

A Work Project, presented as part of the requirements for the Award of a Master's degree in Finance from the Nova School of Business and Economics.

Topic of the Thesis:

“Gaining a competitive advantage through data analytics and business intelligence in the banking industry”

Jerzy Adam Bialogorski

Work project carried out under the supervision of:

Francisco Queiró

03-01-2021

Abstract

The banking industry is at the brink of a digital revolution with start-up companies pushing technology into this sector. This paper aims to research exact methods that Fintech use to disrupt the field and explain how established Banks could make an impact by implementing them into daily business. To give clear recommendations on trending techniques, a quantitative study was conducted with a preceding quantitative research stating the importance of the matter. The results are clear, with Artificial intelligence being, by far the most common, state of the art technique used to disrupt the way people use and perceive banking.

Keywords: Fintech, Data Science, Banking, Big Data, Neo Banks, Data Analytics

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209)

1. Introduction

1.1. Introduction to the topic

Banking is an example of a rather specific business sector. It is in banking where trust accounts for a huge role, with established and endured institutions historically working like magnets for individuals seeking solid, and secure financial services. It is also the banking sector that has been resistant to disruptive technology for many decades, preserving conservative image with many complicated structures and a high degree of regulation.

The arrival of Fintech companies strongly indicates the need for change and innovation. With the new generation of digital customers seeking digitalisation and personalisation in every aspect of their life, banks need to adapt to fulfil these needs. In such constellation, it is crucial to be able to depend on solid technology, in order to imply changes. Therefore it is vital to identify those, and define which exact ways of implementation can prove beneficial. (Dietz et al. 2016)

In the XXI century, data has become a strategic asset, a commodity that is not only traded, but most importantly, used to expand and improve the way businesses operate. In the modern, fast paced business environment, huge, established multinational companies have very limited time for data scepticism, as data changes the way we live and work in almost all day to day aspects. Start-up companies, on the other hand are often born digital entities that create their business models around data and use latest trends in the field of data science to find value in the market. Such competition is forcing traditional businesses to restructure the way they operate and think about new technologies and their possible implementations. With rapidly evolving analytic techniques, big data and data gathering techniques, the trend is here to stay and will only gain on importance in the markets of tomorrow. (Marr 2017)

Companies like Google or Facebook are very often presented as an example of entities that are built on their user's data but the trend is spreading widely across all the industries. Data

science is an ever growing trend in the banking industry and is more often perceived as being a competitive advantage for those players who succeed to implement it across their organisation. Through the last decades, banks have had to face and incorporate digital innovation into their structures to present their customers with an ever growing offer. Innovations such as plastic credit cards incorporating microchips, or in recent years online banking, have proven that such institutions are keen and able to evolve. This time, the industry is approaching a revolution, rather than evolution and is challenged to welcome Data Science into its structures. Data science tends to be interpreted very broadly, and there are many ways to understand it. It is very important for management entities to clearly understand the exact possibilities of how particular technologies can help their companies grow and attract new business. Banking of tomorrow will no longer be associated with a particular institution, or even a physical building, but rather it will be seen as a service that provides a certain set of benefits to their end user. Services on demand, popularity of content providers and mobile apps that allow people to fulfil their everyday needs have created demand for banking to go digital, more customer focused and available at our fingertips, at any time. The common shift towards subscription models, shared economy and on demand services is a reality and it elevates the expectation of customers in every industry. People are becoming used to being served with greatly personalised offers and tailor made products without the hustle of taking unnecessary actions. Technology is here to help banks adapt to the new reality and will show, that the ability to stay up to date is as crucial in this sector, as it is in the whole economy. (Arslanian and Fischer 2019)

1.2. The objectives of this thesis

Banks and financial institutions are facing a challenge to adapt to new, dynamically developing digital reality and urge to answer the question of how to utilize Data Science and

define which technologies will be particularly important in the banking industry in the years to come.

This paper is set to present the status quo in the industry and explain some crucial Data science principles and implications. Moreover, the research conducted is aimed to highlight the exact technologies that have gained relevance within the last years. In order to be able to explore this topic a research question has been formulated:

“What should traditional banks learn from FinTech companies and how to make the impact with data science?”

To deliver a grounded answer to this question, the second chapter of this paper starts with a description of the current status of data science and explains the basic terms and concepts with the possible implications for the industry. Furthermore, current leaders in data utilization in the banking industry are presented and shortly analysed. Chapter 2 continues with an example of a fintech that has been able to work their way up to becoming a stand-alone licensed financial institution. After explaining the theoretical background, the 3rd chapter presents the reader with the methodology and description of a conducted study. Subsequently, the reader is presented with statistical results.

The 4th chapter discusses the results of the study and its possible implications for the whole industry, highlighting the most relevant technologies.

2. Theoretical background

2.1. The meaning of big data for companies

The vast majority of the world’s data is generated by users interacting with services and applications to solve every day, individual needs. Every click, input or even credit card

transaction leaves a digital “fingerprint” containing information that, gathered together account for the Big Data. Big Data has become very valuable to companies that are able to extract insights and intelligence out of it. The amount of things that can be done digitally, or even simple devices that are connected to the web, like our cars or speakers, provide for a vast, exponential growth of data volumes recorded. The growth is so substantial that in 2018 IBM reported that over 90% of the world’s data has been gathered within the two preceding years, with the trend becoming ever stronger. Big Data, with the help of data analysis has found many applications all over the market that allow existing businesses to improve and encourage creation of new ones to solve problems in an innovative way. Data can definitely be seen as an opportunity, but what does it mean for the banking industry?

(Cao 2018)

2.1.1. Open banking initiative

Companies around the globe gather customer’s data in order to gain intelligence utilizing it. Nevertheless, the customer’s data gathered by an institution belongs, by law, to the individual generating this data. This means that each person has a right to forward their data to a third party of their choice.

Innovations and regulations introduced in the banking sector within the last ten years have forced the industry to evolve into a new, digital, transparent reality. Open banking initiative regulates matters concerned with data sharing and makes it possible for its transfer with the use of special, newly created vehicles. A special vehicle that has been created to allow for uncomplicated data transmission within financial institutions is called API. API stands for Application Programming Interface and can be used as an intermediary to transfer our data or orders to another provider. By doing this, the entity receiving our data can come up with a whole new concept of analysing records to provide us with even more tailored, better and more

efficient services and offers to manage our time and money. Many start-ups in the Financial sector are built up on this principle, that “feeds” their innovative, state of the art models in order to provide meaningful insights. API has found many applications, not only to “retrieve” data but also allowing programmers and visionaries to give customers access to more convenient services, such as mobile phone wallets or wireless payments. The implications and possibilities seem enormous, but the majority of them are made possible thanks to data analytics, as it lies at the heart of banking revolution. (internationalbanker 2020)

2.1.2. Big Data, Data Analytics and Business Intelligence in Banking Industry

The term Big data describes large datasets with vast volumes of information. Every day, hundreds of millions of transactions are recorded within the industry, creating an ever expanding “ocean” of data. This information comes in many forms, as structured and unstructured data and can be gathered using different techniques and according to various principles. Data reaching the banking industry can be divided into transactional data and insights gained through the customer’s interaction with the bank. This division is of major importance from the data scientist’s perspective, since the transactional data is mostly very standardised and structured, what allows for a huge degree of automation. The data gathered through interactions, on the other hand, comes often in a great variety of different formats and can, in the most cases, be only analysed by taking an individual approach to each case, therefore being hard to automate and scale-up. Since the whole concept of using Business intelligence enables widespread automatization of tasks, finding patterns in standardized approaches and discovering variations is the most common approach within the industry. (Hasan, Popp, and Oláh 2020)

2.1.3 Artificial intelligence

Artificial intelligence is often associated with big tech companies striving to engineer their algorithms to perfection. The technology can be used not only to analyse complex datasets but has also the potential to be trained to take over some of the human's duties and make dreams like autonomous vehicles a reality. The Big tech companies are particularly interested in the AI implications in the banking industry, as the companies take on highly skilled, immensely talented visionary employees utilizing their specialist findings in the banking sector field. McKinsey estimates, that by implementing Data analytics and AI technologies, global banking business can gain up to 1\$ trillion additional value per year. This is one of the reasons why banks should seek to implement Artificial intelligence into their daily business.

By analysing each customer's behaviour individually and comparing their actions with known, or newly discovered patterns AI could contribute to offering a tailor made, direct banking service for everyone. Personalized services, tend to attract more attention as they suit individuals better and are much more efficient than standardised products and campaigns. By understanding customer's needs, financial institutions have the opportunity to significantly boost their revenues, while reaching, never before encountered, levels of cost efficiency. Implementing AI in the company means complete redesign of the old structures, saying goodbye to silos and working in divisions in order to unite all the bank's functions into working with a cross functional platform. This, on the other hand, while extremely hard to implement, could pay off quickly, as the institution would become much more agile. Becoming agile and getting rid of structured processes is the key to compete in the ever growing, fast paced business world of tomorrow. Agile companies can innovate faster, are able introduce new projects and ideas within days or weeks instead of months or years, therefore staying on the lead in their respective fields. (Biswas et al. 2020)

2.2. Fintech as neo-banks

Disruptive technology firms in the financial sector tend to emerge as start-ups with innovative ideas on how to improve services and customer experience offered by established banks. Modern technology opens a whole new spectrum of data management and utilisation possibilities, that are adopted through many industries, mostly by start-up firms, due to their innovative staff and unattainable agility. New entrants in the financial industry can choose to be standalone entity and compete directly with banks or cooperate and fill a niche that is not fulfilled by their ordinary business fields. (Rubini 2017)

Neo-banks is a term that describes fintech entities whose primary goal is not to innovate on their product and develop new opportunities with data science, but rather to focus on accessibility. Neo-banks are shortening the distance between banks and customers offering much simpler processes and sleek multichannel approach to platform based banking. Although the field is just emerging, it is already quite difficult to differentiate between neo-banks and “classical” fintech in many cases since the constant evolution of these concepts has made the boundaries rather blurry. (King 2014)

2.3. How to “Spotify” banking – Fintech that has become a stand-alone bank - N26

Fintech institutions are changing the landscape and defining new rules that the banking industry will follow in years ahead. Only a few years back, in 2013, just an idea of such an enterprise was widely met with critique and underestimation. Back then, two friends, soon to be entrepreneurs decided to prove everyone wrong and started a company called N26. Their start-up has taken a lead in redesigning mobile experience and created an app that allowed accessing the banking features with just a few easy steps, often in only a click. What is more, most of the bureaucracy known from traditional entities were replaced with simple clicks and any necessary bureaucracy with simple email forms. The traditional bank branches concept

gave space to online platform services what allowed for huge savings that were directly translated into smaller fees for future customers.

Reputation and the word of mouth is greatly valued in the digital services environment, as the digital era has made comparison and transparency much easier than before. This is why customer opinion and recommendations are crucial to the future of digital entities. This is naturally also the case with N26, that relies on recommendations, and where about half of their growth is being organic.

The company took a mixed approach in the topic of cooperation. Firstly, the firm started to develop their own platform, infrastructure and by acquiring their own license. Secondly, in a steady environment, and limited partnerships, in order to be able to offer even more services to their digital customers through the use of international money transfers or insurance services, and the implementation of premium services such as the full metal black card offering exclusive benefits.

Agility and continuous growth are properties often associated with start-ups and fintech companies, this also being the case with N26. This allows a company to quickly adapt to new market regulations and changing conditions with new, better suited proposals for their clients. New regulations in the banking environment are seen by the company as opportunities rather than difficulties or threats and are used to continue to grow and improve.

This case study shows that focusing on customer's needs and solving their problems is a great strategy, also in the banking industry. Getting licensed and focusing on a strong front-end application continues to speak to new customers who see banking as a service, not a place to go. (Grynkiewicz 2019)

2.4. Examples of established Banks adopting data science into their daily business

To further stretch the importance of researching the exact relevant data science techniques to help Banks innovate and prove the importance of this trend, a few examples of global traditional institutions leading the digital way forward will be presented. Based on the list published by the World Finance – an acknowledged magazine providing a comprehensive outlook on the industry, this part will focus on three traditional institutes that have made it to the top of the list of most digital banks. The list is opened by a Singaporean bank – DBS, followed by a Turkish Garanti BBVA and British Barclays. Although the chapter concerns this particular list, many rankings regarding top digital performers have been analysed with listed institutions to be seen frequently at the very top positions. By choosing established institutions from different continents and markets, they are most certainly representative of the trend. (Darrah 2017)

The DBS Bank has developed a great – the world’s largest - variety of APIs (APIs described in chapter 2.1.1) in order to be able to exchange data with various entities to improve the overall experience and assure compatibility. Furthermore, the bank has acquired a rich portfolio of strategic partnerships that make the use of APIs efficient and secure. By gaining access to many ecosystems and platforms, customers are presented with much wider variety of products, while still being loyal customers of the Bank. (DBS 2020)

Garanti BBVA strongly follows the principle of digitalisation not only on the customer’s side but also emphasises the role of data analysis within internal processes. The bank successfully cuts the costs involved with trading, administrating and managing accounts with cross selling and tailored offers increasing operational profits. The institution successfully focuses on customer analytics with the goal to create value and to improve their offering for each and every customer. The high satisfaction rate among online customers allows to build up a solid customer base that is growing through the word of mouth and social media channels – one of the success indicators in the digital world. (Garanti BBVA 2020)

Barclays is leading the way in the field of mobile banking, with its own mobile banking applications setting industry's measure of the customer app usage. A very well thought and executed mobile application has allowed for a radical change in the way of conducting transactions in the matter of only a few years. Over 90% of the bank's transactions are executed using their mobile environment with the trend growing. This example show the eagerness of customers to adopt such technologies when conducting banking activities. (Business Technology Research 2020)

The analysis of the 1Yr. Stock performance of those banking institutions (figure 4-6 in the appendix) was compared to the general trend in the banking sector in 2020. Since the year 2020 was not lacking in unprecedented events shaking the market and the whole economy, the world banking market has lost about a third of the capitalisation, according to the information published by the portal Statista.com. Despite the general trend being negative, the traditional, yet strongly digitalised banks represented by DBS, Garanti BBVA and Barclays were able to outperform their competitors and take smaller losses than their more traditional counterparts. Barclays stock plunge accounted for about 15% of its value, with Garanti BBVA taking a 13% loss, still outperforming the market with DBS Bank managing to limit the stock price losses to only 3%. This shows the high ability of the digital banks to adopt to turbulent conditions and be less affected by negative global trends. (Norrestad 2020)

2.5. The need for this study

FinTech start-ups are disrupting the banking and financial industry, defining the new rules of the game, changing the way customers think about transactions and shortening the distance between institution and the service user. These entities are very competitive, solving problems that bigger, established companies were not able, or not even aware of. New technologies and digital nativity of start-ups allow them to quickly scale-up their products to win new and

different markets, customer groups or create innovative applications. The fact that not only properties, but also computing power can be rented instead of build or bought gives young entrepreneurs an extreme flexibility and the ability to be agile to further introduce new innovations, that can be “the next big thing” on the market.

The financial Industry and Banking face a huge challenge with their customers constantly switching to digital solutions in almost every other aspect of their lives. Most of the players, as shown in the previous chapters, have realised that they have to move forward with the times and implement the latest technology to stay competitive. Today, almost every Bank wants to profit from Data science, Data analysis, Business intelligence, but not everyone understands which technologies are to be implemented and how exactly they are able to help in the respective fields. (Wharton and Sidhu 2019)

This study researches different options available and picks up on the most common ones, giving an explanation and potential implementation fields in order to give a clear recommendation where to put the focus in the near future.

3. Qualitative content analysis

3.1. Methodology

Quantitative and qualitative methods of research are two main types to lead a study. Researchers spend a huge amount of time comparing and analysing both methods in order to be able to choose the most suited one for their researches. This paper is aimed to answer the specific question, namely: “What should traditional banks learn from FinTech companies and how to make the impact with data science?” A decision for one of the research methods had to be concluded.

The quantitative method is aimed at evaluating the content in a systematic and objective manner in order to present an unbiased result. This method focuses on a structured approach,

with pre-defined steps and clear criteria that are precisely selected for the study with the evaluation material carefully chosen. The data should be carefully examined and the sources proved to ensure the quality of the input. This method focuses on statistical presentation of reality, what results in confronting the researcher is with a frequency or distribution of the test values and measures. (FlexMR 2019)

The qualitative method on the other hand is concerned with data that is rather non numerical and delivers results without the help from statistical and mathematical models.

The data for qualitative analysis can come from texts, but also interviews, audio records or videos. The focus is more on subjective observation and fundamental analysis that is conducted by comparing patterns and drawing conclusions. This method is to be used when the data consists of non-numerical observations, opinions texts, etc. Both methods can compliment each other to give the research broader, more rounded results backed by not only numerical but also “factual” data. (Hammarberg, Kirkman, and de Lacey 2016)

This thesis is mainly presenting and analysing data with the help of a qualitative content analysis and legitimizing the matter with the help of quantitative sections. The paper further shows and analyses results which provide an interesting insight into the topic of Data science and business intelligence within the banking industry. The method was chosen because of its many advantages, especially the high speed and accuracy when analysing a significant amount of data. Implementation of this method has provided for reliable results, made it possible to quantify the research question and to contemplate it statistically.

3.2 Data

3.2.1 Terminology

The quality of a study can only be as good as the data that is fed to the analysis tool and model. In order to be able to conduct an insightful and meaningful study, terminology has to be

derived from an acknowledged, trusted source. In the world of start-ups and data science, there a lot of buzzwords that are eagerly and commonly used without full understanding of the meaning. The field is very fast paced, constantly changing and evolving, with new concepts and technologies introduced almost on a weekly basis, that is why a dynamic source has to be used in order to assure the meaningful analysis. This analysis will build up on the terminology list created by the platform called Dataquest.io. Dataquest is an online learning platform completely dedicated to data-driven technologies and has been able to earn a strong reputation in the field. Through not only passively watching the market but also conducting numerous analysis and winning data science competitions, the team is able to provide even greater insights for different sectors to the data driven world. The start-up that is responsible for the platform is aimed to intrigue and teach future data driven leaders by offering an ever evolving number of courses with strong hands on approach and a connection to real business problems, acknowledged by such entities as Facebook, Uber or even Harvard University.

The data retrieved from the Dataquest website is a list of fundamental fields of focus associated with the Data science, published after a thorough analysis of the current state and evolvement of new trends. The terms used represent general fields of focus, that are well suited to analyse the banking industry data science engagement without getting into technical details. By involving and contributing to the disruptive technologies world, Dataquest is at the forefront of innovation and is able to provide up to date, unbiased list of terms that enables people to speak the language of data science. The exact terminology researched can be seen in Table 1 of the Appendix, where it is presented together with the relative frequencies of occurrence.

(Howard 2018)

3.1.1. Literature

The analysed literature is based on two principles. Firstly, only books and articles with the date of first publication within the last few years were taken into consideration. This principle guarantees that the analysis is truly up to date and that the trends analysed are actually taking place, instead of considering those that were relevant years ago. Secondly, Books and articles were considered by their acknowledgment and their importance for the industry. This factor led to choosing publications written by the industry leading companies and consultancy firms from the filed or publications featured on the prestigious list of top relevant books in the banking field by providers like YahooFinance, CNBC, Financial Times.

The literature aims to cover all the aspects of banking and fintech industry. It is not only focusing on the technical analysis but, most importantly covers the topic like the whole financial sector analysis, the influence of banks and Fintech and even fields like monetary policies. Only a broad selection of sources on the topic as a whole will allow this analysis to be complete, therefore representing and showing the state of data science in both, the banking and fintech environment. It is not always black and white which source should be considered representative for banking and which for the Fintech analysis. Since this paper focuses mostly on very recent publications, there are some positions that could be seen as a contribution to either of the categories. The key to decide was to focus on what the source is describing, is it focusing on the ability of traditional, established banks to join the digital revolution like “SMACing the Bank”, or is it regarding Fintech in that matter like “Digital Bank – how to launch or become a digital bank” which uses the term “Bank” mostly as a substitute for start-up in a Financial technology environment. The list of the Analysed literature can be found in the Table 2 in the Appendix.

3.1.2. Literature on traditional Banks and Financial Industry

The sources clearly focus on the functioning, and the role of banks and contemplate various challenges such institution face. Since the works are purposely focusing on traditional banking tasks, it was important to choose not only texts that help us better understand the purposeful ways the banks work such as “Money, Banking and financial markets” or “Investment banking explained” where we get a wide outlook on the functioning of the industry.

To capture the role of the banks, sources specialising on the whole industry and implications of the banking had to be analysed. In this spirit “Makers and Takers” and “Management of banking and financial services” that show how financial systems influence and function in the real world were used for the analysis. One more aspect that is crucial to this sector is money and currency. To capture this field, books such as” The Bitcoin standard” had to be taken into consideration, where the vision of currency in a decentralised monetary system is represented. To round the picture and highlight transformations that not only have already taken place but are also widely discussed in the traditional Finance and Banking environment, market reports from the top consulting firms like KPMG, EY or Deloitte and outlooks have been taken into account when creating the source list. The reports are considered as sources that describe the traditional side of the market as they are clearly targeting the change within established institutions.

3.1.3 Literature on start-up companies in the Financial sector

Fintech companies are relatively new to the industry, nonetheless they are gaining more and more attention every year. Such ventures are on the mouths of many, that is why, a wide variety of literature, books and articles are being published tackling the topic from various perspectives. For the purpose of this thesis, a choice of publications has been chosen to cover the broad world of such start-ups. The literature concerning this matter often relates directly to the technology world, cutting the restrictions and presenting what the technology would be capable of in a lean,

agile firm, if implemented in a right way. That is the reason, why the sources are much more of a technical nature, representing truly the scene in a start-up world.

The literature concerning Fintech contains works as well on the technical nature of such companies and their implications on the industry and our everyday life. It is crucial to explain here as well how the Fintech work and technology is transforming lending and shaping a new era of small business opportunity, in the publications such as “Learning practical Fintech from successful companies”, “Fintech: evolution or revolution” but also their impact with the works like: “Fintech, small business & the American dream : how”. It is true, that Fintech are proposing a much wider product range than that of the traditional Banks, therefore the majority of sources chosen focus on the implication this has on the customer and the influence on the market.

3.3 Analysis

To begin with, the whole collection of sources, divided into two cohorts was examined once again and prepared for the empirical analysis with the key of choosing the best criteria for the process. The study was conducted using a program written in a python programming language that was tailor made for the purpose of the research. The main goal of the code was to run through electronic copies of all sources and compile a statistic on how frequently various data science related terms are appearing in the text. To ensure the correct functioning of the program, samples of data were scanned using a professional text analysis program – MAXQDA and compared with the results of identical samples scanned with the python code.

The amount of literature researched varies through the samples, with different word and page counts in the two cohorts. To be able to compare them and the results, a relative statistical measure had to be implemented. The number of hits of every term was divided by the total number of pages analysed, creating a ratio of hits per page. In order to be able to draw specific

and meaningful insights and answer the research questions, a ranking of top performing terms was introduced and graphically analysed. Since the research aims to find out particular trends, the list of top performers was created only from the point of view of the Fintech companies. Additionally, to compare the general demand and awareness of data related terms, the terms “data” and analysis” were analysed separately within the two cohorts. The top performing Terms were then analysed by the time and frequency of their occurrence. The last part of the study focused on comparing the performance of the most digital banks to the general market trend.

3.4 Results

Study results provide us with two very valuable insights into the digital transformation of the financial industry. The first part, makes the demand for data and analytics very clear, with the second part pointing out which exact fields of knowledge, currently dominated by Fintech start-ups should be of particular interest to the established players in the field of banking.

The study has analysed over 10.000 pages of the most up-to-date, carefully selected texts on the topic of banking, financial markets and Fintechs. Books, articles, journals and market reports yielded far over 12.000 matches with the data science related terminology signifying the importance of this field within the banking sector.

Looking closely at the results, it is clear that the cohort concerning fintech literature had scored most of the matches, understandably stating the technological lead of Fintech start-ups. With the results showing 70% of the hits originating from the fintech literature, despite the number of analysed pages in the cohort being 30% smaller than in the one on banking. What seems obvious, has yielded another, much more interesting statistic. In the first part of the study only words “data” and analytics” without any further context were taken into consideration. This aimed at determining the need of those two aspects within each cohort. The term “data”

has scored a frequency of 1,25 per page within the first cohort and 0,43 within the banking literature, being the most frequent term of all those that were analysed. The term analysis, occurred more often in the second sample with the frequency of 0,20 per page in comparison to 0,15 times per page within the start up sample. The results show a clear need for data and analysis within two samples. The lower frequency of the “analysis” term can account for the fact that the fintech literature goes much deeper in the details and divide this term into many sub categories, therefore replacing the term with a more specific expression. This can be seen in Figure 1 of the Appendix, while Figure 2 presents the top performing among the Fintech companies.

The main part of the study was to reveal the top trends within the Financial and banking industry where the fintech start-ups take the leading role. The terms “data” and “analysis” will no longer be considered, since they are too broad, therefore not pointing the study in any direction. Top performers are presented in the Figure 2 of the Appendix.

The first place goes to the term “artificial intelligence”, or simply “AI”. This comes at a surprise since the frequency within the fintech sample is really high, it comes as being 0,3 times per page, compared to only 0,02 in the literature of the traditional banks. The second and third place is taken by the terms “Big Data” and “Machine learning”, with both, about 0,1 hits per page, stating yet again, a significant increase in comparison to the second sample where they account for only 0,02 to 0,01 hits per page. These results are very satisfactory, as the technologies clearly complement each other and can be accounted for various applications in the industry. Worth mentioning is also the next position on the list, that comes closely to the results of the previous terms, namely “Algorithms”. This term accounts for almost 0,1 hit per page and represents a very steep increase, as it is barely even present in the second sample. The enormous difference in frequency shows that start-ups, even in the financial industry are not

interested in counting bills, but rather writing code. The full list of results is to be seen on Table 1 in the Appendix.

The next part of the analysis was conducted by dividing the Fintech text sources into two categories, one containing works published in 2018 and earlier and the second one with the most up-to-date texts published in 2019 and 2020. The results can be seen in the Figure 3 in the Appendix. This study clearly points out the huge focus on the term “Artificial Intelligence” within the last two years. This part researches only the four top performing terms, mentioned above, and while a slight decrease in the frequency is apparent among other terms, “Artificial intelligence” gains a lot of attention occurring on almost every page (0,89 times per page), compared against the still strong but less frequent representation in the older literature (0,19 times per page).

4 Discussion

The Banking industry is experiencing a change, with new, emerging, innovative, start-up companies, utilising modern technology to analyse the financial industry. At first sight, such entities are quite the opposite of the big, established banking institutions operating in the traditional manner. Nevertheless, there is a lot that they can learn from each other. The literature research and the study conducted in this paper was designed to find the answer to the research question, namely to specify the exact fields and technologies where Banks are lacking behind in comparison to the methods of the Fintech companies.

The study yielded two very interesting insights. It has shown, that both types of companies are aware of the value of data and the urgent need to utilize it by introducing purposeful ways to analyse it. The second part of the study clearly pointed out which exact trends and fields in the vast spectrum of data science are the focus of the start-up companies in the financial industry.

Firstly, the study established that, like almost every other industry, the banking industry is highly interested in acquiring insights and information using valuable data previously unutilized for many years in the past. In respect of this principal by focusing on very broad terms and analysing two parallel samples a strong representation of both has been observed proving the anticipated results. The compared samples consist of the books, journals and articles published within the last few years, most of them dating not earlier than 2015. This enabled the study to be up to date with the latest trends in the field. As the industry is still dominated by relatively few, established players, many young innovative companies are keen to work their way in by disrupting the sector with the use of technology.

As Fintech companies are gaining attention, big banking institutions have to react to the rising competition from their side. Many institutions find their own ways of innovating, creating subclusters or innovation hubs to tackle the topic of data science and data analysis. This phenomena has also been identified by Carson Lappetito in his article titled: “*The Digital Divide: To Stay Competitive, Banks Must Embrace New Technology*” where he not only describes banks embracing and leveraging technology, but also shows fintech companies in a new light. Since the banks understood the importance of data, institutions are investing in a variety of projects that aim to improve some of their existing KPIs. By doing so, the technology can leverage the traditional way of doing business, help to retain or even attract new customers. This is the result of financial specialists embracing technology and designing ways of implementation that improve the existing processes. Financial technology start-ups on the other side, are often led by people with ideas from both the financial and IT worlds, with tendencies to think outside the box. This enables them to find niches in the market that are not covered by the banks traditional business and fill them with their state of the art concepts, that are outing the customer and their needs in the middle of the process. (Lappetito 2019)

Up to this point, the study and research has established a high demand for Data analysis, and the far-fetched digitalization of the banking sector. By doing so, a solid foundation for further research was established, since the world of data science is very broad and the lack of focus on particular technologies can lead even the most promising projects to fail. The second part of the study was designed to identify specific trends and applications of data science that are trending in the exciting universe of young, innovative start-up companies present in the Financial sector. This paper focuses on the top three most frequently occurring trends and explains the possible implications, as well as the opportunities that come from implementing the methodologies. The results strongly suggest that the main concern within the fintech companies is on Artificial intelligence (AI), followed by Big data and Machine learning. Just a few years into the past, it would be really surprising to find such terms describing state of the art technologies in the context of Financial industry. Artificial intelligence can be hugely advanced by Machine learning as it is one of the most common ways in implementing it, and can work its best when given access to the vast amounts of data, big data containing a variety of cases. Those three terms are not only the most frequent ones appearing in the researched literature, but they greatly compliment each other. The way in which machine learning functions and the role of Big Data has been described in the second chapter of this paper, as they compliment Artificial intelligence, a conclusion of the impact of these three technologies will be drawn. The focus on the Artificial intelligence as a trend is further strengthened by the fact that it appears more than 4 times more frequently when looking at the most contemporary literature – this published in 2019 and 2020 than in the earlier works, where it has already outperformed the other terms. While the terms “Big Data”, “Machine Learning”, and “Algorithms” are still present and strongly represented in the most up to date sample, their occurrence is slightly less frequent which can suggest the shift towards more targeted interest on the AI. All those terms are strongly connected to the topic of Data science and can

complement each other, but the results clearly point out the focus on the Artificial intelligence and its rising significance within the banking sector. Implementing artificial intelligence within the industry creates tremendous opportunities for banks and their customers as it opens the way to a new level of personalization. It has already been stated in this paper that the demand for personalisation is an ever increasing trend in almost every industry, and the financial sector has to adapt as well. With artificial intelligence trained, thanks to supervised machine learning, to recognise patterns, applications are able to evaluate each clients risk, financial performance and anticipate their needs, creating tailor made banking products ranging from car loans to special account types or even investment portfolios. This trend was also recognised by the management consulting company PwC, what further proves the significance and backs the results of the conducted study. PwC also recognises personalisation as one of the key advantages gained by implementing Artificial intelligence, but also points out many other significant applications. According to the paper published by PwC Artificial intelligence has two more important fields where it can also make huge impact, maybe even more important than personalisation. Those fields are improving efficiency and cost savings. AI can contribute to taking efficiency to new levels as the highly automated process can generate results in no time compared to traditional methods, with an endless numbers of possible scenarios. Although many CEOs in the banking industry agree that their companies are not well prepared for the implementation of such technologies, as it would require restructuring of the whole data strategy within the firms, they are highly encouraged to consider implementing it due to the potential cost savings. (Berns 2020)

The comparison of the general market capitalization to the stock performance of banks that are widely considered to be at the forefront of the digitalization the findings in chapter 2.4, has yielded very optimistic results for companies willing to adopt digital technologies. Researched entities were able to outperform the market and retain a greater portion of their stock value,

while their traditional counterparts have on average suffered greater losses. This proves that data science makes companies more robust in dealing with unforeseeable events and gives them greater flexibility when adopting to change. There are several reasons to justify this phenomena. Data science can make corporations much more agile, as the impact of new measures and trends can be simulated by the algorithms in no time and the best possible way of handling a situation can be chosen. (DhanHyaa 2020).

Another reason why the more digitised banks are better at handling anomalies, is the fact that their offerings are much more suited for people in their current situation, not the least by allowing AI to contribute to the creation of the product being offered. Lastly, the superior performance can be accounted for simply by much lower operating costs, as the technology, after training, is able to handle extensive analysis and predictions in no time at marginal variable cost compared to traditional analysts,

The conducted research was completed using a large amount of literature and text relevant to the topic, however the bigger the sample, the more representative the results. One way to elaborate on this study is therefore to conduct it using a much bigger or modified sample (for example: texts taken from only a regional market) to show the trends in another light. A further interesting angle, would be to interview the founders of the financial start-up founders and the CEO's of the traditional banks on the topic of trending and future sector trends in order to compare their respective outlooks. This would greatly elaborate the topic and would complement the results of the quantitative study with a qualitative analysis.

5 Conclusion

In the last few years Data has become a new precious commodity as companies all over the world have realised its potential value and ways of utilizing it to an advantage. Start-up companies are finding possibilities to innovate in almost every industry, forcing established

players to cooperate or digitalise their businesses on their own. In the financial universe fintech start-ups are emerging as well, trying to find a niche to disrupt this traditional industry. Due to the rash development of the Data science field in the last years, there is a huge uncertainty, especially among established players, about how this can be utilized in order to introduce potential improvements to existing processes and path new ways of doing business. Fintech institutions are often quite the opposite of huge corporations that provide banking services with multiple large departments covering various business areas. Due to their size and agility, start-ups are rather focusing on particular technology or a niche that is not yet covered by their traditional counterparts. This technology involves implementing and finding new ways to utilise various data science related methods in order to make progress. Such ventures on the contrary are tech companies with a good understanding of the banking business. This enables them to think outside the box at complex processes without any of the restrictions encountered by traditional banks. By starting and focusing on their future clients, Fintechs are developing made to measure solutions for customers that are already used to dealing with digital services in all other aspects of their life. This study has shown the strong need for data analysis in the banking sector and identified top trends where Fintechs are committed to developing new concepts. With the help of Data science techniques, state of the art literature on banks and start-ups in the financial industry, together with a specially written Python script, relevant trends can be identified. Artificial intelligence (AI) has been recognised as a hot topic constantly gaining on importance with complimenting technologies, Machine learning and Big data at second and third place. It is AI that drives the innovation, with limitless possibilities ranging from offering tailor made banking products for individual customers to noticeable reduction of operating costs for whole institutions. What is more, the possible cooperation of those two types of ventures will ensure the achievement of mutual goals with the implementation of AI into the business structure, in order to take the industry into further decades of the XXI Century.

6. Literature

- Arslanian, Henri, and Fabrice Fischer. 2019. *The Future of Finance*. Hong Kong: Springer Nature Switzerland AG.
- Berns, Michael. 2020. 'How Mature Is AI Implementation in Financial Services?' Frankfurt.
- Biswas, Suparna, Renny Thomas, Shwaitang Singh, Brant Carson, and Violet Chung. 2020. 'AI-Bank of the Future: Can Banks Meet the AI Challenge? | McKinsey'. Mckinsey.Com. 2020. <https://www.mckinsey.com/industries/financial-services/our-insights/ai-bank-of-the-future-can-banks-meet-the-ai-challenge>.
- Business Technology Research. 2020. 'Digital Transformation Trends in Banking and Financial Services in 2020'. BTR Hub. 29 January 2020. <https://btrhub.com/digital-transformation-trends-in-banking-and-financial-services-in-2020/>.
- Cao, Longbing. 2018. *Data Science Thinking: The Next Scientific, Technological and Economic Revolution*. Data Analytics. Cham: Springer International Publishing. <https://doi.org/10.1007/978-3-319-95092-1>.
- Darrah, Kim. 2017. 'Top 5 Most Innovative Digital Banks'. 2017. <https://www.worldfinance.com/banking/top-five-most-innovative-digital-banks>.
- DBS. 2020. 'Trade Digitalisation'. 2020. <https://www.dbs.com.sg/corporate/solutions/digital/trade-digitalisation>.
- DhanHyaa. 2020. 'The Agile Approach in Data Science'. Iunera. 2020. <https://www.iunera.com/kraken/big-data-science-strategy/the-agile-approach-in-data-science-explained-by-an-ml-expert/>.
- Dietz, Miklos, Somesh Khanna, Tunde Olanrewaju, and Kausik Rajgopal. 2016. 'FinTechnicolor: The New Picture in Finance'. McKinsey&Company.
- FlexMR. 2019. 'Understanding Quantitative vs. Qualitative Research'. Medium. 17 April 2019. <https://flexmr.medium.com/understanding-quantitative-vs-qualitative-research-8f7cbf748765>.
- Garanti BBVA. 2020. 'Our Leading Applications | Garanti Bankası'. 2020. <http://surdurulebilirlik.garantibbva.com.tr/garanti-bbva-sustainability-approach/material-issues/digital-transformation/our-leading-applications/>.
- Gryniewicz, Tomasz. 2019. 'This Fintech Attracts 10,000 Customers a Day'. 2019. <https://www.netguru.com/blog/n26-fintech-disruption-digital-banking>.
- Hammarberg, K, M Kirkman, and S de Lacey. 2016. 'Qualitative Research Methods: When to Use Them and How to Judge Them'. *Oxford Academic*. <https://academic.oup.com/humrep/article/31/3/498/2384737>.
- Hasan, Md. Morshadul, József Popp, and Judit Oláh. 2020. 'Current Landscape and Influence of Big Data on Finance'. *Journal of Big Data* 7 (1): 21. <https://doi.org/10.1186/s40537-020-00291-z>.
- Howard, Wolf. 2018. 'Data Science Terms and Jargon: A Glossary'. *Dataquest* (blog). 20 February 2018. <https://www.dataquest.io/blog/data-science-glossary/>.
- King, Brett. 2014. *Breaking Banks : The Innovators, Rogues, and Strategists Rebooting Banking*. Singapore: John Wiley.
- Lappetito, Carson. 2019. 'Council Post: The Digital Divide: To Stay Competitive, Banks Must Embrace New Technology'. Forbes. 2019. <https://www.forbes.com/sites/forbesfinancecouncil/2019/10/22/the-digital-divide-to-stay-competitive-banks-must-embrace-new-technology/>.
- Marr, Bernard. 2017. *Data Strategy: How to Profit from a World of Big Data, Analytics and the Internet of Things*. 1st Edition. New York: Kogan Page Ltd.

Norrestad, F. 2020. 'Market Capitalization of Global Banking Industry 2020'. Statista.Com. 2020. <https://www.statista.com/statistics/265135/market-capitalization-of-the-banking-sector-worldwide/>.

Rubini, Agustin. 2017. *Fintech in a Flash Financial Technology Made Easy*. London: Simtac Ltd.

Wharton, and Luvleen Sidhu. n.d. 'Why Fintech Is Disrupting Traditional Banking'. Accessed 6 December 2020. <https://knowledge.wharton.upenn.edu/article/fintech-disrupting-traditional-banking/>.

6 Appendix

Table 1. Occurrence of Terms per Page in each cohort

Cohort	Fintech	Traditional Banking
Data	1,25	0,43
Analysis	0,15	0,20
Algorithms	0,09	0,02
Big data	0,10	0,02
Database	0,03	0,02
Machine learning (ML)	0,09	0,01
Artificial Intelligence (AI)	0,30	0,02
Business Intelligence (BI)	0,01	0,001
Data Visualisation	0,001	0,001
Data Exploration	0,01	0,02

Table 2. Analysed Literature

Fintech Cohort	Traditional Banking Cohort
Arslanian, Henri, and Fabrice Fischer. 2019. <i>The Future of Finance</i> . Hong Kong: Springer Nature Switzerland AG.	Ammous, Saifedean. 2018. <i>The Bitcoin Standard</i> . United Kingdom: Wiley.

Bernegger, Marc P. 2018. <i>The WealthTech Book</i> . United Kingdom: Wiley.	Bernanke, Ben, Timothy F. Geithner, and Henry M. Paulson. 2019. <i>Firefighting: The Financial Crisis and Its Lessons</i> . New York: Penguin Books.
Chakraborty, Sumit. 2018. 'FINTECH : Evolution or Revolution'.	Cecchetti, Stephen G., and Kermit L. Schoenholtz. 2017. <i>Money, Banking, and Financial Markets</i> . Fifth Edition. Dubuque: McGraw-Hill Education.
Chishti, Susane, and Janos BarBeris. 2016. <i>The Fintech Book</i> . United Kingdom: Wiley.	Chang, Chia-Ying. 2017. <i>Capital Flows, Financial Markets and Banking Crises</i> . 1st ed. First Edition. New York, NY : Routledge, 2017. Series: Routledge international studies
EY. 2019. 'Global Fintech Adoption Index'. Global: EY.	Deloitte. 2018. '2019 Banking and Capital Markets Outlook'. International: Deloitte.
Garvey, John, Peter Burns, Olwyn Alexander, and Stephen O'Hearn. 'Global Fintech Report 2019'.	EY. 2018. 'Global Banking Outlook 2018'. EY.
Gupta, Pranay. 2018. <i>Fintech: The New DNA of Financial Services</i> . Berlin, Boston: De Gruyter. https://doi.org/10.1515/9781547400904 .	Fleuriet, Michel. 2019. <i>Investment Banking Explained: An Insider's Guide to the Industry</i> . Second edition. New York: McGraw-Hill Education.
Kitao, Yoshitaka. 2018. 'Learning Practical FinTech from Successful Companies'. Nikkei: Wiley.	KPMG. 2016. 'Global Banking and Capital Markets Credentials'. International: KPMG.
KPMG. 2020. 'Pulse of Fintech H2 2019'. Global: KPMG.	Krantz, Matthew, and Robert Johnson. n.d. <i>Investment Banking For Dummies</i> . New Jersey: Wiley.
Lee, David, and Linda Low. 2018. 'Inclusive Fintech: Blockchain, Cryptocurrency And Ico', World Scientific: Singapore.	Krishnan, Sankar. 2014. <i>Power of Mobile Banking : How to Profit from the Revolution in Retail Financial Services</i> . New Jersey: Wiley.
Loesch, Stefan. 2018. <i>A Guide to Financial Regulation for Fintech Entrepreneurs</i> . Chichester, UK: John Wiley & Sons, Ltd.	Mazzucato, Mariana. 2018. <i>The Value of Everything: Making and Taking in the Global Economy</i> . Penguin.
Popper, Nathaniel. 2015. <i>Digital Gold Bitcoin</i> . Sydney: Harper Collins.	McMillan, Jonathan. 2015. <i>End of Banking: Money, Credit, And the Digital Revolution</i> . Zurich: BookBaby.
Skinner, Chris. 2014. <i>Digital Bank Strategies to Launch or Become Digital Bank</i> . Singapore: Marshall cavendish.	Ng, Jeffrey, and Subhash Shah. 2020. <i>Hands-on Artificial Intelligence for Banking</i> . Mumbai: Packt.
Tanda and Schena. 2019. 'Fintech, Bigtech and Banks : Digitalisation and Its Impact on Banking Business Models'. <i>Palgrave Macmillan Studies in Banking and Financial Institutions</i>	OECD. 2016. <i>Green Investment Banks: Scaling up Private Investment in Low-Carbon, Climate-Resilient Infrastructure</i> . Green Finance and Investment. OECD.
Vaughan, Liam. 2020. <i>Flash Crash: A Trading Savant, a Global Manhunt, and the Most Mysterious Market Crash in History</i> . First edition. New York: Doubleday.	Pond, Keith. 2017. <i>Retail Banking</i> . Reading: Gosbrook.
Wewege, Luigi, and Michael C. Thomsett. 2019. <i>The Digital Banking Revolution: How Fintech Companies Are Transforming the Retail Banking Industry through Disruptive Financial Innovation</i> . 3rd ed. Boston: DE GRUYTER.	Raghunathan, Balaji. 2018. <i>SMACing the Bank</i> . Boca Raton, FL: CRC Press/Taylor & Francis Group.
	Rogoff, Kenneth S. 2016. <i>The Curse of Cash</i> . Princeton: Princeton University Press.
	Suresh, Padmalatha, and Justin Paul. 2017. <i>MANAGEMENT OF BANKING AND FINANCIAL SERVICES</i> . India: Pearson.

	ooze, J. Adam. 2018. <i>Crashed: How a Decade of Financial Crises Changed the World</i> . New York: Viking.
	Zuckerman, Gregory. 2019. <i>The Man Who Solved the Market</i> . New York, NY: Portfolio / Penguin.

Figure 1. "Data" and "Analysis" occurrence frequency

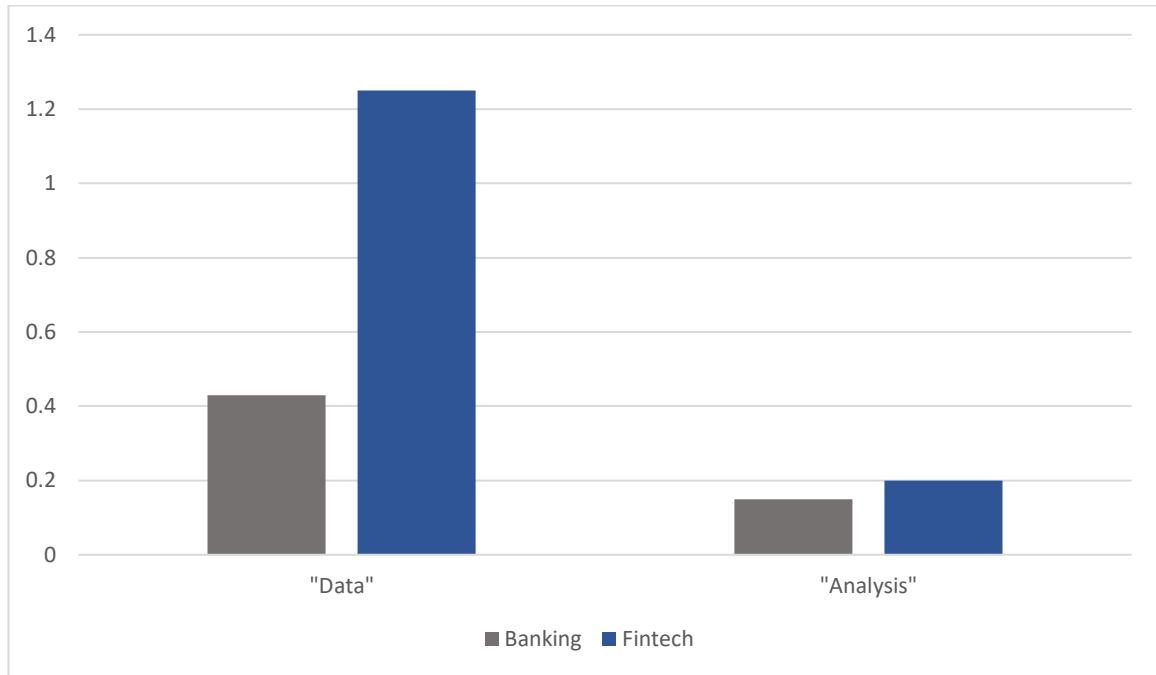


Figure 2. Top most frequently occurring Terms

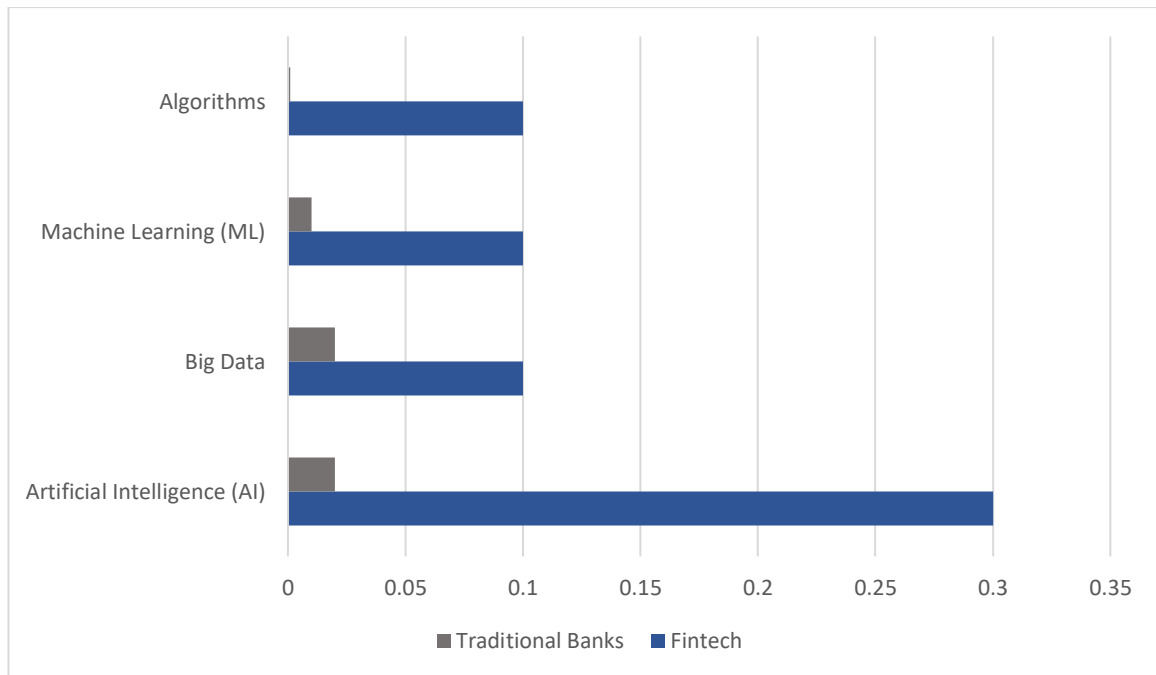


Figure 3. Frequency of occurrence
within different periods

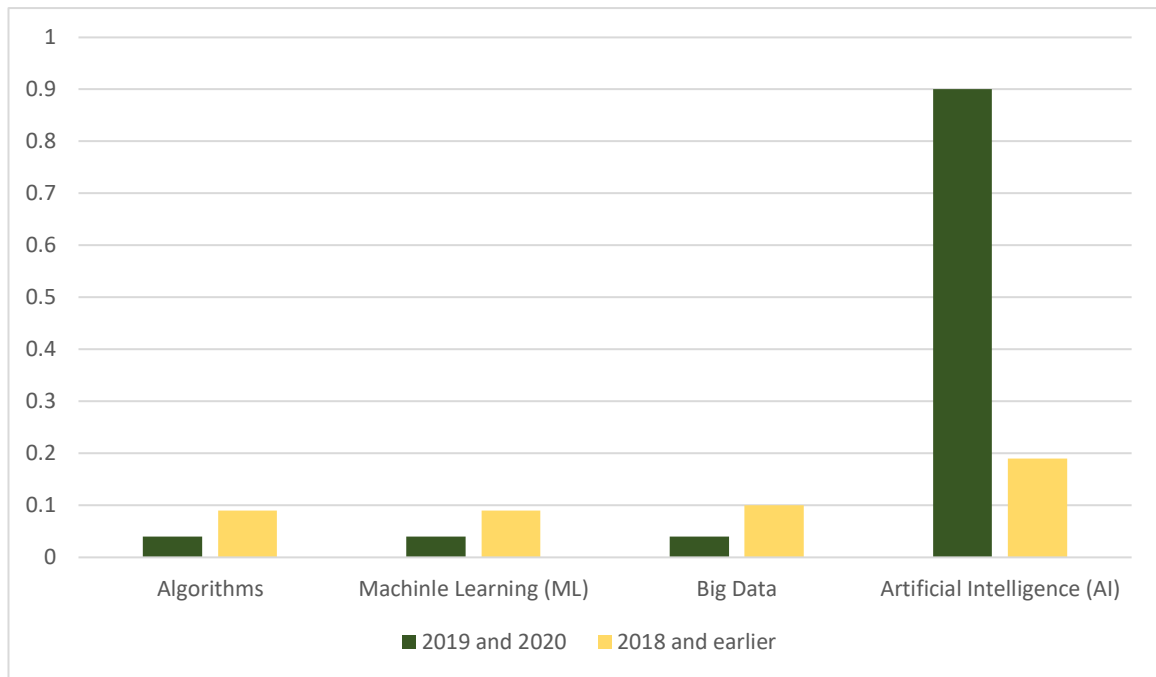


Figure 4. DBS Bank Stock 1Yr. Performance. Source: finance.yahoo.com



Figure 5. Barclays Bank 1Yr. Performance. Source: finance.yahoo.com



Figure 6. Garanti BBVA Bank 1Yr. Performance. Source: finance.yahoo.com

