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Advanced Analytics in Retail Banking in the Czech Republic

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Declaration of Authenticity

I hereby declare that all the materials presented herein are my own work, or fully and specifically acknowledged wherever adapted from other sources.

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Abstract

Advanced analytics and big data allow a more complete picture of customers' preferences and demands. Through this deeper understanding, organizations of all types are finding new ways to engage with existing or potential customers. Research shows that companies using big data and advanced analytics in their operations have productivity and profitability rates that are 5 to 6 percent higher compared to their peers. At the same time it is almost impossible to find a banking institution in the Czech Republic exploiting potential of data analytics to its full extent. This thesis will therefore focus on exploring opportunities for banks applicable in the local context, taking into account technological and financial limitations as well as the market situation. Author will conduct interviews with bank managers and management consultants familiar with the topic in order to evaluate theoretical concepts and the best practices from around the world from the point of Czech market environment, to assess capability of local banks to exploit them and identify the main obstacles that stand in the way. Based on that a general framework for bank managers, who would like to use advanced analytics, will be proposed.

Keywords: advanced analytics, big data, technology, retail banking, innovation

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Introduction

Banking industry around the world faces turbulent times. In the wake of financial crisis in 2008 and following sovereign debt crisis in Europe, it has historically lowest levels of trust among customers (Edelman, 2014). Moreover, it faces strong regulatory pressures (Ernst&Young, 2012) and robust offensive from new entrants to the industry (Deloitte, 2014). Banks do feel need for a change. In the recent survey conducted by Eisert and his colleagues from A.T.Karney, vast majority of bank executives expressed desire to become more efficient and customer-centric. Unfortunately for them, neither has happened so far (Eistert, et al., 2013). Banks in the Czech Republic were arguably only scratched by the financial crisis, but they too are not immune to competitive pressures from new entrants, saturated market and evolving regulatory landscape.

In addition to these changes, consumers are altering the way they behave. This movement was spurred by new technology developments and novel services in other sectors. Proliferation of smartphones and tablets, access to the internet from virtually any place, and social networks changed the way clients access or use products and services. In combination with superior customer experience provided by firms such as Google, Apple or Amazon, these developments raised customers' expectations regarding what to expect from their local bank. Since 73 percent of millennials in the United States would prefer financial services from three abovementioned firms to their own nationwide bank (Scratch, 2013), financial institutions clearly have not managed to adjust the level of services they provide to the standards expected and required by their clients.

Along with abovementioned changes in the banking industry another revolution has taken place. Thanks to technology advances, there has been rapid increase in produced data. In 2013 every day 2.5 trillion (10^12) gigabytes of various information were created, while 90 percent of current data was inexistent 2 years ago (Hagen, et al., 2013). New software platforms have enabled processing these data in the real time and for a fraction of previous costs. This enabled firms to employ analytics in their operations in the way unthinkable ten years ago. The trend got name *"big data"* and according to James Manyika from McKinsey, a global consulting firm, it will revolutionize the way businesses operate and bring significant

productivity improvements to almost every industry (Manyika, et al., 2011). Various researches already indicate that companies that are using analytics in their decision-making process are more successful than their peers in terms of profitability (McAfee & Brynjolfsson, 2012).

Advanced analytics, to the large extent enabled and powered by big data are potential profit driver for every industry. Ranging from more precise credit risk analysis to marketing offerings tailored to individual's preferences, banks around the world seek ways to utilize analytics in their operations. Having access to immense amount of information they are in a great position to capitalize on them, although strict regulatory environment, legacy IT systems and historically not very innovative culture pose significant barriers in doing so. In some banks, the process has started several years ago; others are only exploring potential benefits advanced analytics could offer. In any case, the trend is clear (Coumaros, et al., 2014). Advanced analytics bring potentially disruptive competitive advantage for banks (Deloitte, 2014). Although the tendency in their use is rising, with the exception of technology companies, most of firms are far from fully utilizing potential big data and advanced analytics offer (Aslett, 2013).

Taking these aspects into account, the main goal of this thesis is to find out how retail banks in the Czech Republic are currently utilizing advanced analytics and to propose a framework that will familiarize executives with aspects that are necessary to consider when launching any initiative relating to advanced analytics within their banks.

In order to reach this goal, in the first chapter we will firstly clarify relationship between advanced analytics and big data. After defining big data and advanced analytics, we will look at how businesses can utilize them as well as risks and limitations inevitably tied to them. In the second chapter, we will further examine in greater detail technical aspects of the topic, namely IT infrastructure necessary for operation, data scientists required for analysis and financial costs connected with advanced analytics. In the third chapter, our focus will turn to retail banking. We will discuss specifics of the industry as well as underlying trends that are transforming it in the present. After that we will look closer at application of advanced analytics in the banking sector and bring several examples of banks that succeeded in implementation of various projects.

As the thesis aims particularly at Czech banking market, in the fourth chapter we will discuss specifics of Czech banks, the market, in which they nowadays operate, as well as their experience, plans with, and attitudes towards advanced analytics. After identifying main trends and challenges they face, we will provide readers with a concise framework that will summarize key issues that need to be considered before starting any project using advanced analytics.

In the course of writing this thesis, two main sources of information will be used. Theoretical part will be based primarily on secondary sources falling into three groups. The first category will be books about big data and advanced analytics, published in the recent years, such as one authored by Thomas Davenport. Secondly, as the topic is novel and rapidly expanding, for sake of including the most current findings, academic and business journals such as Harvard Business Review, Bloomberg BusinessWeek or MIT Technology Review will be included. Thirdly, as the area is of great interest to technology and consulting firms, a significant share of references will have origin in corporate reports from firms such as McKinsey&Company, Deloitte, IBM and alike.

Secondary sources would not suffice for describing situation in the Czech banking, therefore the last chapter will be based primarily on several personal interviews with managers and data analysts working in local retail banks as well as management consultants familiar with banking industry in the country and CEE region.

1. Advanced analytics and big data

Big data and advanced analytics do have various interpretations. Therefore, before we look at their potential application in the banking industry we need to firstly specify these concepts and discuss different attitudes towards them. After that we look at risks and limitations that advanced analytics have and their potential use in companies.

1.1 Concept delineation

According to Mike Rote, CEO of Teradata, advanced analytics is an application of various analytic techniques to data in order to solve various business problems. In contrast to classic business intelligence, advanced analytics focus not just on description of a situation, but even more on prediction and estimation of future trends. Companies that are proficient in using them better understand competitive environment and developments in industry, while being able to optimize their operations (Teradata, 2005). Advanced analytics are oftentimes called big data analytics as well, since they generally require large and complex datasets. But big data systems do have also other applications and not all of them are directly related to analytics (Berman, 2013). In the same time, these two terms are closely linked and intertwined. Therefore, in order to comprehend advanced analytics it is necessary firstly to understand big data.

It is possible to say that big data has recently become omnipresent. The very first mention of the term can be tracked to a paper by Michael Cox and David Ellsworth who described challenges connected with visualization in the situation when concerned datasets become very large (Cox & Ellsworth, 1997). The paper was published in 1997 and since then use of *big data* has grown rapidly. Between May 2004 and 2014 the number of searches for big data through Google increased more than 12 times (Google , 2014). Yet, because of its shared origin between academia, media and tech industry, it still does not have a clear definition (Ward, et al., 2013).

There exist various descriptions originating from different environments, each of them emphasizing different aspect of this phenomena. Before looking more closely at their specifics and potential use, we will try to specify, what precisely the term big data represents.

Some of characterizations come from corporate world. For example, Oracle sees big data as: "*non-traditional, less structured data*" (Oracle, 2013), whereas Microsoft frames them as: "*the term increasingly used to describe the process of applying serious computing power – the latest in machine learning and artificial intelligence – to seriously massive and often highly complex sets of information*" (Microsoft, 2013).

Academics came up with their own explanations. Danah Boyd and Kate Crawford describe big data as "*a cultural, technological and scholarly phenomenon that rests on the interplay of technology, analysis and mythology*". Besides classic emphasis on technology and analysis they work with, and in the same time also challenge, general belief that big data are source of truth and objectivity (Boyd & Crawford, 2012). The one definition, which is cited perhaps the most often comes from a report by META Group, now known as Gartner, a leading research and advisory firm in IT industry. Even though one would not actually found any mention of the term *big data* anywhere in it, the report laid down the fundamental description consisting of *three Vs*: *Volume, Velocity* and *Variety* (META Group, 2001).

The first *V* stands for volume. The amount of data grows exponentially. Nowadays, more information cross the internet every moment than were stored in the entire system 20 years ago. If Walmart wanted to keep customer data it gets every hour, it would need 50 million filling cabinets worth of text. (McAfee & Brynjolfsson, 2012) The size is not an end in itself, but it has far-reaching implications, besides requirements on storage and processing capacity. Probably the most important effect of exponentially rising volume of information on analytics is that larger datasets significantly increase performance of prediction models and thus help increase quality of decisions. (de Fortuny, et al, 2013).

But the size of datasets does not seem to be primary concern for most of firms venturing into the sphere of big data. An executive survey by NewVantage Partners from 2012 seems to confirm that. This venture capital firm surveyed over 50 executives in large organizations and concluded that only 15 percent of companies were focused on analyzing datasets larger than 100 terabytes (NewVantage Partners, 2012). Moreover, what the word *big* means is relative. Moore's law, a well-known rule named after one of Intel's co-founders, prescribes that the number of transistors on integrated circuits doubles approximately every two years. (Moore, 1965) This rule is often extended also to other spheres of technology. Growth of

computing power and developments in technology tremendously increased the amount of data at our disposal. In 2012 approximately 2.5 exabytes (2.5 billion gigabytes) of data were created every day and the amount has been doubling approximately every 40 months (McAfee & Brynjolfsson, 2012). Therefore, what was considered as big data a few years ago can now be seen as a standard dataset. This is the reason why even today some authors have begun using the term *massive data* to describe ever larger datasets. One could use a book *Mining of Massive Datasets* (Leskovec, et al., 2014) or IBM's *research center for Massive Data* cases in point (Davenport, 2013).

The second *V* means velocity. The amount of data currently at disposal is not only vast, these data also flow very quickly. The rise of social media and increased internet accessibility, among other things, exponentially enlarged the amount of information created every moment. According to Petter Bae Brandtzæg of SINTEF ICT, the largest independent research organization in Scandinavia, 90 percent of world's data in 2013 were only generated during 2 years preceding it (SINTEF ICT, 2013). Increasing computing capacity in combination with high-speed networks means that this ever increasing flow of information can now be processed almost in the real-time.

The speed is thus very important attribute. Access and ability to analyze streaming data plays a significant role, especially in industries where decisions need to be done within very short periods of time, such as financial organizations or security forces. The ability to obtain and evaluate information faster than enables better decision-making since organizations now work with data that are more recent and thus more valuable. According to the NewVantage Partners' survey, this aspect is a primary focus of 12% of large institutions and will grow by one third by 2016 (NewVantage Partners, 2012).

Even though big data systems enable to capture and analyze information, another important aspect gaining on importance is the time that a company needs to prepare and execute a response (NewVantage Partners, 2013). This attribute goes beyond the scope of technical solutions and relates primarily to decision-making processes and management in companies in general.

The third *V* stands for Variety. Variety relates to increasing number of information sources and formats organizations can and need to integrate in order to conduct analyses. The

challenge in this case is how to collect, store and manage structured and unstructured data, such as posts on social media, location and purchasing behavior data, call center recordings or sensor updates (Souza, et al., 2013). Increasing number of features studied may lead to complications, because of higher variance and risk of over-fitting. But if done properly, increasing number of studied variables does indeed have positive influence on prediction power of analytical models. Need of connecting information from diverse sources is primary issue when executives are considering implementation of big data systems (NewVantage Partners, 2012).

Increase in amount, speed of data and the number of potential sources inherently leads to higher complexity. Even though availability of data improves decision making in general, there is no clear solution that removes all ambiguity. More recently, due to the issues connected with quality and sourcing of data that firms implementing big data initiatives face, 3Vs have been extended and the word *Veracity* has been added. It emphasizes that in order for any analysis to be valid and helpful, data on which it is based need to be properly cleansed, of sufficient quality and properly managed (Zikopoulos, et al., 2013). In a way, it symbolizes natural level of uncertainty, with which analysts have to work. No analytical model can fully account for uncertain events, such as weather no matter how complex model it is using. On the other hand unpredictability of one data source could be offset by combining several, on their own less reliable, inputs into one output (Schroeck, et al., 2012).

Previous paragraphs tried to describe main components of big data. Generally, it is possible to say, that if a company works with extensive datasets with data flowing fast from diverse sources, in various formats and operates with a degree of uncertainty, it is working with big data. In the same time, it is important see big data more as an umbrella term rather than a clearly defined ecosystem. Each situation does not have to meet every single criteria to fit in the category. In fact, because of popularity of the name, many vendors claim their solutions to be based on big data even when they clearly fit into the category of traditional business analytics (Davenport, 2013).

1.2 Attitudes towards big data and advanced analytics

Perceptions of big data range from extremely positive to rather critical, depending on who answers the question. For example, the report on this subject from McKinsey & Company begins with claim that ”*Big Data is the biggest game-changing opportunity for marketing and sales since the Internet went mainstream almost 20 years ago*” (Court, et al., 2013) and paints very optimistic future. On the other end of the spectrum one could find researchers from Harvard and Northeastern University who coined the term *Big Data Hubris* in their article on inability of Google Flu Trends to estimate real incidence of influenza-like illnesses (it overestimated incidence in 2011/12 flu season more than twice) despite the fact, that this project has been considered as one of the most successful practical applications of big data in real life (Lazer, et al., 2014).

Alex Pentland from MIT argues that *“the power of big data is that it is information about people’s behavior instead of information about their beliefs*” (Pentland, 2014). Increasing general interest has led to significant increase of use of the term also in investor presentations and conference calls with analysts. In 2013 the number had risen by 43% compared to previous year (McDuling, 2013). But it is not just about use of the term. According to CB Insights, a company tracking investments of private equity firms and venture capital funds, between 2008 and 2012 investment into big data startups tripled from 463 to 1 398 million US dollars annually and totaled 512 deals during the period (CB Insights, 2013).

Not only investors and technology firms embrace advanced analytics and big data. Various surveys conducted in course of the last 2 or 3 years have shown steady increase of knowledge of the topic among executives as well as the rise in number of big data initiatives that firms in different industries have started. According to McKinsey Global Survey the number of companies using big data for business functions grew from 25 percent to 33 percent on average between 2012 and 2013, with biggest advance of 14 percent in category of R&D. In the same study 46 percent of companies said they were using advanced analytics for budgeting and forecasting, up from 34 percent in 2012 (McKinsey & Company, 2013).

However the main question is, whether all this effort eventually pays off. Erik Brynjolfsson and Heekyung Kim from MIT and Lorin Hitt from University of Pennsylvania tried to answer

this problem in the paper published in 2011. They studied performance of 179 major publicly traded corporations and examined whether there exists any relation between the extent of data driven decision-making these firms employ and their financial performance. The conclusion was that data savvy companies were 5 percent more productive and 6 percent more profitable compared to peers in their industry (Brynjolfsson, et al., 2011). Similar conclusion was drawn by researchers from IBM who surveyed 900 businesses in 70 countries in 2013. According to them, companies that substantially outperformed their industry averages very often attributed their success to the use of advanced analytics. They not just invested more, but also used enterprise-wide strategy and backed big data initiatives from top executive level (Balboni, et al., 2013).

It is a bit harder to estimate attitudes when it comes to the Czech Republic as there are not many researches that pay closer attention to the Central European region and even fewer focus specifically on the Czech environment. One of a few was conducted in 2013 by EMC, an IT firm headquartered in the US. It concluded that support for big data initiatives among local managers is relatively low compared to other countries. Only 8 percent of Czech companies believed that big data can give them a competitive edge. This is only a quarter compared to the world average. Although majority (64 percent) perceived big data positively, almost 50 percent did not plan any big data initiative. Major concerns (in 76 percent of cases) these firms had were high costs, followed by doubts about return on investment, irrelevance for business operations of a particular firm and fears that company's culture is not prepared for implementation and use of advanced analytics (EMC, 2013).

1.3 Risks and limitations associated with advanced analytics

Corporations look primarily at potential of profit growth and consider issues such as customers' privacy to be a barrier to efficient operation rather than a genuine concern. However, this is not always the case with governments and public. Due to growth of the use of internet and smartphones with GPS modules, much of behavior is easily traceable. This create risks of misuse or unethical exploitation. In one experiment in 2006 at Harvard, a group of scientists studied interests of and relationships and their change over time among 1700 students. Even though these data were anonymized, when other researchers started to

work with the dataset they quickly found out that it is possible to de-anonymize the group relatively easily as relationships between individual members create unique patterns (Boyd, & Crawford, 2012). Even though this was only insignificant case and did not lead to any abuse, it showed how even anonymized information used for analytical purposes can pose to individual's privacy. The situation is more serious when it comes to data brokers, companies that aggregate personal data of people in order to sell them later to interested parties primarily for marketing purposes. Through various sources they accumulate dozens of characteristics and based on individual's data in their disposal can assume specific occupation, illnesses or other very sensitive characteristics. As the industry is not regulated, for a few cents per name it is possible to obtain a list of police officers, domestic violence victims or genetic disease sufferers (Dixon, 2013).

One of the most recent scandals related to privacy was triggered by a data driven experiment conducted by data scientists at Facebook. The research paper published in mid-2014 is based on an experiment conducted in 2012, when the company altered news feeds of 700.000 users for one week. Some people saw above-average number of posts that Facebook identified through its natural language processing algorithms as relatively negative, others saw more positively toned posts. The result was that users who were shown low-spirited statuses became more negative themselves and vice versa (Meyer, 2014). Although the study was not illegal, it breached ethical standards of scientific research and caused public outcry.

The field of advanced analytics is in the present controlled rather lightly, but there are two primary regulations that do indirectly cover it even now: privacy protection and anti-discrimination. In case of privacy protection, laws differ among individual countries. Data brokers mentioned in previous paragraphs operate legally in United States with hardly any control from governmental agencies. On the other hand, in the European Union privacy protection is more stringent. Notable example in this area is recent decision of European Court of Human Rights against Google, forcing it to enable EU citizens to request deletion of data it gathered about them (Overstraeten, et al., 2014).

Concentration of large amount of data may be especially risky as potential damage caused by illicit access increases with the growing volume of data that are stolen. For instance, in the beginning of year 2014 hackers managed to steal data about 70 million customers of

Target, a large US retailer. These information included not just names, but also addresses and credit card numbers (Merick, 2014). Yet, not many consumers are alarmed by the risk of their personal data falling into unauthorized hands and being misused. According to the research done by KPMG, approximately 70 percent of customers do not have problem with giving telecommunication companies access to their personal information provided that they get a discount in exchange (Koubova, 2014). But as companies will continue using data at their disposal for analytical purposes, cases of misuse and abuse will most likely grow, eventually forcing governments to introduce more comprehensive regulation.

Another important question is whether decisions backed by data analysis might infringe upon equal treatment of employees and customers. Perfect personalization may have adverse impact on discrimination in pricing, quality of services clients get or treatment of employees. These risks were one of focus areas in the report authored by John Podesta, acting as the Counselor to the President at the White House. According to his report published in May 2014, there are clear indications of unequal treatment of citizens enabled by big data technologies (Podesta, et al., 2014). For example, one study found that individuals with *black-identifying names* are more likely to see ads containing word *arrest* than those with *white-sounding names*. Racially based filtering of information is creating information bubbles leading to possible knowledge inequality (Podesta, et al., 2014). Another risk is hidden in so-called *redlining*. Historically, in the United States in the second half of 20th century some banks were reluctant to grant loans to African-Americans, Latinos or Jewish citizens. Racial profiling would be illegal, therefore they were using address of applicants as a proxy. Thus a person living in a certain neighborhoods would not be able to obtain a loan or mortgage even though an institution could claim that applicant's race was not taken into account in the process of evaluation. Although this practice was banned in 1975, growing amount of data firms have about their customers may create new proxies for *digital redlining* and enable to treat individual customers based on behavior of a group an algorithm associates them with (Podesta, et al., 2014).

1.4 Potential use of advanced analytics

Increased availability of data and analytics has caused shift in management paradigm. With the volume of information tripling just between years 2003 and 2008 (Bounie & Gille, 2012) managers are gradually losing ground for making decisions based on their intuition. IBM summarizes this well in a commercial promoting its analytical systems. The ad starts with the question asking, how would a person standing at the road with cars passing by, having only a snapshot of how the road looked like a few minutes ago, decide when to cross (IBM, 2010). This claim is an exaggeration. Companies have been making decisions for decades without perfect information and even the most advanced technologies available today cannot guarantee certainty. No technical tool guarantees that the information one can get now will improve strategic or operational decisions without many other factors being present. Yet, the claim in IBM's advert is good expression of gradual change in thinking of managers. Recent study on 442 business executives showed that absence of up-to-date and accurate data is a major cause of reduced confidence in decision making (Harvard Business Review Analytic Services, 2013).

1.5 The importance of analytics

Advanced analytics offer wide variety of use cases across different industries and company business functions. Generally, these can be divided in three main groups depicted in figure 1. Firstly, better knowledge of needs and preferences of customers and trends in the market helps companies develop better offerings and target them more precisely than ever before. In the same time, as they have more information also about their inner workings, firms can optimize procedures and processes in order to increase speed and bring down the costs of operations. And lastly, they can make decisions while better informed about surrounding competitive environment.

McKinsey estimates that big data can create significant additional value across different sectors in the economy. Full utilization of advanced analytics potential is expected to bring extra value equal to 300 billion USD to US healthcare industry alone, 250 billion to EU public administration, potentially more than 60 percent increase in net margin for US retailers and 50 percent decrease in product development costs in manufacturing sector (McKinsey & Company, 2011). Individual industries can utilize big data to different extent. Construction sector is likely to gain less by using them compared to media or telecommunications. Yet, in almost every case, even if it is just about making internal processes more efficient, companies can gain additional value.

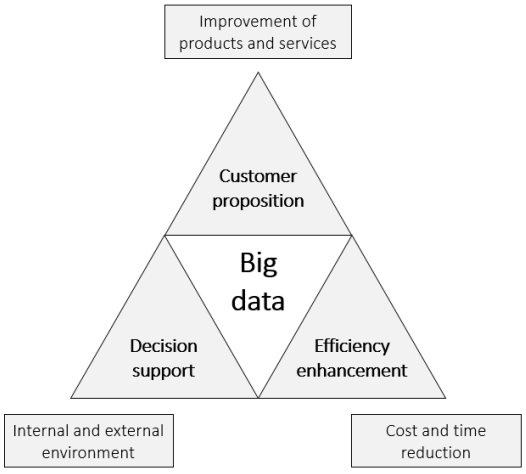

Figure 1 Three dimensions, in which big data help companies (Figure by author, based on Big Data @ Work by Thomas Davenport, 2014)

1.5.1 Customer proposition

Figure 1 above depicts three main ways how firms can use big data to improve the performance. The first one is customer proposition. In order to succeed in the marketplace, companies need to come up with products that match customers' needs. This involves more than just a creation of good products or services. In addition to that, they need to deliver them in the timely manner and way clients want, for price they accept and build lasting customer relationship. Big data can help in all these areas.

For example, tracking of customer behavior could help firms to create offerings that they will value more. The way Google designs and modifies its services is a very good example of this approach. Through A/B testing, by showing individual users different versions of its products, it can test and evaluate whether changes in functionality or design provide them with any additional value. Features that do may be rolled out globally, while those that do not will be the most likely abolished. In 2011 alone, the company run more than 7000 different tests (Christian, 2012). This approach enables Google fast adjustments and prevents large-scale failure.

Companies can experiment with pricing in the similar manner. One management consultant interviewed in the process of writing this thesis pointed at approach that one major Czech bank employs when calculating loan rates it offers its customers. The bank continually adjusts interest rates and matches them with momentary demand. The system tracks what is the borderline, after which clients with certain characteristics tend to refuse bank's offer. It then tries to push up the rates towards this number while making sure that interest will not exceed the rate that would make the bank uncompetitive. The bank can use this system, partly because of size of its operations. With hundreds of requests in every client category every day it can relatively precisely estimate the right percentage.

The same approach can be applied in customer care and other business areas such as promotion. Big data make possible to gather intelligence from unstructured sources like social media posts or speech through text and voice recognition software (Danson, et al., 2012). An algorithm can track and analyze all mentions of a company by an individual customer and combine them with recordings from his or her past interactions with customer service helpline. With sufficient data it can flag customers that are likely to be irritated enough to need some special care in order to prevent them from leaving for another competitor.

Data savvy companies can leverage better knowledge of their clients when promoting products. Netflix is one of leaders in this field. In order to better target customers it has created over 76 thousand of movie sub-categories based on tags including attributes such as level of romance or plot conclusiveness, capturing dozens of movie characteristics. The database includes categories such as *Dark Suspenseful Sci-Fi Horror Movies* or *Visually-*

striking Foreign Nostalgic Dramas. Netflix is using these tags in combination with user behavior in order to very precisely determine what characteristics individuals seek in movies they watch and then offer recommendations based on these information (Madrigal, 2014).

1.5.2 Efficiency enhancement

Besides improved customer offerings, advanced analytics based on big data technology enable to decrease time and costs invested in the process of creating them, both in opportunity and real terms. Despite relatively high initial set-up costs big data platforms can help companies to cut storage and processing costs. For example, the cost of storing 1 terabyte of data using a Hadoop cluster, a technical platform widely used by companies, amounts to 5 percent of expenditures associated with traditional storage solutions. In the similar way, it is possible to significantly increase performance, which means much less time needed for calculations. For example Macy's, a major US retailer, was able to process re-pricing of its 73 million inventory items for sale in 1 hour instead of 27 hours normally needed thanks to new big data technology (Davenport, 2013). Time save means that many more analysis can be performed with given resources, providing companies with information necessary for making good management decisions.

More importantly, in addition to these direct savings there are also indirect benefits. There is a famous quote attributed to a department store owner John Wanamaker in the late 19th century, who said that half of the money he spent on advertising was wasted, but he did not know which half (Gray). This may change thanks to new tracking technologies. If a company can more closely observe and evaluate behavior of its customers, it can better allocate marketing resources. In case of advertising, it would be adjustment of investment in communication channels that achieve the highest return on investment instead of just spreading expenditures in a way that is traditional in a given industry.

1.5.3 Decision support

Complex environment and time pressure force executives to make decisions with high degree of uncertainty. In the moment of a strategic choice, they often do not really know what the actual situation is, not just in the market they operate in, but also in their own companies. Even though there exist numerous internal and external reporting mechanisms in every

corporation, and industry trends sooner or later surface, at that point it may be already too late for a distressed company. Examples of Nokia or Blackberry, until recently leaders in their target segments, are case in point. Decision inertia or making strategically wrong conclusion will not be cured by more information, but more data can help managers to choose the right path in many situations. As more data about current events and trends based on combination of multiple sources are becoming readily available, executives are getting new support tool for making better strategic or operative choices.

Already, there are companies in the market providing similar services. One of them is Recorded Future. Its algorithms create synthesis out of more than half million open web sources and create predictions for both companies (in areas cyber and competitive intelligence) and government institutions (with focus on defense intelligence) (Recorded Future, 2014). Although the idea that it is possible to predict events based on openly accessible data on the internet may sound implausible, in 2010, shortly after it was founded, the company obtained an investment from Google Ventures and In-Q-Tel, which is the investment arm of US Central Intelligence Agency (Shachtman, 2010).

2. Physical infrastructure

New technology is the cornerstone of advanced analytics. Although analytics do not have to be necessarily running on big data platforms, as was argued above, accuracy of models is significantly reinforced if amounts of data used for analysis fall into the big data category. In that moment the speed and actual feasibility of any analysis depends on using big data systems, since they enable users to execute analysis in a scope, speed and while using significantly more information sources than normally possible. Therefore, it is necessary to understand what would be requirements for a company thinking about launching its own big data initiative. As cost of running own system starts at around 750 thousand US dollars per 3 years according to Oracle (Dijcks, 2014) not taking into account expenditures on data scientists, executives need to be sure that they will be able to utilize insights.

2.1 Technology behind advanced analytics

Usually, data are processed in traditional relational databases that store data in rows and columns of numbers. However, this approach becomes inefficient once the amount of data exceeds a certain volume or if it comes in unstructured formats. Moreover, if the volume of data is too big, it cannot be processed fast enough on a single server, regardless of its computing power. New generation of technology can overcome these hurdles. For instance, Hadoop, an open-source software, is able to divide data across many different computers while providing highly scalable processing and storage environment that is able to handle immense data volumes (Davenport, 2013). In this way it is possible to use relatively cheap commodity servers instead of powerful, but very expensive brand systems. In addition to that, big data is intertwined with new programming languages such as Pig, Hive and Python, new hardware architecture and cloud storage.

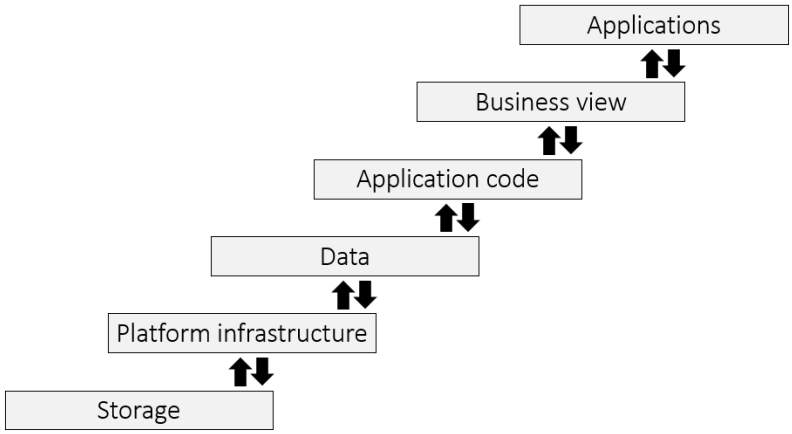

Figure 2 The Big Data stack (Davenport & Dyché, Big Data in Big Companies, 2013)

Figure 2 depicts 6 layers, to which according to Davenport and Dyché big data relate: Storage, Platform infrastructure, Data, Application code, Business view and Applications (Davenport, et al., 2013). In case of storage the primary benefit is decrease of costs associated with it. Platform infrastructure concerns primarily functions enabling integration, management and application of complex computational processing. Data is a separate asset and require specific management and governance. Application code stands for a particular use of data, such as search for a specific type of customer in database of social media transactions. Business view layer makes data available for further analysis by data scientists. The last part consists of various applications such ach visualization tools or business intelligence software that enable even ordinary managers to understand insights hidden in the data (Davenport, 2013).

Hadoop, a platform mentioned above is one the most commonly used in the world of big data. But it is only question of time until a newer and more efficient alternative will take its place. This may be already happening. In June 2014 Google's executives at its annual developers' conference announced that the company abandoned Hadoop in favor of more flexible data systems it has developed (Vance, 2014).

There exists wide variety of methods for analyzing big data. A/B testing, mentioned earlier, is just one of them. Others are for example association rule learning, where algorithms look for relationships between variables, cluster analysis, where the goal of an algorithm is to find

a small homogeneous groups sharing similar characteristics or machine learning, algorithms enabling to evolve their behavior and neural networks well suited for pattern recognition or optimization (Manyika, et al., 2011).

Nature of this thesis makes it superfluous to describe underlying technology in greater detail. The most important thing here is to realize that if a company wants to use advanced analytics in its business operations, in the most cases it needs to purchase and maintain a complex and expensive computer system in order to do so.

2.2 Interpretation of advanced analytics

Translation of information companies harvest into business insights is an essential part of the process. But people who do so are in limited supply, very expensive and yet inevitable. These are the three main adjectives associated with data scientists, around whom there has been a big hype in the last few years. The name of an article in Harvard Business Review, titled *Data Scientist: The Sexiest Job of the 21st Century* (Data Scientist: The Sexiest Job of the 21st Century, 2012) is just one of many arguing that a new type of employee will be fundamental for firms trying to compete in the transformed marketplace.

The occupation itself is not new, even in the past many companies needed knowledge workers with advanced mathematical and IT skills who would be able to analyze and interpret information. The difference is that as the number of firms using data has grown, the demand for data scientists has risen as well. McKinsey Global Institute, the research arm of global consulting firm McKinsey, reckons that by the end of this decade businesses in the US will need to fill almost 200 thousand deeply analytical positions and find further 1.5 million data-savvy managers (McKinsey & Company, 2011). Peter Sondergaard, the global head of research at Gartner estimates this number to be much higher. According to him, by 2015 4.4 million IT jobs will be created due to the surge of big data use, 1.9 million of them in the US. In addition, every IT position created will generate 3 positions outside the field (Gartner, 2012).

Universities are introducing new academic programs to keep up with the demand. In 2013 candidates could choose among big data programs at many of top US universities such as Columbia or Carnegie Mellon University (Henschen, 2013). But demand is still exceeding

supply of data scientists, mainly because they need to possess diverse and specific skillset. They need ability to code, proficiency in scientific methods, strong quantitative skills as well as good communication abilities and business knowledge (Davenport, 2013).

Attracting and retaining right employees will therefore be one of main issues connected with advanced analytics in the coming years. Limited availability of skilled employees who would analyze and manage big data are two of top three challenges corporations face when trying to implement big data initiatives (IDG Enterprise, 2014).

2.3 Costs

Advanced analytics require considerable upfront investment into infrastructure and people. Even though they do not have to necessarily requite big data, in the most cases they will. Therefore, in the following cost calculation of a new system we will assume that a company will use a big data platform. Although far cheaper than traditional systems that are already in place, initial investment can discourage executives from starting a project since it mean additional expenditures.

Cost of hardware and licenses amounts to tens of thousands US dollars per individual computing node (Dijcks, 2014). The larger amount of data a firm needs to store or analyze, the larger network of these nods has to be. Probably the best way to express the price of a project is through cost per terabyte of stored data. This enables the easiest comparison between new solutions and older legacy systems since it overcomes the problem of difference in physical components and focusses on performance. As technology progresses, the prices of hardware will fall. Therefore, the numbers stated in Figure 3 will most likely not be valid beyond 2014. Units are in millions USD.

	Data Warehouse Appliance	Hadoop
Volume of Data	500 TB	500 TB
System Cost	22.7	1.4
Initial Acquisition Cost	5.5	0.2
Upgrades at 20% CAGR	8.4	0.3
Maintenance / Support	8.2	0.2
Power / Space / Cooling	0.6	0.7
Admin	0.8	0.8
Application development	6.6	7.2
Total cost	30 million USD	9.3 million USD

Figure 3 Cost breakdown example (Winter et al., Big Data: What Does It Really Cost?, 2013)

In 2012 IT companies estimated cost per 1 terabyte to be around 1.000 USD if company was using a big data platform (Bantleman, 2012) (Bertolucci, 2012) (Winter, et al., 2013). As technology becomes more wide-spread, the prices fall. More recent price estimates put price per 1 TB to level around 700 USD (Dijcks, 2014). But the absolute number is meaningless without comparison to cost of traditional storage systems. As alternative solution, data warehouses would cost around 100.000 USD per terabyte (Cohan, 2014) companies can save 90 percent of their project budget dedicated to hardware and software while getting the same performance. Even though it is necessary to add cost of application development and administration, these are comparable in both cases.

Companies need to count with expenditures on data scientists as well. In Silicon Valley annual cost per person does have six figures and companies usually need to hire more than one. A team of ten scientists can cost a company around 1.5 million USD per year according to Shashi Upadhyay, CEO of Lattice, a provider of big data applications (Bertolucci, 2013). Though their cost differs based on the country they will be hired and working in. Smaller companies may decrease these costs by choosing cloud services, in which case they pay only for capacity they use and hire services of external data scientists paid by hours of work.

Although the survey on 751 companies conducted by IDG Entarprise, a technology company, showed that an average business plans to spend about 8 million USD on big data initiatives in 2014 (IDG Enterprise, 2014), vast majority of data (97%) in 2013 were still stored in legacy systems (Aslett, 2013).

3. Advanced analytics in retail banking

Financial institutions are well positioned to benefit from advanced analytics. They already do have access to a wealth of data about their customers and their behavior. I addition to that, they are able to cooperate with numerous other partners to extend the pool of information even further. In the same time, the industry is under significant transformation due to change in customer preferences and expectations and threat of new, more agile entrants (Eistert, et al., 2013). All of these forces provide banks with strong incentives to innovate. On the other hand, the industry it has specific position compared to other sectors of the economy. This position may limit the scale and scope of use of advanced analytics. Therefore, before describing potential application of analytics in the industry it is necessary to examine both external and internal limitations that are caused by specifics of banking industry.

3.1 Specifics of banking industry

If banks cope with barriers specific for their sector, they could extract significant additional value from advanced analytics (Manyika, et al., 2011). Looking at the context, in which they operate, it can be said that there are two forces pushing in the opposite directions. On one hand, there are barriers slowing down the progress. On the other hand, there are accelerators as well. Figure 4 depicts these four main drivers.

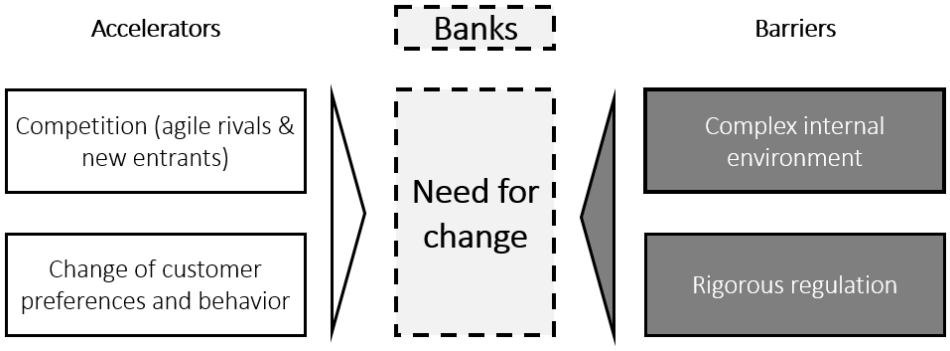

Figure 4 Change accelerators and barriers influencing banks (Figure by author)

Barriers are constraints connected primarily to legal limitations of what a company can do with the data about its customers and regulatory oversight present in banking industry. Even

though every company is under scrutiny of governmental agencies to a certain extent, financial organizations belong to the most supervised institutions. In addition to that banking industry is known to be inflexible and relatively slow in response to changes in business environment, which hinders any innovation (Gordon, et al., 2014).

Although banks do not tend to innovate swiftly on their own, changing circumstances are forcing it to adapt. Technological developments lowered sector's access barriers making entry for new competitors easier. These new entrants consist from leaner and more agile on-line banks as well as competitors from other industries such as retail and utility providers, or start-up companies with potentially disruptive solutions. The old model with multiple layers of management and large network of physical branches seems to be losing edge in the face of streamlined operations of newly built banks. These new companies are in advantaged position, because they do not have to cope with complex legacy core banking systems as well as organizational structures that are hard to change. But even if there was no threat of new entrants, changes in customer attitudes and preferences forces transformation upon banks. Thanks to loss of trust in financial firms and much better customer experience in other sectors clients have become less loyal and more demanding.

3.1.1 Regulation

Regulation is the first cause for concern. Because financial industry does have specific standing in business environment any problem could tip the whole economy out of balance, as it happened in 2008, when financial crisis in the US spread over and caused the biggest economic downturn since the Great Depression. Therefore, it is not surprising that governments prefer tighter control to laisse fair approach. Precautionary attitude may help keep the system stable, but it goes far beyond macro level and in case of Czech Republic requires banks to consult virtually any change in consumer terms with an oversight agency. This hinders rapid reinvention and innovation. According to one bank manager interviewed as a part of the research, introduction of any new product takes approximately 2 months longer than would otherwise, just because the bank has to comply with fixed time periods before adjusting parameters of its products. But the situation is not very different abroad either. According to one survey, banks in Europe and United States consider regulatory

compliance as the biggest challenge and also as top investment priority (Sullivan, et al., 2014).

3.1.2 Slow pace of innovation

The second specific of the industry is slow pace of innovation. Historically, banks have modernized slower than other organizations and so far there have seen a little of disruptive innovation (Banerjee, 2009). According to the survey from 2014, only around 10 percent out of 560 bank executives believed that their companies are innovation leaders and about the same number felt prepared for tackling innovation challenge (Sullivan, et al., 2014). There are two main reasons for that.

The first is related to regulatory environment created by governments described above. If it takes time, a lot of effort and bureaucracy to introduce any innovation, it will naturally slow down the pipeline of new ideas. Secondly, banks are often large and complex enterprises with numerous levels of management, complicated decision-making process and various interest groups. To arrive at a decision and implement any change thus takes much more time compared to other, more flexible and leaner firms. For example, one major Czech bank was still using MS Office 2003 version in 2013, because before it was able to execute the roll out of 2010 version, MS Office 2013 was released and the project was halted. In addition to general slowness, Eastern European banking sector is specifically behind compared to its western peers in terms of innovativeness (Dietz, et al., 2012). Even though financial institutions spend on IT 9 percent more than other industries, these investments do not fully materialize their potential value due to insufficient controls, poor resource allocation and a lack of performance transparency (Bensemhoun, et al., 2011). Albeit on statistically small sample, this conclusion was confirmed during personal interviews with bank managers. All but one complained about incapability of their banks' internal IT departments to cooperate with business functions in the company and deliver solution in a timely manner.

Coumaros from Capgemini, a consultancy, argues that information silos are one of the biggest barriers banks face in implementing big data technology (Coumaros, et al., 2014). Survey by Infosys conducted in 2013 concludes the same. According to its respondents, IT systems are one of the biggest barrier for banks of all sizes (Infosys, 2013). For example,

when Deutsche Bank in 2012 tried to implement a system that would analyze all its unstructured data it came across various challenges. Its data were stored in 46 different data warehouses and there was 90 percent overleap. As the IT infrastructure bank was using at the time had been built in the course of two to three decades, significant investments would be needed to integrate these platforms. Moreover, executives would then need to find out how to utilize old equipment that had cost hundreds of millions Euro over the years (Coumaros, et al., 2014).

3.1.3 Competition

Compared to this, new entrants can build infrastructure from the scratch, which makes it possible to better capitalize on new technology. For example Air Bank, one of the recent entrants to the Czech banking market prides itself to be paperless. If a customer does not specifically request paper communication, all documents, from contract to monthly account balance reports are done electronically. Another relatively new market player is mBank, a subsidiary of Polish bank BRE Bank. Founded in 2000 as world's first internet-only bank, it has recently introduced redesigned internet banking that enables its clients to shop in online financial product e-shop, features intelligent search in transaction history and allows users to create budgets and measure performance. Customers appreciated progressivity, according to case study by Forrester Research, around 45% of mBank's newly opened accounts in the after-launch period could be associated to interactions with marketing content of the new mBank (Forrester Research, 2013).

As a good example of how complicated such adjustment for existing banks can be we can use an example told by one management consultant. A Czech banking firm was trying to update its core banking systems back in 2011. The project took one and half year, cost approximately 1 billion CZK and eventually failed, resulting in dismissing a part of bank's executive board.

Fresh models introduced by new generation of banks are not just attractive for customers, but also more cost efficient. By transferring significant part of activities online, automation and self-service these banks can serve many more customers per employee resulting in low headcount compared to assets under management. For instance, in one of banks that entered

Czech market relatively recently, less than 150 employees manage all operations and serve half million customers. This number includes even staff in call centers, although a big part of IT operations is outsourced. In addition to lower operation costs and higher profitability smaller and flatter management enables these banks to react faster on changing environment and decisions of competitors.

Some competitors originate in financial industry, although not in retail banking. Knab, a digital only bank, was launched by Aegon, leading insurance provider in Netherlands. It offers customers personal archive with all interactions with bank employees including support line call recordings. In addition to that, it provides customers with a tool, with which they can manage their financial plans. This tool aggregates and integrates information about all their accounts and offers some forecasting and budgeting features (Pearson, 2013). By offering this tool Knab gains access to complete financial information of its customers, even when they do not use it as a primary bank. It can thus target its offerings much more precisely than it otherwise would.

In addition to aggressive new banks existing actors have to face entrants outside of financial industry. Even retail giants such as Walmart and Tesco has entered the financial sector. Tesco initially ventured into the sector in cooperation with Royal Bank of Scotland in 1997. Since 2008, after paying RBS 950 million GBP for its share it is the sole owner (Kollewe, 2008). With its superior knowledge of consumers thanks to loyalty cards, titled as *the first example of big data* by its former CEO Sir Leahy (Bold, 2013) it can pose significant competitive threat.

In addition to established, but until now outside of financial industry operating firms, innovative start-ups constitute the second group of novel competitors banks need to counter. Brian Ascher, a venture investor, explains the rise on new financial start-ups partially as a result of technology developments, but other important factor according to him is behavior of banks during financial crisis. Conservative approach to risk taken in 2008 left many individuals and small companies without access to loans. These under-banked and unbanked individuals created interesting target segment for new companies (Ascher, 2013) same as shadow banks including peer-to-peer lenders are able to capture a rising portion of business loan demand (The Economist, 2014). Start-ups, such as Moven in the US, besides classic

financial services, integrates customers' social media timeline and offers them insights on how their social life impacts spending habits (Pearson, 2013). Moven in this way gains access to highly personal information about its clients. Once the access is granted, it can further use acquired information for marketing or risk management purposes.

Narrowly focused firms specializing at closely defined activities such as business loans (OnDeck), payment technologies (SquareUp), money transfer to developing countries (Xoom) or community investment (eToro) provide added value for customers while being potentially very profitable for its owners. Even though it is unlikely that any of them will be able compete with full service banks, they further diminish margins of bigger institutions and thus put them under additional stress.

3.2 Change of customer attitudes and behavior

The other important source of mounting pressure besides direct and indirect competition is coming from bank customers. This force be split into two parts. The first one is connected with personal attitudes towards traditional financial institutions and the second with clients' financial behavior. According to recent study on more than 10 thousand millennials (people born between 1981 and 2000, currently accounting for 80 million people in the US (Schwabel, 2012)) by Scratch, in-house consulting firm of Viacom, banks are the most likely industry to be disrupted in upcoming years. 53 percent of respondents did not think their bank was anyhow different when compared to its competitors, one in three planned to switch bank in the next 90 days and about the same number believed that in the future there will not be any banks at all. Attitudes are best summarized by following statistics. Four leading banks are among ten least liked companies. 73 percent would prefer Amazon, Google or PayPal to be their financial services provider. And last but not least 71 percent would "*rather go to the dentist than to listen to what banks are saying*" (Scratch, 2013).

Although the study of Scratch (2013) focused exclusively on millennials who represent significant number of customers, but do differ from older generations, event older consumers, far from tech savvy, demand better service. According to Paole Cederle, CEO of UniCredit Group, even older generation not addicted to the internet, whose members still prefer personal visits of bank's branches have expectations shaped by services such as on-demand

television and require much more assistance and professional recommendations from staff compared to the past. Instead of having to choose from a catalogue of products they want salespeople to know their situation and needs, and guide them through the decision process (Mckinsey & Company, 2013).

Distrust of consumers is confirmed by another study done by Edelman, the world's largest privately owned PR firm. Its annual survey conducted on 33 thousand respondents showed that banks are the least trusted industry with only 51 percent of respondents trusting them compared to 79 percent who trust technology industry. Moreover, this number is still not accurate as the results are skewed upwards by countries such as China (where 76 percent of respondents trust banks) and Indonesia (74 percent). If we looked specifically at developed countries, the overall picture would look even bleaker. Only 24 percent in Spain and 23 percent of people answering survey questions in Germany trust banks (Edelman, 2014). Another important consumer group that feels ignored are women. According to one survey in the USA, 73 percent of them complained that they are given inferior advice and terms compared to male counterparts. As they currently control 50 percent of US private wealth and head one third of households, banks need to address these concerns as well (Sullivan, et al., 2014). Customers perceiving banks so negatively will substitute their services in the first possible instance for a viable alternative. As the number of possible substitutes keeps rising, financial institutions need to think about the ways that would help them regain sympathy of their clients.

But even if perception by consumers was not as negative as it is now, banks would be probably forced to innovate more nevertheless. The reason is a change of way its clients use different services caused by advance of mobile internet, smartphones and tablets, and new services based on them. Clients got used on seamlessly integrated ecosystems by companies such as Google or Apple and superior consumer service by Amazon (Sullivan, et al., 2014) Speed and convenience with which they can get desired products in other industries emphasize in minds of consumers how irksome financial institutions are. They are no longer willing to accept long waiting times and bureaucracy often connected with purchase of financial products.

In the same time, people change the way they make decisions. Thanks to the Internet it is now possible to find information, reviews and compare prices of virtually any product. With trust towards media and institutions on historically lowest levels (Edelman, 2014) they are turning to their social circles and independent opinion leaders with questions before choosing a product or service. This trend correlates with the rise of social media and blogs, which have made process of advice crowdsourcing more convenient and faster than ever before. Other important influencer of purchase behavior are automatic algorithms coming with recommended products and services for the next consumption. They can figure out what consumers need before they do and then offer it to them. According to MacKenzie, Meyer and Noble from McKinsey, these recommendations already account for 75 percent of sales on Amazon and 35 percent of films watched on Netflix (MacKenzie, et al., 2013).

The third aspect of consumer shift, besides expectations and information sourcing, is change in how clients purchase products and services. Continuing proliferation of various electronic devices has enabled individuals to purchase virtually anything out of their living room at any time of a day. Mobile sales accounted for 3 percent of e-commerce in 2011 but were expected to rise to 15 percent by the end of 2013 (MacKenzie, et al., 2013). Some estimates expect the web to influence more than half of all retail transactions, with value around 2 trillion USD, by 2016 (Bommel, et al., 2014).

This trend is demonstrated on rising popularity of online banking. According to American Bankers Association, between 2004 and 2011 popularity of internet banking as a preferred banking method rose from approximately 25 to 65 percent (PricewaterhouseCoopers, 2012). But most banks are still not prepared yet for digital disruption of their models, although their executives do see the change as an important challenge to overcome (Sullivan, et al., 2014). Old model relaying on sales through bank's advisors sitting in its branches is no longer working as customers are increasingly making decisions about what they want before they even enter the branch. Companies that want to be successful in the future therefore need to rethink the business model and integrate new platforms such as peer-to-peer advice and professional research tools in order to steer customers towards the desired decisions (Eistert, et al., 2013).

Despite strictly regulated environment, innate misgiving about the change and innovation and complexity of any adjustment, banks need to rethink their entire business operations. With distrust of consumers at record highs, rising expectations and change in behavior it is only a question of time until a new entrant, meeting needs and desires better will join their ranks and disrupt the industry. The first step in avoiding that is to better respond to consumers' requirements. Advanced analytics can help firms find out, what these wishes are.

3.3 Potential of advanced analytics in retail banking

Retail banking is in a very good position to profit from advanced analytics. It is already intensively using IT technologies, is able to afford top tech talents, already has good access to wide array of client data and to a certain extent it has been using data-driven decision making (Manyika, et al., 2011). Previous situation analysis showed, it needs implement advanced analytics if it plans to face new trends. In this part of the thesis we will look at areas, in which benefits would be the highest. In 2012 consulting arm of Deloitte published a report, which besides other areas explained how banks can capitalize on advanced analytics in 14 different areas (Deloitte Development, 2012). These areas could be generally divided in two distinctive groups: operation efficiency enhancement focused on cost saving and customer oriented analytics aiming at increasing revenues. Next paragraphs will examine these opportunities in greater detail and show examples of banks who have successfully applied them.

3.3.1 Improved risk management

Cost saving can be broken down into two parts. The first one is using analytics for improving customer risk assessment. Historically banks have been using credit ratings (FICO score in the US, CRIF and SOLUS in the Czech Republic). Credit scores estimate likelihood that a client will pay back his or her loan. For apparent reasons rating companies do not fully disclose their methodology, but there exist some indicators of what is taken into account when a person's score is calculated. According to Consumer Federation of America, main components of FICO are payment history, outstanding debt, length of credit history, new credit taken recently, and other factors. Considering race, sex or marital status from when calculating a score is prohibited by law (Consumer Federation of America, 2005).

Because of limited data inputs, credit scores cannot predict threat of individual's default with certainty. That results in declining some loans that would be repaid if granted and granting a number of loans that eventually will not be repaid. Advanced analytics can help banks narrow this uncertainty gap. By feeding more internal and external data into algorithms financial companies can significantly improve precision of their credibility estimates. According to Toos Daruvala, a director in McKinsey's New York office, this is how one of their client firm solved the problem with insufficient underwriting model. Before, the efficiency (ability to discriminate between good and bad risks) of its model was in range 40 to 45 percent. After adding a range of external sources and additional internal information that the bank already had in its disposal it was able to increase the prediction power of model to 75 percent (Daruvala, 2013). Even when banks do not have much data about customers, it is possible to improve performance of models by teaming up with other companies, such as telecommunication operators since experience shows that ability to pay up a debt can be derived from telephone invoice payment history (Daruvala, 2013).

In the Slovak Republic cooperation between mobile operators and banks may happen in the near future. In the beginning of 2014 media in the country published a story about Orange, one of major Slovak mobile operators, collecting consent of customers with publishing their data in a credit register. Public perceived this as a controversial as the company was doing so under the pretext of new service activation, with consent written in the small-print of the contract (Valcek, 2014). Although the cooperation has yet to start because of certain disagreements, it is probably just a question of time.

Introduction of new variables into the risk evaluation offers great potential, but poses some risks on its own. As mentioned earlier, banks are heavily regulated. Privacy and anti-discrimination regulations may significantly limit what institutions are allowed to do with data. Internal data analysis in one Czech bank have shown that gender and marital status can offer some insight into likely behavior of a client, yet, it is questionable whether the bank would be allowed to use such variables for actual evaluation of loan eligibility.

Time is important variable as well. Big data analytics can significantly speed up calculations and thus enable data scientists to test more different scenarios. Bank of America is using big data platform to analyze and detect early high-risk clients. Normally, it would take mortgage

default calculation 96 hours to evaluate all 10 million loans the bank has in its books. New platform manages the same task just in four hours. This enables the bank to more run scenario analysis and other tests with higher frequently (Coumaros, et al., 2014).

The other field connected with risk optimizing is fraud detection. Credit card companies and banks has been trying to identify extraordinary transactions in order to prevent frauds to happen. If a string of credit card payments of a person made is situated in one country and suddenly there the card is charged on the other side of the world, an algorithm can conclude that with high probability this transaction is fraudulent. There need not to be any sophisticated mechanism to spot such derogation, however, more advanced mechanisms are necessary for noticing less clear abbreviations. Because of technology limitations, algorithms work often only with history of transactions that happened in the last few weeks, decreasing efficiency of fraud detection. But companies such as Cloudera, a big data start-up currently valued at around 3.5 billion USD, enable firms to feed models with a decade of transaction data significantly increasing precision of fraud detection while making the process faster and cheaper. In case of a global credit card company Cloudera's solution enabled it to uncover the largest instance of fraud in the company's history (Olson, 2013).

Federal Reserve System estimates that in the US in 2012 there have been 31.1 million fraudulent transactions worth 6.1 billion USD (Gerdes, et al., 2013). As majority of costs are borne by credit card companies, they have strong interest in identifying and blocking these transactions before payments are cleared. In the same time, more precise systems are able to prevent false alarms and costs resulting from their resolution, such as when an individual travels to an exotic country and tries to pay by his or her credit card. False alarm may cause that his or her card is subsequently blocked from preemptive reasons.

The last example of how banks can utilize big data to reduce risk comes from Netherlands. Radobank, a Dutch bank, tried to tackle criminal activities at its ATM's. It created a model taking into account location of individual ATM's, their proximity to highways, season, weather conditions, etc. Based on results it optimized the network to increase security and improve customers' convenience by locating them to strategic spots (Coumaros, et al., 2014).

3.3.2 Process efficiency enhancement

The second group of cost saving applications of advanced analytics are related to process efficiency improvement. The financial crisis, subsequent losses followed by complex regulations and new capital ratio requirements in the recent years forced banks to significantly reduce costs of their own day-to-day operations. But cutting headlong or too deep could do more harm than good for the future development of company's operations once the crisis is over (Accenture, 2008). Approaching this process through analytics may thus generate better targeted cuts.

Often the first target of cost optimization are suppliers and procurement. Analytical systems can better track performance of products and services banks pay for. Marketing expenses is one of such areas. According to the report by Bhandari from McKinsey, integrated analytics approach can provide companies with savings in their marketing spending between 15 to 20 percent, accounting for 200 billion USD annually worldwide (Bhandari, et al., 2014). Optimization of marketing expenditure is relatively easy, provided the company knows how the decision process of its customer looks like and where are the main touchpoints. After that it can apply marketing-mix and attribution modeling to find out what are the main decision influencers. The advantage of advanced analytics is that it enables firms to adjust models for numerous variables such as weather, period of year or special promotion of a competitor (Bhandari, et al., 2014). As result, the company can adjust and align spending so it better fits behavior of its target group.

Many firms currently use communication channels their customers ignore, because it has been industry practice and other competitors behave the same. Advanced analytics enable firms to decide on facts. One insurance company in the United States in this way increased marketing productivity by 15 percent annually between 2009 and 2012, while not investing more into marketing in absolute terms (Bhandari, et al., 2014).

In the same way it is possible to analyze majority of processes that are outsourced to other firms in supply chain. Being able to measure real worth of these services gives banks the opportunity to objectively asses their fair price and decide whether to continue in using them if a change of supplier is reasonable from business perspective.

Although it seems straightforward in theory, in fact not many firms do detailed mapping of their marketing funnel and consumer decision journey. The ultimate problem thus is not to find the answer in the data, but to be able to articulate, which information will be necessary to answer a given question. Although vast majority of Fortune 500 companies has at least one big data initiative under way, most of them has yet to fully grasp what the new opportunities are and how to create a competitive advantage through advanced analytics (Hagen, et al., 2013).

3.3.3 Cost savings in internal operations

The next area where banks can bring their costs down are their internal operations, namely compliance-related expenses, workforce, processes and operational decisions. Any of these generates or is capable of generating variety of data streams that if investigated can help banks render better decisions

In the first instance, advanced analytics can help them examine cash flows in the company as well as expenses on workforce or capital investments and thus uncover hidden costs. According to Vipal Monga, senior editor at Wall Street Journal, AT&T was able to increase free cash flow in the company by more than a third to almost 20 billion USD in 2012 thanks to the use of big data analytics. In order to achieve that it needed to reconcile accounting methods and computer systems in 12 previously independent companies. After it done so it was able run analysis such as one that showed how much more cost efficient would be to build teleconferencing rooms as it enabled the firm to cut expenditures on employee travel. Similar techniques were used by AT&T to cut down inventory and account payables days (Monga, 2014). Generally, correct execution of business process simplification can considerably improve operational performance while cutting cost by more than 25 percent and reducing operational risk (Sullivan, et al., 2014).

Large corporations, the group where many banks belong, suffer from having to manage complex and inefficient organization structures. The bigger the company becomes, the higher is the potential number of processes that run bellow their optimal level. In the same time complexity prevents efficient management. Sullivan from PwC reckons that all banks wanting withstand competitive pressures coming from more cost efficient new entrants will

need to optimize their operations (Sullivan, et al., 2014). Advanced analytics can help executives gain overview and enable them to streamline and simplify procedures. This creates great potential for savings. For instance, one community bank was able anticipate workloads and adjust staffing in its call centers and branches by analyzing transaction data and applying voice recognition algorithms on recordings from its call centers (Versace, 2013).

Since the financial crisis banks have been gradually downsizing the workforce. In order to do so efficiently, meaning letting go staff that is the least productive and brings less added value for bank's operations compared to others, companies need to be able to evaluate performance of employees. Especially physical branches pose a substantial fixed cost burden. According to PwC Banking 2020 Survey, many executives already believe that the importance of branches will be diminished in the coming years. The number of employees branches need to service clients has already been falling (Sullivan, et al., 2014). Well-designed IT systems with automatized processes and algorithms capable of machine learning enable substitution of human workforce in some business areas entirely.

Performance evaluation, even though seemingly meritocratic, can fail to equitably asses different managers if simple KPI's such as branch profit or number of customer are taken into account. In complex environment, where managers hardly control majority of variables, simple objectives may lead to corner-cutting and short-termism, causing harm in the long run. For instance, after taking into accounts variables such as location it may turn out that a loss making branch fares much better than expected and another one, profitable, performs well below its potential. In addition to evaluation, advanced analytics can assist managers when deciding whether to hire new employees, how to allocate them to match peaks in customer demand or in which areas of training to invest based on the location and position of employees.

Besides process and workforce optimizing banks are now able to better evaluate virtually any decisions, ranging from ATM network design to assessment of revenue increase impact of branch refurbishment, as new systems are able to handle complex multivariable algorithms more efficiently. A leading bank in the North America once planned to remodel its branches but did not know which setting, furnishing and equipment would bring the best results.

Therefore, it hired firm Applied Predictive Technologies that specializes on such solutions and has already worked on projects for 6 out of 15 largest North American banks. Their software scanned thousands of factors to find that could influence behavior of customers based on the location, population, income and others. In the end it identified specific features and signage that were suitable for individual branches. It also estimated incremental added value for specific expensive items. The company estimates that incremental profits achieved by commissioning such analysis amounts to 10 million USD (Applied Predictive Technologies, 2014).

3.3.4 Customer related analytics

Even though better risk analytics or process streamlining do have indirect impact on quality of the service customers get, improvement of internal operations is not sufficient in the face of changing industry. If banks want to regain lost trust and retain clients for whom it is becoming ever easier to change their provider of financial services, they need to do more. Most of incumbents aspire to revamp their models and become more customer centric (Sullivan, et al., 2014) with focus on customer experience and new added value for their customers. But the real change has not happened so far (Eistert, et al., 2013).

Regardless of which framework is chosen, advanced analytics would probably offer potential for improvement in every element it consists of. But in order to preserve structure, we chose to approach the analysis through a model consisting of four parts: customer acquisition, retention, usage and profitability. A bank that efficiently employs advanced analytics can gain more customers, prevent existing customers from leaving to competition, influence to what extent clients are using its services and through cross-sell and more precise pricing improve profitability. Before elaborating potential impacts, we firstly explain what precisely *superior knowledge* in our understanding stands for and how this knowledge can be acquired by financial firms.

Superior knowledge

Historically, the amount of information banks had in their disposal and were able to work with was limited to personal information, product portfolio a customer has been using, credit rating and approximate wealth derived from account balance. But as one manager said during

the interview, his firm cannot tell anything about lifestyle of its customers as it does not track where they shop or travel. If banks are not capable of distinguishing who their clients really are, they cannot provide them with products and services they want or need. This was confirmed in another interview with representative of another bank. When asked which client information a bank teller uses when deciding about products he or she will offer or recommend to a customer, the answer was that their offerings are based primarily on the size of bonus they will get for selling particular product or service in a given month. Although this was primarily caused by inefficient incentive scheme the bank employs.

Advanced analytics enable companies to change this. Many banks have access to customers' information even in the present, but they were not able to meaningfully utilize them. By tapping into transaction and location data, customer behavior and comparing it with tens of thousands other clients over a time can render valuable insights about what they may want and need.

How a person behaves or where and what he or she purchases tells much about his or her inclinations. If there is an affluent businessman and a rock singer are living in the same street, although they may have comparable wealth, it is reasonable to assume that these two people do live differently. They may stay in the same luxurious hotels, but the businessman is more likely to often visit a theatre or opera. They may own the same brands of cars, but they will probably shop at different clothing stores. If a bank was able to associate tags with different locations where individuals frequently purchase goods and services, it could create much more precise segmentation of its customers. The bank can theoretically find out whether a person had moved by looking at IP address of computer used for accessing internet banking at night, or putting together two trips to IKEA in combination with visit to another furniture store happening within one week. If a person visited Disneyland while on trip to Paris or shops at stores with children fashion, it may mean that she has a child. But algorithms can be even more precise than that.

A good example is Target, US retailer that is capable to say not just whether a woman has children, but also whether she is pregnant and if yes, in which trimester she is. Target is able to do so thanks to large database of customer information it manages. Every customer is assigned a Guest ID and all future interactions, ranging from use of credit card, discount

coupon, and customer help-line to filling a survey and opening a promotional email are associated with it. In combination with purchase history and personal information, from address and estimated salary to the time it takes to drive to the nearest store, the company gets good overview about everyone. In addition to these information Target can generate internally, it can purchase external datasets and find out whether a customer studied at a college, what are her political leanings and reading habits.

Analysts in the company found out that it is possible to assign even a pregnancy prediction score based on consumption of 25 specific products. If a hypothetical customer bought "*in March cocoa-butter lotion, a purse large enough to double as a diaper bag, zinc and magnesium supplements and a bright blue rug. There's, say, an 87 percent chance that she's pregnant and that her delivery date is sometime in late August*" (Duhigg, 2012).

Target, and also other companies hide their predictive capabilities in front of their customers. They fear that clients could be uncomfortable if they knew, how much information about their lives companies have. According to Duhig, Target's promotional coupons to pregnant customers worked only when they did not have an impression that they had been spied on. Therefore in personalized promotional leaflets irrelevant products are added and precision is thus artificially diminished (Duhigg, 2012).

When Turner and his colleagues from Said Business School at the University of Oxford surveyed 124 bank executives in 2012, one of the areas of interest was the most preferred sourcing of data for analysis. Majority of respondents said they were interested primarily in transaction and log data, followed by events, emails and point of sale information (Turner, et al., 2013). In 2009 banking industry stored the second largest amount of data per firm with more than thousand employees (on the first place were securities and investment services) (Manyika, et al., 2011). Although these are primarily internal transaction data, we assume that as the use of big data in analytics will progress, less conventional sources will be used as well.

Possible ways to find out different information about customers are virtually endless and depend mostly on legal constraints and technology capabilities of a company. Banks can find cues in data from social networks or in behavior of other people associated with given

customer to create new offerings, set the price she is willing to pay, promote them in efficient way and deliver with speed and convenience.

Social networks, blogs and other sources on the internet have become one of the most important information sources for companies. Observing opinion leaders, competition and public attitudes allows firms to detect industry dynamics, competitive landscape, and actual trends. In addition to that, social media provide customer insights about products and services that companies offer. There exist several platforms that accumulate different streams of information, yet it still takes about 80 percent of analysts' time to gather information before starting to analyze it. New analytical software can significantly decrease this time (Hattysson, et al., 2013). By distilling information directly to less complex insights or identifying sources of special importance it can make analysis either cheaper as less people need to be employed to deliver same value to the company or more beneficial as scope of analysis will go much deeper with the same resources.

Acquisition

In the highly saturated retail banking market it is hard to acquire new clients. Products that banks offer do not differ very much and it is hard to preserve price advantage in the long run (Kanchan, 2012). In order to gain new customers, banks therefore need to come up with superior products. This does not necessarily mean that they need to cut down the price. Although for some customer segments and specific products the price is the only differentiator, in many other cases more variables play significant role. Whether the key is convenience, functionality or specific features, customers search for the offering that will satisfy their requirements the best. The search have been always rather complicated process, as banks used to offer complex products with nontransparent pricing and a lot of small-print customers would easily overlook. According to CurrencyFair, a peer-to-peer currency exchange service, over 70 percent people consider bank advertisement to be confusing and 64 percent believed them to be outright misleading (CurrencyFair, 2014).

Advanced analytics help banks to come up with better products, because they make possible to uncover and respond to needs and preferences of individual customers. Complex product portfolio is a problem for two reasons. The first one, as Dan Ariely from MIT proved in some

of his experiments, that although people have strong preference for wide choice in theory, if they are supposed to choose from too many options on their own, they often become puzzled and may not make any purchase at all (Ariely, 2009). Secondly, complexity makes efficient management more challenging and in many cases leads to suboptimal overall results (Revisiting Complexity in the Digital Age, 2014).

According to Mocker, Weill and Woerner, digital technologies now enable companies to create wide product portfolios and in the same time target them very well. As an example they use Amazon. The company offering millions products can, based on information it has, choose those that individual customers are the most likely to buy (Mocker, et al., 2014). Banks' product portfolios are far smaller compared to those of Netflix or iTunes, yet this could apply to them as well. Through better targeting of offerings and adjusting them to individual's needs, banks can increase the probability of purchase.

In category of acquisition we can include also offerings for groups of customers previously under-banked for various reasons. Detailed segmentation enabled by advanced analytics allows to spot niche segments of customers for whom previous product offerings were not interesting or available. If a bank was able to modularize its portfolio, it could come up with specific, yet from bank's cost perspective inexpensive product combinations.

People who have defaulted in the recent past are special group of clients that is currently ignored. As this group is generally riskier, banks are often very conservative when evaluating which services they will provide them with. Advanced analytics enable more precise risk evaluation and thus more realistic assessment of actual situation of a previously financially troubled client. This way they can help banks accept these customers sooner than they would be willing before (Deloitte Development, 2012).

Advanced segmentation has been enabled primarily by big data that turned the process on its head. According to interview with John Forsyth, a partner at McKinsey, old approach focused on understanding needs and desires of customers. Now it is possible to observe actual behavior in great detail and seek to understand drivers that led to it later. Although there are inevitable challenges comprised in this approach as well, it seems more promising than the old one (Gavett, 2014).

Companies usually want to acquire as many customers as possible, but not all customers bring equal value. Some of them may be more expensive to serve. For instance, airlines would prefer to avoid passengers with heavy luggage and no firm likes constantly complaining individuals who require significantly more attention from employees. Advanced analytics enable banks to estimate characteristics of a customer in terms of behavior and life-time value for the company and adjust services he or she gets accordingly. Recognizing 'micromarkets' based on data customers create when dealing with the company or its partners help in prioritizing whom to serve and thus maximizing profitability in the long run (Goyal, et al., 2012). The one thing companies need to address in this point is a concern that advanced segmentation will turn into implicit discrimination, which could bring them unwanted attention of regulatory agencies and public.

Retention

Acquisition of new customers is important for all businesses aiming at expanding their operations. However, companies in pursuit of new clients often forget that endeavor to acquire new customers may be much more expensive and inefficient strategy in the long run. Companies should therefore act in a way that would maximize the number of customers (as well as employees or suppliers) they are able to retain (Reichheld, 1996). Advanced analytics help banks better manage relationships with their clients, mainly through better customer service.

Based on data from various surveys we can conclude that financial institutions are not excelling in providing good customer care. According to Harland Clarke, a provider of integrated payment solutions and marketing services, household attrition rates in banking in the United States increased between 2011 and 2012 from 19 to 22 percent for 1st year and 20 percent for 2nd year customers, with rates falling as customers stay longer or use more products. Attrition rate for clients with four or more products is only one quarter of those with only one product (Harland Clarke, 2012). Although the scale loss of existing customers differs around the world, the trend is confirmed also by global survey focused on banking industry Ernst&Young conducted in 2012. In the report based on its results EY concludes that the number of customers planning to change their bank in the coming year increased by 5 percent to 12 percent since 2011. The number of consumers using services of only one bank

has fallen as well, from 41 to 31 percent while the group using three or more banks expanded from 21 to 32 percent (Ernst&Young, 2012). Vast majority of customers have changed their main bank in the last ten years and the number who have done so in the last year has grown in all countries with the exception of Japan.

Three main reasons for decision to change a bank were high fees, customer service and inadequate product or service offering. There is a clear shift towards requirement of increased convenience and flexibility from the side of clients, which they feel banks are not able or willing to meet (Sullivan, et al., 2014). Majority of respondents in EY's survey (with exception of those living in India and China) believed that banks do not adapt the products and services they offer as needs of their customers evolve. And it is not the question of information availability. Vast majority, on average 70 percent, of over 28.500 customers who answered the questions in the survey would be willing to give up more information about themselves and their families if it resulted in better customer service (Ernst&Young, 2012).

As banks do have a lot of customer information in their disposal, they well placed to use them to understand better problems, needs and attitudes of individual customers. They could, for example, compare transactional behavior of an individual with other clients who share some similar attributes. Based on behavior of others banks could to a certain extent predict likely actions or a tendency to seek specific products, services or advice, such as mortgage, investment opportunities, etc. If the company is able to approach the customer first, it gains first-mover advantage. If this customer conducted market research on his own, he might have already found a competitor offering better terms.

Trend working on such principle enabled by advanced analytics is called the *Next Best Offer* or NBO. It refers to a client proposal based on specific individual's traits and past behaviors, purchase context and specifics of the service and organization. (Davenport, et al., 2011) A bank is likely to be capable of a better offering than its competitors as it has more information about its existing customer, especially if it is individual's main bank. Superior offering in combination with the right timing can significantly increase not just the chance that the client will purchase offered product, but also that his satisfaction with the bank will grow.

Selling new product to the existing customer may cost as little as 20 percent compared to expenses connected with acquisition of a new customer, previously not using any of bank's

services. Moreover, there is a negative correlation between the number of products the customer has and likelihood that she will change her bank (Kona, et al., 2010). Therefore banks should focus more on cross- and up-selling to customers they already have and tie them further to their services.

Besides being able to offer right product, the other important factor when speaking about retention is customer relationship. Customers dissatisfied with the level of service they obtain in branches or when calling a helpline will probably sooner or later try to find new financial service provider. Advanced analytics can help prevent this from happening in three areas: prevention of dissatisfaction through additional service, convenience and more efficient resolution of any conflicts thanks early detection systems.

Firstly, with more information about a person financial institution can offer better additional services such as loyalty program with partner discounts highly relevant to the customer. Although loyalty systems are one of the biggest loyalty drivers in the banking industry around the world, in European countries their penetration is relatively low. In Germany only 5 percent of bank customers were enrolled to such scheme compared to 48 percent in India (Ernst&Young, 2012). Although the trend in this area has positive slope, many of such programs offer only general discounts, out of which only a fraction is perceived as relevant by individual customers.

The second area is convenience. Big data theoretically enable banks faster processing of loan applications thanks to better risk analysis systems. Automation can increase accessibility of services such as investment products or loans as customers will be able to complete purchase process within minutes and without physically entering bank's branch, from any place and at any hour of day. Additional features, such as expenditure tracking within internet banking application and intelligent search in past transactions are probably not the main drivers when customers decide whether to change their provider, but they can help banks improve their, currently not very positive, perception.

The last area concerns problem solving, should any difficulty in relationship between the bank and individual occur. Dissatisfaction leading to a change of bank tends to be based not on one negative experience, but rather on a string of failures. In fact, if a bank is possible to resolve an issue in the way that surprises customer in a positive way, event can even

strengthen his or her affection towards the institution. This observation, known as *service recovery paradox*, was described by McCollough and Bharadwaj in 1992 (McCollough & Bharadwaj, 1992). This paradox is not applicable to every negative situation customers can find themselves in, as it seemingly works only in cases that are no very serious. (De Matos, et al., 2007) Nevertheless, there is usually a longer series of negative experiences behind dissatisfaction leading to loss of customer, which offers multiple opportunities to set the matters straight.

Advanced analytics can provide banks with much more precise customer attitude tracking. If they were able to identify occasions that need special intervention in order to preserve good relation so the bank has the opportunity act before negative spiral resulting in the eventual loss of customer spins out of control. With right technological platform, opportunities to experiment with different sources of data to identify such cases are virtually endless. For instance, one US bank is using data from social media in order to detect customers at risk. Another example is an Asian bank that screens its recordings from call centers with algorithms in order to estimate true sentiments of customers (Hagen, et al., 2013).

With hundreds of thousands clients and even higher number of interactions through different channels this would not be possible without software. Yet, according to the survey of Association for Information and Image Management, less than 15 percent of banks in the US observe social media sentiment with help of automatized tools. Groups that either do not screen social media or wait until an issue is reported are of about same size (Miles, 2013). These 15 percent include firms that do large scale monitoring only, looking for signs of problems and do not use it for evaluation of individuals' preferences and needs. As there are relatively cheap solutions, for this high-level analysis, not requiring much customization or integration with bank's internal data, the number seems to be very low. High customer satisfaction is one of the main requirements if the bank is aspiring to cross-sell or up-sell an individual. Increased attention is therefore not just important, but also inevitable (Pearson, 2013).

Although the main focus of this section was increased ability of retention advanced analytics provide, it does not mean that it is necessary prevent every single customer from leaving to competition (Rajagopalan, 2010). In some cases, the analysis may show that costs of serving

an individual are too high or lifetime value too small to justify additional care from the business perspective. Even after taking intangible and hard to measure criteria, such as negative impact on quality perception by social circles of a dissatisfied individual, in some situations it still may be sensible to let him or her go.

Usage

Revenues of banks can be divided in two categories: interest and non-interest income. Various banks operate with different fee structure, but generally fees can be either flat – paid for using a product for a certain period, such as monthly fee for a bank account, or per use – such as ATM withdrawal fee or fees retailers pay banks for every credit card payment customers do in their stores. In case of the first group, banks want customers to subscribe for as many services as possible and do not really care whether they are using them. In the second case, they are interested in frequent use by customers as this frequency directly influences their revenues.

Share of non-interest income has risen significantly, from 25 percent of net operating income in 1984 to 43 percent in 2001 for US banks (Stiroh, 2004). In Germany the rate is a bit smaller, amounting to 30 percent for commercial banks in 2007 (Busch, et al., 2009). Although there are extreme cases, where non-interest income makes up for almost all net operating income, economists from German Central Bank reckon that this source of income is decreasing volatility of revenues and thus serves as a stabilizing factor in case of retail banks (Köhler, 2013). Stable income, especially at the time of feeble recovery in the aftermath of global financial crisis motivates banks to induce client behavior that would guarantee them this relatively risk-free income.

Banks try to incentivize clients to use products more if it brings them profit, but they generally do so in broad campaigns, such as recent effort by major Czech banks to persuade customers to switch from classic to contactless cards. Advanced analytics, thanks to their segmentation and pattern recognition capabilities, can determine, which clients do have the biggest potential for service usage improvement as well as cases, where the lack of usage is caused by inadequate product being sold to them. After signaling out individuals with the high perspective, banks can use analytical instruments to identify, which marketing tool and

channel have the highest likelihood of persuading clients to behave in desired way. This approach is likely to increase the efficiency and return on investment on various marketing initiatives.

Increased usage may be valuable for banks even if they do not directly gain any monetary value on it. Algorithms advanced analytics are using can correctly predict actions only if they have datasets are large enough to identify spending and other behavior patterns. Therefore, the more data on purchasing behavior banks capture, the higher value they can derive from the insights based on them. In the best case scenario, banks could be able to predict when an individual plans to go for a vacation and where she will make her next purchase (Prasad, 2010).

Profitability

Better targeting together with process, price and portfolio optimization are the main drivers of improved profitability advanced analytics can deliver to banks. As enhanced targeting capabilities are described in acquisition as well and retention parts and process optimization is mentioned in several places in the thesis as well, this section will deal primarily with portfolio management and afterwards it will touch upon tailored pricing.

Banks do have much smaller product portfolios compared to retailers such as Amazon, but that does not mean they do not need optimization. Analytics can show which products or product combinations are the most profitable faster and to greater detail than would be normally possible. Managers can then identify important features as well as those that do not bring enough value and provide either additional marketing support or cease their offer. They can do the same with assessment of competitors' portfolio (Deloitte Development, 2012). Benchmarking on real time basis may help managers adjust pricing of their own services before too many customers could notice disparity.

More importantly, insights captured through advanced analytics enable banks to use dynamic pricing. Normally, a change of price can be risky as setting it too high may cause loss amounting to millions. In every decision, the bank is therefore choosing between earning, although not the maximum possible amount, and learning, possibly leading to a loss of potential revenues (Harrison, et al., 2012). Size of the risk depends on bank's flexibility in

readjustment the price if it is initially set too high. Here complex learning algorithms can track micro trends in customer responses and provide correction much faster.

It is questionable, how is dynamic pricing suitable for products such as current accounts. In the Czech Republic has been used for setting primarily credit card or loan interest rates. But in the US, market leaders already use it for many other purposes (Quittner, 2012). The trend in pricing of financial products, according to Robert Phillips from Columbia Business School shows increasing use of analytical approaches, micro segmentation and dynamic pricing, resembling price setting in retail and telecommunications (Phillips & Rhode, 2006). Bank of the West in California, a subsidiary of BNP Paribas, was one of the first banks that attempted to use dynamic pricing for products such as current account. It takes into account recent use of products, balances of an individual, specific geography as well as demographics and adjusts proposed rates, fees and service benefits accordingly. As dynamic pricing promises increase of operating profits by 10 to 12 percent, more banks will consider its introduction in the future (Quittner, 2012).

Here we need to bear in mind frequent objection against banks concerning lack of transparency in pricing (Sullivan, et al., 2014). Models taking into account many different variables before calculating final price are hardly easily comparable through the industry. Moreover, depending on regulatory setting, dynamic pricing may be in effect prohibited by rules such as obligation to inform authorities in advance before any pricing change comes into effect. Since regulatory rules differ widely across different jurisdictions, for sake of an argument they are ignored at this point.

4. Advanced analytics in the Czech banking sector

Banking industry in the Czech Republic exhibits certain specifics that need to be highlighted, before looking at potential application of advanced analytics. These particulars are result of several influences related to history of banking in the country, current market situation, ownership structure and specifics of individual institutions. Therefore, before proposing any recommendations, we will firstly look at status quo and attitude of banks towards analytics and big data. This analysis will be based on secondary sources and interviews with bank executives and management consultants with deep knowledge of Czech retail banks.

4.1 Research methodology

In order to create accurate overview of retail banking in the Czech Republic two main sources of information were used. The first one, secondary sources, consisted primarily of official statistics, reports and academic papers published by Czech Banking Association and Czech National Bank as well as publications by their analysts in academic journals, and reports published by commercial banks and consulting firms. These were used as a baseline helping describe current competitive situation and uncover general trends in the banking market.

The second source of information, aiming at understanding current practices, challenges and overall perception of advanced analytics by Czech banks and their managers, is a set of interviews conducted between January and July 2014. Respondents were 8 middle level managers working for financial institutions and 2 management consultants. Some of interviewees were familiar with other banks besides just their current employers as they worked for different institutions in the past. In terms of expertise, managers represented different departments, which was reflected in their responses. Most of them were active in, CRM and product management. Two of respondents worked on analytical positions, although several other managers did have some analytical responsibilities as well. As information managers revealed were very sensitive nature, all of them required anonymity for themselves as well as their institutions.

Overall, interviewees had deep knowledge of 8 different Czech banks and a one leading mass-market consumer finance provider. These institutions were divided into three different

groups based on their characteristics. The first group consists of market leaders, large institutions with annual turnover between 30 and 45 billion CZK. The second group is comprised of mid-size banks with turnover between 12 and 18 billion CZK. The third one entails smaller banks that are relatively new in the market and consumer finance firm

Before drawing any conclusions from the assessment, it is important to mention shortcoming of the research. They are connected with the size of the surveyed group, which was too small to enable us to articulate a universal judgment about the situation in the industry as a whole. Moreover, biases and anecdotal experiences of individuals, most of whom had a narrow field of specialization may not be consistent with overall situation in the bank they represent. On the other hand, even with limited sample it is possible to see several patterns to be consistently present in operations of almost all banks. Whether it is use of analytics in decision-making or main challenges and barriers banks need to cope with, it seems that there are several persistent trends enabling us to describe the situation of advanced analytics in the Czech retail banking sector as well as likely future trends.

4.2 Market situation and challenges

After tumultuous period during nineties, the sector has been in the recent years well regulated and capitalized, with above average return on equity (The Economist, 2011). Thanks to privatization the sector has one of the highest ratios in foreign ownership from both CEE and global perspective. As banks in the country use conservative business models, focusing on traditional services and preserving loan-to-deposit ratios, they are resilient in case of financial turmoil (Deuber, et al., 2012). Proof of that is performance of Czech banking sector during recent financial crisis. Even when the situation in the world markets was critical, Czech banks did not have problems with liquidity. Stress-tests conducted by the Czech National Bank in 2011 concluded that the banking sector would withstand even 5-6 percent drop of GDP (Dubska, 2013).

Profitable, concentrated and saturated are three appropriate adjectives characterizing Czech banking industry. The sector had net profit around 2 billion CZK and return to equity oscillating around 16 percent in every year between 2009 and 2011 (Wright, et al., 2012). In 2013 there were 45 institutions holding a bank license, employing over 40 thousand

employees. The number includes 22 branches of foreign banks and 5 building societies. However, the market power is concentrated in hands of a few institutions. According to Czech Banking Association four largest banks in the Czech Republic have 57.2% of assets, 52.3% of gross loans and 57.9% of deposits under their management. Thanks to the growth of medium-sized banks, currently covering less than a quarter of the market, this share is decreasing. Altogether, banks held almost 4.800 billion CZK in assets in 2013 (Czech Banking Association, 2013).

From the market perspective, the banks face strong competitive pressures. This is one of the reasons why Moody's, a rating agency, maintains negative outlook for Czech banks (Moody's, 2013). Two main reasons behind this pressure are low interest rates and high return on equity that makes the market very attractive for new entrants.

Interest rates close to zero make new loans and mortgages significantly cheaper compared to those in years leading to crisis, when the market was booming. As loan fixation ends for many clients, a lot of them consider loan refinancing at lower rate. In 2012, 25 percent of newly provided mortgages fell into refinancing category and experts expect this number to increase further (Svoboda, 2013). Banks that do not offer their clients more favorable conditions will likely struggle to prevent them from refinancing their loans at competing institutions. Since in addition to this pressure the number of banking institutions have increased recently, the banks will likely face decreased interest income in the future.

As mentioned earlier, returns on equity (RoE) in the Czech Republic are much higher than in other countries in the region. RoE of 20.6 percent in 2013 seems very lucrative when compared to 4.15 percent in Hungary, 7.8 percent in Slovakia or -31.6 percent in Slovenia. On average, RoE in the CEE region was 11.5 percent (Raiffeisen Research, 2014). This difference creates interesting opportunity for potential newcomers to the market. Intensifying rivalry and new firms with innovative business models are the main competitive trend also according to the report on Eastern European banking by McKinsey (McKinsey&Company, 2013).

In 2007 FIO Banka and mBank, a subsidiary of a Polish bank belonging to Commerzbank group, launched its services in the country. In 2011 three other banks entered the market. The first one was Equa Bank, backed by private equity firm AnaCap Financial Partners, the

second was Air Bank, owned by Czech private equity firm PPF and the third incomer was Zuno, an online bank, which is a subsidiary of Raiffeisenbank. Recently the banking market witnesses increased activity coming from Russian investors. Sberbank acquired Volksbank in the Czech and Slovak Republic in 2012 and from market share perspective it plans to overtake Raiffeisenbank by 2018 and double its branch network by 2015 compared to 2013 (Solc, 2013). LBBW, another small German-owned bank was sold in the beginning of 2014 to Expobank owned by a Russian financier (Mikulka, 2014).

Even though according to the Czech Banking Association clients in the Czech Republic do not switch their main banking services too often (only 2 percent did so in the previous year), many are beginning to diversify their portfolios. Between April 2013 and 2014, 13 percent of clients began using services of another bank besides their main one (Czech Banking Association, 2014). Small banks were already able attract over one million of clients, 300.000 increase compared to the last year (Nemec, 2014). Even though, many of them are not using these banks as a primary provider, once customers open an account elsewhere, it is much easier for them to leave in the future. New entrants and competitive pressures caused by low interest rates are recognized even by some banks in their recent annual reports (Komercni Banka, 2014) (Raiffeisenbank, 2014).

4.3 Current approach to big data and analytics

Interviews conducted during the research process concerned three main areas of interest. Firstly, we were looking at capabilities and experience with using analytics in day-to-day operations in the present. Since advanced analytics require knowledgeable users and established processes that enable to utilize insights, it was necessary find out whether there actually is any organizational base, upon which new systems could be built. This requirement does not consist only of processes and capable managers. Physical infrastructure, namely core banking and other IT systems, is equally important.

Secondly, we identified things bank managers see as the main impediments on the way towards advanced analytics adoption in their institutions. These fell in three main groups: technical challenges relating to data and analytical tools in hand, personal challenges, where we deal with human resources and ability of cross-functional cooperation that is necessary

when dealing with advanced analytics, and operating environment covering decision making processes and leadership. Outcomes of these two areas of research summarizes following section *Status quo*.

The last area we looked at were expected developments in the near future from the perspective of respondents. We questioned banks' plans in terms of implementation of new analytical tools, creating partnerships with external data providers and sourcing new data streams. In addition to that we tried to find out what are their expectations relating to industry transformation caused by technology developments and change of customers' preferences in the future. This part is described in section relating to *Future plans*.

Information obtained in the process differed significantly in some areas. Part of the variation could be attributable to respondents' position in their organizations and their personal attitude towards analytics. However, there were noteworthy differences that went beyond individuals' situation and subjective perception. In the end, taking into account organizational structure, human and other resources, current use, attitude and future plans, it was possible to create two performance clusters. We call the first one, a group in the north-eastern part of Figure 5, *pioneers*. These organizations are relatively efficient in use of analytics and plan on building further capabilities in the future. The rest was identified as f*ollowers*. For various reasons banks in this cluster either did not have capabilities or very positive attitude towards analytics. In some cases both were barriers were present. As is clear from the Figure 5, the difference is not related to the size of institution. Nor was identified any other specific characteristic that could explain the clustering. In the end of both Status quo and Future plans sections main differences between group of pioneers and followers are highlighted.

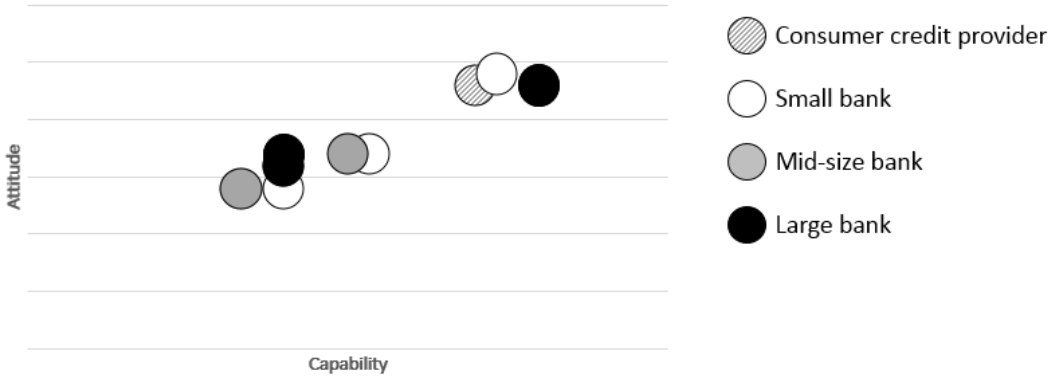

Figure 5 Attitude and capability of Czech banks in relation to advanced analytics (Figure by author)

4.3.1 Status quo

Despite general hype around big data and its potential contribution most of banks participating in interviews has been using predictive analytics only in limited scope and scale. Even where predictive models are in use, they are founded primarily on relatively static information such as client product portfolio. Several banks are using *event-triggered marketing*, whereby a specific behavior of their customers is activating certain processes. But its potential is usually not fully utilized. Although some of them are theoretically able to track and spot even seemingly insignificant events, such as when a client uses mortgage loan rate calculator on their website, they mostly relay on simple one-time triggers such as large withdrawal from credit card.

Even when analytical capabilities are in place, banks often fail to act upon insights they extract from their databases. Based on several informal interviews with consultants from all leading management consulting firms active in the country, no Czech bank currently has a major working advanced analytics initiative, although some are pivoting small scale projects. This opinion was generally confirmed in interviews with bankers as well.

As mentioned before, if banks are currently using any information about clients, these belong primarily to the group of static data such as basic information, product portfolio composition, credit score etc. Some banks are exploiting transactional data for marketing and risk purposes, but majority either cannot or is not interested in doing so. At the time of interview,

no bank was able to utilize information from social networks and use of data related to client's location was scarce.

Three main areas of present use are risk management, CRM and sales. However, reliability of this conclusion may suffer from the fact that there were no respondents from other departments. As, especially in larger banks, different departments operate independently without much interaction, it is possible that questioned managers were not fully familiar with situation in their firms. Majority of banks is using platforms developed by external vendors such as Teradata, SAS or Oracle, though several of them plan to create advanced internal tools on their own in the future.

When it comes to challenges that prevent seamless embracing of newest technologies, respondents saw four main barriers: ownership structure, complex organization, legacy IT infrastructure and general approach towards data and analytics in the company. Some banks are struggling because of each of these, others did not see any of them as a major obstacle. Generally, it can be said that these issues are what sets apart group of pioneers and followers.

Limitations caused by foreign ownership

Vast majority of banks operating in the Czech market is foreign owned. Although this has certain advantages, in case of advanced analytics it is rather obstacle for three reasons. Firstly, decision power of local executives in case of expensive projects is limited and while they have to follow general strategy of banking groups they belong to, their chance to influence this strategy is relatively limited. Therefore, one of explanations of low activity in the area of advanced analytics was that foreign owner has yet to decide about the strategy and no one knows when this may happen or what the final word will be.

Secondly, sometimes foreign owners focus their innovativeness on domestic market and roll out globally only projects after they succeed at home. This means that any novel project such as CRM platform using predictive analytics is developed and tested elsewhere and implemented in the Czech subsidiary later. This causes not just significant delay, but also limits options of subsidiary since it can use only existing solution that may not fully fit its needs. In one instance, a local subsidiary is waiting several years for a basic CRM system its parent bank had developed. Because of delays on the parent's side it will take at least several

more months until basic campaign management functions are accessible and as the project is not very high on priority list of responsible IT department, it may take even more.

Lack of control over decision-making process and development of a platform are sometimes accompanied by reluctance of the owner to invest in its subsidiary. In one instance the local branch is not performing as initially expected and any unnecessary projects are thus halted for any foreseeable future. Although one could understand unwillingness to invest further funds in a loss-making enterprise, even manager from one relatively successful mid-sized bank claimed that due to high expected costs there is no chance that his firm would launch any initiative on its own.

There are exceptions to the rule, though. If we look at how ownership influences performance it can be said that its adverse effect can be offset by performance and size of a given bank. It means that bigger and well performing banks have greater degree of independence than smaller and weaker subsidiaries.

Complex organization

Complex organization was quoted as a major obstacle in almost all cases when the respondent was worked for a bigger bank. The complexity is problematic in three levels. Firstly, it is extremely difficult to push any major project through the hierarchy in reasonable amount of time, because approval process is too slow. Thus it takes several months before any general agreement is reached. Taking into account complicated implementation due to need of cross-departmental cooperation, swift reaction from the bank to almost any situation seems almost impossible. For example in one bank there is a constant struggle between CRM department interested in measuring efficiency of its promotions and marketing communication department that is rather reluctant to share any data as it fears that it would mean loss of independence. Any project that requires cooperation of these two units has to take into account this struggle.

The second problem connected to complex hierarchy is the issue of competing interests. There are several departments running projects in the same time. As there is only limited amount of financial and human resources, it is necessary that a project leader goes through

numerous negotiations and is experienced in horse-trading, making the whole process much more complicated than necessary.

The last issue connected to complicated corporate structure and project ownership. As executives across the bank change their positions relatively often, it is hard to get a patronage from an executive sufficiently high in the corporate ladder for a longer term. This is the reason why one bank still has not launched its long planned big data project. Department responsible for transactions prepared pivot in cooperation with external supplier that would give the company insight into transactional behavior of its clients. Although the project was expected to start in winter 2014, the executive who sponsored it was affected by changes in the leadership of the bank. After he left his position has yet to be filled. It seems that there is no chance of starting the pivot before winter 2015. As this was only small project, taking into account flexibility of bank's IT department, it is hard to imagine that a larger scale venture would be possible anywhere before 2017. In another firm, the head of pricing department was transferred to equivalent position in CRM unit. As he does not have any prior experience with CRM, it will take several months until he familiarizes himself with its operations.

However, even though it is possible to say that complexity is directly related to size, not all large banks had problems with hierarchy and decision-making process. According to a representative of a major bank belonging to the group of pioneers, ability to launch a project is dependent primarily on how an individual can build and present business case for it. It he or she is able to come up with persuasive reasoning, people from diverse departments can come together and support it in reasonable time period. Even though it requires a certain effort, according to him it is not very complicated.

Technology infrastructure

Another major challenge influencing feasibility of use of advanced analytics is related to implementation phase. Before any analysis can take place, it is necessary to get access to right data and set up functioning analytical platform. This requires cooperation of various stakeholders, which is particularly difficult according to interviewees. Concerns connected with IT departments can be again divided into three groups: data access, existence of software platforms and capability of IT department in the bank.

Data collection and access is one of problems managers are facing. In some cases management of data access is so strict that it makes virtually impossible to access data outside of manager's function without significant bureaucratic burden. In one bank there are five different data warehouses and if transaction analysts want to get data about clients loan history, they need to send written request to another department and wait for days until it is approved. This approach, although partially understandable due to sensitive nature of individual's financial information, hampers flexibility in analysis as it limits data any analyst has in his or her disposal. This makes any experimentation leading to discovering valuable insights unlikely. Another financial institution does not have access to vast majority of transaction history of its clients as it is stored in deposits on magnetic tapes for cost reasons.

Even if a bank has access to the right data it often lacks suitable platform for their exploitation. The most extreme example was the institution that still does not have any CRM system for campaign management in place or another one, which is still using intranet developed in mid-nineties. But even in other cases, where suitable software platforms exist, variety of problems still persists. Two cases are the most prevalent. Firstly, oftentimes the platforms do not suffice. Although they support traditional business intelligence activities and track client interactions across different channels, they do not enable machine learning, or more advanced features such as text recognition and rely on good judgment of employees using them. This judgment is often missing. Bigger banks in particular have problem with incentivizing use of limited tools that are already in place. One manager complained that bank tellers that are more capable leave banks and work as financial advisors for companies such as OVB, as these companies offer pay strongly linked to performance, which better rewards good sales skills. Those employees who stay are often inferior in sales capabilities and generally disengaged. Thus even when they know client's history, they do not make much effort in utilizing this knowledge when offering new products. This was confirmed by another manager who said, that too often the only information used by bank tellers when deciding which product to offer is a monthly sales quota their branch needs to fulfill.

The third challenge is usually stretched IT department. All but one bankers interviewed in the process of information gathering complained about slow and uncooperative IT in their firm. Sometimes the reason was that IT functions are outsourced abroad, which makes any

communication with programmers more complicated. In other cases IT department is overwhelmed by different requests. One manager complained that already in July, all capacities of IT division are booked out and even if they weren't, any project that is delivered in time shorter than a year is a big exception.

Data analysts are often seen as uncooperative as well. For instance, in one bank it may take five meetings before they accept data request, as they require extensive specification of all characteristics. A person who complained about this fact considers it to be indirect filtering, since managers think twice whether they really need the data if they know how hard is to obtain them. A management consultant who worked on pricing project for another a leading bank in the Czech Republic illustrated complicated work with data analysts by case when his team was asked to wait 8 months for data about client segmentation necessary for their analysis. On the other hand, sometimes managers are ones to blame. Not knowing how databases are structured they often require unnecessary, irrelevant or very hard-to-get information. One small bank overcomes this by requiring product managers to handle basic work with databases on their own. The last problem is understaffing of crucial functions. In one bank, after organizational changes a team of data analysts consisting of 5 people was assigned additional workload previously managed by 10 segment managers, while not getting any additional resources.

Exceptions to the rule can be explained by higher agility and better staffing policy. If CRM department of a bank does not exist or has three employees, its capabilities are be much lower than of a bank paying between 30 and 50 full time employees to work on CRM. Having enough resources attenuates competition between departments and fosters cooperation while enabling more projects to be done. This explains how one bank can be struggling for years to upgrade MS Office 2003 to more recent version while other is running on Google Documents platform and using cloud storage for internal communication.

Attitude towards analytics

As mentioned earlier, overall perception of big data and advanced analytics in the country is less positive than usual. It was clear also from interviews that managers who seemed restrained when speaking about analytics and their use. This can be partially attributed to

challenges they face described in previous sections. If it is really so complicated to push forward any real change, it is understandable that managers seem to be complacent and prefer to operate only within boundaries of their job description instead of launching new ventures that could impair their career while not making any difference in bank's operations.

Then there is an innate mistrust created by proponents of advanced analytics. The reason is that the way bank representatives usually get in touch with new technology ideas is through interactions with people who try to sell them one. Three managers implied that hype around big data is just something created by management consultants and IT vendors that want to sell their services, software or hardware solutions. As banking industry is one of the most lucrative sources of revenue for these firms, executives have doubts about real motivations of professionals advocating big data.

Majority of interview respondents held positions in headquarters and provided insights into banks' inner workings. To see whether there is demand for more or better data among client facing employees one of discussions was held with a head of branch of a leading bank in the country. Although the director did not know how and which data is collected, he could share his opinion about its accuracy and sufficiency. According to him, the bank he works for was previously buying client info databases from external sources, but they were considered too expensive to be worth their added value. Currently, it is working only with its own information. Although the only insight bank clerks are getting is alert that the client is missing certain products in her portfolio and her propensity to buy them, marked with one to three exclamation marks, the director considered it to be sufficient and believed that it is responsibility of bank personnel to persuade client to make a purchase. Where he felt more information would be desired was when new customers come to the bank. In their case, if they do not have any relationship with a leasing or insurance company that operate within the same group, bank clerks do not have any information.

Even people who are working with business analytics on daily basis seemed not to have major issues with status quo. One of key benefits big data platforms have compared to traditional solutions is the speed. But this was not considered as important by managers. When one of a few people very familiar with advanced analytics was asked how long an algorithm runs before it mines requested data, the answer was three days if the query is not a

simple one. Yet he was not impressed by opportunity to decrease this time to three hours. He represented the institution that had considerable lead in use of analytics compared to its peers, yet the fact that it takes his department up to a year to develop and test complex predictive model did not seem to concern him.

Generally, respondents from pioneer cluster of were worried more about obtaining actionable insights from data currently available rather than how to access new information sources. One of managers complained that even now his banks works with close to hundred data points for each individual in its CRM system. Adding a stream of data from social media would, according to him make the situation hardly better. However, since pioneers have been widely using analytics in the past and they do not face same challenges as their peers, they are more open to experimentation and advanced use, even if it just means looking for a new ways how to get more value from existing data.

4.3.2 Future plans

When asked on competitive landscape and new entrants, managers from bigger banks were not afraid of newcomers with lean business models such as Air Bank or mBank. They felt that their ability to gain customers is limited and that majority of customers still require traditional, and preferably wide branch network. On the other hand, as mBank reportedly has approximately half million customers, their assumptions may be proven wrong in the near future. Managers, both from smaller and bigger banks, were more anxious about potential new entrants from outside of the industry, such as Google or PayPal and to lesser extent also retailers like Tesco. Their two main concerns were that these firms have much greater knowledge about customers and if they figure out how to use it for designing financial offerings, they will be able to respond to customer needs much better than any bank ever could.

Moreover, with new generation of customers accustomed to using smartphones and other devices for shopping and online banking, the main advantage residing in physical branches may cease to be important. As one respondent said, if a person gets used to paying by phone with NFC chip instead of debit card, he or she may not need services of a bank until there is a need for a loan. Banks will thus not just lose important source of information, but also

chance to build a relationship they now have since early teenage years, when people usually start using the first current account. These forces strongly incentivize them to better utilize information about clients and innovate despite their intrinsic conservatism.

Even though none of banks participating in interviews is currently using advanced analytics on large scale, many are experimenting with pilot initiatives. These projects can be divided into four main groups. The first relates to transaction behavior, the second concerns use of social media, the third is linked to geolocation and the last one to web and mobile banking app use. Information regarding specifics of several of these initiatives are very limited as they were considered as highly sensitive. For example, when it came to cooperation with telecommunication operators one of respondents was willing to say only that she cannot *confirm or deny* that such cooperation exists. Others were more forthright. Based on their information it is possible to outline how banks are planning to use advanced analytics primarily for risk management and CRM purposes in the near future.

Improved risk management

Currently banks are using principally credit score provided by external companies, with access to loan databases and other financial behavior of the population, when deciding whether to grant a loan. Proprietary models that calculate these scores are secret, but generally it can be said that it is possible to predict what score an individual will be given by looking at ratio of income and monthly installments he or she is paying. Although these scores can predict loan default probability relatively well, they do so on a static basis. They observe financial health of an individual in the moment of loan application but cannot efficiently predict whether this individual is likely to get into financial trouble in the future.

One way how to make estimates of default risk is to look at transaction activity of an individual. One company is analyzing where and for what its customers pay. For example, if an individual makes a payment at online gambling site it automatically negatively influences his or her credit rating. Another finding was that clients that move within the country very often, possibly as a part of their job, are more risky than those living only within a very small region. The firm was able to gain these insights after it conducted complex data experiments.

But since building a model that would test similar hypothesis currently takes several months, the number of analysis it can conduct in a given time period is relatively limited.

Another way to uncover risk of a loan applicant is to look at his or her social media profile. One company is currently testing pre-scoring of its potential clients with help of an external company from Finland that developed platform enabling this kind of assessment. Although just testing is currently in progress, the provider of the solution promises that based on attributes such as number of friends, stated interests and other indicators it is able to predict individual's financial responsibility.

The last project in this area is related to fraud detection. Apparently, there are impostors using online loan applications, which some companies offer. They fill in fraudulently obtained personal details and can be granted a loan in the name of someone else. One company is currently testing solution that should uncover these frauds by looking at the way an applicant is filling the form as there is a difference between real applicants and swindlers in the speed and order in which different fields are filled.

Enhanced CRM and sales

Ability to serve customers well is related to banks' knowledge of their needs. As soon as a person becomes bank's client, the institution tries to maximize her lifetime value. It does not mean charging as much as possible on fees, but to predict and lead her through customer's life cycle. This means to cross-sell new products and services, up-sell to more expensive standard, spot early any dissatisfaction, know when to contact and come up with new offering, and if needed, prevent the customer from leaving (Anderson, et al., 2002). In order to know when to approach and what to offer, banks are starting using various analytical tools.

One bank is trying to learn about customers through their social media profiles. As one manager in discussion said, based on the information his bank currently has, it is impossible to say anything about life style of individual clients. Another bank is interested in cooperation with telecommunication providers. Even though it could theoretically map daily routes from people's home to their work and analyze where they shop by tracking location of transactions, TELCO operators could provide much more specific information such as how often a person sleeps at home, how big is his or her social network and so on. This would give banks stronger

insight into their clients' daily life style, which would significantly enhance their capability of predicting their needs.

But even now it is possible for retail banks to create special social network from customers' transactions. Especially bigger banks that store long history of transactions in their databases and serve big client base are able to do such analysis. However, in order to do so, they would need convenient access to transaction history data. One of banks interested in studying relationships among its clients is unable to do so, because the most of transaction history is being stored in deposits and thus is not readily accessible. One possible use of such network is analysis of complete financial product portfolio customer have not just in a given bank, but in all institutions. Being able to determine that a client is using credit card issued by another provider or pays monthly installments for her mortgage is the first step on the way to win her over. This particular use case is something the Bank of America is already doing (Davenport, et al., 2013).

Another project relaying on transaction tracking one of banks was planning is supposed to improve tracking of customer preferences. With help of external vendor this bank wants to screen and analyze transactions in the real time. This should help it to better understand where individuals pay the most often so it can offer loyalty discount and bonuses that are highly relevant for them. As this bank is one of those facing issues with decision-making process and currently also organizational changes, the experiment has yet to start.

The last known use of advanced analytics is dynamic pricing of loans used by one of major Czech banks. Rates that diverse client groups are offered are constantly pushed higher up to the level when the number of clients declining the offer is too high to maximize profit. The model uses relatively narrow group segmentation and adjusts its proposals according to the recent behavior of these segments.

4.4 Strategy for big data systems implementation

After summarizing potential and current use of advanced analytics in banking, future plans and barriers to better utilization, we would like to propose a high-level framework for bank executives who plan to use advanced analytics in operations of their own institution. The

strategy consists of four main components: formulation, persuasion, implementation and evaluation, and summarizes key building components.

4.4.1 Strategy formulation

An overarching corporate strategy is the first step on the way towards better data utilization. The strategy will ensure systematic and efficient selection, development and implementation of individual projects. Most of interviewed institutions lacked clear plan of advanced analytics use. We felt that this was one of the reasons why managers were not very open to experimentation. Although individual departments would know about diverse applications, there was no consensus about overall approach on corporate level. It is understandable that departments want to avoid discussions and consensus building across the organization that would cost them precious time if they are able to launch small-scale projects on their own. On the other hand, if the ambition is to go beyond minor initiatives, there has to be general company strategy. Any advanced analytics strategy needs to fulfill two main criteria.

Firstly, it needs to be aligned with general corporate goals. Even though all banks strive to make profit, their approaches to doing so differ. Larger institutions cannot significantly increase the pool of its clients. Therefore, they focus on customer retention and increase of usage as well as profitability. On the other hand, smaller banks need to firstly build their client portfolios and thus will be interested in aggressive customer acquisition. Target customer groups, on which institutions focus further influence needs they have when working with them. Since needs are diverse, different tools and platforms that serve them best. For example a consumer credit provider has generally more risky clients than retail banks and thus will probably aim primarily at enhancement of its risk analysis. On the other hand, large bank will need good CRM to maximize profit and prevent customers from leaving to more agile competitors.

Secondly, the strategy has to take into account situation and specifics of a given institution. Banks do have access to numerous data streams already and it is possible that analytical tools developed by some departments could be used by others if they knew about their existence or had access to them. On the other hand, there may exist restrictions that limit a particular use. Situation of the bank should be analyzed from three perspectives: data availability,

technology infrastructure and human resources. During interview phase, in case of several banks there were more respondents per institution. In such situations it became apparent that perception of situation differs across departments both in terms of needs and capabilities. Knowing what is achievable can help project managers narrow down range of options in consideration.

Once an executive responsible for drafting strategy knows what are specific goals of the firm and it existing capabilities, she can look at available solutions and estimate what is their return on investment and feasibility

4.4.2 Ensuring support

Knowledge of what is the best option is not sufficient. In order to succeed, support of various stakeholders needs to be secured. As explained, complex management structure and competing interests of different departments belong to major obstacles when banks try to innovate. Therefore, any company-wide strategy will need strong endorsement of key executives.

Starting at the very top of the hierarchy, it is important that a program is acknowledged and backed by a powerful executive who can enforce cooperation of managers. Many international companies have created a position of *chief data officer*, in others data initiatives are backed directly by CEO (The Economist Intelligence Unit, 2012). The power of executives can be illustrated by an example told by one management consultant. When his team needed a dataset for analysis, responsible department estimated that it will take at least a month to collect requested information. After intervention of a vice-president, the data were in disposal within a week.

But support from the top is often not sufficient either. Besides, it is important to persuade also lower-level executives as well as ordinary employees that they should cooperate. In order to do so it may be necessary to adjust the strategy so it accommodates preferences as well as concerns of important departments. The same is true for client facing staff. One of complaints heard in course of the interviews was that bank clerks do not properly fill reports from meetings with clients and do not use insights they are given during sales process. Inaccurate inputs defeat the purpose of any analysis. For example, one bank wanted to

conduct a behavioral analysis of clients asking for loan refinancing based on data from the initial client meeting where information for loan eligibility are collected by banks employees. When dataset showed unexpectedly high average income, analysts found out that several applicants were supposed to have monthly salary of 999 999 999 CZK. After short investigation the team found out that some bank clerks fill in random information to the questionnaire for the sake of speeding up the process, since they do not expect that anyone will need these data to be accurate. To prevent such situation, it may be necessary to align current incentive schemes in a way that everyone who contributes to data gathering, evaluation or use is properly rewarded.

4.4.3 Project design and implementation

Design and implementation phases involve decisions about project's specifics and execution. Which data the bank needs to collect and analyzed and what platforms as well as specific tools are required to do so. Then comes the question whether external vendor, because of know-how, or internal IT department will develop tools. Capability is not the only concern in this case. External providers can deliver of-the-shelf solutions more cheaply and in a timely manner. In contrast, IT departments can provide the company with more individualized solution. However, taking into account difficulties many banks have in cooperation with internal IT department, outside provider may be preferred choice, although, internal IT is always needed at least for integration of external platform with bank's internal systems.

Once the platform is set up, it is necessary to secure that the numbers used for analysis are accurate and that experienced analysts operate it. Even the most sophisticated system will not help if the bank lacks experts who would manage numerous data streams and build predictive models that extract insights from the data. According to several reports, recruitment and retention of capable data analysts are one of the biggest challenges companies are facing (Bertolucci, 2013) (Data Scientist: The Sexiest Job of the 21st Century, 2012). It is thus important for banks to consider not just what they would like to do with the data, but also to create an environment in which it is possible.

4.4.4 Application and evaluation

The very purpose of advanced analytics is to provide companies with actionable findings (Breuer, et al., 2013). A concern one of interviewed executives voiced was that even if his bank was provided with extremely valuable insights, he would question its ability to act upon them in an effective manner. In addition to that, he was afraid that after taking into account all necessary costs associated with building analytical capabilities, maybe broad and indiscriminate marketing campaign could in the end bring higher return on investment than a campaign tailored to individual's needs. Therefore it is necessary to ensure that there exists willingness and capability within the organization to implement whatever recommendation analysts arrive at. In one Czech bank it takes up to a year between the moment when decision about a change in current account pricing is made and the moment when customers actually see the difference. By that time suggested pricing can become suboptimal again.

Well-designed strategy and preparation phase should ensure that the company undertakes only projects it is able to capitalize on. Yet, it is necessary to monitor and evaluate how and whether insights gained through advanced analytics are translated into real actions and whether these are bringing expected value. Without stable positive results support for advanced analytics in the organization will wane and make future initiatives harder to push through. Therefore, it is advisable to firstly approach projects through lean start-up approach, whereby the company creates minimum viable product and it is prototyping and experimenting with solutions rather than crating complex solutions (Ries, 2011). With this tactic failures can be spotted and corrected much faster. Later on, when there is a proof of concept, large-scale application can be built.

4.5 Summary

In the present, retail banks in the Czech Republic are not fully utilizing potential of advanced analytics. Although one could find anecdotal examples of their use, primarily in case of campaign selection, event-triggered marketing and risk profiling, compared to leading institutions abroad, these are only basic ways to exploit them. Moreover, there were stark differences when it came to individual firms, which led to creation of two performance

groups: *leaders* and *followers.* Interviews uncovered three main factors that prevent banks from being more active.

The first barrier resides in foreign ownership. Several banks do not control decisions when it comes to expensive projects and they have to comply with general strategy of their banking groups. Even when in domestic markets of their owners advanced analytics are already common, Czech subsidiaries need to wait until these solutions are transferred. This transfer can possibly take several years. In other cases, costs involved are the main hurdle. In the present economic climate foreign owners are sometimes reluctant to undertake large investments. However, cost and decision-making power limitations are applicable primarily to small and mid-sized firms, since when it comes to larger banks, foreign owners do not seem to be a problem and institutions are relatively free to launch any initiative.

Even when ignoring issues relating to ownership and costs, slow decision-making process and complex structure are significant impediments to innovation and efficiency. In majority of the cases, managers were complaining about bureaucracy and rigid hierarchy that prevent them to pivot and launch any larger project within a reasonable time frame. Not just they need several approvals before starting any initiative, they are forced to cope with various interest groups existing within a firm during the process. Existing environment in banks incentivizes to inaction and complacency as any change is complicated to achieve and risky for an individual.

The last important obstacle seems to be outdated and insufficient technology infrastructure. Advanced analytics require modern IT systems, which is a problem for many institutions. Their internal computer systems, sometimes developed in the mid-nineties and only partially upgraded since then, do not suffice when it comes to modern platforms. In addition to that, internal IT departments are often stretched and lack capacity for any larger project. If we add understaffed and sometimes uncooperative analytical departments, it is not surprising that banks have yet to launch any larger advanced analytics initiative.

These factors lead to not very positive attitude of managers towards new systems. However, their outlook is influenced also by doubts about merits of advanced analytics. During the interviews several managers expressed doubts about the real value of analytics and implied that hype around the topic is caused primarily by IT firms and management consultants who

have vested interest in promoting analytics as it could mean a vital potential revenue stream for their own businesses.

Despite these barriers, there are some outliers that rank well above average when it comes to use of advanced analytics. Difference resides not in their size or ownership structure. The main dissimilarity of these banks is faster decision-making, better IT capabilities as well as more positive attitude. The group of leading firms have launched several projects using advanced analytics and compared to others, they do have bolder plans for the future. These projects concentrate primarily on improvement of CRM, more efficient sales and risk optimization. By using transaction data, past behavior as well as data from third parties, banks are, or soon will be, able to increase efficiency of their actions.

In the last part of the chapter, we provided managers, willing to launch projects related to advanced analytics in their own company, with a high-level framework. It consists of four parts and takes into account situation in the Czech banking. First of all, there is a great need for overarching corporate strategy. Clear strategy can increase return on investment by helping to choose the best projects and supporting synergies between individual initiatives. Secondly, it is inevitable to secure buy-in from leadership as well as from other key stakeholders. Backing from the board will speed up the whole process. On the other hand, cooperation from the other departments and staff is crucial for successful implementation and functioning of any project. Furthermore, it is important to ensure that project's costs and timing are in line with initial plan and that the company has sufficient resources, both human and technological, to run it. Last, but not least, it is necessary utilize gained knowledge to prove that project was worth the investment. Not acting upon insights would defeat the purpose of any analytical initiative and without good results, future plans could be threatened.

Conclusion

The aim of this thesis was to analyze the use of advanced analytics in the banking industry in the Czech Republic and to propose a general framework that would guide managers on the way of their adoption.

The first chapter explained concepts of big data and advanced analytics as well as their potential for companies, and challenges that are connected to them. It showed how mounting amount of data, speed of their flow and variety, as well as veracity create a window of opportunity for virtually every firm. Whether it is because of enhanced CRM, faster product development or more efficient marketing, many organizations are embracing advanced analytics. It is true that there is a lot of hype around the topic, but growing body of research seems to confirm that firms using advanced analytics really do perform better than those that do not. (The Economist Intelligence Unit, 2012) (Brynjolfsson, et al., 2011)

The second chapter covered practical aspects of advanced analytics. Any company willing to utilize them in its operations needs to take significant initial costs into consideration, as with high probability an investment into IT infrastructure will be necessary. In addition to that, the firm would need to hire skillful data scientists who would be capable to translate data into actionable insights. As these people are in limited supply and very expensive, any strategy should take these aspects into account.

The third chapter of the thesis attempted to describe the change of competitive landscape in banking and to construct a business case for the use of advanced analytics in companies and specifically retail banks. Improved risk management, enhanced process administration, cheaper operations and increased value provided to customers represent strong incentives for any banking institution that wishes to succeed in the market. In addition to that, we looked also at potential challenges that the banks implementing projects based on advanced analytics could face, namely regulation and historically low innovativeness of the industry.

We concluded that banks are in specifically good position to capitalize on advanced analytics for various reasons. They control great amount of personal and behavioral data of customers and are big enough to afford systems and people necessary for utilizing information these data could offer. Although there are several obstacles, from legal concerns to significant

investments that would be necessary, since competitive, regulatory, and customer pressures are mounting, banks are likely to attempt to exploit the data more than they did in the past.

In the fourth chapter, based on several interviews with bank managers and management consultants familiar with the industry, we focused on the goal of the thesis and assessed the actual situation in Czech retail banks in relation to the use of advanced analytics. Based on information gathered in the process, we proposed a high-level framework covering four key areas relating to the use of advanced analytics in companies.

During the initial phase of writing the thesis, the assumption was that Czech banks are actively trying to catch up with their more experienced peers abroad and they either already use sophisticated advanced analytics or are close to launching pivot projects that would enable them to do so. The reality proved to be different. Majority of banks in the country does not widely use advanced analytics, besides selection of clients for campaign purposes. Moreover, their managers are rather conservative when it comes to greater data exploitation. In course of the interviews, several reasons underpinning their attitude came to light. Firstly, foreign-owned smaller Czech banks generally do not have decision-making power when it comes to large IT projects. Secondly, even if banks do have the power, the process is so complex that it significantly prolongs the time any larger innovation needs before it is implemented. Managers who try to come up with novel solutions thus need to exert significant effort and possess large political capital if they want to achieve any change. Thirdly, advanced analytics require well prepared IT infrastructure and many banks still run on legacy systems built many years ago, sometimes in the mid-nineties. Internal IT departments often lack capacity and ability to develop suitable solutions quickly and cheaply enough. In addition to IT problems, in some cases cooperation between business and analytical departments is suboptimal, either because of understaffing or insufficient cross-departmental communication. And last but not least, managers themselves have mixed opinion about advanced analytics as they suspect their proponents in the ranks of IT and consulting firms from having ulterior motives when promoting them.

However, not all banks perform poorly in terms of current use of advanced analytics or their future plans. After analyzing institutions that do relatively well, we can conclude that size and ownership structure is not the key. Rather than that, there are three other commonalities.

The first one is relatively swift decision making process that enables to launch an initiative within a reasonable time frame. The second one is respectable IT infrastructure, both in terms of platforms and hardware as well as people who work with them. The third shared attribute is rather good attitude towards analytics. Leading institutions do have a longer history in using predictive analytics in their operations. Although they sometimes seem to struggle to find relevant insights among stockpile of data, positive attitude of their managers towards data driven decision-making is relatively deeply engrained in their corporate cultures.

Leading institutions use advanced analytics for CRM, risk and sales purposes. They use both internal data (customer information and to certain extent also transaction data) and experiment with third party data sources. Although geospatial and social media information utilization is limited so far, pivot initiatives test their broader use for the future.

Based on opportunities for companies, use-cases in banking industry around the world and gained knowledge about the local environment, a framework that should guide executives willing to embrace advanced analytics was established. It consists of four parts. First of all, every bank needs a clear strategy. Individual projects should be fully aligned with corporate strategy and objectives. Projects should not be run independently, but rather form a consistent system, in order to better utilize resources and exploit potential synergies. Having clear focus will ensure that initiatives are chosen and implemented efficiently and systematically. Secondly, managers need to secure support from top executives as well as other stakeholders. Otherwise, unnecessary clash of interests could hamper and slow down any promising project. Winning approval from numerous parties may consume a lot of energy, but it is essential for any larger-scale project. Thirdly, it is necessary to plan project's specifics and thoroughly monitor its implementation, as these are crucial to success of all initiatives. Lastly, once the system and people are in place, and access to data is secured, banks need to figure out how to translate insights into practical actions improving their bottom-line. Not doing so efficiently, would not just mean waste of resources, but could cause undermine support for analytics in the company and thus threaten future projects.

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