sector. The reason this topic is believed to be important, is because the transition to this new technology in the labour market carries risks during the implementation of change in the workplace environment (Krämer & Cazes 2022).

Therefore, the aim of this thesis is to answer the 1st research question: What are the areas of:

- a. Application and benefits of AI in banking?
- b. Challenges for AI in banking?

This research question will seek to discover the potential areas of applications of Artificial Intelligence (AI) in banking, as well as their respective benefits and challenges of their future adoption in the banking system.

Moreover, the thesis will seek to extract the opinions on the future of the banking industry with AI and answer the 2nd research question: what is the outlook for the future of the banking industry?

On the other hand, despite existing research papers and publications on various topics concerning AI, there is still a gap in research as for the extent of the

readiness of society for this approaching change and for the attitude and perception of the public with regards to AI (Vasiljeva, Kreituss, & Lulle, 2021). Therefore, this thesis will also seek to understand the sentiments and attitudes of bank key stakeholders towards Artificial Intelligence (AI) and answering the 3rd research question: What is the sentiment towards the use of AI in banking?

The need arises to talk about As Ahvenharju, Minkkinen, & Lalot (2018) mentioned, the future is being created now. It is better to be anticipating and proactively engaged in paving the way rather than passively receiving it as an inevitability (Ahvenharju et al., 2018). Therefore, it is deemed necessary to talk about the challenges of the new market order, if banks want to keep their competitive edge and market shares, in the fast-moving world of today.

1.3 Methodology presentation

The research follows an inductive qualitative method approach conducted by analysing 15 interviews that take place on 15 episodes of a podcast called “AI in banking” – later changed name to AI in financial services – which interviews key stakeholders in the banking and financial sector and discusses topics related to AI and finance (Faggella, 2019-present). In addition, two other interviews were conducted by the writer of the thesis, one with a bank employee and another with a customer manager at the international company London Stock Exchange Group. This method of research will allow for the results that emerge from the data to be organized and classified into categories and themes that will facilitate the analysis (Thomas, 2006).

Also, the third research question is answered by running all the opinions from the interviews through a sentiment analysis model, Azure Machine Learning, to determine which areas of AI and banking elicit negative, neutral and positive sentiments. Moreover, the sentiment analysis results will also allow for an evaluation of the reliability of the Azure Machine Learning model.

2 Literature review

2.1 Definitions and types of AI

First to be able to deeply understand the concepts of Artificial intelligence, a clear explanation needs to be provided. One of the most important innovators in the field in the field of Computer Science and Artificial intelligence, was John McCarthy who is recognized as the father of Artificial Intelligence due to his astounding contributions. He first coined the term “Artificial Intelligence” in the 1950s, when he defined it as “the science and engineering of making intelligent machines” (McCarthy, 2007, p. 2). His work was motivated by his conviction that humans will reach deeper understanding of their intelligence, by saying "I don't see that human intelligence is something that humans can never understand." (Stanford University, n.d., main page). Today, there are many definitions for Artificial intelligence, however defining it, is not easy because AI evolution is so fast that what was considered intelligent behaviour previously may not be noteworthy today. One simplistic way to define AI is to view it as the science of making machines operate with a humanlike intelligence and behaviour to complete tasks that require human intelligence if these tasks were to be performed by men. Also, AI can be referenced to human intelligence as cognitive potential to solve problems and create solutions. (Kaplan & Haenlein, 2019b.) In short, it is an intelligence fashioned by human and exhibited by machines. Therefore, it is seen as a man-made tool emulating the cognitive functions of the human brain (Tai, 2020). By this it becomes clear how AI differs from other technological concepts like Internet of Things (IoT) and big information data. AI uses these IoT devices and sensors around us that collect data, to analyse them and extract meaning out of chaos. (Kaplan & Haenlein, 2019b.)

2.1.1 Level of AI by complexity

As human intelligence is composed of many elements like neural, cognitive, social, emotional, and situational, so AI varies by degrees of complexity and operation. Artificial intelligence can be classified in three levels from the simplest to the most complex: (Kaplan & Haenlein, 2019b.)

Artificial Narrow Intelligence (ANI) or weak AI: refers to AI that is used only to perform specific narrow tasks in specific areas, like face and voice recognition or driving a car (Kaplan & Haenlein, 2019b). This class of AI, also called applied artificial intelligence (AAI) emulates human intelligence for defined tasks to create “commercially viable smart programs or machines” (U. Paschen, C. Pitt, & J. Kietzmann, 2020, p.153). However, although ANI is beneficial to the enhancement of the quality of human life, it still carries many risks and dangers in case of malfunction, like disrupting electric grids or destroying nuclear power plants (Tai, 2020).

Artificial General intelligence (AGI): is a higher form of AI that transcends ANI and is able to reason and autonomously solve problems that were not pre-designed within its program (Kaplan & Haenlein, 2019b). By the power of its speculative intelligence, AGI can understand and learn any intelligent task, even to the point of equating or exceeding human performance in these tasks (Tai, 2020).

Artificial Super intelligence (ASI): is the 3rd generation of AI and is sometimes called true AI due to its capability of solving problems instantly in several areas and surpass humans in all tasks. For example, solving at once complex mathematical problems or writing a best-seller book in an instant with no reproachable faults. (Kaplan & Haenlein, 2019b.) This type of AI is seen so far only in science fiction movies where it will surpass by far human knowledge and abilities (U. Paschen et al., 2020).

A summary of those intelligence is presented in the below table:

Table 1. Level of AI (adopted from Kaplan & Haenlein (2019b, p.18)).

Artificial Narrow Intelligence (ANI)	Artificial General Intelligence (AGI)	Artificial Super Intelligence (ASI)
<p>Weak, sub-human level AI</p> <ul style="list-style-type: none"> - AI application to targeted areas. Limited scope of work. - Non-autonomous and incapable of to solve problems outside of scope of work. - Equals/outperforms human in limited and specific areas. 	<p>Strong, Human-level AI</p> <ul style="list-style-type: none"> - AI application to many areas. - Ability to solve problems autonomously in several areas. - Surpasses and equals human in many areas. 	<p>Conscious, self-aware and beyond human level</p> <ul style="list-style-type: none"> - AI application to all areas. - Capability of solving problems instantaneously in all areas. - Outperforms humans in all areas.

As shown in Table 1, the different levels of AI possess different set of capabilities with different sophistication levels and the following figure 1 give an example of the capabilities of such AI levels.

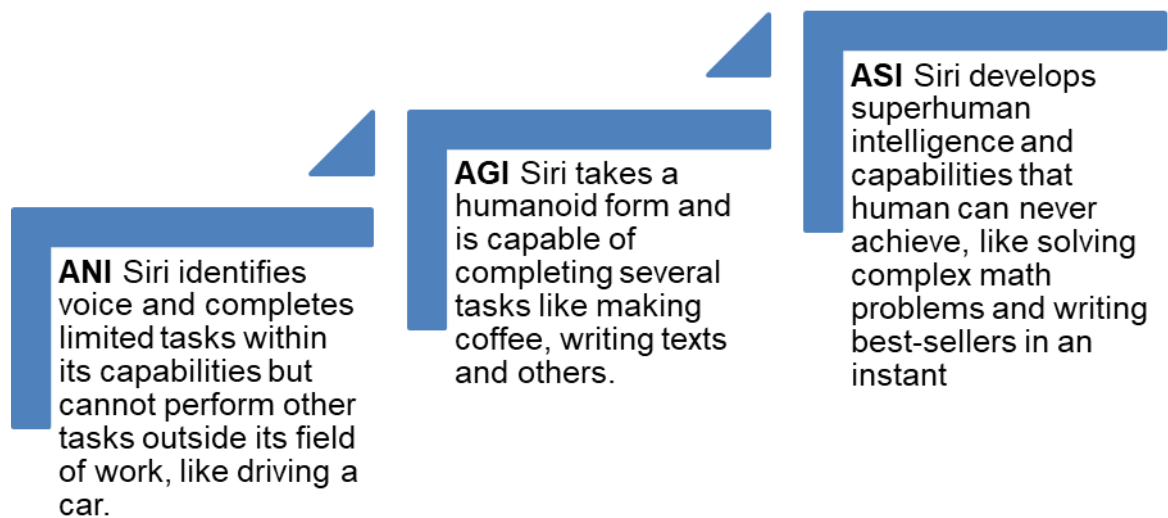


Figure 1. Illustration of AI stages with an example (adopted from Kaplan & Haenlein (2019, p.16)).

As shows in Figure 1, the example of Siri illustrates the potential evolution of the AI capability as it progresses from lower to higher levels of complexity and sophistication.

2.1.2 Types of Intelligence

Some characteristics reflecting the “Intelligence” in AI are specifically relevant in the business world:

Cognitive intelligence which is the basic skill expected from AI to complete specific tasks like the capability to recognize patterns and employ systematic thinking (Kaplan & Haenlein, 2019b). Cognitive tasks are typically associated with human intelligence. These tasks encompass a wide range of abilities, including perception, reasoning, learning, interaction with the environment, problem-solving, decision-making and even showcasing creativity. (A. Rai, P. Constantinides & S. Sarker, 2019.)

Emotional intelligence, although machines obviously do not experience emotions, however they can be taught to detect them and recognize a certain emotion from facial expression for example. If these emotional and social skills are teachable to individuals, then AI can learn to imitate them. Emotional intelligence in AI requires it to distinguish and be versatile and adaptable when faced with different emotions. It also requires AI to display traits of self-confidence and awareness, by monitoring the interlocutor feelings or emotions and adapting accordingly. (Kaplan & Haenlein, 2019b.)

Social intelligence is the ability to comprehend others and behave rationally and emotionally with others which is more advanced than just emotional intelligence, in the sense that it requires AI to detect and acquire skills in mimicking empathy, teamwork skills and inspirational leadership characteristics (Kaplan & Haenlein, 2019b); As well as interpreting others' mental states and interact in complex social groups in order to predict how the other party process thinking, feeling and exhibit behaviour (Schröder & Mckeown, 2010).

It is important to note that AI functions totally differs than expert systems. Expert system is defined by rules coded by humans into its system. It follows the rules and criteria fed into its code. For example, if an expert system were to identify human faces in a picture, it would search from the criteria in its system that defines what is a human face. For instance, it would look at the shape of the nose and the presence of two eyes. Real AI on the other hand, handle such task in a different manner. It imitates the brain structure and its neural connections and uses large data to extract knowledge by itself. It is similar to the method of how a child learns to identify faces. It is not by rules dictated by the parents, but after seeing many faces, at some point, the child will start distinguishing what is a face and how it differs from other objects. This approach allows AI to handle much more complex tasks than expert systems. (Kaplan & Haenlein, 2019b.)

In the early days of AI, computers used to simulate and imitate human behaviour based on rules coded in its system. The coder applied a logic-based algorithm that if a certain variable appeared it will be answered with a specific

response, which dictated the outcome based on a set of internal rules. Nowadays, this method of logic-based approach is being substituted with data-up approach, whereby the AI teaches itself from the data information fed into its system to recognize patterns and make associations, without programmer having to understand how and why the AI reached that result. (Bauguess, 2017.)

AI systems can be categorized into three groups based on the above mentioned cognitive, emotional, and social intelligence competencies they possess (Kaplan & Haenlein, 2019b):

Analytical AI is capable only of cognitive intelligence. This type of AI views the world via a cognitive representation and applies a learning process that bases future decision on previous experiences. This type of AI is the most commonly used in businesses today. In the banking and financial sector, one of its forms is programs or software that detects financial frauds and money laundering. (Kaplan & Haenlein, 2019b.)

Human-inspired AI is capable of both cognitive and emotional intelligence. This type of AI can consider cognitive and emotional elements in their decision-making process. For example, an AI firm named Affectiva, utilizes an advanced vision technique to detect expressions of joy, astonishment, anger and other emotions during its interaction with humans. This can, for example, allow to improve the recruitment process of new employees or enhance the customer experience, by taking into consideration the human emotional reaction during communication. (Kaplan & Haenlein, 2019b.)

Humanized AI is the highest level of AI in terms of complexity. It can make use of cognitive, emotional, and social intelligence, making this AI self-aware and self-conscious during its operation. At the moment, humanized AI is yet to be seen and is a project for the future that is not yet available. (Kaplan & Haenlein, 2019b.)

The following table 2 presents the types of intelligences present in each AI system.

Table 2. Types of AI systems (adopted from Kaplan & Haenlein (2019b, p.18)).

	Expert Systems	Analytical AI	Human-inspired AI	Humanized AI	Human beings
Cognitive Intelligence	No	Yes	Yes	Yes	Yes
Emotional Intelligence	No	No	Yes	Yes	Yes
Social Intelligence	No	No	No	Yes	Yes
Artistic Creativity	No	No	No	No	Yes
Supervised, Unsupervised and Reinforced Learning					

As seen in table 2, the progression to higher levels of AI, includes more types of intelligence.

2.1.3 AI decision-making processes

The means by which AI process information to reach decisions are illustrated in the following figure 2.

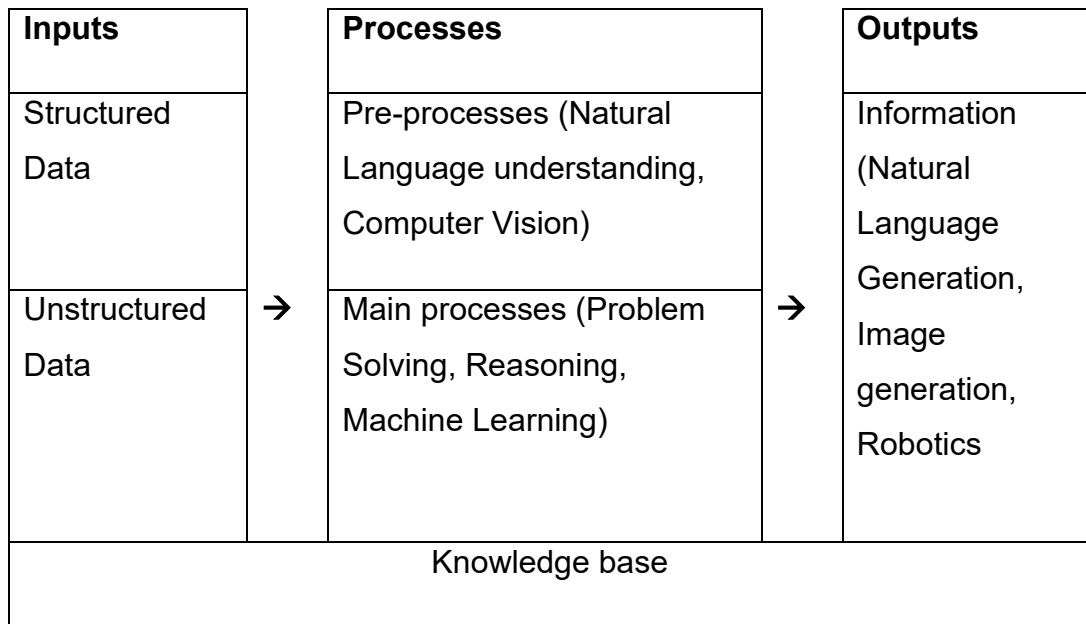


Figure 2. Building blocks of artificial intelligence systems (adopted from J. Paschen et al. (2019, p. 1412)).

Inputs:

AI makes use of input data to analyse and process them to generate the information needed as a final outcome, like a decision or a response. The inputs used by AI and fed into its system can take two forms, structured or unstructured data. Structured data are organized data like sales figures and inventory items. While unstructured data can be anything any digital data from social media, any video or audio file or text. The analysis of unstructured data is more difficult and due to its complexity can only be analysed by AI. (U. Paschen et al., 2020.)

Pre-process:

When it comes to processing these inputs, AI operate in two phases. First, it pre-processes the information to decipher it in a language it can understand,

then moves on to solving the problem through processing the main task. (U. Paschen et al., 2020.)

The pre-processing is the first phase of data cleaning and transformation so that it can be understood by the AI and further processed in the 2nd stage. For example, in the pre-process, AI applies Natural language understanding (NLU) which is when AI transforms by the aid of speech recognition, the human language. First, it does it without attributing meaning to the word, then after that it ascribes meaning to the text to deduce from them the instruction or the goal of the conversation. One of the biggest challenges of AI in the pre-process phase, is accurately understanding the true meaning of the command and not misinterpreting it. Since NLU depends on many factors like the phrasing, wording, jargon, context of the conversation, dialect and others, extracting the true meaning without ambiguity can be very challenging. Thus, NLU applications usually follow grammar rules and use dictionary to interpret the relationship between the words and their context, then establish the most likely inferred meaning, by using statistical models. (U. Paschen et al., 2020.)

Another example of pre-processing is computer vision, whereby AI convert the images in a representation that interfaces with its system (U. Paschen et al., 2020).

Main Process:

The main process of solving the task at hand, is conducted through 3 types of intelligent practices: problem solving, reasoning and machine learning. The latter however, utilized the other two processes to deepen its knowledge and enhance the decision making. (U. Paschen et al., 2020.)

Problem-solving entails of choosing among the option that will achieve the best result. In case of multiple solutions, divergent problem solving evaluates several outcomes that are equally beneficial. While convergent problem solving strives to find the best solution. (U. Paschen et al., 2020.)

Reasoning, as is with humans, depends on logic to reach a resolution. It is in this area that AI shines. AI systems surpass traditional reasoning capacity. It uses “top-down” or “deductive” reasoning to attain solutions based on pre-set assumptions and hypothesis. Also, it can utilize “bottom-up” or “inductive” reasoning to propose solutions based on observation. (U. Paschen et al., 2020, p. 150.)

Machine Learning allows AI to improve all its processes over time, without having to rely on defined rules and existing instructions. Early feats of machine learning were dependant on pre-programmed instruction set by humans that guides AI in its learning. However, with the advancement of AI technology, programmers were able to create algorithms that allows AI to develop itself and draw out new knowledge from large amounts of data, all that by improving its precision with each repetition. And thus, machine learning ML became a subset and the principal distinctive element of AI systems. (U. Paschen et al., 2020.)

As mentioned above, AI’s main characteristics is its capability to learn from past data through Machine learning ML techniques, hence further classification of AI based on its learning and reasoning techniques can be established (Kaplan & Haenlein, 2019b):

Supervised learning method allows the AI system to link certain results based on a set of past labelled data. Therefore, it uses already classified and labelled data to compare it to the subject in question and extract a conclusion. For example, an AI system can identify an image by comparing it to a database of labelled images. Also, it links a set of inputs to a set of labelled outputs, using statistical methods and inferences already familiar to humans, like linear/non-linear regressions or classification trees. (Kaplan & Haenlein, 2019b.) Usually, classification tree models are used when the target variable is of nominal value, while regression models are used when the target output is numerical (Moro, Cortez, & Rita, 2015).

In **Unsupervised learning method** the inputs are marked with a label but not the output. In that case, the AI system needs to deduce the algorithm structure

from the data sample itself (Kaplan & Haenlein, 2019b). This method of deducing the data is often performed through a technique called Latent Dirichlet allocation LDA which aims at understanding topicality based on the frequency of words used (Moro et al., 2015); For example, understanding the topics discussed in a document based on the number of terms used that are attributable to each topic. Also, another method is through performing cluster analysis, where the AI system groups the data according to its own inferred analysis and structure, without having a reference to compare it to. Speech recognition for example can be performed by the aid of unsupervised learning. (Kaplan & Haenlein, 2019b.)

In **Reinforced learning method**, the AI system is tasked with an objective of maximizing a certain output by applying a range of commands to influence the output result. A simple example is if an AI system were to learn to play Pac-man, it would learn to maximize the score by operating the Pac-man in different directions. (Kaplan & Haenlein, 2019b.)

Knowledge base

The knowledge base of AI is composed of past data and previous results of accumulated knowledge that affect future performance and subsequent results. In earlier models of information systems, data retrieval used to be conducted through a series of hierarchical and clear outlined commands from structured data. However, advanced AI systems can handle more complex unstructured data, internal information retrieved from pre-processes as well as intrinsic self-generated information. Deep learning, on the other hand, produces intertwined implicit knowledge that cannot be comprehended without context and referral to every single network layer that was used to reach that knowledge. (U. Paschen et al., 2020.) Each of these networks creates the data base of Artificial Neural Networks ANN that attempts to mimic knowledge acquisition and the organizational behaviour of the human brain. Same as the brain depends on its

neurons, AI uses its processing units that are interconnected layers by restricted links. (Huang, Tsou, & Lee, 2006.)

Output

After having completed the main process, AI will communicate end result as meaningful information, that can be understood by humans by mean of Natural language generation or as input data to be integrated into other IT systems for further processing. The natural language generation is the backward process of natural language understanding, where AI generates words and compose sentences in a conversational context, to communicate the end result of its process. This communication can take the form of text reports or the more complex format of speech generation. Other forms of output can also be image generation from text description or navigational instructions for robotics to interact with its environment and maintain its balance. (U. Paschen et al., 2020.)

2.2 The challenges of the current banking landscape

Increased regulations

Following the last financial crash in 2008, stricter regulations were imposed on the banks. Over 50,000 regulations were published between 2009 and 2012 in G20 countries, making the banking system the most regulated industry in the world. The compliance to those regulations creates challenges even to the largest banks and are still to this day manually monitored by specialized expert regulators. (Königstorfer & Thalmann, 2020.) This increased regulation along with the complexity it brought has also pushed banks to turn to technology with the hope of alleviating this burden and aiding them even partially in the regulatory reporting process. This created the term of RegTech, combining the terms Regulatory and Technology, to refer to the technology that is helping banks comply with the regulatory requirements. (Fenwick & Vermeulen, 2021.) Machine Learning is being used to improve the banks' compliance to

regulations by increasing the effectiveness and transparency of its systems (Wall, 2018). An example of the imposed regulations is the Comprehensive Capital Analysis and Review (CCAR) which requires banks and financial institutions to maintain at all times an adequate level of capital that withstands stressful situations and to make proof of following a “robust forward-looking capital-planning process” (Wall, 2018, p. 59). The CCAR requirements are adequate documentation of the processes used in the bank models. Also, another way AI is helping banks conform to the imposed regulations is by overseeing the internal systems within the bank and alerting in case loopholes or internal frauds are found. An example on this subject is using AI automated systems to monitor traders’ activities to detect suspicious behavior that could lead to insider trading frauds. (Wall, 2018.)

Increased competition from parallel channels

The first wave of upheaval in the banking system started a decade ago with the rise of smartphone technology which created new expectations from the banks to move their banking activity from branch and call centres to more mobile and digital channels on the go. This created pressure on traditional banks to invest in new IT infrastructure to accommodate the change. However, currently another wave of disruption is on the rise, led by multinational technology companies and it will take the banking system by storm, while traditional banks are still focused on their quarterly KPIs, total assets, revenues and net profits. (Carpenter, 2020.)

The bank’s main activities are lending, processing payments and managing deposits. All these factors are currently being challenged by new systems, new lending channels, and new credit sources. The fierce competition from non-traditional channels increased due to deregulations and availability of Challenger banks, FinTech, online lenders and/or online process payment systems like PayPal and MyBank. These new channels provide the same niche services as the banks but are subject to different and more lenient legislations

because they are registered as financial service provider and do not possess the title of Banks. (Königstorfer & Thalmann, 2020.) Also, the innovations developed by FinTech has contributed to the emergence of app-based tech start-ups that provide digital financial services more attractive to millennials (Fenwick & Vermeulen, 2021).

Moreover, the products and services provided by the banks are more or less homogenous, which makes it harder for the banks to differentiate their products and retain customers (Königstorfer & Thalmann, 2020).

As mentioned above, banks are now facing new types of competitions also from the big tech companies with their large resources, like Google, Amazon, Apple, Facebook, who already possess a large quantity of personal data on their customers. These companies are capable not only to snatch market shares from traditional banks, but also render them and their service a mere commodity. Moreover, all the disruptions seen up to this day, will pale in comparison to the coming changes that large Big Tech companies will push in the future. (Carpenter, 2020.)

For example, Amazon is targeting Small Medium Enterprises (SME) lending by offering loans to its e-commerce sellers, exceeding 3 billion USD granted as loans. Also, Amazon is making use of ML to analyse sales, transactions and automate credit risk decisions. Facebook is planning on releasing its own currency Libra that will facilitate payments by allowing apps to handle financial transaction without going through the banks, as the middlemen. In China however, the upheaval already started in 2014, when e-commerce giant Alibaba launched its Alipay payment platform and consolidated numerous financial products and services under the umbrella of the largest financial institution in the world, Ant Financial. (Carpenter, 2020.)

Customer expectation

Modern customers have become more empowered, less patient, and they now demand more from the businesses they interact with, including their banking

institutions (Carpenter, 2020). Today's customers, who are accustomed to the service standards set by consumer internet companies, have raised their expectations. They now anticipate a similar level of consistency, convenience, and personalization from their financial-services institutions (McKinsey & Company, 2020). the emergence of challenger banks and the continuous influx of fintech companies joining the market has resulted in customers being presented with abundant options. As a consequence, their expectations regarding the customer experience have been permanently elevated. (Retail Banker International, 2022.) Moreover, the Big Tech companies consistently set higher standards to user experience, and users are well aware of what constitutes a superior experience. As a result, their expectations are on the rise, and they demand services that cater to their individual requirements. Hence, customers now demand that banks demonstrate a deep understanding of their unique needs and preferences, and they expect to receive personalized and seamless experiences. (McCumber, 2021.) At the moment, many customers view their relationship with their bank as nothing more than a transactional one, akin to the relationships they have with utility companies like electricity or water providers. However, given the wealth of data and insights that banks possess about their customers, they should be leveraging this information to engage with their customers more frequently and provide them with valuable advice and information that goes beyond basic transactions. For example, a bank could offer a home purchase package that combines an appropriate mortgage, home insurance, and furnishing loan, or a car purchase package that includes financing, insurance, and breakdown cover. (Carpenter, 2020.) Moreover, the utilization of AI holds the potential to provide customized services (Vijai, 2019) and by leveraging AI technology and machine learning, banks can employ specific algorithms to analyse and forecast customer behaviour, enabling the development of customized plans, and aligning with customer expectations (Noreen, Shafique, Ahmed & Ashfaq, 2023).

2.3 Application of AI in banking

2.3.1 Customer-facing applications

There is a wide misconception that AI needs to be highly advanced and indistinguishable from humans, in order to be able to inflict a dramatic change on our society (Verganti et al., 2020). On the contrary, AI does not need to be able to replicate human behaviours and decisions – sometimes referred to as “strong AI” in the field of computer science (Verganti et al., 2020, p. 213). Imperfect weak AI which is capable of completing simple tasks like collecting and organizing data, analysing patterns, suggesting recommendations based on past behaviours. That alone is already enough to create significant change when applied at large scale. (Verganti et al., 2020.)

AI in customer interaction

A research analysis done by Soni, Sharma, Singh & Kapoor (2019) showed that the most penetrated areas by AI are related to specific job categories and tasks within an organization are customer interaction area, sales platform and human skills (Soni et al., 2019). Customer interaction is the most basic form of communication between a company and its customers. Previously in the conventional process, this communication was held on a human-to-human level. However, it has been shifting to a Human-to-Machine communication basis, like chatbots. (Sands, Ferraro, Campbell, & Tsao, 2021.) According to research conducted by Juniper Research (2017), chatbots can save at least 4 minutes of a customer service agent’s time. This shift will reduce human error and personnel costs; provide an instant personalized response, and increased value for the customer (Soni et al., 2019). In banking, chatbots can easily handle customer basic tasks such as responding frequently asked questions (FAQ) or performing payments requests (Ragotham, 2019). Chatbots are able to bring forth self-service and troubleshooting solutions to customers while freeing congestion from call centres and branches (Donepudi, 2017). A client is

more likely to experiment with different portfolio scenarios or risk products when dealing with a chat-bot rather than on a live interaction with a human customer service agent. This process of trying out different scenarios will allow the customer to retrieve the most value of the transaction and obtain the best outcome. (Soni et al., 2019.)

In addition, personalized banking and recommendations are growing. With the use of computational intelligence and ML feeding on clients' past history and spending habits, banks are able to provide customized financial advice with tips and suggestions to improve the financial wellbeing of the customer. (Donepudi, 2017.) Applications using AI are capable of tracking the user's spending behaviour and provide him or her with personalized advice on accumulating savings and containing expenses. Hence, with the use of smart financial advisory, users can handle money more efficiently. (Kaur, Sahdev, Sharma & Siddiqui, 2020.) Moreover, the rise of such technology in the financial sector have revolutionized asset management by creating robo-advisors that give investment recommendation and transaction analysis where the AI is able to detect fraudulent behaviour or early signs of dementia in customers by distinguishing erratic account movements (Kaplan & Haenlein, 2019b).

AI in marketing and sales

As businesses shift from the traditional method to electronic method of selling products and services, many integrate the use of AI to provide a better buy-sell experience to both parties, via AI generated sales predictions, recommendation engines, warehouse automation and innovative e-commerce platforms (Soni et al., 2019).

With the use of AI, banks can use granular data in their marketing campaigns to target each client specifically and contribute to the retention of existing clients and the acquisition of new ones. This method of analysing data gives insight into the preferences of customers and allow an accurate classification of clients and products by probability of acceptance of each product by a customer. Thus,

creating a highly specialised system for predicting customer behaviour. Moreover, the analysis of transactional data by AI can also give insight in the lifestyle choices and behavioural patterns of their customers and hence provide targeted marketing campaigns for each. In addition, AI can help sales employees approach customers that are more likely to accept a purchase. (Königstorfer & Thalmann, 2020.)

A study conducted by the financial group BBVA compared the results from branched equipped with AI against other branches. The results showed the AI equipped branches sold twice as many products to small medium enterprises (SME) more than the other branches. (Alfaro, Bressan, Girardin, Arias, Asadi Someh, & Wixom, 2019.)

AI in detecting customer satisfaction and loyalty

AI can also detect unsatisfied customers by facial recognition and inform the employees to attend to their needs (Kaplan & Haenlein 2019b). According to a study done by Mauro Castelli, Luca Manzoni and Aleš Popovic (2016), AI is also capable of predicting the quality of banking services perceived by the customers and strive to maximize it. In the study, the quality of service (to be maximized) was considered as the waiting time the customer has to undergo before being served. While the operational cost (to be minimized) was considered as the number of open counters. The bank's management wish to minimize operating costs by opening the minimum needed number of counters, while customers wish to be served quickly with a minimum waiting time. In that case, AI was able to overcome the limits of standard statistical models and calculate the optimum number of open counters with minimum operational costs for the bank. The semantic method used by AI surpassed in accuracy the traditional statistic and regression methods, previously applied like estimating the number of customers based on previous data, past dates like rush hours and high or low season. AI was able to synthesize a satisfying outcome based on personal data, preferences, past types of transactions, past surveys of

customer satisfaction given a waiting time (i.e. a waiting time of 15 minutes can be perceived as acceptable for some customers, but not for others) and to come up with optimal results satisfying both parties, the bank and its clients. (Castelli et al., 2016.)

2.3.2 Business-enhancing applications

Lending practices, loan approval and credit scoring

AI has the potential of making more accurate predictions with previously unused data types. Machine learning (ML) models are used to determine customers' credit history and make informed decisions on loan grants. (Ragotham, 2019.) These models can rank potential customers by evaluating their creditworthiness based on alternative data that was not available in the past, like social media, internet activity, websites visited, online channels and online purchase history (Fares et al., 2022; Ragotham, 2019.) More data types are taken into consideration by AI when evaluating the credit risk of customers. Non-traditional data sources such as utility bills, telecom data, data from social media sites (log ins, click data and others) in addition to smartphone-based data, such as calls, texts, apps and socio-demographic data, contribute to better estimations of the probability of consumer default and thus conclude that the resulting model can predict defaults in microlending more precisely. (FICO, 2022.). The utilization of data mining and machine learning techniques will facilitate analysis and enable on the spot optimal credit decisions (Fares et al., 2022). Moreover, the ease of conducting complex simulation by AI, like random forest regressions, support vector machine and decision trees that outline all the possible scenarios, are better suited at predicting credit defaults (Bakar & Yosi, 2017). In addition, AI capabilities can discover financial statements fraud in balance sheet and income statements and highlight potential fraudulent customers before any lending decision takes place (Königstorfer & Thalmann, 2020).

AI-based models apply random weights to each of the factors that have an effect on credit solvency, then performs a countless number of iterations, to identify the exact weight value that will result in the most accurate credit risk prediction. Moreover, Machine Learning is highly suitable in credit risk assessments, because of the complex relationship between the client's profile, its consumption habits and big sample size to be studied. (Bakar & Yosi, 2017.) A case study on probability of default developed by Deloitte France (n.d.) concluded that AI models that use "random forest", "gradient boosting", and "stacking methods" all surpass in quality and performance, the traditional logistic regression models that are still in use in banking (Deloitte, n.d.). Nevertheless, in spite of the superiority of AI systems in producing higher quality credit scoring models, these models are still dropped in favour of statistical-based techniques, due to their complexity and lack of user-friendliness (Bakar & Yosi, 2017). So, following the outlined above, the traditional methods consisting of statistical regressions of customers and study of financial ratios proved to be less accurate than the new hybrid method of combining the old ways and the new AI algorithmic based models (Königstorfer & Thalmann, 2020).

The use of AI in lending can give banks an edge over non-banking competitors. The large amount of data that commercial banks have collected on their customers in combination with banks' experience in credit risk management and their relationships with their clients can give banks a competitive edge against newcomers. (Königstorfer & Thalmann, 2020.)

Moreover, with the aid of ML, banks can now measure credit pricing more accurately and identify customers that are being overcharged or undercharged in terms of risk premium relative to their actual level of risk. For example, ML system can accurately predict the riskiness of a customer. If a client is being charged a high-risk premium more than is justified compared to his or her level of risk, then the ML software can identify the mismatch and offer a lower interest loan to the customer and even offer to increase the loan amount, hence increasing market shares. On the other hand, if a risky client is not charged

enough risk premium or interest, the ML can detect the client and either adjust the interest rate or decline to grant a loan to the customer. (Wall, 2018.)

Also, the use of Artificial Intelligence along with traditional financial ratios significantly improves the accuracy of credit prediction. In addition, some combinations of different AI methods like Support Vector Machine (SVM), Artificial Neural Networks (ANN) and Decision Trees, provide superior results than other credit rating methods. (Nazari & Alidadi, 2013.)

In summary, ML is capable achieving superior quality of results in risk management and create more accurate risk models by analysing complex and non-linear trends within big data collections (M. Leo, S. Sharma & K. Maddulety, 2019). Data-driven AI applications for lending decisions have the capability to analyse vast amounts of data, offering personalized financial advice, calculations, and forecasts. These applications can be integrated into end-user devices, personal robots, and financial institution servers. They enable the development of tailored financial plans and strategies, conducting research on customized investment opportunities, loans, rates, fees, and tracking progress accordingly. (Vijai, 2019.) Moreover, the predictability of these models grows exponentially with each additional information added to the system, thus, continuously enhancing the model over time. (Leo et al., 2019.)

Fraud detection, Security and Anti-Money laundering

The banks had always had a large responsibility in what concerns the personal information of their customers. And now, as the majority of transactions are conducted online, the pressure on the banks has increased as they are expected to provide even more reliable and secure means for performing transactions. In this area, AI can prove to be useful in protecting customer information against cyber security threats including malware, hacking, phishing and ransomware. By using cognitive fraud analytics, a ML model can be trained in real-time behavioural profiling to subsequently flag suspicious behaviour. These AI-based systems consider customer behaviour patterns instead of exact

rules and therefore will be more efficient at detecting fraud than manual monitoring. (Ragotham, 2019).

Moreover, banks use Anti-Money laundering procedures and regulations to prevent criminals from disguising illegally obtained funds as legitimate income. The detection of criminal activity is subtle and can only be efficiently contained by the use of fast AI and ML. (Donepudi, 2017.) Some machine learning methods like “topic modelling” which is a form of text mining that utilizes machine learning to recognize patterns in big data of unstructured texts and “cluster analysis” which consists of grouping objects based on their similarities, can detect normal and abnormal financial behaviour of market participant (Bauguess, 2017, p.3). Moreover, by the mean of supervised machine learning techniques, AI is able to detect fraud based on human instructions and previous fraud examinations, to match similar patterns or trends of a possible misconduct. Nonetheless, a hybrid method of supervised and unsupervised learning can be applied to improve the process and reach an even more successful outcome. For example, by using unsupervised learning to detect anomalies in the data using nothing but the data itself, then following that applying supervised learning algorithm guided by human to inject human knowledge into the process, whereby the results and patterns found via unsupervised learning are matched to previous user-defined data of past frauds. This will enhance the fraud detection process with each new training data. (Bauguess, 2017.) Another example given by Kaur et al. (2020) shows that the data analytics company FICO developed the Falcon fraud assessment system, which is built on a neural network shell that uses advanced deep learning and artificial intelligence systems. This system is an example of effective data analysis techniques implemented in the banking system. (Kaur et al., 2020.)

AI in payment processing, deposits and account management

The main aims of overseeing the payment process are firstly to ensure the good management of banking business and payment network and secondly, to prevent frauds. For the first part, AI can improve the infrastructure management by making it more efficient through estimating ATM network usage, predicting cash withdrawal amounts per day at specific branches; analysing branches performance, detecting process inefficiencies and supervising the extensive bank's operating network. In some cases, it is also able to give recommendation for branch opening locations. (Königstorfer & Thalmann, 2020.) For example, BBVA used AI to optimize the locations of their new branches and thereby generated €39 million in cost savings in 2015 (Alfaro et al., 2019).

For the second part, AI can recognize potentially fraudulent transactions and money laundering transactions by detecting patterns in large sets of transactions and credit card frauds (Königstorfer & Thalmann, 2020).

In addition, AI can contribute to decrease financing costs for banks by identifying customers that are willing to make long term deposits. Increasing those deposits, will decrease the bank's reliance on outside financing sources. On the other hand, as previously mentioned, AI can predict with high accuracy the amount and branch locations where cash deposits are more likely to take place. This knowledge by AI can help optimize the logistics behind those transactions like cash transports and decrease the related costs. (Königstorfer & Thalmann, 2020). Also, AI is being incorporated into automated teller machine (ATM) with cameras that utilizes machine vision and facial recognition to improve security for customers, as well as predict maintenance and cash demands (Kaur et al., 2020).

Prediction of financial distress

In a central bank context, Machine Learning (ML) is a useful tool for performing financial supervision. ML can recognize issues that require closer review by

putting to use longstanding proven statistical methods to analyse financial data. Also, ML can study literatures and publications related to financial systems from one side and then from another side it can also analyse other literature concerning financial supervision to combine both distinct knowledges and come up with an opinion on what is a healthy financial system and how does supervision oversee it and maintains stability in the system. (Wall, 2018.)

The edge that ML possesses over statistical method is that it is not bound by the theoretical hypothesis defined by statisticians to predict correlation between variables. ML with its deep learning capability allows the data to talk for itself bringing to light valuable relationships that were not identified by the theorists. This is especially useful when analysing for example general economic forces and macroeconomic data whose inputs are so numerous and intertwined that it is difficult for a human to accurately define the correlations. In that sense, ML can reveal previously unknown relationships that improve the understanding of financial markets and institutions. (Wall, 2018.)

Also, unlike traditional statistical methods, ML does not need to convert qualitative data into discrete numbers to perform its analysis. ML is capable of inferring relationship by dealing directly with words thanks to its natural language processing capabilities. (Wall, 2018.) A recent study done by Elhoseny, Metawa, Sztano & El-hasnony (2022) introduces a novel financial distress prediction model called the Adaptive Whale Optimization Algorithm with Deep Learning (AWOA-DL) technique. The AWOA-DL method combines a deep neural network based predictive process with Whale Optimization Algorithm (WOA) which is a nature-inspired metaheuristic algorithm that mimics the hunting behaviour of humpback whales. This AI model aims to accurately predict financial distress and assess the financial health of companies and supporting risk management decisions. (Elhoseny et al., 2022.)

2.4 Challenges of AI implementation

2.4.1 Banks limitations

Infrastructural changes

With all the benefits that AI provide, the implementation of AI does not come without challenges. AI is a broad term and requires several underlying processes and methods to establish it. AI is technological intensive and requires large infrastructure investments for the bank in terms of developing technological process levels as well as the related human trainings and onboarding of new specialized workforce, for the good functioning of AI. (Königstorfer & Thalmann, 2020.) Moreover, besides the time-consuming process of implementing AI, there remains a problem of compatibility with other IT systems. Banks still use outdated IT infrastructure with poor data quality, based on legacy systems that is not compatible nor transferrable nor sufficient to support the implementation of an AI workflow in an organization. (Columbus, 2020.) Part of the banking stubbornness and resistance to change and innovation is due to these antiquated systems still in use in some banks today like the COBOL, a programming language from 1959. And these legacy systems and their natural limitations are among the largest obstacles for the digital transformation of banks. (Vahromovs, 2021.) In addition, the lack of standards to ensure communication between various existing software and AI will create incompatible application programming interfaces (API), which will result in gaps in the operation of AI and its useability with other systems. Therefore, due to these current technical limitations, the consulting firm McKinsey predicts that 40% of AI potential will not be accomplished. (U. Paschen et al., 2020.)

Strategy and planning

Another AI adoption problem is a lack of vision and clarity about the requirements and process implementation related to AI, which is due to insufficient investigation prior to starting the project. Experts believe that an AI project should first start with determining the underlying business problem, by answering the following: (Vasiljeva et al., 2021).

- What is the object of prediction if there is an available opportunity?
- How would the implementation affect the business?
- What data is needed to complete the project? (Vasiljeva et al., 2021).

According to surveys conducted by McKinsey and company less than half of large organizations apply AI initiatives in a meaningful way (McKinsey & Company, 2018). And even though recent advancements in AI-based technologies have demonstrated their effectiveness and practicality by enhancing information analysis speed, delivering more accurate and reliable data outputs, and enabling employees to focus on high-level tasks. A significant number of corporate executives still lack understanding when it comes to strategically leveraging AI in their organizations (Fares, Butt & Lee, 2022). Research conducted by Ransbotham, Kiron, Gerbert and Reeves (2017) revealed that while 85% of business executives recognized AI as a crucial tool for gaining a sustainable competitive advantage, only 39% had a strategic plan in place for its implementation. This lack of knowledge about how to effectively utilize AI hindered their ability to incorporate it into their organizations. (Ransbotham et al. 2017.)

Privacy and sensitive information

There are significant concerns regarding customer privacy and security when it comes to the implementation of AI in banking. Since banks possess sensitive and personal data of their customers, any mishandling or hacking of this data can have severe consequences. The Financial Conduct Authority (FCA), which

is the banking regulator in the UK, supports the adoption of AI in financial services but emphasizes that it should not compromise customer privacy and security. (Lui & Lamb, 2018.)

In banking, as part of compliance plan to enhance the daily business processes, AI can collect phone calls of employees (Königstorfer & Thalmann, 2020). This is considered as misconduct according to the European General Data Protection Regulation (Official Journal of the European Union, 2016). Therefore, banks need to find a balance between compliance management and protecting the privacy of their employees and customers alike. Moreover, extracting behavioural information and lifestyle choices from customers, poses a question as to what extent customer personal data is allowed to be collected and used by banks. (Königstorfer & Thalmann, 2020).

To ensure that banks meet regulatory standards in utilizing AI technology, the FCA promotes the use of 'RegTech', which refers to technology specifically designed to ensure compliance with regulatory obligations. According to Lui & Lamb (2018), there is no dedicated regulation for AI at the moment, and it falls under general regulatory requirements. This loophole in regulation could potentially allow AI to evade regulatory oversight by the FCA. (Lui & Lamb, 2018.)

Regulatory requirements

Nevertheless, it was only in 2018 that the European Union started implementing regulations concerning AI technology and up to this day, there is still confusion, misunderstanding and contradictory information related to those regulations. This has led to the confusion of AI vendors, a slowdown in the development of their technology work and misunderstandings between businesses and AI as to what data should and can be exchanged. These disorientations negatively affected the attitude towards AI. (Vasiljeva et al. 2021.) In addition, the rules generated by AI from data are frequently incomprehensible to humans. This lack of comprehensibility creates a challenge when it comes to explaining AI

decisions, which in turn hampers the practical implementation of AI models, particularly in heavily regulated domains such as finance which demands strict requirements from intelligent systems in order to be acceptable for use. (Weber, Carl & Hinz, 2023).

In credit analysis, the application of deep learning techniques can substantially improve lending decisions, however, the lack of transparency and explainability in these model poses significant obstacles for application (Wall, 2018; Zhang, Wu, Qu & Chen, 2022). This problem is more aggravated especially within the European Union where the enforcement of the General Data Protection Regulation (GDPR) allows every citizen to have the right of a clear clarification of the means and processes that lead to the final decision. (Wall, 2018.)

2.4.2 AI limitations

Lack of emotional exhibition

Despite the advancements in AI technology, there still exists a challenge in the emotional domain as it has not yet reached the level of human emotional intelligence. In the context of wealth management and investment banking, employees and relationship managers have the ability to connect with investors on an emotional level; A territory not yet within the capabilities of AI. So, the role of human employees remains important when dealing with a client's life events and critical situations such as divorce, the death of a parent or a spouse, or losing one's job. A successful workplace would make use of a hybrid model that leverages the strengths of both AI computing power and the emotional intelligence of humans. (Königstorfer & Thalmann, 2020.)

Biased training data

Another challenge is assuring the unbiasedness of data in the system. Therefore, the quality of data fed into the system to train the AI needs to be

carefully considered. The input data can sometimes be incomplete or biased or skewed. This bias can also be the result of human normative biases, like opinions, cultural assumptions, prejudices, and others. (U. Paschen et al., 2020; Alelyani, 2021.) And as AI can be a self-learning model, it improves itself with the data fed into its system and becomes more accurate with every use. Nevertheless, the model is as good as the input data fed into it and the algorithm as good as the data it operates with. Therefore, feeding biased information into the AI system will generate biased outcomes. (Königstorfer & Thalmann, 2020). On the other hand, another problem may arise from the divergence between the training data and the target customers due to temporal bias which is when data evolves over time and is no longer consistent with the input data (Omowole, 2021); or from sampling bias when the input data selected from the population is skewed towards specific sections of the data and does not reflect the population distribution (Omowole, 2021). In that case, it makes the training data unsuitable for the ML model. The drawback appears when data used to train the ML algorithm is not representative of the category of the targeted customers. An example of this issue appears in lending when the data that trained the ML algorithm for credit risk evaluation is dissimilar to the category of customers being considered for the granting of the loan. (Blattner & Nelson, 2021.)

AI skill gap

The rise of adoption of AI in the workplace, created a new wave of specialized labour associated with this phenomenon such as robot designers, engineers, coders, and others. As of 2018, more than one third of the most needed work skills are AI related. Nowadays, the shift is in process, but the market has not adapted yet. In the US, job posting related to AI skills remain open longer than others. This is due to a lack of specialized labour to fill these positions. Moreover, on the other part of the globe, China started implementing AI education in schools and universities. Therefore, the AI skills are the skills of the future. (Soni et al., 2019.)

Ethical problems

As technology is advancing, more and more AI machines are capable of matching and outperforming humans in a range of activities, including banking (Kaur et al., 2020). This will adversely affect workers, economies, and societies as a whole. Some even refers to it as a fourth revolution. Same as in previous industrial revolutions, current technological progress will provoke ethical issues involving labour rights and social inequalities. But this time, the change will not only affect unskilled labour; all types of job are being put into question and revised for better performance. (Elliott, 2023.) Three variables are believed to be a determinant of the immediacy and likelihood of automation in a particular profession: The extent to which a job is routine-based, skill-based and socially interactive (Wright & Schultz, 2018). The ethical concerns that arise question the change in the social fabric of society. For instance, research conducted in 2017 predicted that automation could replace 47% of today's occupations in as little as 10 years. (Frey & Osborne, 2017.)

Nevertheless, the interaction of customers with human employees for instance, will remain particularly important in situations in which AI does not have an adequate answer to customers' questions or when AI recommendations have an unintended negative effect on the lives of customers (Königstorfer & Thalmann, 2020).

In addition, many questions are raised on how machines can be held responsible for their actions, especially in the near future when AI will still not have reached its full potential. And even so, mistakes will be made, who will take the blame for the deficiencies in the programming of the robot or for wrong decisions made by AI? (Lagarde, 2018). The bank needs to reconsider its communication techniques with customers. For example, in the case that AI has rejected a loan request based on algorithmic data that are hard to explain in plain language to customers and lay people alike. (Königstorfer & Thalmann, 2020.)

2.5 Factors affecting AI adoption

Competition and external forces

After discussing some of the areas in which AI has been beneficial for the banking sector, it is evident that AI has become an attractive technology. However, several factors contribute and facilitate AI adoption. Recent environmental shocks, such as the COVID-19 pandemic, have increased interest in AI and led to the emergence of many online businesses that leverage AI applications like virtual assistants and chatbots. (Mhlanga, 2020; Vasiljeva et al., 2021.) Additionally, rising market competition has pushed businesses to adopt AI as a means of gaining a unique competitive advantage and avoiding being surpassed by competitors. This race to the top has shown that as more businesses utilize AI, it becomes increasingly necessary for others to do the same. (Vasiljeva et al., 2021.)

Inter-department collaboration

Another factor that can significantly affect the adoption of AI in internal business processes is the level of interconnectedness and collaboration between the IT department and business representatives within a firm. A greater interest and involvement from the IT department in the business processes, as well as a willingness from business representatives to develop their technology skills, can facilitate the adoption of AI within a business. By improving collaboration between different departments and encouraging employees to develop their technology skills, businesses can ensure a smoother adoption of AI and reap the benefits of this technology. (Vasiljeva et al., 2021.)

Public sentiment

Societal sentiment plays a crucial role in the speed of AI adoption and acceptance. The ease of introducing a new technology into any industry largely depends on the attitude of the public and organizations towards it. (Kelly, S., Kaye, S. A. & Oviedo-Trespalacios, O., 2023). There is a notable variation in the perception of AI among employees working in organizations that have already implemented AI solutions and those working in organizations that do not plan to adopt AI in the foreseeable future (Vasiljeva et al., 2021). Furthermore, the socioeconomic system must be considered when implementing AI to prevent negative externalities and societal backlash that could limit the technology's potential. Therefore, companies must address the challenges of fear and resistance to change to facilitate the adoption of new technologies in the information and communication technology (ICT) domain, including AI. (Vasiljeva et al., 2021.)

Also, Vasiljeva et al. (2021) found that social factors like trust and positive perceptions of AI have a positive impact on its adoption. The below table 3 was created based on the insights from Vasiljeva et al. (2021) concerning the factors that influence the acceptance and rejection of AI in various contexts:

Table 3. Factors towards acceptance and rejection of AI (Vasiljeva et al., 2021).

Factors towards acceptance of AI	Factors towards rejection of AI
High trust level in the new technology	Low trust level in the new technology
Optimism as useful tool for performance augmentation	Fear of lay-off due to AI
Tech-savvy competencies	Unfamiliarity with AI technology
International companies	Local companies

Factors towards acceptance of AI	Factors towards rejection of AI
Previous experience with automatized systems	No previous experience with automatized systems
Existing AI implementation	Absence of AI implementation

Table 3 shows several factors that positively and negatively influence AI adoption (Vasiljeva et al., 2021).

Different societies have varying attitudes towards AI, which are influenced by factors such as education level, interest, and familiarity with the technology. It is possible that an individual's lack of interest or indifference towards AI may stem from a lack of knowledge about its applications, rather than simply nonchalance. (Vasiljeva et al., 2021.) Moreover, employees' attitudes towards AI differ depending on whether they are currently using it or not. Experts argue that the attitude towards workplace digitalization depends on employees' previous experience with automation systems, as well as management's involvement in providing support to employees, such as encouraging them to accept the new technology and assuring them about job stability and continuity while clarifying their new role in the workplace. (Vasiljeva et al., 2021.)

3 Research methodology

3.1 Research methods

3.1.1 Presentation

The purpose of this second part is answering the research questions posed in the beginning of the thesis. This is done by analysing interviews from experts to get to know from a practical point of view, the applications and impact of AI in banking and investigating how artificial intelligence is changing the banking industry. Moreover, this part will also include a study of the sentiment analysis of the people involved with banks, namely stakeholders, such as bankers, managers, regulators, investors, employees, suppliers, etc., in order to get their opinion on the future of AI in banking.

This part is accomplished in two ways:

The 1st method of analysis was done by following the method of qualitative content analysis which is an inductive approach that involves analysing qualitative data to identify themes, categories, or concepts that emerge from the data (Lindgren et al., 2020; Miles & Huberman, 1994; Thomas, 2006). This was done by examining the discussions taken place on episodes of a podcast called “AI in banking” (later, the podcast name was changed to “AI in Financial Services Podcast”) which is one of the podcasts produced by a market research and publishing company named Emerj.com (Faggella, 2019-present). The discussions in these podcast episodes revolve around many subjects related to the application, adoption and expectation of AI in banking and financial sector; And they include guests from reputable banks and companies like HSBC, Citi Bank, Visa and others. Each week Emerj Founder Daniel Faggella interviews top experts, and each episode draws from the unique perspective of the guests on the show.

In addition to the above, two private interviews were conducted by the researcher - writer of this thesis - with two anonymous persons involved directly and indirectly in the banking sector. The first is a compliance officer at a bank in Lebanon and the second is a Customer Manager at London Stock Exchange Group.

The aim of this part is analysing the discussions and to hear from the experts about the applications of AI in banking that will confirm or even add to what was mentioned in the literature review part.

The 2nd method of analysis is a continuity for the 1st method. It consists of making use of the Azure Machine Learning Model available in Microsoft excel to extract the sentiment analysis of selected interviewees by running their discussion into the model and assigning a sentiment to each sentence or idea they make regarding AI in banking. The purpose of conducting a sentiment analysis report is to capture the opinions, outlook perception, hunch and sentiments of the interviewees towards the future role of AI in banking. This will allow to have an idea about which areas of AI in banking invoke positive, neutral or negative sentiment. In addition, it will shed light on the readiness of the banking sector to accept and adopt AI by evaluating the attitude of stakeholders towards it.

Besides, the use of the Azure Machine Learning model, will also allow for an examination of the effectiveness and accuracy of the said AI model.

3.1.2 Qualitative analysis methodology

The key to successful qualitative analysis is being consistent and systematic throughout the whole process and the research process consisted of executing the below steps in order:

Choosing the interviews to be analysed based on specific selection criteria and the guest's relevancy for the research in terms of experience and

involvement with AI and banking. Detailed explanation of the data selected is presented in the next chapter 3.2 Data collection.

Transcribing the interviews from audio to text with the aid MS Word Dictate function. Then, correcting the transcription by proofreading the transcribed text and comparing it to the audio interview. Following that, the researcher cleaned the text data by removing duplicate words, typos, confused words and other irrelevant information. According to Ritchie and Lewis (2003), the data used in qualitative research, often referred to as qualitative raw data has many forms and most commonly includes verbatim transcripts of interviews, discussions, audiotapes, etc. that have many details and intertwined content that is hard to analyse without proper sorting and organization. (Ritchie & Lewis, 2003). Therefore, the next stage of organizing the data was crucial to the analysis of the results.

Organizing the data by categorizing and assigning each sentence to a theme/category or subtheme/subcategory.

This inductive analysis approach used to analyse the interviews in this research allowed research findings to emerge naturally from raw data without being limited by preconceived notions. According to Thomas (2006), it is bottom-up approach to data analysis that is often used in exploratory research, when the researcher aims to gain a deeper understanding of the phenomenon under study and it allows for the discovery of new insights and ideas that were not previously considered (Thomas, 2006). In the case of this research, the bottom-up approach consisted of coding the data, which is a process of abstracting the information, whereby the researcher labels condensed meaning units with descriptive codes that are closely related to the original text (Lindgren et al., 2020). Therefore, the researcher organized the content from the podcast interviews into Excel by scrutinizing each sentence or collection of sentences that constitute an idea, and then assigning each to a category or theme. After having grouped the ideas into categories, the researcher reviewed the ideas and reconsidered the classification several times.

After reviewing the data, the researcher had to identify repeating ideas and recurring themes to group them under a broader category or main theme that captures the essence of the subject being conveyed (Ritchie & Lewis, 2003). These codes are then combined with other codes containing similar content to form sub-categories and sub-themes. Next, these sub-elements are combined to create higher-level categories and themes and further organized into main categories, and themes. (Kyngäs, 2020).

Open codes → Sub-categories and sub-themes → Main categories and themes.

Table 4. Example of coding and classification process.

Open codes	Sub-category	Main category
<i>"I think AI is going to touch more areas of the bank than people can at the moment believe"</i>	AI future adoption	Future of banking

In the case where a sentence contains more than one idea, it was divided into 2 sections to clearly delimitate the object the sentiment is assigned to.

For example, in the sentence, "the food was good, but the service was not so much", tackles two different topics which are food quality and service quality. Hence, the organization of the data consists of splitting the sentence into two: The food was good. The service was bad; Then, analysing each part separately. In the context of this research an example was the sentence "Banks are going to start learning how to apply AI repeatably, but we are not there yet and where are today there is a lot of uncertainty". Several topics were included in that sentence. The first part "Banks are going to start learning how to apply AI repeatably" is related to AI future adoption, while the second part "we are not there yet and where we are today there is a lot of uncertainty" is related to current AI capability.

In addition, each of the codes extracted from the data were reformulated and explained to convey the core ideas in a concise summary.

This was necessary because the original sentences as spoken by the interviewees, although more authentic, consist of detached phrases from a conversation which may be difficult for the reader to comprehend without the context of the entire discussion. The following example illustrates the summarization:

Table 5. Example of data summary in coding.

Original sentence	Core idea summary
<i>“My feeling is it is very, very hard to create some kind of sustainable differentiation. Obviously, you can come up with some things which will distinguish your bank against ours for the time being, but nothing will prevent other banks in most of these cases, to catch up with you. It will take him a while, but frankly I don't see what can you do which you will be able to hold on for many, many years.”</i>	No long-term sustainable differentiation or competitive edge for banks.
<i>“I feel like the competition is not only banks versus banks, but also banks versus startups and you know frankly large companies like the Google amazons and facebooks of the world. so I think getting a handle on that is really really important.”</i>	Competition will be banks vs Fintechs startups vs Big Techs

Moreover, during this phase, it became apparent that certain categories were overlapping, and some codes were appearing under more than one category. As a result, the categories were reconsidered, and this led to some being merged and others deleted altogether. For example, one of the interviewees mentioned *“I think AI is going to touch more areas of the bank than people can at the moment believe”*, in other words, it can be understood as “I expect that AI will be widely adopted in banking in the future.” This sentence could fall under the category of “AI expectation” as well as “AI future adoption”. Those two categories overlap in that case, and it was noticed that the category of “AI expectation” was overlapping with other categories that expressed opinion on the future. The reasoning is that any phrase that expresses expectation is aimed at a certain subject, like expectation to AI future adoption or expectation to AI future applications etc. Therefore, it was deemed appropriate to remove the categories of “AI expectation” and “AI aspiration”. The following tables illustrates how the categories of “AI expectation” and “AI aspiration” were merged with other categories.

Table 6. Example of category review and consolidation.

Before review	After review
AI expectation & AI future adoption	AI future adoption
AI aspiration & AI future application	AI future application

Moreover, other challenges were faced as well with overlapping themes and categories due to the topics discussed in the interviews being related and interconnected. Looking into the future of AI in banking through the lens of the interviews, several themes emerged that caused challenges in classifying them due to their interconnectedness, like “AI application” and “AI capability”. AI capability refers to the scientific ability of an AI system to perform certain tasks or functions. Examples of AI capability are its ability to understand and process natural language, recognize images, use machine learning algorithm, conduct

predictive analysis, etc. While the AI application refers to specific use cases where these abilities are applied to achieve specific goals or solve particular problems. For example, AI applications can include fraud detection, credit scoring, customer service chatbots, and risk management, among others. It is easy to see the interconnectedness of the two expressions and how one engenders the other. Hence, it is challenging to always understand the true meaning intended versus the actual meaning conveyed by the interviewee when the two expressions, AI application and capability, were used interchangeably. Therefore, to facilitate the analysis, the themes of “AI application” and “AI capability” were analysed as one group “AI applications and capabilities”.

Another challenge arose from the interconnected expressions of “AI future application and capability in banking” on one hand and “AI future adoption” on the other. In qualitative research, understanding the nuances of participants' statements is crucial in accurately interpreting their meaning. When interviewees expressed their ideas about how AI could be used in banking, it was not immediately evident whether they were indicating a specific area of AI adoption or merely suggesting potential uses of AI in banking. The reason is that opinions about AI's future applications in banking indirectly imply an expectation for their future adoption. Therefore, it was challenging to accurately determine the interviewees' stance on AI future adoption. Nonetheless, for the sake of the analysis and to be able to delimitate between statements, the category of “AI future adoption in banking” includes only the statements that explicitly and clearly indicate opinion on AI future adoption.

Another example was the categories of AI current applications and AI current adoption. Generally, when interviewees discuss current areas of AI application in banking, it can be assumed that these applications have already been adopted. Therefore, statements pertaining to AI current applications and capabilities can be classified under the category of AI current adoption in banking, unless the interviewee explicitly states that an AI application is available and technically feasible but not yet implemented in banking.

In addition, the category “AI adoption challenges in banking” was classified under “AI adoption”, but one could argue that it could also be a subcategory of “Bank challenges”. This is because the challenges related to AI adoption are not unique to AI itself, but rather stem from broader challenges faced by banks in adopting new technologies and implementing them effectively in their operations.

3.1.3 Sentiment analysis methodology

After having organized and classified the data into categories. The next phase consisted of **conducting a sentiment analysis**. The latter is a field of natural language processing that aims to identify and extract subjective information from text data, such as opinions, attitudes, emotions and feelings of the public opinion about a particular topic. It involves analysing and classifying the polarity of text data as positive, negative, or neutral. (Pandya & Mehta, 2020.) The application of the sentiment analysis can be document-based to analyse general sentiment from an entire document; sentence-based and aspect-based which is involves identifying the sentiment associated with specific aspects or entities within a document or sentence. (Pandya & Mehta, 2020; Liu, 2012.) The sentiment analysis conducted as part of this thesis applied a sentence-based approach. The process of sentiment analysis involves sentence division into subjective and objective classification. Then processing of data can be done through machine learning techniques or lexicon-based approach. (Pandya & Mehta, 2020.) The following table illustrates the two different techniques of supervised and unsupervised in conducting sentiment analysis, as well as the lexicon-based techniques.

Table 7. Machine learning techniques (modified from Pandya & Mehta (2020, p. 604)).

Supervised	Unsupervised
Linear classifier (Support Vector Machines or neural networks)	sentiment lexicons (Azure Machine Learning)
Probabilistic classifier (Maximum Entropy or Bayesian network or Naive Bayes)	grammatical analysis
Decision Tree classifier	syntactic patterns

Table 8. Lexicon-based techniques (modified from Pandya & Mehta (2020, p. 604)).

Lexicon based approach	
Dictionary based	Corpus based
Statistical or semantic	-

Tables 7 and 8 showcases the different techniques applied in Machine learning approach and Lexicon-based approach for conducting sentiment analysis.

In the case of this thesis, the sentiment analysis was conducted through Excel by running the interviewees' comments sentence-by-sentence into the Azure Machine Learning Model, while ignoring the host's comments. This approach allowed to capture only the interviewees' opinions and sentiments. The host's

comments and arguments were not analysed to prevent any inconsistencies in the sentiment analysis.

The sentiment analysis generated by Azure machine learning returned a range of sentiments ranging from negative to neutral to positive, along with an assigned score ranging between 0 and 1 where 0 indicates a most negative sentiment, 1 indicates a most positive sentiment, and 0.5 represents a neutral sentiment.

The following stage consisted of **Analysing the results** by evaluating the sentiments in each category or theme to know which codes evoke certain sentiments and what is the overall sentiment towards a specific theme. For example, studying the overall sentiment towards future AI adoption in banking and which statements evoked the most negative and positive sentiments.

The final stage involved **presenting the results** by associating the evoked sentiment with each code in each category. Additionally, a table was created to display the distribution and percentage of each sentiment per subtheme and subcategory.

Overview of Azure Machine Learning

Microsoft provides a Sentiment Analysis tool within Excel, known as Azure Machine Learning, which is a cloud-based platform developed by Microsoft and provides tools and services for building, training, and deploying machine learning models. Previously, sentiment analysis required a supervised learning algorithm that was human-based to create a dictionary of positive and negative words. For that reason, a sample of around 5% of the total statements had to be manually examined and classified by a human, to be set as a reference criterion to be followed by the system classifying the sentiment ("Excel: Sentiment Analysis," 2016).

On the other hand, Excel and the Azure add-in utilize natural language processing algorithm and a generic dictionary containing positive and negative

words (Vela, 2022). The Azure excel add-in uses the Multi Perspective Question Answering (MPQA) Subjectivity Lexicon, which is a ready-to-use general purpose dictionary with 5,097 negative and 2,533 positive words pre-assigned, each allocated a strong or weak polarity (“Excel: Sentiment Analysis,” 2016).

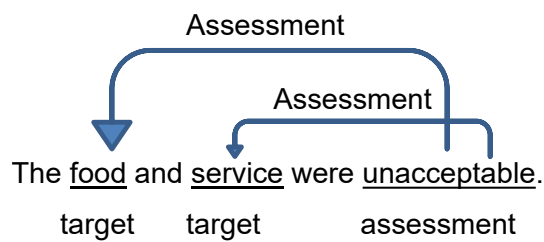


Figure 3. Illustration of NLP in Azure Machine Learning (adopted from Microsoft (2023c)).

Table 9. Sentiment generated from NLP (adopted from Microsoft (2023c)).

Opinion	
Target	Assessment
Food	Unacceptable (Negative)
Service	Unacceptable (Negative)

The Azure model used for this research is an excel add-in designed to be user-friendly and ready to use without the need for any programming or technical skills. It provides a simple interface within Excel that allows users to perform sentiment analysis on text data.

Azure Machine Learning is designed to be highly scalable and flexible, allowing for developers to modify the training data and algorithms as needed, nevertheless, it is worth mentioning that in the case of this research, the Azure

Model was used only with the standard (not customized) language service features built on pre-trained data within the Azure Excel add-in.

3.2 Data collection

This section presents the discussions that occurred in multiple interviews on the podcast “AI in banking” (also referred to as "AI in Financial Services"), which features AI researcher and host Daniel Faggella who interviews various stakeholders in the banking sector. His guests are very diverse, but they share in common their competence and knowledge about AI and involvement in the financial and banking sector. As of 17 Feb. 2023, the podcast had 89 episodes of interviews with guests discussing various aspects of AI related to banking and financial services. Given the large number of episodes and guests interviewed on the podcast, only a selected few were considered for this research. The selection criteria for each interview can be seen in the table below, along with an explanation as to whether sentiment analysis was conducted or not on certain interviews.

Table 10. Data selection criteria.

Interviewee	Basis of selection	Sentiment Analysis
Ian Wilson (Faggella, 2019 July 1d).	Relevant job position, Head of Artificial Intelligence at HSBC	Yes, expresses opinion on how banks are experimenting with AI and how banks can deliver value with AI in the coming years.

Interviewee	Basis of selection	Sentiment Analysis
Dr. Nishant Shandra (Faggella, 2019 July 1b).	Relevant education and job position, PhD in machine learning, senior director at Visa at the time of the interview. Currently, senior director at Azure AI in Microsoft	Yes, expresses opinion about how AI will be incorporated in banking.
Lee Smallwood (Faggella, 2019 July 1a).	Relevant job position, COO at Citi Bank.	Yes, expresses opinion about where banking is heading with AI
Sergey Gribov (Faggella, 2019 July 1c).	Relevant experience being an entrepreneur and founder of many tech startups in the field of financial technology and Artificial Intelligence	Yes, expresses opinions about the market change that is happening in the financial sector and how AI plays a major role in the shifting of power from banks to new Fintech firms
Gunnar Carlsson (Faggella, 2019 July 9).	Co-founder of Ayasdi, a well-known Anti money laundering AI software vendor in the banking space that has a large experience with banks and financial institutions	Yes, expresses his views about where AI is heading in the realm of banking and describes the areas where AI will bring improvements to the banks processes

Interviewee	Basis of selection	Sentiment Analysis
Adam Hunt (Faggella, 2019 July 16).	CTO and chief data scientist at RiskIQ, a subsidiary of Microsoft that is specialized in digital threat management solutions. The interview discusses AI in handling cybersecurity in banking and financial services.	Yes, expresses personal opinion about the future of AI and its potential benefits in the areas of security and fraud prevention in banking.
Ohad Samet (Faggella, 2019 July 22).	CEO of TrueAccord, recovery and collections platform powered by machine learning that is used in banks and financial institutions. Previous experience in the Nordic payment company Klarna and various other roles in machine learning for financial services.	Yes, expresses his personal opinion and expectation about which area of AI will be more prominent in the future of banking. Gives example from personal experience about Wells Fargo, Klarna and TrueAccord.
Owen Hall (Faggella, 2019 July 29).	CEO of Heliocor, a regulatory, technology and consulting company specialized in fraud detection and prevention. Relevant job experience. Owen mentions in the interview having 25 years of experience working for banks and in banks.	Yes, the interview includes personal views and expectations on the uses of AI in banking. As well, Owen expresses his opinions about what will give banks advantages over the competition in the future.

Interviewee	Basis of selection	Sentiment Analysis
Sebastien De Brouwer (Faggella, 2019 September 24).	Relevant job position, as Chief Policy Officer at European Banking Federation	Yes, expresses opinion and expectations of how AI will affect the banking sector, and how regulators should deal with the new AI technology seeping its way in banking.
Ritchie Ng (Faggella, 2019 December 30).	Chief AI officer at Ensemble Capital, a quantitative hedge fund that uses AI to trade financial options. The interview discusses unique application of AI in banking, for trading and capital management, as well as hiring AI scientists in banking.	No, talks objectively about the applications of AI in banking and trading.
Peter Voss (Faggella, 2021 June 1).	Founder of Aigo.ai, one of the most advanced natural language interaction platforms that implements a brain-like cognitive architecture. The interview discusses unique use cases of AI chatbots in banking, along with specific challenges related to banking.	Yes, expresses personal opinions about the deficiency about current chatbots and the potential of AI in the future, by emphasizing the importance of conversational AI and citing examples from his own personal experience.

Interviewee	Basis of selection	Sentiment Analysis
Christophe Makni (Faggella, 2021 August 1).	Relevant work experience as managing consultant for lean AI and automation at Basler Kantonalbank in Basel Switzerland	No, talks objectively about the process of finding new AI opportunities in the financial services space including banks.
Greg Council (Faggella, 2021 November 1).	Relevant work experience, VP of product management at Parascript, an AI vendor that serves many sectors including banking and finance	No, the discussion does not include personal opinions. The interview discusses an AI use case and the process of implementing AI to automate the paperwork heavy process of lending
Greg Council (Faggella, 2021 December 1).	Relevant work experience, VP of product management at Parascript, an AI vendor that serves many sectors including banking and finance	No, the discussion does not include personal opinions. The interview discusses a specific use case of AI in banking, where AI fits in the process of check payments, which is an exclusive banking mean of payment.

Interviewee	Basis of selection	Sentiment Analysis
Dr. Scott Nowson (Faggella, 2022 July 1).	Relevant job position, Artificial Intelligence Leader at PwC, a global consulting firm whose reputation precedes it and deals with financial institutions and banks	No, the discussion does not include personal opinions. The interview discusses the process of implementing AI in financial services organizations to detect anti money laundering and financial fraud.
Anti-Money Laundering and compliance officer in a bank in Lebanon	Relevant job position in banking, as well as relevant department of work where AI applications are very prominent	Yes, the interview questions were formulated to invoke the sentiment of the interviewee concerning AI in banking
Customer Manager at London Stock Exchange Group	The interviewee is a key person in the sales process of financial research platforms that includes AI capabilities and is targeted for banks, and anyone involved in finance and market research. His insight about his customers' attitude, as well as his, towards the AI smart features in his products are valuable to this research and help understand bankers' impression and perspective towards AI	Yes, the interview questions were formulated to invoke the sentiment of the interviewee concerning AI in banking

3.3 Data analysis

After having coded, abstracted, and classified the text by themes and categories, the data analysis allowed for an inferred structure to take shape based on the recurring themes mentioned in the interviews. And, it became clear that the recurring topics throughout the interviews can be connected according to a temporal classification (Figure 4), which divides the topics discussed about banking between present and future. Additionally, the connection between topics can also be viewed through a hierarchical classification (Figure 5 and 6), where the main topic is placed at the top of the tree and subtopics are arranged underneath it based on their relevance and relationship to the main topic.

For example, each sentence from the discussion was assigned to a sub-category who in turn was assigned to a main category and then all categories converged under the main topic, subject of the research.

For example, the sentence: *“I think historically there has been a pretty broad and rudimentary sort of set of financial options available in credit analysis.”* [Lee Smallwood]

→ Old business methods (Sub-category) → Bank challenges (Main category)

This method was applied to all sentences in the interviews to group them all in the tree tables shown in figure 5 and 6.

However, the figure 4 was important in visualizing the present state of the banking system with current AI adoption and capabilities to compare it to the future expectations and aspiration for future AI adoption as well as banks future competitiveness. Hence, figure 4 was important when comparing the sentiment analysis of current AI applications and future AI applications. It allowed to see the progression over time of bank challenges and AI adoption. On the other hand, figure 5 and 6 were important for classifying the data, in the hierarchical tree table and make associations between categories, subcategories and codes.

Temporal classification:

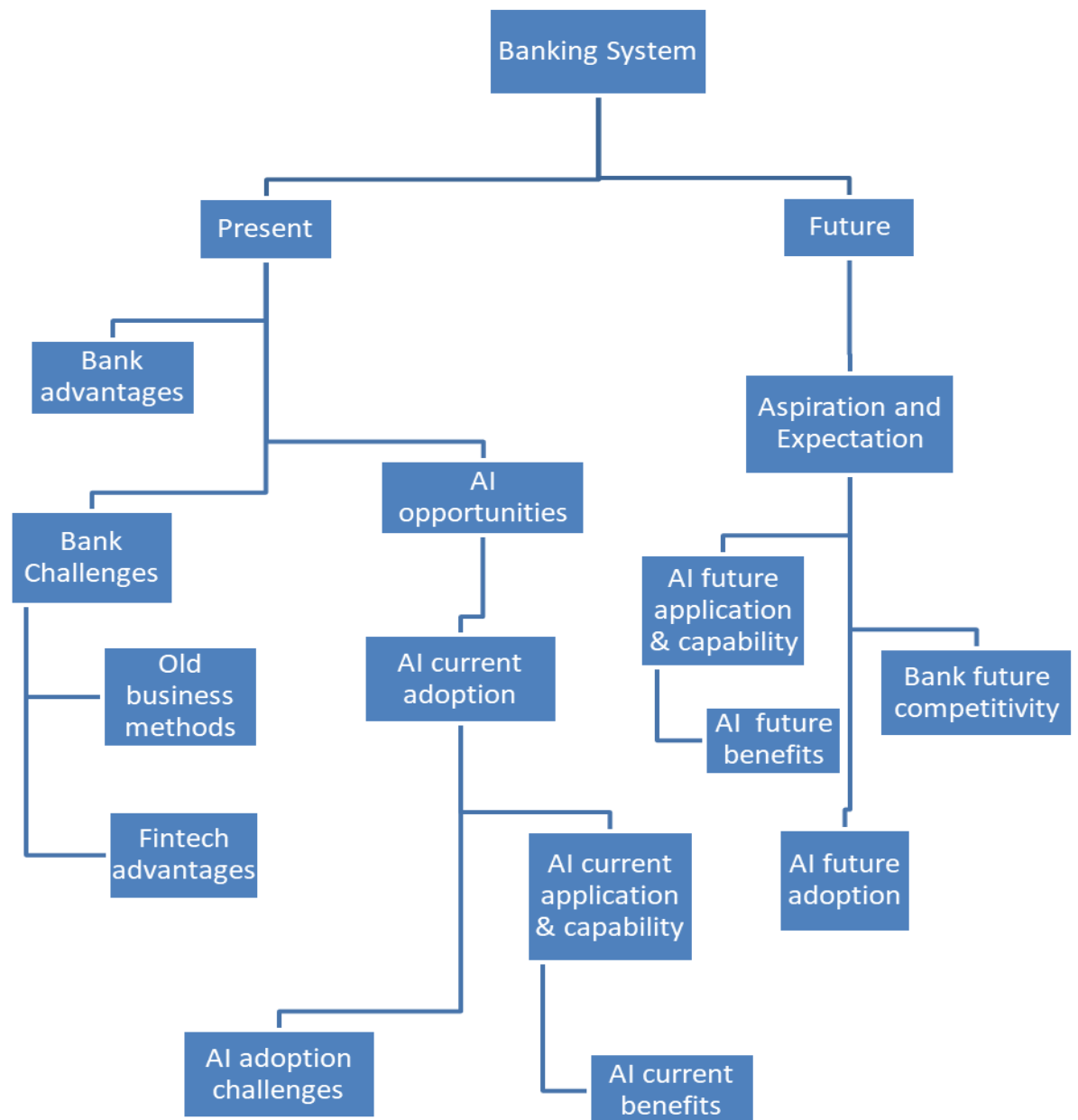


Figure 4. Banking system current state and future outlook.

Hierarchical Classification:

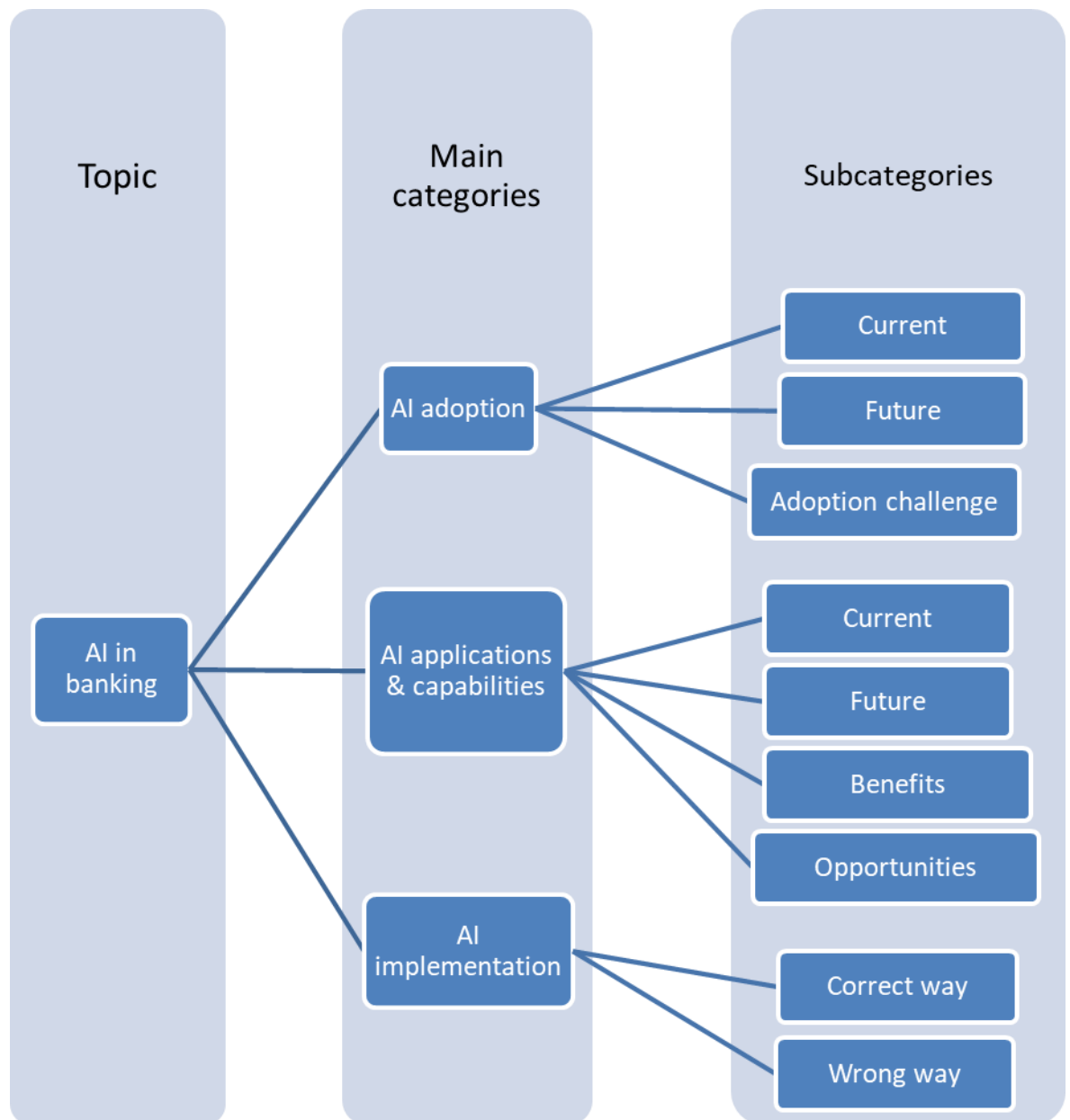


Figure 5. AI in banking hierarchical classification.

It is important to see the relationship between Figure 5 and 6 and understand how figure 5 is part of figure 6. It shows that AI in banking is part of the factors that contribute to the future competitiveness of banking.

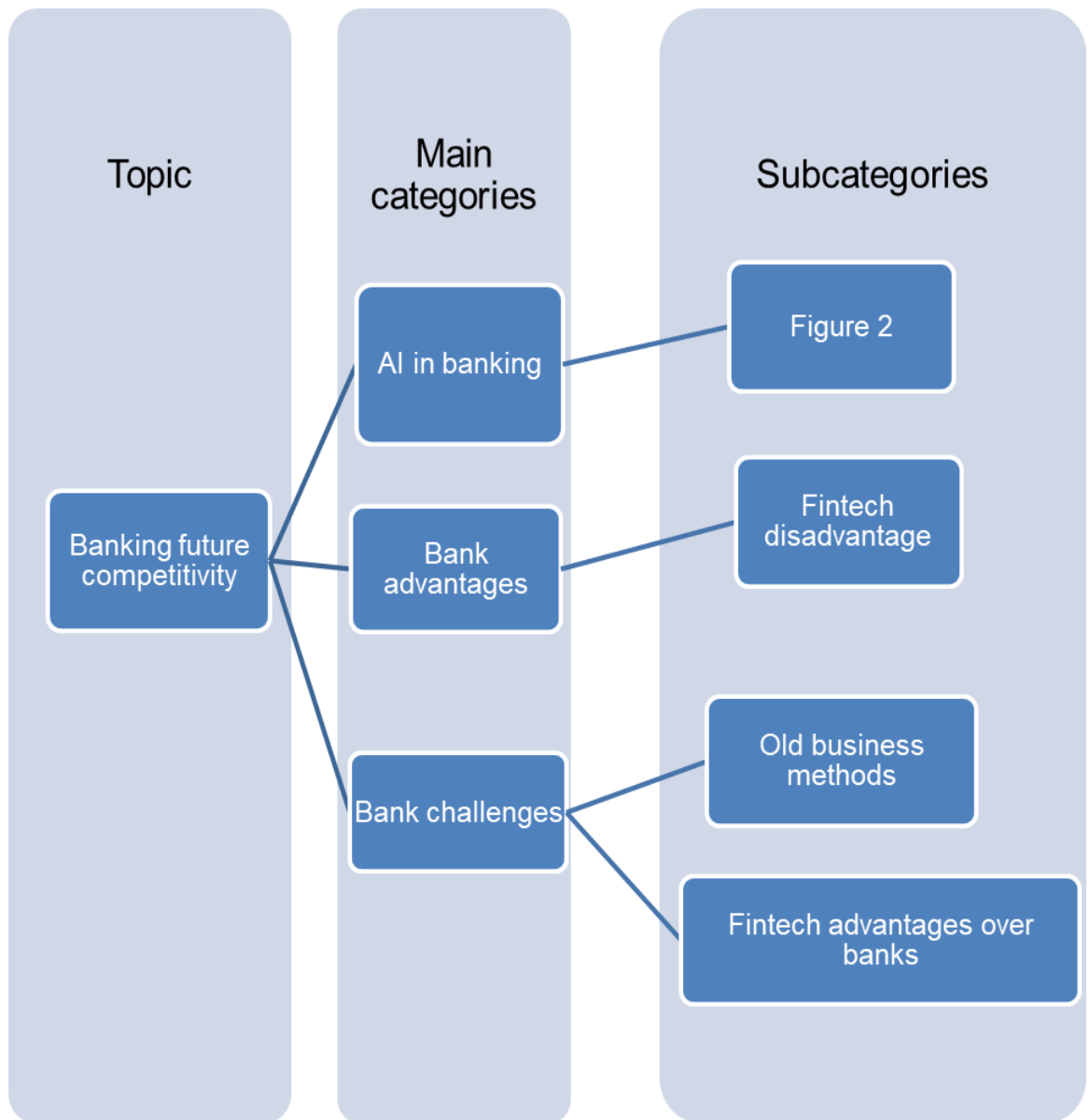


Figure 6. Banking future competitiveness hierarchical classification.

4 Results

4.1 Areas of application of AI in banking

4.1.1 AI applications

AI assisted decision-making

AI in banking encompasses the utilization of computer systems to execute human decisions. While this can involve simple tasks like using an Excel sheet with event statements, the true power of AI lies in its ability to replicate complex human decision-making processes through advanced machine learning techniques. In capital markets or trading businesses, numerous factors influence traders' decision-making processes. However, automating these processes was not as feasible a decade ago compared to the present time. The advancement of compute power and the abundance of available data have significantly enhanced the potential for automation. [Lee Smallwood.]

A trader who has been using traditional statistical methods might be looking for new ways to up her game and improve her performance. She could consult the AI team to develop together a new algorithm around her habits that will automate some of the repetitive functions or maybe create a new machine learning model with innovative ways of solving her existing tasks. [Ritchie Ng.]

Customer Prediction

AI is being used in banking to anticipate foreign exchange demand from clients and understand their behaviour in order to cross-sell them more products and acquire foreign currencies at better rates and increase profitability. By leveraging AI, banks can anticipate their clients' next moves and prepare for them with educated guesses and cost savings. On the other hand, this AI capability of predicting money and currency withdrawals, can help the bank prepare their currency reserves in advance and decrease unaccounted risks. [Ritchie Ng.]

These insights were not possible in the past without AI, because the banks have a large number of clients and could not go manually into each client's cash flow to try to make sense out of it. However, now with deep learning, AI can find clusters of clients with similar behaviour and target them with products specifically designed for them. [Ritchie Ng.]

Also, the application of AI prediction capability involves identifying customers who may be dissatisfied or likely to leave the bank, thereby causing churn. This presents a significant data challenge that is difficult to address manually. However, by leveraging AI, we can narrow down our focus to individuals at high risk of exiting the relationship. In addition, another area of application for AI is sorting the data sets of complaints and understanding trends of complaints to handle them rapidly and avoid any exacerbation of the problems. [Gunnar Carlsson.]

AI Market Research capability

AI is slowly making its way into the dealing room of banks researching stocks and market movements [Ritchie Ng].

An example of AI Market Research capability is the product "Refinitiv AI Alerts" offered by London Stock Exchange Group which is an intelligent assistant software that employs AI to research market data and provide personalized, timely and actionable market insights for financial professionals in a world of exploding data [Customer Manager at London Stock Exchange Group].

AI will play a big role in helping financial markets sift through large quantities of data, to prioritize, categorize and rank newsworthy information to get streamlined in a recommendation fashion to the readers, making AI a big opportunity in the financial news market [Lee Smallwood].

AI personal assistant

Our clients value the smart features Refinitiv AI Alerts offers because behind the scenes it evaluates their behavior, meetings and contacts to provide daily updates of news content, breaking news, and pre-meeting briefings through Microsoft Teams for their most frequent customer interactions. This includes the Significant Development feed from Reuters news. [Customer Manager at London Stock Exchange Group.]

Companies and banks aspire to create a hyper personalized assistant that can help people in their everyday lives and not just perform simple tasks like paying bills and resetting passwords [Peter Voss].

Know Your Customer (KYC)

A crucial area of AI application is in customer intelligence. Customer intelligence entails understanding and categorizing customers, gaining insights into their needs, preferences, behaviours and their taxonomy, and using that knowledge to drive targeted actions. Customer intelligence can take on different forms and serve multiple purposes. Firstly, it enables banks to identify the most suitable products or services for specific customer segments. By analysing customer data, banks can tailor their offerings to meet the unique requirements of different customer groups, enhancing customer satisfaction and engagement. Also, AI-powered systems can analyse customer behaviour patterns and identify signals of dissatisfaction. [Gunnar Carlsson.]

The application of unsupervised learning techniques in segmentation involves identifying and understanding different groups within a customer population [Gunnar Carlsson].

AI will be used to enhance customer understanding [Owen Hall].

There are numerous unexplored areas that have not traditionally been recognized as services within banks. AI is poised to touch various processes

within a bank, including customer profiling, to gain a deeper understanding of individual customers. [Owen Hall].

Customized experience

The company TrueAccord uses AI algorithms to offer personalized payment solutions to consumers in debt, which has provided a delightful experience that makes customers want to do more business with the company [Ohad Samet].

Wells Fargo ATM can remember past transactions and predict future ones, making it more convenient to customers and builds into the overall experience of how customers perceive Wells Fargo bank [Ohad Samet].

AI will play a significant role in various aspects of the banking industry, particularly in understanding and profiling new customers, personalized product selection, and offering valuable advice. These areas include providing guidance and recommendations to customers who may not have previously received personalized advice due to their smaller financial portfolios and who traditionally wouldn't be considered a big enough customer for the bank to actually justify getting that level of advice. However, AI can assist these customers in suggesting suitable financial strategies, investment opportunities, and cost-saving measures. [Owen Hall.]

First of all, let me say that we strongly believe that AI will have indeed a transformative effect on the banking industry and actually may impact most of the activities in banks. One of the most significant areas of AI impact is the potential to enhance the customer experience. [Sebastien De Brouwer.]

The banks who will succeed are the banks who will have a better interactivity with their clients. This interactivity allows for the delivery of contextualized offerings, targeted products, and personalized experiences based on customer data. Additionally, many banks are exploring the use of AI in providing investment advice and recommendations. [Sebastien De Brouwer.]

Credit scoring

Fintech are getting smarter in the way they look at someone's credit risk profile. AI will provide new capabilities for banks in assessing the creditworthiness of clients with no history, or for student's loans by considering new criterias like university major and the university rank, to assess student loan applications. Banks are also getting more creative with the technology in terms of thinking about credit risk and executing on a very differentiated product and experience. [Lee Smallwood.]

Similar examples were given on how AI is used in Asia to assess the creditworthiness of customers who may not have a long credit history or an extensive track record. Trying to assess how good a bet someone might be based on a lot of other features that come out is a prime artificial intelligence thing. It is certainly in existence now but the ability to use indirect ways of assessing risk is going to grow tremendously. [Gunnar Carlsson.]

There are a lot of applications for AI which would provide better credit worthiness assessment [Sebastien De Brouwer].

AI will bring improvements to the banks processes by providing faster risk assessments and alternative ways of assessing risks that are impossible without AI, like evaluating credit risk on individuals with no track record [Sergey Gribov].

The current most prominent areas where AI is being used in banking is credit analytics and front analytics and these are mostly seen in Asia with Alibaba leading the way [Ritchie Ng].

Also, any sort of consumer lending, like mortgage for example, is a great example where the adoption of digital technology has been really effective in sort of changing the landscape of finance [Lee Smallwood].

Mortgage lending

In the mortgage lending space, AI presents an opportunity to streamline this workflow in mortgage lending. Traditional document automation allows AI to

collect information from standardized document types, such as forms, facilitating searches and data extraction. However, AI can go further by employing advanced machine learning techniques, specifically leveraging deep learning elements. For instance, AI can handle more complex tasks that involve significant variability and make decisions on the correctness of documents, indicating if they require further review. [Greg Council.]

Check payment

AI is able to automate parts of the check payment processes. One area in which AI is being utilized for check verification is signature verification, which was previously a task performed by humans. It can analyse the check image to scan for small details that could point to a counterfeit check. Now instead of the teller going through thousands of checks that are accurate and correctly written, the teller can now focus on the checks that are flagged as fraudulent by the AI and analyse them in more detail. [Greg Council.]

Enhanced business processes:

There are a lot of applications for AI which help better manage the bank, better manage risk in a bank and improve security in a bank [Sebastien De Brouwer].

AI will be used to automate manual processes and onboard customers more efficiently, including transaction automation [Owen Hall].

Early phases of AI adoption in banking are all about improving current business processes and being able to build competence and improve systems rather than necessarily having to rethink banking wholeheartedly [Ian Wilson].

AI allows for better fraud management. Using AI methods, even if credit card issuance increases 20 or 30%, the number of frauds does not increase, due to AI having better prediction capability without inflicting bigger fraud numbers.

Thanks to AI, there are system which allows to analyse more than 200 different data sources on a person who is submitting the application. [Sergey Gribov.]

In commercial banking, current practices involve manually analysing Excel sheets extracted from their data lakes to prioritize potential companies to pursue. Bankers might identify a company that already trades with 50 of their existing customers, which seems promising. However, this process is time-consuming and reliant on manual effort using Excel. However, bankers envision an AI-powered application that addresses this challenge and automates the prioritization process. With such AI application, bankers could start their day by opening the application, which would leverage advanced algorithms to extract and analyse data from the entire corpus of the bank. The application would then identify and present a list of top companies that are most likely to generate valuable business opportunities. This AI-powered solution would eliminate the manual effort of sifting through vast amounts of data. [Ian Wilson.]

AI is also showing a massive improvement in terms of user interface and removing a lot of old school style forms, paper and fax and other similar forms. AI can help us to really sift through the massive amounts of data that are continuing to be collected in the sector. [Lee Smallwood].

Customer interaction and chatbots

In resetting passwords and re-establishing client credentials, the procedure is methodological and does not include open-ended questions. Therefore, a narrow-focused chatbot can be applied. [Peter Voss.]

Chatbots should provide personalized recommendations based on clients' transaction history and preferences. Moreover, chatbots should be capable of understanding context and remember past conversations to give meaningful insights. The future hopes to see chatbots reaching more sophisticated technology levels to be capable of detect customers stuck on pages and intervene automatically to address them. [Peter Voss.]

Anti Money Laundering

A significant application of AI in banking is in combating financial crimes, particularly money laundering, although its potential extends to various other types of crimes as well. The complexity lies in analysing vast amounts of data to assess the risk associated with customer behaviour solely based on transaction analysis and "know your customer" information. [Gunnar Carlsson.]

The problem of Anti money Laundering (AML) is a needle in a haystack type of situation, where a very small percentage of transactions are actually fraudulent yet finding them is very challenging given the large number of transactions to be evaluated. Current AI level cannot accurately find the needle in the haystack, but it can reduce the amount of hay, here referring to the number of transactions flagged as fraudulent and that need to be verified. [Scott Nowson.]

In my compliance work, I usually look for certain local or international fugitives who try to open a bank account with us. Given the names can be written differently in different languages, of course it is difficult, and time consuming for the officers to try and look for all the iterations of writing the same name to identify a fugitive. Fortunately, the bank developed an intelligent system that looks phonetically to all the iterations and similar sounding names, to help the officer identify these risky persons. This kind of software draws out all the iterations of a name by phonetically matching the sounds of two similar alphabets and transcribing the result to the output language. This is especially helpful when searching for foreign names which are not originally based on the Latin alphabet. For example, the name محمد which is an Arabic name, can be written as: Mohammad, Mohamad, Mouhammad, Mohammed, Mohamed, Mouhammed, Mohamid, Mouhammid, Mauhammed, Mouhamet, etc... and the possibilities are numerous. [AML & compliance officer.]

Fraud detection

The application of unsupervised learning techniques in anomaly detection is used to identify unusual or suspicious behaviour that may indicate criminal activity and looking for behaviour that is divergent from the pattern of normal, to be used for fighting financial crimes and frauds [Gunnar Carlsson].

AI will have a significant impact within the banking sector, particularly in ensuring the validity of transactions. It is crucial to address the growing concern of fraud in financial services, as individuals unintentionally expose personal information throughout their daily activities. This information can be exploited by malicious actors to defraud people of their money. AI will play a crucial role in authenticating the identity of individuals conducting online transactions and enabling banks to verify the true identity of customers and enhance overall security measures. [Owen Hall.]

In the Lebanese banking system, depositors are obliged to explain the source of income for cash deposits greater than 10,000 USD. Therefore, many suspicious activities can be conducted by operating beneath this limit. Fortunately, the bank developed an IT system that can monitor such suspicious behaviour and inform us of such repetitive tradings below this margin. [AML and compliance officer.]

AI synergy with existing technology

The integration of AI with existing bank systems such as rule engines and Optical Character recognition (OCR) creates more intelligent systems. Rule engines for example, is used to automate a wide range of bank processes. However, by incorporating AI into the rule engine, financial institutions can improve decision-making by analysing data in real-time and making dynamic adjustments on the spot based on customer behaviour and preferences. Similarly, AI can enhance the bank's OCR systems, which have the capability to identify text and letters from images, paper documents, and other sources. With

the help of AI, these OCR systems can be upgraded to classify and make decisions based on the content within the documents, adding a new level of functionality and accuracy to the process. [Christophe Makni.]

4.1.2 AI benefits

The implementation of AI conversational interfaces brings about several advantages. Firstly, it enhances interactions by providing more efficient and effective communication channels. Basic inquiries and interactions can be handled seamlessly, improving customer experience and satisfaction. Simultaneously, this automation of routine tasks lowers operational costs for businesses. Moreover, AI conversational interfaces also benefit employees who previously dealt with these basic inquiries. With AI handling the repetitive and straightforward questions, employees can focus on more complex and value-added tasks that require human expertise. This improves their day-to-day work experience, allowing them to tackle more advanced and challenging aspects of their roles. [Ian Wilson.]

AI will take over the basic questions in the chats and will liberate the humans on the other side of the chat interface to focus on the more advanced queries. This will create a ripple effect and elevate many other areas within the bank. [Adam Hunt.]

RiskIQ offer AI products that help junior stock analysts appear like senior stock analysts by improving their workflow; and this is done by AI collecting and pivoting information inside the app freeing up some of the analyst repetitive workload [Adam Hunt].

The AI initiative of “Refinitiv Alerts” solve the problem of data explosion and lack of sufficient actionable insights to make professionals more productive and happier. [Customer Manager at London Stock Exchange Group.]

A 2-billion-dollar client of mine, whose CEO remembers the company early days when he knew every customer on a personal level is now thrilled that

technology is moving in a direction where with the aid of AI and automation, he can achieve that same personalization at scale, because conversational AI can potentially remember every client and conversation and engage it. [Peter Voss.]

Integrating chatbots services offers numerous benefits. Firstly, automation enables the delivery of enhanced customer service. With chatbots, customers can access support and assistance 24/7, ensuring availability and responsiveness at any time and at a much lower cost. This scalability and accessibility contribute to a better customer experience, improving customer satisfaction and reducing wait times. [Peter Voss.]

Traditionally, many banks have relied on a labor-intensive approach to handling Anti-money Laundering, involving numerous investigators dedicated to this task. However, AI offers a solution to streamline and optimize these efforts. While it may not be the spectacular kind of AI, still its impact is substantial. By leveraging AI technology, banks can significantly reduce the number of investigations required in financial crimes, focusing investigators on the most critical cases that demand their expertise. This approach allows investigators to concentrate on matters of utmost importance, enabling them to perform their jobs more effectively. Ultimately, it also reduces the need for massive groups of analysts dedicated to this type of analysis. The introduction of AI in financial crime analysis enables a more targeted and efficient allocation of resources. [Gunnar Carlsson.]

The AI-powered personalized payment solutions to consumers in debt has provided a delightful experience that makes customers want to do more business with the company [Ohad Samet].

AI allows to provide better financial advice, but also at a low cost [Sebastien De Brouwer].

The benefits of using AI in conjunction with existing bank technologies are numerous. Financial institutions can improve internal processes, decision-making and reduce costs by leveraging the power of AI to automate and optimize processes. Ultimately this will lead to a more competitive and

successful business, that is more likely to succeed in an increasingly digital and competitive market. [Christophe Makni.]

AI assistance in the mortgage lending reduces the waiting time and effort involved, leading to improved customer experience and cost savings. By leveraging AI as an assistive tool, mortgage lenders can simplify tasks, accelerate processes, and mitigate risks. The collaborative partnership between AI and human professionals leads to more efficient and reliable mortgage lending, benefiting both banks and customers. [Greg Council].

AI can make the check payment process more efficient and minimize fraud risk. The ability of AI to accurately perform a task that is prone to error by humans, is the reason banks are looking to automate this process with AI. Banks have been reallocating their employees to higher value tasks and freeing them from performing monotonous functions. With AI, the human labour will be shifted to a supervisor level that oversees the process. [Greg Council.]

AI is capable of reducing the false positives of fraud - legitimate transactions wrongly flagged as fraudulent - and money laundering transactions by discovering trends and going through thousands of data spanning over many years in just seconds. [Scott Nowson.]

4.1.3 AI challenges

Segregation of departments

There is a lack of cultural unity within the bank where different departments operate in silos and fail to see where each division fits within the big picture of the bank. Taking traders for example, the traders and front office people are all the time busy when the markets are open or searching for new clients to hit their targets etc. They fail to notice the importance of interacting with the technology department to work together and find solutions for their problems. In addition, convincing the different parties of the importance of this interaction

could be arduous and could create frustration among the players. For example, a trader may express their discontent with collaborating with the technology department while their fellow traders are engaged in profitable activities. [Ritchie Ng.]

AI Talent challenges:

1. Talent Attraction Challenge:

The primary reason why banks have difficulty attracting new talents is that the bank segregates its technology department from its other divisions. The bank places its data scientist and AI-qualified workers into a technology division located at the bank-end department of the bank with limited communication with the front desk where all the traders and revenue generating units are located. This creates a communication barrier that prevents the technology team from performing at its peak potential. Hence, discouraging new talents from going in the banking sector knowing in advance that their work will not have a big impact on their company, as it would have in big tech companies. Therefore, the limited contribution that data scientists and AI teams can provide in banking, deters potential talent from settling in this sector. [Ritchie Ng.]

There is scarcity of AI talent in the market at the moment and AI jobs in banking are less attractive than their counterparts in Big Tech companies where they could be doing ground-breaking research on cancer treatment or revolutionizing technologies in self-driving cars or other flashy jobs [Adam Hunt].

2. Lack of AI-qualified employees

Another challenge for banks lies in acquiring the necessary expertise to develop AI solutions. While having skilled data scientists is crucial and they play an essential role, it is equally important to ensure that there are trained professionals to support the underlying AI infrastructure. This includes having a competent back-office team dedicated to managing and maintaining the AI systems. [Sebastien De Brouwer.]

3. Talent acquisition challenge

Attracting talent stands out as a primary challenge in banking and that is throughout the company. At the senior levels, it is crucial to demonstrate the company's commitment to technological adoption and have champions who drive the adoption and usage of the technology within the institution. Similarly, at the junior levels, establishing effective channels, formats, and methodologies to attract talented individuals with the required expertise poses significant difficulties at the moment. Currently, the competition extends beyond banks competing with each other; it also includes competition with startups and large companies like Google, Amazon, and Facebook. This intensifies the challenge of recruiting and retaining skilled individuals within the banking industry. [Lee Smallwood.]

4. Lack of knowledge on AI

Resistance from the IT department proves to be the most difficult obstacle for AI in banking, because introducing a new technology that employees have little understanding of, can lead to reluctance and pushback. [Owen Hall.]

Lack of culture of innovation

In some instances, leaders of organizations have great willingness to bring transformative changes to the organization, but the ecosystem is not ready for the adoption. In other cases, it is the other way around where a company have the technological capability, but its management lacks the vision for innovation within their organization and are reluctant to proceed with AI adoption because they fail to see the benefits of using AI within their organization and the value that can be created by analysing their data with AI. [Nishant Shandra.]

Banks lack a culture of innovation that makes them resistant to change. One of the main challenges in implementing AI lies with the resistance from individuals in the IT department who may have limited understanding of the technology. [Owen Hall.]

Additionally, the hierarchical structure of banks can pose difficulties in embracing AI, especially when decision-making power rests with individuals who may be hesitant to take risks, particularly if they lack a comprehensive understanding of AI. Based on my extensive experience working with and for banks over the past two decades, I have observed that the greatest obstacle in driving change is often the resistance from those responsible for implementing the change. [Owen Hall.]

Strategy and planning

The problem is in once you have these 14 chat bots that you've paid for you know in sweat and blood and dollars, it becomes very, very hard to throw that out and say: OK, now let's do it properly. Let's throw this all out and do it properly. You really need to build the infrastructure. And what we spend a lot of time with our customers is saying: what is sort of the corporate brain that you're trying to build here, what is that core infrastructure? What are the APIs that you will eventually need? And then the first application will implement it on the basis creating that foundation to be able to add other channels, to add other functionality and so on. This, quite frankly, requires thought and planning. [Peter Voss.]

You would have money thrown at all sorts of different AI projects who would shoot up in all sorts of different directions. People start building groups within the AI sphere with lots of different groups within a bank who would have all sorts of different AI groups. In addition, you are also seeing a bit of chaos in the sense that you have got all this furtive money going left, right and centre, but no structure to it. [Ian Wilson.]

There is a lot of learning going on right at the C-Suite and understanding about what AI is. And I think we are seeing a transition from the, let's just jump in and do something cool phase to actually let's do this correctly phase. [Ian Wilson.]

It is a big challenge to do this infrastructure transformation and it is a big step for the leaders to take and invest in this transformation, because they realize

that payoffs may not be in one or two years. The payoff potentially would take probably five years if not a decade. [Nishant Shandra.]

One of the most high-ranking bankers that we spoke to, one of the biggest large banks in the world, a bank based in Europe, had given us a very poignant quote: he had said if AI is run by finance, it's unlikely to be able to get off the ground. In other words, if we expect every AI project to return X percent within next year or the year after, we are never going to have the confidence to invest in AI [Daniel Faggella (in the interview with Nishant Shandra).]

Uncertainty towards AI evolution

The uncertainty surrounding AI and its evolution is a main barrier for adopting AI in banking. AI is currently at its infancy and there is a lot of uncertainty on how the technology will develop and to what extent it will be transformative to the sector. Moreover, there is also uncertainty on how the customers will respond to the new technology and if they will welcome the change brought by the AI technology and at what rate customers will start to adopt AI. Will it become part of their workflow and normal life or is it going to be too unusual? All these questions make bankers reluctant to invest heavily and fully adopt AI at the moment. [Sebastien De Brouwer.]

Banks have reputations to maintain and thus cannot throw themselves in new uncharted territories without pondering on the potential consequences. Banks deal with sensitive financial information and need to ensure the security and privacy of their customers' data. Therefore, they are hesitant to adopt new technologies without thoroughly evaluating the potential risks and ensuring they have adequate safeguards in place. This fear of the unknown and the potential risks associated with adopting AI, creates a barrier to its adoption in banking. [Sebastien De Brouwer.]

The key point about AI for me is its risk, it is highly uncertain. So, there's a lot of risk with any deployment. [Ian Wislon.]

A key part of AI is going to be its roadmap over the next five years. AI is going to mature dramatically. The vendors are going to mature dramatically. AI products are going to mature dramatically. The teams who deploy AI applications are going to mature dramatically. But we're not there yet and where we are today is lots of uncertainty. [Ian Wilson.]

Also, one of the significant challenges in deploying AI solutions is establishing comfort level among businesses regarding their effectiveness. AI Vendors often face the challenge of proving the capabilities and benefits of their AI solutions. Demonstrating tangible evidence of successful implementation in production environments can be challenging, especially in the context of machine learning where clear and straightforward answers are not always readily available. [Ian Wilson.]

Regulation and compliance

Banks being heavily regulated and supervised, makes them very cautious in terms of adopting new technologies that have not been fully tested.

Furthermore, gaining approval for new technologies from regulators and supervisors, who may not have a complete understanding of AI, also poses a challenge. [Sebastien De Brouwer.]

The fintech sector has been one of the slowest to see a ton of disruption and I think that's mainly because of some of the regulatory hurdles and capital requirements and other requirements for startups in the space. [Lee Smallwood.]

There is difficulty in applying deep learning in compliance due to its lack of transparency. In the banking particular regulatory environment, to pass audits, banks must be able to explain how certain decisions were taken. Although progress has been made in understanding neural networks, it is not possible to use deep learning due to the opaqueness and lack of explainability of the AI decision making process. [Scott Nowson.]

Banks are being slowed by regulatory and security concerns. The banking sector have survived many crises over long periods of time probably due to these same rules and regulations which protected and preserved the sector, however, those same regulation and security measures contribute to the hindrance of innovation, namely AI adoption. [Nishant Shandra.]

Legacy systems and infrastructure

Another challenge is that banks have a lot of huge legacy. They do not start from scratch as perhaps some other new players. So they have legacy in terms of systems, in terms of infrastructure, in terms of networks and in terms of people. [Sebastien De Brouwer.]

The banking industry because of various reasons, security being one, regulatory reasons being another, they had traditionally stuck with legacy softwares which are licensed softwares. Now they realize that working on the legacy domain limits their capabilities in various ways. It limits their capabilities in terms of using the strength and power of the big data. It limits their capabilities in speed at which they can respond. It also ties them to certain organizations and their products. Hence, companies' growth is limited by how fast new features can be released by their legacy vendors. So, these are definite challenges in the world of banking. [Nishant Shandra.]

In the banking industry and others which are built on very strong, well tested pizza dough, which is the software, the underlying strength of an organization. And then on top of it, over a period of last few years, we have built business intelligence (BI) and data science capabilities and then were topped up with outcome-oriented services which are new generation of BI and AI capabilities. However, data is big in terms of volume and velocity. What is happening is these software are not able to take that load because the toppings are becoming heavier and heavier. In Lasagna, the data science and software engineering are ingrained in one bite. Those layers are intelligent and have data science capabilities and BI monitoring in-built, they have AI intelligent ways of

detecting data fraud in-built at every layer, as opposed to doing it at the very end. And these are the intelligent software platforms which will fundamentally transform or ingrain if I may call you know the AI capabilities in this space.

[Nishant Shandra.]

The major challenge faced by banks is being constrained by outdated technologies that have been in use for over 40 years. It is astonishing to see numerous banks still heavily rely on mainframe computers, despite the significant technological advancements made in the past 30 years. The difficulty lies in the fact that these mainframe technologies are not easily modifiable, adaptable, or customizable. As a result, banks find themselves in a situation where they need to become fintech of their own in order to overcome these limitations. [Owen Hall.]

Unquantifiability of AI results

One of the biggest hurdles I have seen in implementing AI solutions has been the comfort factor and establishing trust and confidence in their effectiveness. This represents a key challenge for vendors as they often struggle to provide concrete evidence and demonstrate concrete results. Machine learning, in particular, poses difficulties in delivering straightforward and definitive outcomes. That is a big stumbling block right now, however, I believe that once these challenges are overcome and AI applications start to be implemented, they will pave the way for a more seamless adoption of this technology. [Ian Wislon.]

AI technological level

Banks want to get deeper engagement from their customers and to tap into new areas of their customer minds. However, such a high quality and deep interaction requires a very advanced AI technology which is not there yet. [Peter Voss.]

4.2 Outlook of the future of banking

I don't think everything has to be built in-house and I think that buying can make sense at times or even partnering and I see this happening more now than it used to and I think that trend will continue to grow [Lee Smallwood].

Banks still possess huge advantages in terms of size, global reach, customer base and reputation. And, coupling these advantages with more focus on AI and elektronification in general, could put banks in a really good place going into the future. [Lee Smallwood.]

Banks offer commoditized services which can be easily replicated by others and offered by most banks and financial institutions which don't typically offer much differentiation in terms of features or benefits. In the short term, Banks might be able to differentiate themselves from the competition from other banks by using AI and new technologies, but eventually the competition will catch up and all banks will be using mostly the same technologies and find themselves again as a commodity. [Sergey Gribov.]

The future of banking is in danger due to the Big Tech companies' ability to slash segments from banking and offer banking services without needing to have a banking infrastructure. Banks will not be replaced totally by Tech companies, but however will be dismantled into pieces. Some areas of banking that are no longer profitable like physical branch visits will be removed and banks will focus on back-office types of services, while the front office services that includes customer interaction will be appropriated by Tech companies. [Sergey Gribov.]

A significant challenge arises from the emergence of specialized technology organizations that are highly focused on specific services. Unlike traditional retail banks that offer a wide range of services and products, these new players concentrate on excelling in a particular area. This poses a competitive threat to large multiservice retail banks as they need to adapt to the changing landscape and attract customers swiftly and cost-effectively. To stay competitive, banks

must find innovative ways to streamline their onboarding process and enhance their value proposition in order to retain and attract customers in an evolving market environment. [Owen Hall].

Individuals are no longer solely reliant on one bank for all their financial needs. Instead, they are seeking out specialized providers that offer tailored services in specific areas. This poses a challenge for traditional banks as they must find ways to effectively compete with these specialized providers while keeping costs in check. Traditional banks need to adapt their strategies and operations to meet the evolving demands of customers and provide comparable services at a competitive cost. [Owen Hall.]

The banks that are going to win over the competition are the ones who will seek to understand their customers better and make use of this information to improve customer retention and customer experience. Also, the use of unsupervised analysis or unsupervised machine learning is the technology that will separate the winning banks from the losing banks in the future, because of the advantages that can be achieved by letting the AI software experiment and look for the best way to optimize the outcome without being bound by set rules or objectives pre-defined by humans. [Gunnar Carlsson.]

In the end, although AI applications are more prominent at the moment in fraud, risk and compliance, these features will be very widely adopted by all banks in the future. They cannot be considered as competitive advantage and banks will not be able to differentiate themselves from each other based solely on those AI applications. Nevertheless, AI applications related to customer experience will be unique to each bank who will create each its own experience for their customers. Those banks who will master this technology are the ones who will attract and retain customers the most. [Gunnar Carlsson.]

The skills that will separate winning banks from losing banks are using AI to lower cost by implementing AI conversational interfaces that are 1: better than humans and 2: cheaper to implement than employing people. So, in the future, efficiency will drive the banking sector [Adam Hunt].

Banks should face the challenges and adapt to the change in the markets by opening their own small organization to do innovative work, build infrastructure, and organization base, to demonstrate the profitability, speed, customer retention and satisfaction achieved through this approach and how it compares to the traditional model. Only then, when the banks have proven the effectiveness of their new approach, will the chief executives of the banks be willing to rip out old banks and install new banks. [Owen Hall.]

It is possible that new elements of banking will be peel off-able as their own little side companies that could be profitable or compete with banks with the integration of machine learning [Daniel Faggella].

4.3 Sentiment analysis

4.3.1 Sentiment overview

To answer this research question, a sentiment analysis was done with the aim of conducting a public opinion research. The data management and organization process allowed for a classification of sentences into categories, which makes them easy to be analysed by groups. The grouping allowed to generate the following categories and subcategories along with their respective sentiment analysis, visible in the below table.

Table 11. Breakdown of sentiment analysis by category.

Topics		Sentiment analysis in %				
Category	Subcategory	Very Neg.	Neg.	Neut.	Pos.	Very Pos.
AI adoption	AI current adoption	33.33	0.00	0.00	33.33	33.33
	AI future adoption	6.25	9.38	15.63	34.38	34.38

Topics		Sentiment analysis in %				
Category	Subcategory	Very Neg.	Neg.	Neut.	Pos.	Very Pos.
	AI adoption challenges	29.73	24.32	18.92	16.22	10.81
AI applications & capabilities	AI current application & capability	28.21	7.69	15.38	23.08	25.64
	AI future application & capability	5.17	3.45	20.69	29.31	41.38
	AI Benefits	4.55	9.09	9.09	43.18	34.09
	AI opportunities	0.00	0.00	15.38	23.08	61.54
Banking System	Old business methods	15.79	21.05	21.05	15.79	26.32
	Bank challenges	34.78	26.09	13.04	17.39	8.70
	Bank advantages	27.27	9.09	36.36	9.09	18.18
	Bank future competitiveness	21.05	15.79	26.32	5.26	31.58
Fintech	Fintech advantage over banks	11.11	0.00	0.00	55.56	33.33
	Fintech disadvantages	25.00	25.00	25.00	0.00	25.00

To showcase the results of the sentiment analysis in a meaningful manner, the following section will delve into the details and present the positive and negative

sentiments of each subcategory. The presentation will commence by examining the current state of the markets and subsequently provide an overview of the prospective future of banking and AI in the financial sector.

Supporting tables for each subsection are available in the appendices and shows a presentation and explanation of each code as well as their respective assigned sentiment.

4.3.2 Future of banks

Bank challenges

Banks today face a plethora of challenges that threaten to disrupt their operations and erode their competitive edge. The Covid-19 pandemic had imposed new challenges on banks, with the need for social distancing limiting physical contact with customers. Meanwhile, Big Tech players have entered the banking space, posing a new challenge to traditional banks. Banks are struggling to maintain a long-term sustainable differentiation and competitive edge, partly due to their conservative approach to technology adoption. In addition, banks are facing a challenge in analysing and serving clients with limited credit history or information, especially in developing markets; An area where Fintech are making use of AI to evaluate credit risk based on new criteria. They also struggle with incomplete customer understanding and inefficient anomaly and threat detection, in addition to difficulty identifying areas of churn that require attention and intervention. The advancing technology creating sophisticated threats that are easier to evade detection are also a concern for banks. Fintech firms are increasingly overtaking banking services and offering more efficient and cost-effective services. On the other hand, the increased digital footprint of customers has led to increased frauds, which makes it more difficult for banks to protect their clients from cyber threats. Also, banks struggle to identify and confirm customer identity online. Banks also face automation challenges due to their legacy systems' rigidity and inadaptability to

new technologies. Besides, the market challenges, banks face also internal challenges. The costly physical presence of banks in terms of offices and branches is weighing on their profitability. Moreover, the largest operational cost incurred by banks is salaries, due to them possessing a large human capital. Banking is one of the most labour-intensive sectors with a significant portion of banks' revenues going towards staffing costs. Lastly, banks deal with a large and unmanageable quantity of data, making manual searching difficult and time-consuming.

Sentiment analysis:

The sentiment results were mostly negative except to false positives caused by misinterpretations of the Azure model. The general negative sentiment expressed here is obvious given that the topic of challenges carries only negative connotations.

It is worth noting that the most negative sentiments were expressed towards banks costly staffing requirements, the automation challenges due to banks legacy systems being antiquated and the new sophisticated threats using advanced technology in an era of increased digital footprints where customers are more exposed to cyberattacks. Also, banks branches were negatively viewed as unprofitable.

The most positive sentiments expressed were about the increased competition from Fintech firms which are pushing banks to increase their efficiency and improve their processes to stay relevant amidst the competition.

Banks' old business methods:

A complementary topic and considered a subcategory to bank challenges is the old methods of conducting business within banks. This topic appeared in the discussions in order to highlight the deficiency of the old business methods and contrast them to how AI can establish a new way of conducting business.

Banks have long relied on human capital to lead the business, although human capabilities present a lot of limitations, like incapability of handling large amounts of data, providing equal good service to all customers, detecting customer satisfaction, predicting customers who are leaving the bank for good. In addition, the business methods are slow, paper-intensive, time-consuming, manual and repetitive, like writing basic rule engines for threats and fraud detection which are easily circumvented; or manually searching through excel sheets to find potential new customers. On top of that, complex operations, like anti-money laundering and loan assessment are still handled by humans with rudimentary methods still in use. Further system limitations appear when employees have to confirm the customer's identity over the phone, noting that even customers prefer not to talk to live agents if the matter can be solved electronically, and more so, they prefer to avoid human customer service altogether when the matter relates to personal and private subjects like personal finance, health issues, etc. Besides, branches are also becoming obsolete and less frequented.

These challenges highlight the limitations of human and process-based methods, to show that banks need to adapt to new technological innovations in order to keep up with the evolving financial landscape.

Sentiment analysis:

This section included a lot of false positives, whereby the Azure model classified several obvious negative points as positive. However, the most negative sentiments on that subject were towards the high cost of hiring and maintaining employees, the obsolescence of physical branches and the dislike of customers in discussing their private and personal matters with a live human agent. Some other negative sentiments were attributed to the paper intensive, repetitive and boring banking processes, searching for potential customers manually through excel and human incapability of detecting customer satisfaction.

Fintech advantages

On top of the bank existing challenges, Fintech companies possess several advantages over traditional banks that adds to the banks' challenges. Being born digital from inception, Fintech do not need to undergo the lengthy and costly process of digital transformation, like their competitors, the traditional banks. Fintechs also take on specific banking functions allowing them to specialize and deliver highly efficient and cost-effective services, overtaking banks. Moreover, their specialization and efficiency will allow them to deliver highly specialized products at a competitive price compared to banks who are multi-service and multi-product. Moreover, Fintechs offer innovative and user-friendly interfaces, excellent customer service, and employ creative technology to manage areas of business, like credit risk. According to some opinions, in the future, technology will be ubiquitous, and banks cannot rely on technology to maintain a competitive advantage in the market, since Fintechs will be using similar technology making any technological edge duplicatable. While they are smart and adaptable, Fintechs may still lack the trust, reputation, and brand recognition of traditional banks.

Sentiment analysis:

The opinions on the above mentioned fintech advantages were all positive, except to an erroneous sentiment analysis which flagged the digital nature of fintechs as negative.

Fintech disadvantages

Nevertheless, Fintechs possess challenges of their own. Fintech are relatively new to the market compared to traditional banks. This raises concerns for customers with regard to the authenticity and legitimacy of Fintech companies. Customers often wonder if the organization they have signed up with and put money with is reliable and trustworthy. Therefore, Fintechs have difficulty convincing customers to place their money and finances in their hands.

Moreover, this trust issue affects the startups in the fintech industry in getting access to large asset managers, institutional clients, pension funds, and high net worth individuals, like banks do.

In addition, also another challenge for fintechs is providing human support when needed. Fintech companies are often smaller in size and have limited staff compared to traditional banks. This can make it challenging for them to handle large volumes of customer service calls and provide human support when needed. Unlike banks, which have dedicated customer service teams and call centers to handle customer inquiries and complaints, fintech companies often rely on automated systems and chatbots to handle customer interactions.

Sentiment analysis:

The sentiment analysis returned negative results in relation to the difficulty of Fintech in providing large loans and retaining reserve deposits like banks do. The most negative sentiments was expressed towards the lack of physical presence of fintech firms, their inability to provide decent customer support for clients and their struggle in acquiring high-profile clients. However, as for the Fintech having no history or reputation, the sentiment was neutral.

Bank advantages

Despite the numerous challenges that banks face, they still enjoy several advantages over fintech firms and other players in the market. Banks have the advantage of their size, customer base, and reputation, which are hard to match by new entrants. Banks also have the advantage of long-standing relationships with institutional clients and high net worth individuals, which can make it easier for them to gain access to these markets compared to fintech startups.

Furthermore, banks have large customer data and unique knowledge and workflows, which if combined with proper AI implementation, they can leverage this valuable data to offer better services to their customers and win over Fintech companies. Banks also have specific functions, such as creating loans from deposits, which is a unique trait of banks. Additionally, banks are in charge

of the money creation system and they possess large money deposits, which are essential for the market's smooth functioning. Most importantly, banks enjoy a good reputation and trust from their customers. Banks have more resources and larger budgets to invest in customer service and support. They have dedicated teams and call centers that can handle large volumes of customer inquiries and complaints, ensuring that customers have access to human support when they need it. This contributes to customer stickiness and loyalty, which are highest in banking than in other industries. This allows banks to build brand affinity and encourage customers to refer to their banks first when they have a need, before going to other channels. In summary, while the challenges facing banks are significant, their unique strengths and indispensable offerings helps them maintain their position as essential players in the financial services industry.

Sentiment analysis:

Bank advantages sentiment was mixed due to several false negatives and with the highest tranche being neutral.

The most positive sentiment was expressed towards banks' large quantity of data which is seen as an advantage that can be leveraged through AI, in contrast to other companies who do not possess as much data about their clients. Moreover, the unique valuable knowledge and acumen that banks alone possess, and that can be leveraged with the help of AI gave a very positive sentiment, emphasizing that this advantage might help banks win over fintechs. In addition, the advantage of banks possessing an existing good relationship with customers was viewed very positively, in contrast to new entrants who must prove themselves first. Also, banks size, customer base and reputation were also seen favourably. On the other hand, banks role as a mediator and creator of money gave a neutral and negative sentiment. In addition, the customer loyalty and relationship stickiness resulted in a very negative sentiment, however that could be a false negative.

Bank future competitiveness

The opinions collected from the interviews suggest that the future competitiveness of banks depends on how well they adapt to the evolving financial landscape. The future will see banks competing against Fintech firms and Big Tech companies. The challenges faced from new entrants to the market will fuel innovation in banking to fight for their position in the market and stay relevant. Some opinions suggested that in the future, banks are expected to rehaul their structure and dissolve part of their departments into fintech companies. The new fintech entrants present a challenge to banks, but the combination of banks' valuable data, extensive work expertise coupled with the proper use of AI systems, could make banks win over the competition. Also, the growth in digital services presents an opportunity for banks to offer personalized customer experiences and increase connection to their brand, leading to good customer retention and more cross-selling opportunities. Nevertheless, banks should focus on building brand affinity and encouraging customers to first turn to their banks when they require assistance. However, another opinion viewed the future of banks less favourably. Banks need to have a competitive advantage survivor mentality and focus on differentiation by service quality, as there will be no long-term sustainable differentiation between banks, since they all offer the same commoditized services. The opinions suggests that Fintech and Big Tech companies will replicate banking services cheaply and more efficiently, which could result in them capturing market shares from traditional banks and rendering the latter to a basic service provider that will handle only bank-specific functions like facilitating money circulation, and with low profitability, which may not attract tech companies anymore. While the competition is increasing and there is a risk of losing their competitive edge, banks still have the opportunity to stay ahead of the curve by quickly embracing technological innovations and deeply integrating AI in their processes.

Sentiment analysis:

The interviews revealed that the most positive sentiments on the future competitiveness of banks were related to the potential for banks to recreate themselves by peeling off parts of their businesses and spinning them into fintech companies. This transformation could ultimately result in the creation of a hybrid fintech-bank conglomerate that would be well-positioned to compete in the market. Additionally, when coupled with AI, banks' specific qualities, such as trustworthiness and reliability, could be elevated to new levels, further strengthening their competitive position.

On the other end of the spectrum, the most negative sentiments were from an opinion from the other camp which have low expectations for banks, seeing them demoted to a generic commodity service that will fill certain basic functions like facilitating the circulation of money in the system. In addition, some negative sentiments were expressed regarding the competitiveness of traditional banks. Participants noted that traditional banks face increased competition from big tech and fintech companies, which could make it difficult for them to maintain a sustainable competitive edge in the market. With similar technology available to all banks, it may also be challenging for traditional banks to differentiate themselves in the long term.

4.3.3 AI in banking

AI current application & capability

The capabilities and applications of AI are in a constant state of improvement, but with all current development, AI is still considered to be technologically in its infancy. It is important to note that not all aspects of AI can be deemed fully operational as of today and depending on the area of application, certain facets of AI may be more effective than others.

In the case of chatbots, the current state of AI chatbots is limited and lacking in several areas. While they have made significant strides in recent years, the best AI chatbot today still does not have common sense or empathy and has a very

limited understanding. The current technology used in AI chatbots is still at a nascent stage, which makes it difficult for them to develop cognitive abilities. Additionally, their memory and learning capabilities are limited, as they cannot link previous conversations together or understand contexts. As a result, they often fail to satisfy customers, especially when the AI is not well integrated into the company's systems. Even more, the current chatbots imperfections are even frustrating and annoying customers that in some cases their re-usability among customers is very low.

Other aspects of AI perform much better than chatbots and are gathering support from market players. Some AI applications mentioned were:

Credit risk: Alternative methods for credit scoring using AI to analyse customer credits with unconventional methods. Student loans analysis with AI, now take into consideration the field of study of the students as well as their university rank, to be assessed by AI and give credit decisions, leading to an enhanced credit risk analysis and better credit default predictability.

Search and discovery: Collecting, organizing, and pivoting data with the aid of AI to provide personalized, timely and market insights, to uplevels junior analysts' skills.

Trading decision making: The advancement of AI technology is also seen applied in areas like trading decision making, which were not possible with the previous technologies. AI analyse large volumes of data and identify patterns that can inform investment decisions.

AI-based AML and fraud detection: AI is being used currently in AML, fighting financial crime, monitoring fraudulent transactions. AI capturing evolving security threats, making it difficult for criminals overcoming AI security.

Phonetic matching: AI system capability that looks for customers based on the phonetic sound of their name, rather than the exact spelling. This is particularly useful when dealing with customer names that have different spellings or

variations, such as those that are commonly found in multicultural or multilingual environments.

Hotspot analysis: categorizing customers into clusters and detecting churn and major shift in customers behaviour, to anticipate which clients are leaving the bank.

Intelligent personal assistant: where AI evaluates customer behaviour, meetings and contacts to provide daily updates of news content, breaking news, and pre-meeting briefings.

AI personalization and contextualization in payment collection: AI is capable of offering solutions in context and communicating with customers in a personalized manner, addressing the customer at the right place, right time, with the right content, to facilitate debt payments for customers.

Even though there are applications of AI in banking, nevertheless, the technology is still relatively new and there are many uncertainties towards its evolution and implementation. Although some forms of AI applications are in existence, new applications are still in the early stages. Overall, AI has the potential to significantly improve banking, but it is important to acknowledge that the technology is still developing and at different speeds depending on the area of application. For example, in customer intelligence, AI is still in its early stages and so far, there has not been any significant or ground-breaking invention, to be seen as spectacular.

Sentiment analysis:

The opinion about AI current capability and application is mixed. The most negative sentiment analysis was heavily skewed towards chatbots, their limitations, their deficiencies, their lack of functionality, their annoyance to customers, etc. Also, some negative sentiment was also expressed towards the current limited capability of AI in customer intelligence. However, on the opposite side, mostly all other AI applications garnered a positive sentiment, with the most positive ones being elicited from alternative credit scoring

methods, AI-based AML, AI in payment collection and AI as an intelligent assistant. (Refer to table 14 in Appendix.)

AI opportunities

AI offers numerous opportunities for the banking industry. There is an opportunity to improve customer services by providing 24/7, scalable service, predictable and at a lower cost. Also, humans are looking for a new way of dealing discreetly with personal and private information. This creates an opportunity for AI because customer support with chatbots and other AI-powered systems can handle delicate and personal matter conversations without judgement. Other opportunities include making use of Artificial Narrow Intelligence (ANI) to automate simple tasks like updating information, renewing documents, making transfers, automating internal processes, and resetting passwords. AI capability fits well with high dimensional multivariate problems, which is largely present in the banking ecosystem, like analysing the type of transactions, amount, location of the transaction, and the time of day when it occurred, in order to extract patterns unseen by the human analyst. These kinds of problems create opportunities for AI applications in banking. Furthermore, data overload creates opportunities for AI to step in and rank news and information as well as managing big data with AI. However, the success of these AI opportunities depends on identifying the right areas of application in banking.

Sentiment analysis: All the opportunities mentioned above resulted in a positive sentiment.

AI benefits

AI has a significant impact on the banking industry. It has brought numerous benefits for banks and customers alike. AI can improve the customer experience, reduce costs and mitigate risks. Conversational AI lowers

operational costs by reducing the number of humans needed in customer service departments and improves the customer experience by providing customized products specifically targeted for each individual and reducing digital fatigue by filtering personalized insights. This personalization results in more satisfied customers who want to do more business with the bank. Moreover, AI helps in detecting customer satisfaction and understanding their needs at a deeper level. It can also streamline banking consultancy and advice services to all clients, A service that was previously reserved only for high-net-worth individuals. Furthermore, banks that leverage AI technology are better equipped to provide better services, 24/7 presence, and consistent results. Also, the speed and performance of AI enable banks to process large amounts of data more quickly and accurately than humans.

Banks that leverage AI technology can stay competitive, improve current business processes, and reimagine the business of the future. This has led to economies in the banks' processes, along with better applications in fraud, risk, credit, and security management. AI systems that search phonetically for fugitives and assist investigators are but one example of how AI is beneficial in the banking industry. The benefits of AI-technology can also be seen as a protective and preventative measure for banks to avoid costly damages in terms of financial loss from frauds or fines and reputational damage.

In addition, AI brings innovative ways of doing business. The application of AI lead to the substitution of the old-style forms and paper-heavy processes with improved and more efficient methods like paperless automation, computer vision, machine learning, and natural language processing, delivering positive return on investment (ROI). On the other hand, AI improves employee and job satisfaction by automating menial work and allowing humans to move to more meaningful tasks. From one side, AI opportunities bring cost savings and a smoother user experience, while on the other side, it leads to higher skill sets for employees and a more fulfilling work environment.

Sentiment analysis:

While the overall sentiment in this section was positive as it discussed the benefits of AI in banking, one statement expressed a negative sentiment about the unequal distribution of these benefits. The statement noted that while AI in risk management is useful, it may not generate as much benefit as AI in regulation. This is because the challenges and complexities of regulatory compliance in the banking can result in much higher risks, and any lack of precision in compliance could lead to significant fines and penalties.

AI current adoption

The current state of AI adoption in banking is somewhat mixed. While there are some areas of banking where AI is not yet being taken seriously, the popularity and attractiveness of AI is drawing attention and causing banks to transform their infrastructure to accept AI. Banks are relatively fast at adopting AI compared to other sectors, but they are hindered by security and regulation issues. Despite these challenges, AI adoption is starting to take off among the biggest finance organizations, particularly in the areas of consumer lending and mortgages, which have been effective in changing the finance landscape. However, there is still some uncertainty towards AI evolution and a cautious sentiment is still dominant in AI adoption due to difficulties in implementation, which is more complex than traditional methods. In the banking security arena, basic AI knowledge and capability is a sufficient pre-requisite for adoption, but a big drawback for banks is their old legacy systems that are unmodifiable, unadaptable, and non-customizable, causing a significant challenge for automation and AI adoption. Overall, while there are challenges, the current state of AI adoption in banking is positive, and banks are eager to transform and adopt AI to improve their processes and services.

Sentiment analysis:

Sentiment-wise, current AI adoption in banking gathered opinions from both camps. The most positive ones suggested that AI is gaining in popularity and attractiveness and banks are eager to adapt AI more quickly than other sectors.

Also, there is a very high enthusiasm towards the current adoption of AI in consumer lending and mortgage which has led to a positive change in the market. Furthermore, even the most basic forms of AI are perceived positively for their potential to bring significant improvements to the market.

However, the negative sentiments were also numerous. For example, negative sentiments stemmed from the fact that there is uncertainty at the moment around AI causing market players to be cautious and carefully reconsider the pace of AI adoption. In addition, the current AI limited capabilities create an atmosphere of disappointments that weighs negatively on its adoption.

Moreover, another very negative sentiment expresses that willingness to adopt AI is not enough, because banks are faced by regulation, security concerns and rigid infrastructure that slow AI adoption. (Refer to table 15 in Appendix.)

AI adoption challenges

Following the last section about the state of AI adoption, it is worth diving deeper on the current challenges for AI adoption that were frequently mentioned throughout the interviews.

The adoption of AI in the banking industry poses a plethora of challenges that banks need to overcome before reaping the benefits of AI. One of the main challenges is the uncertainties surrounding AI. AI is a highly valuable technology with great potentials that can bring positive repercussions for businesses, but the success of AI depends on many factors that cannot be predicted beforehand. The difficulty in quantifying in advance the definite benefits that will be generated with AI builds obstacles for the adoption of this new technology. Moreover, there is uncertainty concerning the responsiveness of clients to AI. Will clients embrace this new technology, will it appeal to them? This lack of visibility creates concern for the people in charge of adopting AI into banking. On the other hand, for AI investment to be successful, AI needs to be deeply integrated into the banks systems which is a highly challenging process for implementation and requires significant expertise which the banks lack;

Moreover, positive returns are to be expected only in the long run. Thus, these challenges and requirements make it difficult for investors to fully invest in AI when there are so much unforeseeable moving parts.

In addition, banks have huge legacy systems, which are often incompatible with AI and limiting its capability. Besides, those legacy systems are heavily regulated and supervised by regulators, making banks less enthusiastic of adopting such new technologies. Also, regulatory consequences of AI adoption remain unknown, and it is challenging to get regulators, policymakers, and supervisors on board with AI and educate them about it. On the other hand, AI needs adequate skills, training, and education for bank employees to ensure a smooth transition into the AI landscape.

On top of that, a recurring concern that was mentioned throughout the interviews is the lack of AI talent in the banking sector. This is a significant challenge that banks need to address. There is a scarcity of qualified AI employees in banking security, and what is more is that the banking sector is less attractive to AI talent than other industries like cancer research or autonomous cars. So, banks do not promote their business as AI attractive, and in addition to that, their hierarchical structure does not facilitate younger employees to suggest new innovations and make changes within the bank.

In summary, AI adoption in banking is challenging due to a variety of factors, including banks' conservatism towards technology, regulatory constraints, lack of AI talent, deep integration requirements, legacy systems' incompatibility, uncertain ROI, and customer acceptance, lack of innovation culture and resistance to change. Addressing these challenges is crucial for banks to harness the full potential of AI and stay competitive in the industry.

Sentiment analysis:

Finally, the overall sentiment on adoption challenge was mostly negative due to the above-mentioned reasons. The most negative sentiment collected was about legacy systems' incompatibility, regulatory constraints, banks' conservatism towards technology, scarcity of AI talent in banking, talent

attractiveness, management reluctance to invest due to unpredictable ROI and general uncertainty around AI.

Despite the predominantly negative sentiments, a couple of positive views were also expressed. One statement highlighted the advantages of AI open-source technology making software codes more open and customizable, facilitating integration and allowing for a more flexible and accessible adoption of AI, than proprietary and licensed software. Another positive perspective about the attractiveness of AI talent in banking was that even though banks are less attractive for AI specialist, however the new cybersecurity threats nowadays apply AI and fighting back these kinds of attacks could be appealing to individuals with a competitive mindset who enjoy strategic and competitive games, seen as applying the good AI to fight the bad AI.

AI future applications and capabilities

Although the interviews delved into the current challenges, trends, and available applications of AI in banking, there was also a notable emphasis on looking to the future. Participants expressed their aspirations and hopes for the application of AI in banking, exploring new potential applications and dreaming about possible solutions that could bring about significant benefits to the banking industry. This forward-looking perspective demonstrated the participants' optimism towards the future of AI in banking and their willingness to explore new possibilities and solutions to harness its full potential.

In the context of the interviews, many comments expressed aspiration and expectation for AI in the future. AI aspiration refers to the interviewee's expressed hopes and ambitions for AI, to achieve certain functions or capabilities in the future that are not yet realized or envisaged. On the other hand, AI expectation refers to the interviewee's anticipated AI future applications and capabilities or adoption in banking with a reasonable amount of doubt and predictability. Expectations are typically based on the extrapolation of current trends and represent a more short-term view of what AI can achieve in

the near-term future. While aspiration reflects a higher level of uncertainty with ambitions that may not yet be achievable and typically happen on a longer time horizon. However, both expressions refer to an opinion on the future outlook of AI in banking.

Concerning future applications and capabilities of AI, the latter has potential in the banking industry and is expected to play a significant role in the future. Banks are looking for AI to enhance their relationship and touch points with customers by providing high-quality conversations and better customer engagement, which will lead to stronger and stickier relationships. For that reason, conversational AI is believed to be particularly important, and banks are hoping for chatbots to be capable of uniform coherent conversations and high-quality personal customer interaction where AI remembers previous conversations and handles queries in a freeform way and provide a seamless customer experience. Furthermore, AI is expected to do a much better job than human agents in such customer facing positions, because AI will potentially have full knowledge on every single customer, transaction and detail. Furthermore, banks are looking for multifunctional AI assistants that can assist customers across many departments and provide personalized investment recommendations and life advice, which were previously reserved only to the wealthiest clients.

Also, there is ambition for AI to be capable in the future to predict customer behaviour, detect customer satisfaction and intervene when a customer is having difficulties navigating the webpage. In addition, AI is expected to handle and prioritize customer complaints, and anticipate for clients in risk of exiting the relationship or leaving the bank and intervene accordingly. Moreover, AI capability in the future will extend to acquiring knowledge on customer interest by analysing customer purchase history, likes and visited pages.

AI is a best fit in handling high-dimensional and multivariate problems, where outcome depends on multiple factors, such as trading decisions and credit scoring. Also, Banks are also looking for AI to improve their existing business processes by replicating human decision-making with AI and surpass it. Such

areas include handling complex AML processes and thorough search for potential customers by considering for example stakeholders related existing clients, like business partners or client of a client. This capability will allow AI to become a powerful platform network and is assimilated as “Facebook for banking”. On the more menial side of work, AI will replace paper reading with computer vision at speed, and other old analytical processes with machine learning, and natural language processing.

Furthermore, the future capabilities of AI are believed to include unsupervised machine learning methods that offer greater flexibility in analysis and can solve problems in situations where there is uncertainty about hypotheses or where there is no general agreement on the best objectives to aim for. These areas include anomaly detection and pattern recognition where unsupervised ML algorithms can be used to identify unusual patterns in transaction data that may indicate fraudulent activity. Also, another area of use is the clustering and grouping customers into different segments based on similar behaviour and criterias deduced by the machine learning model itself.

However, the most emphasized AI applications, which are believed to separate the winning banks from the losing ones in the future, are customer-centric AI applications related to customer understanding, customer interaction, customer experience and Know Your Customer (KYC) processes.

In what concerns human employees at the bank, there is an aspiration for AI future applications to enhance employees’ competences by having various smart tools at their disposal.

As AI continues to evolve, there is a growing understanding of the direction in which it is heading and the crucial issues that it needs to tackle. In the coming future, AI in banking will evolve and mature dramatically and banks will know how to make use of it to improve current business processes and reimagine the future of banking.

Sentiment analysis:

Regarding sentiment analysis, based on what has been mentioned above the overall attitude towards the future potential and capabilities of AI is predominantly positive, with the exception of some false negatives results. For example, Azure may have misinterpreted the meaning of sentences including the term 'Artificial Narrow Intelligence' which has limited scope but nevertheless, such technology remains highly useful in the context of banking. Also, another misinterpretation by Azure was regarding AI capability in detecting dissatisfied clients in risk of exiting the relationship and leaving the bank. The words used about losing the relationship could have mislead the Azure model. (Refer to table 16 in Appendix).

AI future adoption

Based on the opinions collected from the interviews, AI is considered seriously for adoption in banking, and it is expected to evolve and mature dramatically in the future surpassing current expectations. There will be a transformation of bank infrastructure to engrain and adopt AI capabilities into the bank systems. It is believed that around 80% of bank processes can be automated with just the aid of simple ANI, which has sufficient capabilities to handle basic tasks like updating information, renewing documents, and making transfers. The adoption of such ANI models is straightforward and easy to automate. Banks are considering implementing AI in various departments such as risk, credit, and security which are considered low hanging fruits for AI. Loan assessment with AI is expected to grow and be more adopted, and there is a high expectation of AI adoption, especially unsupervised learning AI, in applications that study and better understand customers. One major area of AI adoption in banking is customer interaction, which is expected to be a significant winning advantage for banks that adopt it. One opinion about future AI adoption in AML is that it is growing, yet humans will still be needed to make use of their intuition, which is missing in AI. However, some interviewees have a hard time giving a definite answer as to which AI system will certainly be adopted and how to rank them against each other. Moreover, AI adoption in banking will depend on how

customers perceive it, and currently, it is unclear how receptive or accepting they will be of the technology. Others believe that AI will see a wide adoption in banking, more than is expected and AI applications will discover new service channels that were not existent before. However, this adoption requires an evolution into a more innovative culture which banks lack and a change of mindset from the part of management. From the governments' point of view, banking regulators are looking closely at AI and its ethical implications and have a favourable view of it. Regulators are seeking to facilitate the adoption and avoid any innovation obstacles that might negatively affect the sector.

To conclude, there is a general belief that AI will have a transformative effect on banking and there will be a transformation of bank infrastructure to engrain and adopt AI capabilities into the bank systems. Also, AI open-source technology is growing much faster than licensed software and is gathering support from various companies, including banks. Banking is among the top sectors that aspire to transform with AI and has a high commitment to AI adoption which is believed to be viable within the coming 10 years. AI adoption is a continuous process that will replace old systems one by one with new AI efficient technology. In addition, the future adoption will happen by a ripple effect: As AI evolves and starts bringing investment returns, companies will be more at ease and comfortable with its adoption. And, when competing banks start adopting AI more and more, it will fuel a widespread adoption in the sector to prevent some banks from lagging behind each other.

Sentiment analysis:

The sentiment analysis report indicates a predominantly positive outlook on the future adoption of AI, reflecting the public's favourable view of AI's role in the banking industry. The most positive sentiment was retrieved from the statements talking about the belief that AI will have a transformative effect on banking, the expectation that AI in customer interaction will be a major winning advantage for banks that adopt it, the regulators favourable view of AI, the large number of opportunities for AI adoption in banking, the increased understanding

of AI motivating investments and future adoption, and AI role in the discovery of new service areas.

The negative sentiments were much lower than the positive ones and included mostly false negative results from the Azure model. However, the negative sentiments retrieved were mostly about the difficulty in predicting AI evolution and areas of future adoption due to the high uncertainty surrounding AI. Some experts were reluctant to estimate with certainty which areas of banking will see a better integration and adoption of AI, while others were confident that AI would not replace humans and their intuition entirely.

On a side note, some comments discussed the consequence of not adopting AI in the future and they all resulted in a very negative sentiment. The comments expressed that banks who will not transform themselves will have lower quality customer service and lower profitability. Also, the lack of AI adoption will cause those banks to lag behind the competition to a point where they could not catch up anymore, and the more lagging those banks will be, the harder it will be for them to transform themselves.

5 Research Limitations

Information complexity and technical limitations

This thesis approaches the subject of Artificial Intelligence from a business point of view without diving into the technical aspect or the science behind the AI models. AI is a very niche subject that is a hard to grasp even to the nimblest engineers in the field. The writing and coding of AI requires an understanding of several disciplines like computer engineering, computer science, mathematics, calculus, etc. which are all beyond the scope of this work.

Also, due to the complexity of AI which is outside the limit of my understanding of advanced mathematics and statistics, let alone coding and engineering, I had to disregard many interesting and compelling articles that could have been very beneficial for a deeper understanding of the modus operandi of AI.

Difficulty interviewing banks

Finding banks to interview for the thesis proved to be a challenging task. The initial objective of the thesis was to gather the opinion of bank employees on the impact of AI on banking to evaluate the readiness of the sector in adopting AI. Several local and international banks were approached for that reason at the beginning of the research in 2020-2021. But most banks were hesitant to participate in the study due to various reasons. One of the primary reasons is the confidential nature of the financial industry. Institutions that handle clients' private financial information are very secretive about their methods and their employees' knowledge, as they seek to protect the privacy of their customers and their data at all costs. Another reason is that currently, AI is not widely adopted in all banks, and the ones that make use of this technology are very secretive about it as they consider it a business secret that brings them competitive advantages. Therefore, disclosing information about their AI systems could provide valuable insights to competitors which adopters want to

be kept secret. Lastly, publicizing AI systems in use could make banks more vulnerable to cyberattacks. If a specific AI model is known to be used by a particular bank and if criminals have knowledge about hacking that specific AI model, the disclosure of information could facilitate hacking attempts. On the flip side, if a bank discloses that its operations utilize less sophisticated AI or no AI at all, it also exposes the bank to greater risks. On the other hand, during the thesis project, banks were facing more pressing concerns such as understaffing and daily business challenges due to the outbreak of the COVID-19 pandemic which was in its peak. Also, back then, interest in AI was not as high as it is now. At the time of commencing the thesis, AI did not garner the same level of interest and attention as it does presently. There was comparatively less attention towards AI compared to the present day when AI has gained much more prominence especially after the release of Chat GPT AI and ML model, which has awoken a renewed interest in AI among the general public with google trends showing a quadruple increase in AI related searches towards the end of 2022. However, when the interview with the anonymous bank employee was possible, it reflects the personal opinion of the individual and not the stance of the global institution. On the other hand, as it has been mentioned throughout the research, AI is a relatively new technology but not completely unheard of within banking. Nevertheless, AI has been mostly prominent amongst the largest banks who can afford the investment in the new technology. Lee Smallwood from Citibank mentioned in his interview that AI has been mostly applied among Fintech startup firms but is now starting to appear in finance among the largest organizations (Faggella, 2019 July 1a). For that reason, it is believed that a number of small and medium sized banks declined participation in the research by reason of absence or limited AI in their institutions.

Limited interview pool

The research is based on interviews from various high positions leaders in the finance and banking sector, along with enthusiastic AI vendors who are eager on expanding and applying their products in the market. The vendors are

involved in the research and development for AI and see a brighter future where AI is working alongside humans. Also Bank leaders interviewed in the podcasts are exposed to knowledge about AI, they possess a certain level of awareness about AI and perceive the potentials and the benefits it can bring to their organization, how it can scale their business and help their clients, etc.

However, these leaders do not represent the whole sector. Therefore, it would have been also interesting to get an idea on the sentiment of the average bank employees who are not actively involved or aware of AI and its repercussions and who on the contrary are being subjected to this market change against their will. Their perception and sentiment towards AI may be in the opposite camp compared to their leaders. However, that is not necessarily true, because usually the less someone is knowledgeable about AI, the more likely that person is to overestimate its capabilities and potentials.

Nevertheless, further research is needed to better understand bank employees' sentiment (other than high management and AI qualified individuals) towards the adoption of AI in banking.

Language barrier and discussion limitations

The podcast hosts international guests who have varying level of proficiency in English. Some are native English speakers and some speak it as a secondary language. The limitation arises when non-native English speakers have difficulty fully expressing their ideas and what they really meant behind them, which poses a sort of barrier that does not allow to capture all the concepts behind the discussions. Moreover, in many instances, Daniel Faggella, the host, tries to reformulate what the guest is trying to say to make sure he understood them correctly and then ask for confirmation on the reformulated ideas. Also, in other instances Daniel proposes ideas and asks the guests if they agree with him. Although Daniel tries as much as possible not influence the guests' opinions, however it is debateable as to whether some ideas are the guests' own

thoughts or tainted by Daniel's conversation. This could be considered a minor limitation to the interview analysis.

Azure and sentiment analysis limitations

The sentiment analysis conducted using Azure machine learning yielded inconsistent results. Although the Azure model limitations were known in advance before its application, nevertheless in some instances, the results were disappointingly incorrect. While some interviews were forward-looking, highlighted numerous potential use cases for AI in the future of banking and obviously positive, their corresponding sentiments were sometimes unjustifiably negative, and vice versa. This could be attributed to the inexhaustive lexicon and limited training data within the Azure model. Additionally, the researcher anecdotally plotted the results generated by Azure against the researcher's own sentiment analysis and the comparison showed an agreement of only 68.78%, meaning that only 68.78% of the Azure sentiment analysis matched the researcher's opinion.

As per Azure team, the model is highly sensitive to the input it is given. As the system only processes text, its performance is highly dependent on the quality, fidelity and formatting of the input text. Therefore, it is recommended to use the best possible combination of automatic and human transcription, especially for voice source data, to ensure optimal results (Microsoft, 2023a). In the case of this research, the interviews were transcribed by MS Word dictate function and then reviewed by the researcher himself. The quality of the data could be debatable since there are better performing transcription methods than MS Word, nevertheless the researcher went through all the transcribed data and corrected them manually.

Azure Cognitive Service for language feature models has been trained by Microsoft using natural language text data that mainly consists of complete sentences and paragraphs. As a result, the service performs best when used with data that closely resembles this type of text. (Microsoft, 2023a.)

Moreover, the model works best with short sentences and thus may not be accurate with large texts ("Excel: Sentiment Analysis," 2016). Also, the model does not possess the ability to discern the relative significance of different sentences grouped together in a paragraph. Therefore, it cannot accurately understand the general context from a paragraph. (Microsoft, 2023b.)

The inconsistency in sentiment analysis could be attributed to the limitations of the Azure machine learning model or the methodology used whereby the sentiment analysis was conducted on a conversational text from an oral discussion, and where sentences were analysed individually without considering the context of the entire conversation. During the interviews, many participants discussed the challenges and inefficiencies of the banking system to justify the potential benefits of AI in the sector and the brighter future it could bring. However, since the analysis was done sentence by sentence, it did not consider the whole context of the discussion, which either way Azure is incapable of handling.

Therefore, sentiment analysis has limitations as the sentiment expressed towards a subject may have different meanings depending on the context. For instance, the sentence "Fintech are winning market shares and gaining customers" may be perceived positively and optimistically in the context of Fintech advantages and market position. However, in the context of banking, this same sentence may carry a negative connotation as it implies that banking is losing market shares and customers. Therefore, although the words used in the sentence may convey a positive sentiment, it fails to accurately capture the sentiment regarding banking. In that case, the same sentence infers a negative sentiment towards banking and a positive one towards Fintech.

Another notable weakness of this method is its handling of sentences containing double negatives. For instance, a sentence containing a negative word that is intended to express a positive sentiment, such as "I don't hate the feature" or "banks are not slow because they don't want to transform", might be interpreted as very negative by the sentiment analysis tool ("Excel: Sentiment Analysis," 2016).

It was also noticed from the observation of the sentiment results, that negation sentences get more negative sentiment even if they convey a positive message. Sentences could use negative connotations also to infer a positive meaning, however this is not picked up well by Azure who gives a wrong response.

For example:

- “Banks are not that lagging behind the competition”, “Banks are not slow at adapting changes.” In other words, banks are quick at adapting to change. These sentences aim to give a positive opinion about the speed of AI adoption in banking, however the use of word convey another sentiment for Azure.
- “Companies like this who are **not only** getting smarter in the way they look at someone's credit risk profile using things like the major or the school and things like that, **but also** showing a massive improvement in terms of user interface”. The expression: not only getting smarter but also etc., emphasizes greater benefits and positivity. However, the Azure model gave a negative sentiment result, which is assumed due to the use of the negation words **not** and **but**, negatively affected the outcome. Moreover, after the researcher experimented with the results, it was noticed that removing the expression **not only**, resulted immediately in a positive sentiment.
- “We should be able to uplevel also, **not just** our call center people, **not just** our researchers and security, **not just** our stock analysts, **but** everyone. I think that's where I see the future going.” The negation here is used to highlight that the benefits from AI will not be limited to only certain aspects but will have a large impact in many areas in the future. The sentiment here is obviously positive, but the Azure model results were negative due to the use of the repetitive negation “not just” and “but”.
- “And then the final thing I would say is definitely **not all bad**, like banks still have huge advantages in terms of their size, in terms of their global

reach and customer base, in terms of their reputation". Also, here the use of negation words affected adversely the results.

In addition, the use of examples and analogies to illustrate a point about AI are hard to analyse by the Azure model who looks for sentiment inside a text and cannot understand the broader context behind the example or satire, or irony. For example, Nishant Shandra gives an analogy of Pizza and Lasagna to illustrate the difference between legacy systems and AI systems. Another limitation of the model is its ability to understand satire and sarcasm, like "good luck integrating AI into all your processes".

Therefore, since the Azure sentiment analysis model was not consistently reliable and occasionally produced false positives and false negatives, the ultimate determination of sentiment in statements was also reliant on the researcher's judgment and discretion.

Moreover, Kwok (2021) conducted a comparison of Azure Machine Learning on Excel and AWS Comprehend, two different artificial intelligence (AI) sentiment analysis models, to determine which one was more accurate. The analysis revealed that the sentiment scores generated by the two AI models were quite different, and they disagreed on most of the data, with no discernible trend between the sentiment scores generated by the two models. The author attributes these discrepancies to the relatively new and still-evolving field of natural language processing (NLP) and sentiment analysis, highlighting the need for further improvements in the technology to achieve higher levels of accuracy. (Kwok, 2021.)

Speech-to-Text sentiment limitation

The data to be analysed that was fed into the Azure Model is verbatim transcript of the interviews in the AI in banking podcast. The transcript of a discussion cannot capture the full sentiment by just analysing written sentences. A verbal discussion involves voice intonations that capture much more strongly the sentiment evoked by the interlocutors than a text transcript. Hesitations in formulating

sentences could imply a negative sentiment that text analysis cannot fully assimilate. A stronger tone of voice could imply enthusiasm that evoke a positive sentiment which text transcript method also cannot detect. It is crucial to take into account not only what a person is explicitly stating but also what they are omitting. For instance, does a prolonged silence suggest that the participant is struggling with the topic or merely contemplating their response? (Sutton & Austin, 2015).

6 Conclusion

6.1 Intelligent systems & respective benefits

Based on the theoretical research part and interviews with experts, certain areas of AI in banking have seen higher adoption rates than others due to the current level of technological advancement. The applications of AI in banking are expanding with the development of new use-cases. AI is increasingly being integrated into banking operations, and the future is likely to witness even more AI adoption than the present. The adoption of AI in banking is driven by the need for banks to stay competitive in a rapidly evolving marketplace. Banks are seeking to adopt AI technologies to improve their own offerings and compete with the new market entrants.

AI technological level

According to Verganti et al. (2020), in banking, AI is not always required to mimic human behaviors and decisions, known as strong AI. Even imperfect weak AI which is capable of performing basic tasks, can bring about substantial transformations when implemented on a large scale. This idea was repeated by Gunnar Carlsson who mentioned that what is really beneficial in banking is not necessarily the advanced or spectacular kind of AI, but simple ANI is the kind of bread and butter for banking in the sense that it is a suitable fit for banking activities like decreasing the number of investigations required by humans in financial crimes.

Chatbots

According to Soni et al. (2019), AI has significantly penetrated specific job categories and tasks within organizations, particularly in customer interaction, sales platforms, and human skills. This shift has led to the adoption of chatbots

for customer communication, which can save time, reduce errors, and provide personalized responses, as stated by Sands et al. (2021) and Juniper Research (2017). In the banking industry, chatbots are capable of handling basic tasks, such as answering FAQs and processing payment requests, offering self-service options, and reducing congestion in call centers and branches (Ragotham, 2019; Donepudi, 2017). However, as per the interview with Peter Voss, it was made clear that the current technology utilized in AI chatbots is in its early stages, and the chatbots possess limited cognitive capabilities. These chatbots have limitations in memory, learning capabilities, and contextual understanding, leading to customer dissatisfaction, particularly when the integration with company systems is not optimized. Consequently, the imperfections of current chatbots often frustrate and annoy customers, resulting in low reusability among customers. Nevertheless, the expectation for the future AI models is promising and Peter Voss aspires for newer technological capabilities that will revolutionize the use of chatbots. He foresees the future of the technology to potentially remember every client, their conversations and enabling cognitive capability that will elevate the human-chatbot interaction.

According to Peter Voss and Adam Hunt, chatbots can decrease load on the bank employees and relieve them from the most basic questions in customer service like resetting passwords, inquiring about balances and check collections. This will free up employees to focus on more meaningful tasks and higher-level customer conversations that will empower them to perform more rewarding tasks and boost job satisfaction, as mentioned by Fares et al. (2022) that AI will allow the reallocation of employees to a higher value duty.

Personalization and customer prediction

The utilization of computational intelligence and machine learning in the banking industry has led to the expansion of personalized banking and recommendations. By analyzing clients' historical data and spending patterns, banks can deliver tailored financial advice, tips, and suggestions to enhance the

financial well-being of customers. (Donepudi, 2017.) Additionally, AI's analysis of transactional data also provides insights into customer lifestyle choices and behavioral patterns, facilitating the creation of tailored marketing campaigns (Königstorfer & Thalmann, 2020). Gunnar Carlsson mentions similar ideas that the application of AI in the study of customer intelligence empowers banks to identify the most fitting products or services for specific customer segments, leveraging customer data to customize offerings and enhance satisfaction and engagement. Sebastien De Brouwer adds to that statement by saying that an important crucial impact of AI on banking activities is the potential to significantly enhance the customer experience. By leveraging data analytics and focusing on interactivity with clients, banks can deliver more personalized and superior offerings.

Also, AI has the potential to predict the perceived quality of banking services and optimize it by evaluating the optimal balance between cost and customer satisfaction, as highlighted in a study by Castelli et al. (2016), which is also confirmed by Carlsson who said that AI-powered systems can analyze customer behavior patterns, enabling the identification of signals of dissatisfaction and engaging them before they escalate.

Credit and lending

AI enables more accurate credit predictions by leveraging previously unused data types, such as social media activity, internet behavior, online purchase history and incorporating non-traditional data like utility bills, telecom records, and social media information to enhance the estimation of default probabilities (FICO, 2022; Ragotham, 2019). An example was given by Lee Smallwood that illustrates such AI capabilities. In the student loan industry, there has been a historical lack of diverse and sophisticated financial options. However, newer companies like CommonBond and SoFi are leveraging innovative AI approaches by considering factors such as major or school attended to assess credit risk profiles more intelligently. Gunnar Carlsson also mentions that

introducing novel methods of evaluating credit risk for individuals with no prior history is one of the areas where AI will enhance banking processes.

Fraud and AML prevention

Analytical AI is the most widely employed type of AI in businesses today and in the banking and financial industry, this includes programs or software designed to identify and prevent financial fraud and money laundering (Kaplan & Haenlein, 2019b). Using AI-powered cognitive fraud analytics, a machine learning (ML) model can be trained in real-time behavioral profiling to identify suspicious behavior and enhancing fraud detection capabilities (Ragotham, 2019) and detect patterns associated with money laundering and credit card fraud within large datasets (Königstorfer & Thalmann, 2020). The application of unsupervised learning to detect anomalies in the data, followed by supervised learning guided by human expertise, allows for the injection of human knowledge into the process and improves fraud detection with each new training data (Bauguess, 2017).

Many interviewees discussed the topic of AI in fraud and AML prevention because of its natural fit in solving much of the challenges that banks face in fighting crimes. Owen Hall emphasized the importance of AI in fraud prevention to protect customers who are leaving more and more digital footprints online that make them more susceptible to thefts. Scott Nowson also speaks about AI's capability in fraud and money laundering transactions by discovering trends through thousands of data extending over many years in just seconds which is impossible for humans; and by reducing false positives which facilitates the humans' task in reviewing data. Sergey Gribov also mentioned his company Secure that is doing virtual identity and fraud prevention for banks with AI and is returning much better prediction results. Gunnar Carlsson talked about the use of unsupervised analysis in anomaly detection for fraud. Adam Hunt talked about AI's crucial importance in cybersecurity due to the evolving ways that

criminals commit frauds and who are also using AI themselves for criminal activities.

The benefits attributed to the application of AI in fraud and AML as per Scott Nowson and Gunnar Carlsson are that it reduces the number of false positive alerts and the investigations required by humans in financial crimes. Thereby, freeing human resources and reallocating tasks to a higher level of expertise.

Other applications

Greg Council talked about specific use cases of applying AI in check processing and mortgage handling that did not appear in the theoretical part of this study.

In mortgage lending, the process of validating information is a very detail-intensive and time-consuming process that eats at the bank's employee manhour and customer waiting time to access the loan. AI can help in this workflow is through traditional document automation where AI looks at standardized types of documents like forms and collect information for search. However, AI can also perform more advanced action through employing machine learning and more precisely by applying the deep learning elements of machine learning to handle more complex tasks that include a high degree of variability and give a decision whether the document is correct or needs review.

In checks processing, the power of AI computer vision is being utilized for signature verification, reading dates on the check and analysing whether the date falls within a certain window that is acceptable before rejecting the check. Also, AI can analyse the check image to scan for small details that could point to a counterfeit check. The ability of AI to accurately perform a task that is prone to error by humans, is the reason banks are looking to automate this process with AI.

Also according to Greg Council, the benefits of AI assistance in mortgage lending include reduced waiting time and effort, resulting in an enhanced customer experience, higher satisfaction and cost savings from reduced

manhour involved in the disbursement process. With AI, mortgage lenders can streamline tasks, expedite processes and mitigate risks. The collaborative partnership between AI technology and human professionals leads to more efficient and reliable mortgage lending practices, benefiting both banks and customers. Thus, this synergy of AI and human optimizes the mortgage lending journey, improving efficiency, accuracy, and overall satisfaction.

Christophe Makni also talked about the efficiencies provided by AI in banks' internal processes. AI can enhance internal processes, improve decision-making and achieve cost reduction by automating and optimizing operations. This adoption of AI technology ultimately contributes to a more competitive and successful business, positioning banks favourably in an evolving digital and competitive market. By harnessing the power of AI, financial institutions can drive efficiency, agility and innovation, enabling them to thrive in the modern banking landscape.

6.2 Challenges

6.2.1 Bank challenges

Increased competition

A common theme that was recurring throughout the thesis was the bank challenges. To understand the broader picture of why AI is being considered in the banking sector and what are the benefits that it brings to the table, first one should understand the changes that are happening in the market and how they call for an AI intervention to remediate those challenges.

Competition has intensified with the emergence of non-traditional channels such as Challenger banks and FinTech. These competitors offer similar services but operate under different regulations (Königstorfer & Thalmann, 2020). The rise of big tech companies like Google, Amazon, Apple, and Facebook poses a significant threat to traditional banks as these companies possess vast amounts

of customer data and have the potential to disrupt the industry further, capture market shares from traditional banks and commoditize their services. (Carpenter, 2020). This idea was echoed by Sergey Gribov who views the banking sector as already a commodity with no significant differentiation and believes that Fintech companies will dismantle the sector into pieces, appropriate the profitable banking services and leave the banks to offer low profit generating activities. Lee Smallwood also believes that Fintechs are gradually rendering certain traditional banking services as commodities by introducing innovative solutions that leverage technology and AI to provide efficient, user-friendly, and cost-effective alternatives. Owen Hall affirms as well that there is a challenge for traditional banks coming from the nimbler FinTech firms who are able to provide banking services at a lower cost.

Customer expectations

On the other hand, modern customers have raised their expectations when it comes to banking services. They now demand the same level of consistency, convenience, and personalization that they experience with consumer internet companies (McKinsey & Company, 2020). Customer experience has become a crucial factor in differentiating banks, and customers expect personalized and seamless interactions without unnecessary hassle (Carpenter, 2020). These ideas were repeated by most of the interviewees. Lee Smallwood mentioned that customer experience is one of the key objectives that is driving management for innovation because it has big revenue opportunities and customer experience is really what wins in the end. Gunnar Carlsson claimed that banks that prioritize understanding their customers and utilize this knowledge to enhance customer experience and retention will emerge as winners in the competitive market. Sebastien De Brouwer also states that improvements in the customer experience domain and interactivity with the customer will be the most important aspect of AI applications.

Obsolete infrastructure

AI implementation in banks necessitates substantial investments in technology infrastructure, encompassing the development of technological processes and the training of specialized personnel to ensure effective AI operations (Königstorfer & Thalmann, 2020). Many banks continue to rely on outdated IT infrastructure characterized by inadequate data quality and legacy systems that lack compatibility, transferability and scalability, posing challenges for implementing AI workflows within their organizations (Columbus, 2020).

In the interviews, Sebastien De Brouwer admits that banks possess a lot of legacy in terms of old systems, infrastructure and people which makes it harder to adopt AI as easily as newcomers Fintech companies. This issue is further emphasized by Nishant Shandra who highlights how the legacy systems of banks is outdated and, in many places, incompatible to plug in the new AI technologies on top of the old systems and banks are starting to notice how these legacy domains limit their capabilities in various ways, including innovating with AI. Nishant also gives analogies of Pizza vs Lasagna to illustrate the difficulty of implementing AI in banking within the current old infrastructure. The legacy systems were made solid and formed a good base for data handling of earlier models. The main idea to be understood from the analogy is that the pizza dough represents the original banking legacy system, the base, which is being topped up with heavy toppings which are new intelligent softwares that weigh on the banking system in terms of compatibility and efficiency. And the new way of going forward with integrating AI in banking is by updating the infrastructure to include AI capabilities in-built at every layer of the banking system, reminding of the layers of the lasagna.

Management implications

1. Strategy and vision

According to McKinsey and Company, less than half of large organizations are effectively implementing AI initiatives (McKinsey & Company, 2018). Moreover, many corporate executives still lack a clear understanding of how to strategically leverage AI in their organizations (Fares et al., 2022). Also, the research by Ransbotham, Kiron, Gerbert, and Reeves (2017) indicates that while 85% of business executives recognize AI's importance for gaining a sustainable competitive advantage, only 39% have a strategic plan for its implementation. This knowledge gap hampers their ability to effectively incorporate AI into their organizations (Ransbotham et al., 2017).

From the interviews data, it was mentioned that management lacks a unified vision and company-wide strategy in implementing AI. Peter Voss talks out of experience that he has seen many AI initiatives fail due to improper AI strategies set by management. He gives examples of strategy failures like several departments within an organization implementing AI investments separately on a department scale instead of a companywide adoption. And Ian Wilson gives similar opinions in what concern management early phases of implementing AI whereby no strategic plan was put in place. AI investments ideas were born out of a desire to imitate competitors and showing off the impressive capabilities of AI without having a definite plan for AI growth and maturity within the company. However, Peter Voss urges managers to have sponsorship from the highest level in the company to carefully implement their chatbots and be well integrated within the organization infrastructure.

Also, Peter Voss warns that after these failed investments, a challenge arises in opting for implementing AI properly after having already invested significant resources and sunk costs, both in terms of effort and money, into multiple chatbot systems. It becomes difficult to discard these existing projects and start fresh with a more comprehensive approach.

Nevertheless, Ian Wilson acknowledges a notable shift in the trend of learning and understanding about AI among executives. Moving forward, executives are increasingly aware of the need of planning and strategy in implementing AI in

banking, and they are aiming for a more deliberate approach to correctly implementing it.

Also, Nishant Shandra and Owen Hall mentioned that banks lack a culture of innovation which hinders the adoption of AI within the bank's organization. Nishant adds that the banking industry is an old and resilient sector that has endured over time through continuous changes in the environment in which it operates, such as economic booms and busts and industrial revolutions. Banks have a conservative culture that values stability and predictability, which may not align with the fast-paced and rapidly changing nature of technological innovation. This culture has helped the banking sector survive and remain resilient to market fluctuations. Furthermore, Owen Hall also affirms that banks often have a rigid hierarchical structure that can make decision-making slow and bureaucratic, making innovation and adoption of new technologies challenging. He nevertheless admonish management to listen to the young generation of employees who might be more aware of AI and have constructive feedback to propose for the benefit of the company.

2. Short-sightedness of management

Another barrier to AI adoption that was learned from the interview with Nishant Shandra is the short-sightedness of management when it comes to AI results. In the interview with Nishant Shandra, it is discussed that AI is a new technology that needs time to reach its full potential and prove its worth. However, management often evaluates investments based on short-term Returns of Investments (ROI), and this can lead to overlooking the long-term benefits of AI. Therefore, AI should only be viewed as a long-term investment. If it is evaluated based on short term ROI, it will never be approved as a viable investment. Therefore, as per Nishant management failure to see the value that can be brought by AI is one of the main reasons why management might overlook the implementation of this new technology. Further on in the interview, Daniel Faggella, the host, goes on to mention that according to a discussion between him and a high positioned leader in one of the biggest banks in Europe, the bank executive admits that if AI investment would be evaluated by

finance people, it will never gain traction within the bank. Therefore, AI needs a proper strategy and vision to be viewed as a long-term investment and not just as a conduit to efficiency, but as a revolutionizing that can reimagine the sector altogether. Also, Ian Wilson adds that the banking sector is not there yet by a long touch, referring to the time when AI will start returning positive financial returns.

Internal communication barriers

Ritchie Ng said that the lack of communication between the technology department and business departments constitutes a large hindrance towards the potential development of AI within a bank. The seclusion of the data scientist and AI-qualified workers into a technology division located at the bank-end of the bank, to conduct research and AI innovation, prevents them from seeing the on-the-ground work of the revenue generating units, like traders, relationship managers, where there is real potential for improvement with AI. This barrier of communication negatively affects the implementation of AI and is one of the challenges for the application of AI in banking. This argument confirms Vasiljeva et al. (2021) findings that the level of interconnectedness and collaboration between the IT department and the business representatives directly impacts AI adoption within an organization.

Regulatory constraints

Weber et al. (2023) also mentions that the rules generated by AI based on data often lack comprehensibility to human understanding. This lack of transparency poses a challenge in explaining AI decisions, thereby hindering the practical implementation of AI models, especially in regulated domains like finance where stringent requirements for intelligent systems are necessary for acceptance. (Weber et al., 2023). And the lack of transparency in these models presents significant obstacles for their practical application. (Wall, 2018; Zhang et al., 2022).

Sebastien De Brouwer asserted the importance to acknowledge that the banking industry operates within a highly regulated and supervised sector. As a result, banks often approach the adoption of new technologies with caution. They must navigate through approval processes from regulatory authorities who may not be fully familiar with these emerging technologies. This cautious approach stems from the need to ensure compliance and mitigate potential risks for the industry. Consequently, banks may be hesitant to fully embrace new technologies like AI until they have been thoroughly tested and approved by the regulators. Moreover, Nishant Shandra mentioned that banks traditionally were bound by legacy systems due to regulatory and security reasons.

This sentiment was also echoed by Lee Smallwood from Citi bank who claimed that the Fintech world including banking has been one of the slowest to see changes in terms of AI and machine learning due to the regulatory and capital requirements imposed on the financial sector. These requirements and compliance obligations can act as a significant barrier to innovation and adoption of new technologies, as banks must ensure that their AI technology complies with strictest regulations related to customer information handling and privacy. Failure to comply can result in severe consequences such as hefty fines, loss of reputation, and legal action. Furthermore, the complexity of these regulations can make it challenging for banks to keep up with changing requirements and adapt their AI systems accordingly. This can significantly impact the speed and scale of AI implementation and also even create a disincentive for banks to invest in new technologies that may not have a clear regulatory path.

6.2.2 Intelligent systems challenges

Lack of explainability

The application of deep learning techniques has the potential to enhance lending decisions, but the lack of transparency and explainability in these

models presents significant challenges (Wall, 2018; Zhang, Wu, Qu & Chen, 2022). This issue is particularly pronounced in the European Union, where the implementation of the General Data Protection Regulation (GDPR) grants citizens the right to a clear understanding of the methods and processes that influence final decisions (Wall, 2018).

Scott Nowson explained that at the moment deep learning is not a viable option in the banking environment due to compliance concerns. It is essential to be able to provide explanations and justifications to regulators during audits.

Lack of specialized workforce

Soni et al. (2019) claims that AI-related skills have become increasingly crucial in the workforce, with over one third of the most sought-after skills being AI-related as of 2018. However, there is still a lag in the market's adaptation to this shift, as job postings for AI skills in the US tend to remain open for longer periods due to a shortage of specialized talent. And China on the other hand, has taken proactive steps by incorporating programs for AI education in educational institutions, recognizing the significance of AI skills as the skills of the future. (Soni et al., 2019.) This might translate in new required skills and versatile knowledge demanded from bank employees who have always had a specific education in the past. The future will push bank employees to develop new set of skills that accommodate AI and better expertise in handling its different platforms.

Ritchie Ng also talked about the challenge banks have been facing in attracting AI scientists/specialists to the sector by linking to the previously mentioned challenge, whereby the lack of communication between departments can make the AI scientists feel that their work is meaningless and is not having an impact on the business, thus causing AI talent to leave banking in favor of tech companies who will appreciate their work and put their effort to good use where the results are palpable.

Adam Hunt confirms that there is scarcity of AI talent in the market at the moment. Out of the many possible jobs an AI specialized person can land, banking cybersecurity and fraud prevention is not among the priorities of AI scientists. The latter has the potential of landing much more attractive jobs like self-driving cars or cancer research. Therefore, for banks to attract AI talent they need to fight for them.

Lee Smallwood also emphasizes the importance of AI talent by stating the most important advice for management at the moment is investing in AI talent.

Sebastien De Brouwer also commented on the importance of AI talent and AI education for everyone in the bank. Banks currently face the challenge of acquiring the necessary skills to develop AI solutions and while having data scientists is valuable, it is equally important to have a well-trained support team to maintain the underlying AI infrastructure, acting as the backbone of the bank's AI capabilities. Therefore, this involves ensuring a skilled workforce for both AI development and ongoing support for seamless integration and operation.

On the other hand, it was also mentioned in the theoretical part that banks are still favouring statistical based models over AI systems due to the complexity and lack of user-friendliness (Bakar & Yosi, 2017). This was confirmed by Ritchie Ng who mentions that banks struggle to attract talent in AI domains due to the existing workforce that favours traditional methods and by Owen Hall who said the people in the IT departments of banks are resisting AI adoption due to their incomplete understanding and lack of knowledge about AI.

6.3 Future landscape of banking

Bank Advantage

Banks possess several advantages that can advance them against other newcomers. For example, AI in lending provides commercial banks with a competitive advantage over non-banking competitors. The extensive customer

data, coupled with banks' special expertise in credit risk management and established client relationships, enables banks to outperform new entrants on such specific services. (Königstorfer & Thalmann, 2020.)

Owen Hall adds to these advantages by saying that banks possess reputation as well as trust, brand, and the branch networks that still matter to keep the trust when customers want to speak to a human being. These certain qualities are missing in fintech startups. In addition, both banks and fintechs have complementary strengths, in the sense that banks' advantages are the fintechs' challenges and vice versa, as seen in the table below:

Table 12. Bank characteristic and its outcome.

Bank characteristic	Outcome
Conglomerate of multiple departments and multi-service provider	Low efficiency and higher cost of services
Larger organizations with physical branches	Easier customer contact
Established companies with high reputation and known brands	High level of trust

Table 13. Fintech characteristic and its outcome.

Fintech Characteristic	Outcome
More focused and specialized services	Higher efficiency and lower costs
Smaller scaler organization with mostly online presence	Difficulty contacting customers

Fintech Characteristic	Outcome
Newcomers with unknown brands and questionable reputation	Low level of trust

Also, Lee Smallwood argues that by leveraging their substantial size, global reach, customer base, and reputation, banks possess significant advantages in the industry. Combining these strengths with a greater emphasis on AI and digitalization can position banks favorably for the future.

Opinion on banking outlook

The opinions and feelings of the interviewees on the future of banking with AI, although mostly positive, were still not unanimously positive. Based on the sentiments extracted from the interviews conducted within the scope of this thesis, the outlook for banks, AI future adoption and future applications in banking were mostly positive. However, some opinions about banking continuity in the future were mixed.

Owen Hall acknowledged the shift in consumer behavior whereby individuals are no longer dependent on a single bank for their comprehensive financial requirements. Instead, they are actively pursuing specialized providers that offer customized services in specific domains. This trend presents a challenge for traditional banks, as they must now devise strategies to compete effectively with these niche providers while maintaining cost efficiency.

Still, Lee Smallwood and Owen Hall strongly believe that banks still hold significant advantages in terms of size, global reach, customer base, and reputation. Lee suggested that by capitalizing on their existing advantages and intensifying their efforts in AI and digitization, banks can secure a favorable position for themselves in the future. Owen Hall acknowledged the challenge faced by banks from unconventional channels. However, to remain competitive,

Owen emphasized the need for banks to streamline their onboarding processes, enhance their value proposition and adapt their strategies and operations to meet customer demands while keeping costs in check. Gunnar Carlsson also noted the importance of understanding customers and utilizing AI to personalize the customer experience and improve customer retention. He mentioned the development and correct use of unsupervised machine learning on clients and prospects is where the banks should focus to win over the competition. In addition, in Adam Hunt's opinion, the winning banks in the market will be the ones who will employ powerful AI conversational interfaces that will allow for freeform interaction and at the same time reduce personnel costs.

On the other hand, Sergey Gribov's opinion on the future of banking was the most negative. He highlighted the commoditized nature of banking services where all banks provide more or less the same services which makes it very hard for them to differentiate themselves. Although, in the short term, the first adopters of AI might be able to get ahead of the competition, but in the long run, all banks will be equated to each other since they will all be applying similar technologies, resulting in a return to a commodity status. Gunnar Carlsson partly agrees with this statement that the technology of AI applications in security, credit and other business-enhancing processes will be similar and will not play a role in differentiating winning banks. However, AI applications in customer interaction and customer understanding will elevate banks against others.

However, Gribov's opinion is even more pessimistic on the future banks. He believes that the future of traditional banks is in danger market since challenger banks, FinTech startups and Big Tech companies are able to leverage their agility and technological expertise to replicate parts of banking and take banks' market shares, in areas of high profitability and customer service application. The new entrants to the market will relegate banks to low profit generating activities like low interest lending and money circulation facilitators.

Lee Smallwood, on the other hand, agrees with Daniel Faggella on the possibility that banks will undergo a transformative process by divesting certain segments of their operations and transforming them into standalone fintech companies. This strategic approach will allow for the emergence of a hybrid fintech-bank conglomerate that can effectively compete in the evolving market landscape. Moreover, when combined with AI, banks' inherent attributes, such as trustworthiness, long experience and reliability, can be enhanced, solidifying their competitive edge and positioning them for success in the future.

Alternately, according to Lee, an alternative prospect for banks would be to acquire their competitor and partner with fintech companies as they emerge to make use of the latest AI technology and eliminate their competition.

6.4 Sentiment analysis of AI in banking

Sentiment towards current AI adoption

The current state of AI adoption in banking is a mix of positive and negative sentiments. Banks are showing eagerness to adopt AI and transform their infrastructure, particularly in areas like consumer lending and mortgages, where AI has proven to be effective in reshaping the finance landscape. However, there are challenges related to security, regulation, and the complexity of implementation that hinder widespread adoption. While there is enthusiasm and recognition of the potential benefits of AI, there is also caution and uncertainty surrounding its evolution. The existing legacy systems in banks pose a significant challenge for automation and AI adoption. Overall, banks are positive about adopting AI to improve their processes and services, but there are obstacles that need to be addressed for more widespread implementation.

Sentiment towards AI current application and capability

The sentiment towards current AI applications in banking is mostly positive with the exception of chatbots. Applications like credit risk analysis, search and discovery, trading decision making, AML and fraud detection, phonetic matching, hotspot analysis, intelligent personal assistants, and AI-driven payment collection gathered positive sentiments. However, chatbots on the other hand, has faced challenges and received negative feedback. The negative sentiment towards them was due to a major deficiency which is their limited understanding and lack of common sense. They often struggle to grasp the context of a conversation and provide relevant and accurate responses. Furthermore, chatbots have difficulty in developing cognitive abilities and memory retention. They struggle to link previous conversations together, making it challenging to maintain a seamless conversation. As a result, customers may need to repeat themselves and lead to frustration. When chatbots are not properly integrated into a company's systems, they may lack access to complete information and thus unable to provide personalized assistance. This can create a negative experience for customers who may need to switch between the chatbot and human agents and repeat information.

Sentiment towards future AI applications

The sentiment towards the future applications of AI is very positive. AI has immense potential in the banking industry, with banks aiming to leverage it in many areas. This time, the prospect for conversational AI, particularly future chatbots, is positive and it is seen as crucial for providing coherent and personalized customer interactions, with the ability to remember previous conversations and deliver smooth experiences. Banks envision AI as having comprehensive knowledge of each customer and transaction, surpassing human agents in customer-facing roles. The ambition is for AI to accurately predict customer behavior, detect satisfaction levels, and intervene when customers face difficulties. Banks also anticipate AI to handle customer

complaints, prioritize customer retention efforts, and offer personalized investment and life advice. In addition, there is enthusiasm around AI future capability for handling complex problems such as trading decisions, credit scoring, enhancing anti-money laundering (AML) processes, thorough customer search capabilities, and transforming business processes through machine learning and natural language processing. AI expected unsupervised machine learning methods for anomaly detection, pattern recognition, and customer segmentation are also viewed positively. Customer-centric AI applications related to customer understanding, interaction, experience, and KYC processes are the most anticipated AI capabilities and are seen as essential for future success in banking.

Sentiment towards future adoption of AI

The sentiment towards the future adoption of AI in the banking industry is predominantly positive. There is a strong belief that AI will have a transformative effect on banking, and banks are willing and aspiring to transform with AI and integrate it even more in their systems. Even the sentiment among banking regulators is also favorable, as they aim to facilitate AI adoption and avoid obstacles that could hinder innovation. However, there is still uncertainty about the progression of the technology and the receptiveness of customers towards it which could affect its adoption. Some interviewees believe that AI adoption in banking will surpass expectations and lead to the discovery of new service channels. However, this transformation requires a shift in culture and mindset within banks which is a known obstacle for innovation. In addition, banks will still face adoption challenges that are innate to the banking sectors like strict regulations and incompatible infrastructure which are viewed negatively.

Overall, the sentiment analysis indicates a positive outlook on AI adoption, with the belief that it will bring transformative changes to the banking industry. The negative sentiments were fewer than the positive ones and were related to the uncertainty surrounding AI's future evolution and which applications will rank

better than others. It is also to be noted that the consequences of not adopting AI were viewed in complete negative light, with concerns about lower quality customer service, lower competitiveness and a disadvantaged trailing position that lags behind competitors with no ability to catch up.

6.5 Future research

Ordinary public sentiment

Finally, since this study focused on the perspectives of AI experts and company leaders, one potential avenue for future research is to explore the opinions and sentiments of the ordinary public and regular employees towards the adoption and use of AI in their daily work. In the interview with Owen Hall, he mentions that the biggest challenge for AI adoption is the people in the IT department resisting because they are asked to start using a technology that they have very little understanding of. If even IT experts, who are generally considered more knowledgeable in technology, are opposed to adopting certain changes, it is then likely that other employees without specialized and technical backgrounds will have an even stronger reaction to the idea of embracing AI. Therefore, it is important to consider the views of those who may not have a technical background and full understanding of the technology. Ordinary employees may have a different perspective on the technology and its potential impact on their jobs, which could potentially conflict with the views of AI experts and leaders. The interview pool that was analysed consisted of high-ranking executives from the banking sector as well as individuals with expertise in AI. These participants provided valuable insights and perspectives on the intersection of banking and AI, shedding light on the challenges and opportunities in this domain. Nevertheless, they do not represent the whole banking industry including its labour force. Ordinary bank employees may have concerns about job loss due to AI or stress of undergoing mandatory re-education to remain relevant in a market where having AI qualifications is required and imperative. This could result in strong negative sentiments that may have an adverse effect on AI

acceptance and hinder its future adoption. Understanding these concerns and perceptions could be valuable in identifying potential barriers to AI adoption and finding ways to address them beforehand.

Ethics and transparency

Other areas for future research could be related to specific use-cases of AI in banking. This thesis provided but a general view of the areas of applications and adoption of AI in banking. Future research could delve deeper into each of the use-cases and try to address the specific challenges to each use-case.

For example, in the case of AI in credit and lending, a challenge for the adoption of AI in that domain could be the legitimacy of the use of private data. Where to draw the line on data privacy and data usage? To what extent personal information can be utilized for credit assessment and lending decisions? What if medical records were used as an alternative data source to evaluate creditworthiness? Surely it will improve the predictability of credit default analysis but is it worth compromising individuals' privacy and potentially perpetuating discrimination based on health conditions? These ethical concerns surrounding AI are an ongoing and evolving conversation that requires continuous reassessment in light of technological advancements, societal norms, and legal frameworks. It necessitates striking a delicate balance between leveraging data for innovation and ensuring the protection of individuals' privacy rights and data security.

Also, other future research could delve into the challenges related to explainability and interpretability of AI models in areas such as credit or compliance. As AI models become more complex, it becomes crucial to understand how these models make decisions and provide transparent explanations to customers, auditors, regulators, and stakeholders. Future research could explore techniques to make AI models more explainable, ensuring compliance and accountability in fraud detection processes and transparency in credit decision-making.

Closing Words

In 1994, Bill Gates famously said "Banking is necessary, banks are not." These words have fueled discussions about the future of traditional banks. And while some have predicted the demise of bank branches in the face of digital disruption and online banking, the reality has proven to be quite different. Despite the rapid advancement of online banking and digital transactions, physical bank branches continue to serve as essential touchpoints for customers. The human connection and trust associated with in-person interactions have proved to be enduring factors that cannot be easily replicated by digital channels alone.

AI in banking follows a similar pattern. The introduction of AI and automation in banking has sparked debates about the potential obsolescence of certain banking functions. However, history has shown us that technological advancements do not necessarily eliminate traditional practices but rather reshape them. While AI-powered technologies can automate routine tasks, they also create new opportunities for employees to engage in higher-value activities that require critical thinking, problem-solving, and relationship-building skills. AI can augment human capabilities, enabling employees to focus on complex customer inquiries and essential human-to-human communication which still values the reassurance and trust that comes from face-to-face interactions with knowledgeable bank staff.

So far, banks have maintained their undisputed position, yet the question remains whether traditional banks will remain indispensable in the future or whether new players in the industry will continue to challenge their role as financial intermediaries. In the end, it remains to be seen how the industry will evolve, but one thing is clear, is that banks must be willing to adapt and embrace new AI technologies to stay competitive.

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Interview 1 - AML and compliance officer

- 1- How long have you been working in the banking sector? And how long have you been in your current position?
- 2- Have you seen any evolution or advancement in the tools you use in performing your work?
- 3- Can you tell us what kind of intelligent systems or tools are in use to aid you complete your tasks?
- 4- Do you feel yourself substitutable or threatened by Artificial Intelligence or intelligent systems?

Interview 2 - Customer manager at LSEG

- 1- Can you tell me about your product and if it includes any Artificial Intelligence capabilities?
- 2- Who is your biggest clientele?
- 3- Do your clients appreciate the smart features in your product? How do they react when introduced to the AI capabilities in your product? Do you notice any particular reaction from their part?
- 4- Is there a specific tool or feature in your product that you mention to impress your clients? If yes, does that feature employ Artificial Intelligence?
- 5- What is your sentiment towards Artificial Intelligence?

Appendix 2

Table 14. Sentiment analysis of current AI applications and capabilities.

Table 14. Sentiment analysis of current AI applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
The very best AI chatbot today does not have common sense and a very limited understanding. Also, lacks empathy.				
AI chatbots failure to satisfy customers due to wrong implementation and low integration				
Low capability, non-cognitive AI does not understand properly and has no memory				

Table 14. Sentiment analysis of current AI applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
AI chatbot incapable of linking previous conversations together				
Current chatbots limited understanding				
Current limited technology makes that chatbots lack cognitive ability				
Chatbots lack of memory, lack of understanding and incapability to learn, affects its current functionality and usability				
				Chatbots lack of memory is frustrating when

Table 14. Sentiment analysis of current AI applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				conducting a conversation
			chatbot limited understandi ng capability to connect events and previous conversations	
		AI chatbot incapable of memorizing previous conversations		
	Limited understandi ng and simplistic technology, are not up to the task			

Table 14. Sentiment analysis of current AI applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
Limited capability chatbots are annoying customers				
	AI technology at infancy level			
AI used as open-source technology				
				Lots of opportunities for AI in banking in high dimensional and multivariate problems (AI opportunities and future adoption). Alternative methods for credit scoring

Table 14. Sentiment analysis of current AI applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				and multiple-factor trading decisions (AI current and future applications)
		AI analysis of student loans		
				AI benefits lead to user interface improvement, paperless automation (AI benefits). AI in credit risk analysis (AI current application)
				AI analysis of student loans

Table 14. Sentiment analysis of current AI applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
			AI application progressed from 10 years ago. Currently it is easier to automate trading decision making process with AI, compared to before	
				Better credit default predictability than traditional methods and lower fraud numbers
Not fully capable AI (current capability) Uncertainty towards AI				

Table 14. Sentiment analysis of current AI applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
evolution (current adoption)				
				Loan assessment with AI is capable now but it is expected to be very much improved with time
			Loan assessment with AI	
			Loan assessment with AI is important, but does bring less returns than AI in regulations	

Table 14. Sentiment analysis of current AI applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
	Currently in adoption in call centers			
Technology is still nascent and relatively new, especially in customer intelligence area. Moreover, there is currently no major groundbreaking invention				
			Customer classification in clusters according to similarity. Understanding each customer category's need. These AI capabilities are existing now but will	

Table 14. Sentiment analysis of current AI applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
			improve in the future.	
		AI in AML and fighting crime and anomaly detection		
		Hotspot analysis, detecting major shift in customers clusters. Detecting customers churn and customers leaving the bank		

Table 14. Sentiment analysis of current AI applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				Current usability of unsupervised ML in AML, hotspot analysis and churn detection, ready to be implemented now in banking
		AI can detect evolving security threats. Criminals have difficulty overcoming AI security		

Table 14. Sentiment analysis of current AI applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				AI application does a lot of the collection, a lot of pivoting for the analyst, through the app. So it also uplevels the stock analysts and security analyst skills.
			AI capable of onboarding and protecting accounts because it is a manual process easier to implement than deeply understanding	

Table 14. Sentiment analysis of current AI applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
			customers which requires an advanced technology	
			AI capable of monitoring fraudulent transactions	
			AI system that looks for customers based on the phonetic sound of their name (Current AI application) and helps officers search for fugitives accounts (AI benefits)	
			AI provides personalized	

Table 14. Sentiment analysis of current AI applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
			, timely and market insights	
				Real-time insights around the clock
		AI evaluates customer behavior, meetings and contacts to provide daily updates of news content, breaking news, and pre-meeting briefings		

Table 14. Sentiment analysis of current AI applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				<p>Better collection results with better AI models that personalise services to customers (AI benefits). AI capable of offering solution in context by addressing the customer at the right place, right time, with the right content. Current application in payment collection (current AI application)</p>

Table 15. Sentiment analysis of current AI adoption.

Table 15. Sentiment analysis of current AI adoption.				
Very Negative	Negative	Neutral	Positive	Very positive
			AI is not considered seriously in some areas of banking	
				AI popularity and attractiveness is drawing attention
			Banks are not slow at adopting AI. They are relatively fast compared to other sectors	

Table 15. Sentiment analysis of current AI adoption.				
Very Negative	Negative	Neutral	Positive	Very positive
Banks are eager to transform and adopt AI, but they are hindered by security and regulation issues				
			AI adoption is starting among the biggest finance organization	
				The current adoption of AI in consumer lending and mortgages have been effective in changing the

Table 15. Sentiment analysis of current AI adoption.				
Very Negative	Negative	Neutral	Positive	Very positive
				finance landscape
Not fully capable AI (current capability) Uncertainty towards AI evolution (current adoption)				
currently cautious AI adoption				
				Non-complex and basic AI knowledge and capability in banking security is sufficient

Table 16. Sentiment analysis of AI future applications and capabilities.

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				The AI opportunities for future application are customer support, sales, customer interaction and internal processes
				Banks are aspiring with AI to have a high quality conversation and a better customer understanding and engagement which will lead to a more stickier relationships with their clients
				Companies want that AI Chatbots memorise previous conversations to

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				have a continuous discussion
		There is a need and aspiration for conversational AI		
			Hope that AI reach a level to become as a general assistant to clients with deep engagement	
		Aspiration for a coherent and uniform chatbot interaction		

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				Aspiration for a seamless customer-chatbot interaction
				Hoping that future chatbots memorize previous conversations
		Aspiring for an AI capable of predicting customer behavior and intervening when noticing customer in distress		
			AI ambition for an integrated omnichannel connected conversational interface	

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
		There is a need for conversational AI		
		Vision of having a personal interaction with every customer at a large scale with the aid of AI		
		With the help of automation and AI, personal relationship and interaction with customers is feasible		

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
			Future AI capability will allow to memorise every client and transaction.	
	Business owners are thrilled that AI's future capability will be able to achieve a personal interaction with customers			
Aspiration for a multifunctional AI capable of assisting customers				

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
in many department				
			Vision of a multifunctional AI assistant	
				Banks who are expected to succeed are the banks that will have better customer interactivity thanks to AI
				Expectation that future AI applications will provide personalized investment advice and recommendation

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				AI is expected to provide personalized investment advice beyond just financial advice to all clients, retail and corporate
				Expectation that AI in customer interaction will be a major winning advantage for banks that adopt it
				Lots of opportunities for AI in banking in high dimensional and multivariate problems (AI opportunities and future adoption). Alternative methods for credit scoring and multiple-factor trading decisions

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				(AI current and future applications)
			AI is to be utilised to improve the customer experience of all the clients, and is not just a new technology addressed to millennials.	
				Expectation that AI will be capable of replicating human decision making
				AI in customer experience is seen as one of the important AI application that will drive profits in the future

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				AI is expected to do a much better job than humans in customer interface type of work, because AI will have full customer knowledge and will know every single customer, transaction and detail.
				Expectation of AI to become all knowledgeable about all details and even will know what interests customers on the internet or their facebook page

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				Aspiration on AI capability providing better customized recommendation for clients and discovering new potential clients related to existing clients, like business partners of an existing customers.
				The correct deployment of AI is first through looking at improving the existing business processes and then reimagining a new form of business in the future. (AI correct implementation). AI will improve current business

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				processes (AI benefits) and reimagine business of the future (AI future capability)
			Hoping for AI to be capable of sorting potential customers for bankers to go after	
				Aspiration for AI to support businessline strategies and be able to collect information on potential customers, sort of like a Facebook for banking.
			AI in banking will evolve and mature	

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
			dramatically in the future and banks will know how to make use of AI	
			Aspiration for AI to replace paper reading and old process with computer vision, ML, NLP (AI future capability and application), which will bring in ROI from automation.	

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				AI can read millions of documents in short period of time (AI future capability) and speed up bank processes (AI benefits)
			There is a need for AI applications to handle complex AML process	
Limited capability of AI is still sufficient and useful in banking				
				AI is expected in the future to know customers at a deeper level, know the

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				taxonomy of customers, understand and serve customers better. AI can create customized products for specific customer groups
			AI is expected to detect customer satisfaction and preventing problems and dissatisfaction from growing by addressing them immediately	

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
AI will be able to detect and prioritize clients in risk of exiting the relationship and leaving the bank. Also it will find products that fits well with clients needs.				
				Loan assessment with AI is capable now but it is expected to be very much improved with time
			Loan assessment with AI is	

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
			expected to grow and be more adopted	
			Loan assessment with AI is important, but does bring less returns than AI in regulations	
		Belief that AI applications in KYC will be among the most important important AI applications		

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
			Assumption of widespread understanding of the direction in which AI is heading and the crucial issues that it needs to tackle.	
				The unsupervised methods of analysis with AI will bring more flexibility in analysis and will solve the problems where there is uncertainty on hypothesis and where there is no general agreement on the

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				objectives to be reached
			Customer classification in clusters according to similarity. Understanding each customer category's need. These AI capabilities are existing now but will improve in the future.	
		AI in AML and fighting crime and anomaly detection		

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
		Hotspot analysis, detecting major shift in customers clusters. Detecting customers churn and customers leaving the bank		
			AI future aspiration to more adopt unsupervised learning AI in applications that study and better understand customers	

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
				AI is expected in the future of handling and prioritizing customer complaints. Also AI is expected to understand trends of complaints which will help address them proactively and get ahead of the problem before it expands
		Aspiration to have a free form interaction with AI without the pre-structured queries, where AI would understand		

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
		fully the customer		
				Aspiring for new AI products that level up employees' capability
	AI will be used to service and onboard customers			
		Customer understanding, product customization, Streamlining banking consultancy and advice services to all clients not just high net		

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
		worth individuals		
				AI wide adoption in banking in many areas and AI application will discover new service areas that were not possible before
			Identifying and confirming customer identity online	
		Hoping that future capability of AI will be able to understand customers better to adapt		

Table 16. Sentiment analysis of AI future applications and capabilities.				
Very Negative	Negative	Neutral	Positive	Very positive
		services to their needs		
			Optimistic opinion on AI future capabilities changing the way businesses operate to the better	