Choosing a suitable data-analytics software for a company's operations

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Abstract

In this research, the purpose was to study the different factors that contribute to a company's consideration around choosing a suitable data-analytics software to be adopted into their operations. The research was based around the notion that there currently exists a gap between the information technology and the companies, where valuable data is being wasted by the companies at the cost of their competitiveness due to their limited capabilities in data analytics. Data-analytics software were noted to be potentially valuable for the companies by being able to help bridging the gap between them and the information technology by allowing them to make more use out of data in their operations, but this was not to be taken for granted at any situation due to the overall complexity and extent of the phenomenon.

The research was conducted by performing a literature review on the existing scientific literature around the phenomenon and a case study, which provided a concrete example from a real-world setting. The combined results from these research methods were then analyzed together in a further analysis to identify relevant factors and describe their possible effects as opportunities and challenges for every company to consider, which may eventually steer their choice of a suitable data-analytics software into one direction or another. This research tries to provide better understanding around this process, which is supposed to lead to a specific choice and uncover the reasoning behind it. This can essentially present useful guidelines for the companies interested in adopting data-analytics software into their operations.

The results of the research pointed out that there are plenty of different options for a company to choose from, which can prove out to be suitable for their operations. The choice itself is eventually based on the company's own characteristics and requirements, which may require different forms of evaluations depending on their nature. In addition, it was emphasized that users should be given a central role in the consideration, because they are eventually responsible for the creation of value through data-analytics software and they are significantly being affected by the quality of the software. The opportunities and challenges also presented important points to consider, because their potential effects can easily be overlooked by many companies. The results emphasized that companies should approach the choice with careful consideration from a unique perspective, where the presented issues can essentially be utilized as useful guidelines to increase their chances of finding a suitable data-analytics software for their operations and eventually gaining value from it. However, it can be argued that data-analytics software are still surrounded with a fair amount of uncertainty relating to the companies' return of investment, which suggests that there is still a lot of work to be done in this field.

Keywords
Data analytics, Business intelligence, Integration, Visualization

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Foreword

Writing this master's thesis was undoubtedly the most challenging singular task during my studied, but it was also the most rewarding one. Completing it showed me that I can accomplish anything, when I put my mind into it. I hope that the people reading this thesis will find its content useful in their own work or at least see it as a source of inspiration.

Finally, I especially want to thank my family and friends for providing extensive support and encouragement during this long and arduous process. I also want to express my most sincere gratitude to my supervisors for their valuable guidance and patience, which certainly taught me a lot and made the whole process much more pleasant in the end.

Juho Pietilä
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Contents

1. Introduction

Today's people are living in a world, where information technology plays a huge part in their lives. This is clear because information technology can be seen pretty much everywhere and people are using it for various purposes for both business and pleasure. The relevance of information technology is present in the continuous efforts to develop it further to suit more of people's needs. The extensive use of information technology is emphasized by the efforts to constantly develop it further, which has also led to a massive increase in the amount of data (Zhao, Liu & Zhou, 2018). This phenomenon does not necessarily concern individuals too much, because their operations are not heavily dependent of systematic use of data, but the story is whole different with companies. Companies can use data in various ways, which strives to increase their competitiveness, but also ensure their survival (Brownlow, Zaki, Neely & Urmetzer, 2015). Data does have some concrete value for the companies, but in order for it to be actually useful, the data has to be analyzed first (Marjamäki, 2017). This can be very problematic because people have been noticed to have limited capabilities in data analytics, which is further complicated by the massive amount of complex data being constantly produced. (Morton, Bunker, Mackinlay, Morton & Stolte, 2012; Zhao, 2013) However, information technology does not provide a simple and straight-forward solution to the problem, because even the common database systems are not sufficient enough in handling the vast amounts of data being constantly produced at a rapid pace (Kumari et al., 2018; Bhardwaj & Singh, 2017).

In order to tackle this issue, many companies have considered adopting data-analytics software to support their operations by integrating them with their existing infrastructure (Barrett, Clarke, Tarr & Wise, 1996). Therefore, during the recent years the interest of companies and scientific communities have been increasingly steered toward a specific type of data-analytics software called business intelligence (Sun, Zhou & Strang, 2015), which also serves as the particular focus of this research. However, in many cases this has proved out to be challenging and so far only a few companies have been successful (Wegener & Sinha, 2013). These notions emphasize that there currently exists a gap between the companies and the information technology, where valuable data is essentially being wasted by the companies at the cost of their competitiveness due to their limited capabilities in data analytics. This notion serves as a base for this research, which emphasizes the need to perform further studies around the phenomenon.

From a research point of view, this thesis originally got its motivation from being personally part of a research and development project, which was focused around the objective of choosing a suitable data-analytics software for a specific company's operations. This project is also utilized as the case study in this research. During this project, the phenomenon was studied from a very practical point of view by narrowing the scope to the purposes of a specific company. However, the project showed a lot of potential to study the phenomenon further at a more general level, which would aim to provide better understanding around the process of choosing a suitable data-analytics software and the reasoning behind it. This would essentially consist of identifying relevant factors and describing their potential effects on a company's operations, which can emphasize relevant issues to consider and provide useful guidelines for a broader audience of companies interested in adopting data-analytics software into their operations. Expanding the scope was fundamentally done by adding more existing scientific knowledge and facts into it, because the presented project was mostly centered

around practice. Overall, this means that the work done during the project served as a starting point for this research, which was later individually expanded to study the phenomenon at a broader level by adding more dimensions to it and essentially providing more comprehensive results around it.

This research was conducted by applying a research methodology consisting of two distinct research methods. Firstly, a literature review was performed, which focused on the existing knowledge about defining data-analytic software and its current situation among the companies at a general level. Secondly, a case study was included to provide a concrete example from a real-world setting. In addition, a deeper analysis was performed, which combined the findings from the literature review and the case study to draw conclusions by reflecting the theoretical and practical aspects of the phenomenon. The overall purpose was to investigate the different issues that might be relevant for a company's consideration of choosing a suitable data-analytics software for their operations. The goal was to answer two research questions among these issues. The first question was what kind of factors contribute to a company's consideration around making a choice on a suitable data-analytics software for their operations? The second question was what kind of opportunities and challenges can a company face when they are choosing to adopt data-analytics software into their operations?

Structurally this research is divided into seven main chapters. In the first chapter, there is an introduction to the research by presenting the topic and its purposes briefly at a general level. The topic is emphasized by a motivation behind the research and the vision is led by research questions and methods to reach these goals. In the second chapter, there is a literature review of the existing research among this topic, where the base of knowledge for data-analytics and its current situation are presented in more detail with relevant concepts and their dimensions. In the third chapter, the initial project is presented by describing its characteristics and timeline with their main findings. In the fourth chapter, the research methodology is presented, which illustrates the intentions behind this research and the methods that were applied in order to pursue its goals. In the fifth chapter, the gathered results from performing the case study are presented in more detail, where their meaning is also analyzed at a deeper level. In the sixth chapter, a discussion is formed around the gathered results in relation to the research questions in order to draw reasonable implications around the presented questions. In the seventh chapter, the research and its findings are summarized in form of conclusions by also pointing out the contribution and the limitations of this research along with potential focuses for the future work.

2. Prior research

In this chapter, a literature review is conducted on the prior research around the phenomenon. This essentially serves as the theoretical base of knowledge for this research, which presents the central concepts around the phenomenon and its current situation in the world.

2.1 Defining data-analytics software

Data analytics is not a new concept by any means because it has already existed for many decades at this point. The roots of data analytics from a technological point of view can be traced all the way back to the 1940s, where it was based on operations such as, making calculations, conducting examinations and forming inferences from data (Holsapple, Lee-Post & Pakath, 2014). Naturally, technology has developed substantially from those times and in the modern world, data analytics is being conducted mainly through information technology and software like many other operations as industries have been increasingly digitalized (Mehta & Pandit, 2018). Even though, information technology has increased the efficiency and effectiveness of such operations (Behrisch et al., 2018), their logic in principle remains mostly the same at a general level, which can be seen as a good base to build comprehension on. However, these principles are rather shallow in terms of offering concrete definitions regarding the nature of data-analytics software and its purposes. Therefore, it is important to dive beyond the surface and ask what is meant by data-analytics software.

Generally speaking, data-analytics software can be defined as a solution based on information technology, which is used to process data into information that provides valuable insight for the decision-making processes (Zhao et al., 2018). The insight is based on comprehension about the content of past, current and possible events in the future by shedding concrete light behind their reasons and ideas on how to react on them (Banerjee, Bandyopadhyay & Archarya, 2013). However, the definition of data-analytics software can be rather vague or even controversial in some cases, because it does not say much about the foundation of value as there are different kinds of data-analytics software available, which ideally serve distinct purposes.

The type that particularly suits the purposes of the companies in general is called business intelligence, which has been gaining increasing amounts of attention ever since the 90s (Sun et al., 2015). Business intelligence can be defined as a collection of technologies that are designed for enhancing the decision-making processes by increasing their efficiency and effectiveness (Chaudhuri, Dayal & Narasayya, 2011). From a practical point of view, it comes down to having the right information for the right people at the exactly right point of time, which ideally should benefit the decision-making process (Bose, 2009). It is fundamentally used to gain understanding about the competitive capabilities of a company by examining both internal and external factors that affect the overall operations (Negash, 2004). For example, companies tend to be particularly interested in data that considers their processes, activities of the customers and performance metrics of the entire company (Power, 2008). Overall, business intelligence tends to have various definitions, but the driving force and principle for creating value behind all of them is to support business activities (Holsapple et al., 2014) or to solve business problems (Kohavi, Rothleder & Simoudis, 2002) through the

means of information technology, which are all natural parts of the companies' daily operations. In an ideal setting for data analytics, business-related issues and information technology are tied together strategically and not being treated as separate entities (Watson, 2014). It is very clear why such insight is very valuable for the companies, because they can use it especially for management purposes relating to their operations, which are evidently aimed to yield desirable results and revenues through the aforementioned means.

By taking an initial glance at the definitions of business intelligence, they seem quite desirable in the eyes of the companies. However, it also raises a question if there is a concrete reason for every company to adopt data-analytics software into their operations as a necessity. It has been suggested that the primary reason why companies adopt and use data-analytics software is that people have been noticed to have limited capabilities to utilize and understand large quantities of data, which is present in the modern world (Morton et al., 2012; Zhao, 2013). The utilization can be quite problematic, because the range of different users can be rather broad consisting of various people with different levels of business and technological capabilities, which are both relevant in data analytics (Frenzel et al., 2018; Kohavi et al., 2002). This has also particularly affected the dynamics of the job markets by creating whole new jobs and changing the existing ones, where companies have expressed a demand in capabilities around data analytics (Watson, 2014). However, the underlying problem is further emphasized from the users' point of view because of the notion that the current software products have been noticed to lack in the quality of their usability and functionality features (Fischer, Engler & Sauer, 2017), which can result utilizing them even more challenging. This has led to a realization that a large amount of valuable data is unfortunately being wasted by the companies, because they naturally cannot collect and use everything that is being produced (Mehta & Pandit, 2018). From a business point of view, it has been widely acknowledged that having the ability of utilizing the increasing amounts of data is crucial for the companies to enhance their competitiveness and survival (Behrisch et al., 2018; Brownlow et al., 2015; Marjamäki, 2017). This is essentially achieved through differentiation from other companies by gaining an edge in the decision-making processes (Bose, 2009). Companies had problems in coping up with the increasing amounts of data back in the early 2000s, but the adaptation has currently been made more viable through the technological advancements, where the constantly increasing capabilities of computer processing units and storage units are available at a lower price (Watson, 2014). Overall, data-analytics software have been noticed to help bridge this gap by allowing the companies to make more efficient and effective use of their relevant data in the management of their operations (Behrisch et al., 2018).

Data analytics can fundamentally be described as a process consisting of different phases and technologies, which should ideally lead to a specific end. But what is the starting point for utilizing data analytics? Naturally, before analyzing data and making actual use of it, the data has to be gathered somehow. The current state and the future direction for gathering data is emphasized by a notion that the technological developments have led to various new ways to gather and use data (Zhao, 2013). Data analytics as a field has been developing fast due to the enormous increase in the amount of data produced particularly by the internet and smart devices (Larson & Chang, 2016). In addition, the process of gathering data has changed during the recent years due to the increasing utilization of sensors. The technological advancements among sensors have increased the overall use of wireless sensor networks (Kalpakis, Dasgupta & Namjoshi, 2002). Sensors are generally being utilized for their various functionalities, which are also highly available at a low price and energy consumption levels. (Zhu et al., 2014) Sensors are defined as devices that gather raw unprocessed data from the environment, which is then transferred for reading through digital signals (Saggi & Jain, 2018). For example, sensors can easily collect data about temperature, pressure, frequencies and

motion (Zhu et al., 2014). The benefit of sensors is that due to their small size they can be easily installed to different locations, which are then able to continuously gather data for a specific cause (Wang & Liu, 2010). Gathering a specific form of data may require different kinds of sensors, which are currently available in various forms. In addition, these technologies also provide continuous access to the data, which cuts the overall costs of the operations as the data is readily available when it is needed. (Kumari et al., 2018) The use of sensors and smart devices have made it possible to gather data from the environment very accurately. Currently, it is common that sensors are being utilized together with applications to create comprehensive networks, where lots of data can be readily gathered and transmitted wirelessly to further processing with ease. (Wang & Liu, 2010) Sensors may be used individually or in combination with one another, which allows discovering relationships and patterns between the data. However, achieving such discoveries can be very challenging without the help of some advanced data-analytics tools. (Cagliero, Cerquitelli, Chiusano, Garza & Attanasio, 2018) But when exactly do the data-analytics tools step into the picture?

Data is naturally a crucial and valuable subject in data analytics, but there is more to it than initially meets the eye. The underlying reason to utilize data-analytics software together with data is that companies cannot base actions on data alone as it does not have any meaning at its raw stage (Zhao, 2013). For the data to be actionable and useful, it has to be processed into information, which is done by establishing relations with data (Marjamäki, 2017). Gathering data plays an important part in this, because gathering and integrating more information essentially allows better recognition for patterns and relationships (Bose, 2009). The relations on the other hand can be established by applying logic to the data in a business context (Larson & Chang, 2016). However, this does not count as insight yet, so how can it be gained from an operational point of view?

The operational base for gaining insight lies within the concept of visualization, which is part of the core functionality of the data-analytics software. Visualization is a process, where data is represented in a graphical form, which is supposed to provide the users a better understanding of the issue being analyzed. Through visualization, the users are able to combine the heterogeneous data from various sources with different structures, which can offer flexible ways to interpret and make inferences about the state of data. (Wang, Wang & Alexander, 2015) Visualization gets its value from enhancing the user's interaction with the data, which has previously been acknowledged to be quite problematic (Morton et al., 2012). In practice, visualization can be done by making visual representations of the data, which may come in various forms. The data may commonly be represented in, for example, tables, graphs, charts, diagrams and even maps. Even though data-analytics software offer various and flexible ways to visualize data, it is also worth noting that not every form of visualization is suitable for different forms of data (Hoelscher & Mortimer, 2018). Therefore, this process also needs some understanding about the nature of data along with careful consideration on what needs to be represented and what kind of value can be gained through it. In addition, it is worth noting that having access to technology and visualization do not necessarily automate the process in any way or guarantee value from it in the end. It has been emphasized that vision and insight of the users are just as or even more important than technological resources in this process (McAfee & Brynjolfsson, 2012).

In order to properly adopt and eventually make use of a data-analytics software, it naturally has to be integrated into the company's operations first. The integration is a process where the technological parts of the company's infrastructure, such as software and devices are made to cooperate with each other (Barrett et al., 1996). The integration process for software has been emphasized to be of high importance because currently their operations are considered to collectively relate to each other, rather than being

separate units made for individual operations (Land & Crnkovic, 2003). However, it is worth noting that the integration does not succeed automatically during the adoption because the different technologies have their own characteristics, which have to be carefully considered when combining them with others. Naturally, this may prove out to be a complex process depending on the nature and the amount of different software that are being integrated with each other. In terms of the data-analytics software, this process is crucial because they depend heavily on the ability to use the relevant data being produced by the other software of the company. Ideally, the integration should be established seamlessly, where each software fits well with each other and eventually supports the operations of the entire company, but this absolutely should not be taken for granted as it can be seen as a sum of various structural factors.

2.2 Current situation

Where all the hype around data analytics has led in the modern world is that companies tend to invest heavily in data-analytics projects because of their desire to gather insight out of the extensive data from various sources. Many of them are focused on the acknowledgement that investing in data analytics has been noticed to provide value and increase their competitiveness in many cases (Holsapple et al., 2014). However, the majority of them are experiencing issues in gaining sufficient return of investment due to their inappropriate approach to data-analytics projects, which are fundamentally different to other information technology projects. In traditional information technology projects, the approach involves executing the project carefully according to the plan, which eventually aims to enhance their business processes through change. Data-analytics projects on the other hand usually fall short of such expectations as their relevant operations take place after the initial adoption, which involves considering how to make use out of the available data and how it can be generated into valuable insight. Such insight can naturally be directed towards the central business operations, but some of their qualities may concern unexpected discoveries and effects that can present themselves in various ways. (Marchand & Peppard, 2013) The idea is that data itself can provide new sources for innovation through exploration, where the value presents itself through refinement. The adoption process of new technology can be seen as a relatively simple task, but these results emphasize that it does not actually provide any value yet when data analytics is being considered. Therefore, it is important to think what should the companies take into account during the adoption and use of data-analytics software to better ensure its success.

Marchand and Peppard (2013) have studied the companies' approach to data-analytics projects and noticed that in many cases the companies fall short of their expectations to gain value because of their approach to such projects. Based on their findings, they present five guidelines to follow that are supposed increase the chances of getting a worthwhile return of investment from data-analytics projects. Firstly, they state that companies should place people in the centre of their initiatives. They emphasize that it is beneficial to change the people's way of thinking about utilizing data to create meaningful insight through formal means instead of relying on mere assumptions that are prone to errors. Secondly, they state that companies should emphasize the role of information use in the process of gaining value from information technology. They say the reason behind this is that information technology can be taken advantage of in processing the generally complex data into information that is used to find new ways to solve business problems. Thirdly, they state that companies should employ information technology projects with people from cognitive and behavioural sciences. They emphasize that such people enrich the company's way of working by bringing understanding outside of just information technology and dive more into how people think and act in a business setting. Fourthly, they state that companies should promote

learning in their culture. They say the reason behind this is that the iterative nature of these projects allows making various kinds of discoveries at different points of time, which in turn can be used widely to improve the approaches to solving business problems. Finally, they emphasize that companies should focus more on solving business problems rather that deploying technologies. They say that companies can easily risk their operations by taking information technology tools for granted as the only provider of value from data, whereas their own knowledge and skills are also crucial in the process of identifying less than obvious business problems and eventually solving them. Overall, they emphasize that these five guidelines should especially point out that people are the ones that eventually make the information valuable, not the tools. This is the reason why it is very important to understand how people gather and use information in data analytics. (Marchand & Peppard, 2013)

Lastly, it is worth taking a look at concrete recent results how different companies have been able to utilize data-analytics software to gain a better understanding of the current situation. Wegener and Sinha (2013) conducted a case study, which studied hundreds of large companies around the world. According to their results, only four percent out of these companies were thought to have good level of capabilities in data analytics, even though 38 percent out of them were using data-analytics software. However, they also pointed out that having a good level of analytics capabilities also depends on the cooperative effects of various factors, which were the data-analytics software itself, data, people and intentions. They stated that the capable companies were significantly more likely to outperform most of the other companies within their industry, but also experience significant increases in the efficiency and effectiveness of their internal decision-making processes. However, there is also a problem even if the company is successful in the utilization. According to Larson and Chang (2016), the companies are experiencing difficulties in measuring the actual value gained in the form of return of investment, which are solely gained through the data-analytics software. They state that data-analytics software can certainly act as enablers, but their direct impacts are hard to define in the big picture. Overall, the results present various desirable opportunities for the companies, but also complex challenges that should not be ignored. Therefore, the consideration around the possible adoption should be done carefully by respecting various factors in play.

3. Initial project

In this chapter, the initial project for the case study is presented, which represents the practical side of the research and provides an actual example from the real world around the phenomenon being studied. Firstly, there is an introduction to the project by presenting its context, which provides an overview of its characteristics and goals. Secondly, the project's timeline is presented by dividing it into distinct phases, which are gone through chronologically from start to finish. These phases essentially represent the different steps and processes along with their content, which were performed to fulfil the goals. Presenting the project in question is meant to provide a base for the actual case study that was eventually done in this thesis.

3.1 Context

The case study in this thesis is based on a research and development project involving a company and an external research group. The research and development project took place in the fall and winter of late 2018. The company in question is called Kaltiot Technologies Oy, which is based in Oulu, Finland. They were founded in 2014 and they employed about 20 people in total at the time of the project. Their operations and offering are based on IoT-services and products around their Smart Tracker technology. The technology in question is based on the idea to utilize specialized wireless beacons with Bluetooth connectivity that contain various sensors to perform location tracking and data measuring for designated targets. Such targets may include, for example, assets and locations of interest to gain information about their state at different times. Currently, Smart Tracker has particularly been utilized by construction and logistics companies, whose operations require constant monitoring in order to ensure their fluency in varying circumstances. To make use out of the gathered data, it is then visualized through a data-analytics platform, which is currently being handled by an open-source software called Grafana. However, the company had began to wonder if the current solution was the best option available for them at the given time. To answer this question, it was necessary for them to perform a research and development project.

Before starting the actual project, the company decided to cooperate with the University of Oulu and outsource the project for an external research group to conduct the research and development tasks on their behalf. This meant that the company essentially acted as a client during the project and in turn the research group was the provider. The research group was formed by five master's program students from the University of Oulu, who studied at the faculty of information technology and electric engineering. The project was designed as a part of their mandatory studies, which would require each student performing around 260 hours of work in total that would eventually provide them with 10 credits and valuable working experience from the field. Each of the students were to take equal part in the research and development objectives of the project and different tasks would be designated for them based on their level of expertise and interest. One of the group members was designated as a project manager, who was responsible for the coordination within the group and communication between the client. In addition, the research group had a supervisor from the faculty to monitor the progress of the project and provide guidance if it was necessary. The research group worked directly with the company and their contact person within the company was the CEO of the company. The contact person was essentially the representative of the client, whose task was to

take part in the steering group meetings and provide information and feedback regarding the initiative, which served as the backbone for the project.

The initiative for the project was formed around a primary task of conducting a study about the state of the current solution regarding the data-analytics software and possible alternatives for it. The first aspect of the project was that the group had to study and evaluate the current solution in order to identify its pros and cons. These were used to answer how well the current solution was able to fulfil the business needs of the company. Secondly, the group had to study some well-known currently available solutions, which could serve as possible alternatives for the current one. The company expressed interest and wishes for the group to study the two industry leading solutions, which were called Microsoft Power BI and Tableau. Therefore, the group at least had to study and evaluate these two options, but possibly also search for other viable options. Finally, the main goal of the project was to form a comprehensive study around the issue and result a justified recommendation for the solution to be adopted in the future by the company. The company specified that the nature of the recommendation did not really matter as long as it was justified, so the recommendation could essentially be anything such as developing the current solution, choosing some commercially available option or even tailoring something completely new.

In terms of the requirements for the project and its results, the company had only specified a few by themselves. The most crucial requirements were features that were absolutely necessary to be fulfilled. The crucial requirements are presented below in the table 1 along with their description. There were also some less crucial requirements, which were defined as nice to have features. These features mostly represented a wishlish of features, which were either not available in the current solution or they would be desirable to have at some point of time. The nice to have requirements are presented below in the table 2 along with their description. Overall, the research group had quite a lot of room to explore the different options and they were solely responsible of their own decisions as there were hardly any features that required strict forms of testing either in terms of their approach or their nature of results.

Table 1. Table of the crucial requirements.

Requirement	Description
R1: REST API compatibility.	The solution must be compatible with the REST API technology.
R2: Historical data.	The solution must be able to present historical data from a year away at least.
R3: Visualization.	The solution must be able to visualize data in some capacity.
R4: Grouping devices.	The solution must be able to present and arrange devices in specified groups.
R5: Ease of use.	The solution must be relatively easy to use even without special expertise.
R6: Customization.	The solution must be customizable to some extent to fit the use.

Table 2. Table of the nice to have requirements.

Requirement	Description
R1: State of readiness.	The solution should be able to present the state of readiness for a specified objective.
R2: Real time measurements and tracking.	The solution should be able to perform measurements and tracking in real time on specified assets and present them accordingly.
R3: Thresholds.	The solution should be able set thresholds for specific values and alert in some form if these are exceeded or not met.
R4: Troubleshooting.	The solution should be able to report any presented problems.
R5: Templates.	The solution should be able to provide templates for presenting and sharing data.
R6: Aesthetics.	The solution should be visually appealing to the user.

3.2 Timeline

After getting to know the project's initiative and its practical arrangements at the detailed level, the research group set a schedule for the thirteen weeks of the project by identifying different phases for it by considering what had to be done and how in order to reach the goals. Therefore, each phase was set with distinct objectives and a specific amount of time in relation to the overall resources, which would be required in order to successfully perform them and provide the desirable results. There were four different phases in total, which were called planning, platform studies, integration and forming the solution.

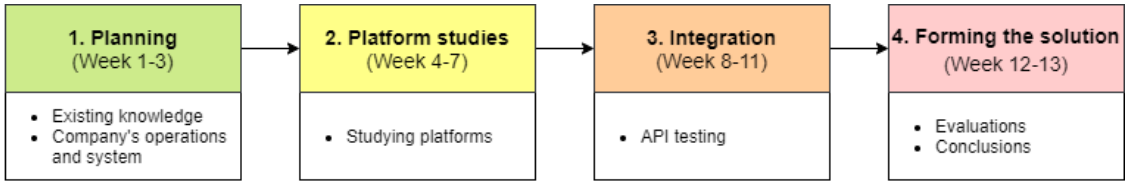

Figure 1. Timeline of the project.

Figure 1 is a simplified representation of the project's timeline, which is divided into four distinct phases. The phases are presented in order and the transitions between them work only in one direction. Each phase contains information about their duration along with their objectives, which can be examined more deeply through their results.

The first phase of the project was called the planning phase, which covered the first three weeks of work. During this phase, the group mostly worked on the practical groundwork of relating to planning and specifying details to basic arrangements. However, one major objective of this phase related to gathering and familiarizing the group with some existing knowledge around the project's scope from scientific sources.

This was an important task because the group naturally had to understand the different dimensions of the topic being researched and eventually make valid justifications based on relevant scientific facts and methods. In addition, a fact that emphasized the importance of this task was that the group's existing expertise within this field was arguably rather limited at this point. The first part of gathering information was to identify some relevant concepts or areas of interest around the project's scope. Naturally, most of these related directly to data analytics by explaining how it is being utilized or principal concepts behind its operations, such as visualization, sensor data and integration. In addition, the group also studied articles about the commercially available options, such as Tableau and Microsoft Power BI in which the company was particularly interested. During this task, it because quite clear that data analytics was a very popular topic within the scientific repositories with no shortage on available publications. The second important task during this phase was to get familiar with the company itself and the dimensions relating to its operations. This essentially required the group to study the offering of the company and the infrastructure behind it. This was important because in order to fulfil the needs of a company, the group would naturally have to know them at some level first. Overall, the purpose of this phase was to establish a base of knowledge for the project, which was to be utilized in later phases in order to comprehensively understand the subject that is being studied in relation to the big picture and steer focus into making relevant findings for it. However, it is worth noting that gathering information was more or less an ongoing process through the project, because advancing on a project naturally leads to different kinds of tasks, which in turn requires specific information that was not initially necessary or people were not aware of. Therefore, it was to be expected that the amount of information would increase along with the expertise of the group.

The second phase of the project was called the platform studies, which covered the next four weeks. During this phase, the group studied the different commercially available options of data-analytics platforms along with the company's current solution and technologies. These were studied primarily by reflecting their features against the specified requirements to get a sense of their possible compatibility. In addition, they were also studied by discovering different pros and cons, which could be used to compete the options and distinguish them from each other by comparing their potential effects on the actual use.

The first platform to be studied was called Tableau, which was originally released in 2003. Through the years, Tableau has grown to be very successful offering a robust and comprehensive solution for data analytics. In terms of the requirements, Tableau faired very well by being able to fulfil every initially specified requirement. Generally speaking, Tableau was seen as a flexible solution with a good level of performance and usability in the same package, which is also supported by a vast range of different technological applications and documentation. However, there was some criticism towards its offering, which stemmed from its pretty high price and a confusing product catalog.

The second platform to be studied was called Microsoft Power BI, which was launched in 2014. Being part of a major company's offering and ecosystem, Microsoft Power BI initially seemed to offer a lot potential and promise. Similarly to Tableau, it managed to fulfil every initially specified requirement. Microsoft Power BI was seen as a well-rounded solution, which is supported by a huge ecosystem. It offered tons of features that are easily accessible for most users either at a relatively cheap price or even totally free depending on the version. However, the Microsoft ecosystem could also be described as a double-edged sword in some cases, because it usually tends to prefer its own technologies and most importantly it was only available for Windows operating systems.

For the additional platforms to be studied, the group was given free hands to explore the available options. For the third platform, the group chose a platform called Qlik, which was already released back in 1993. The choice was made based on its good reputation and a respectable userbase, which contained many big and well-known companies. Regarding the requirements, it managed to fulfil most of them except for the ease of use. Qlik was seen to be a pretty compatible and flexible option with good performance and security, which were also readily available either at a decent price or completely free depending on the version. However, Qlik was deemed to be the quite challenging to use due to its fully script-based operations. In addition to its complexity, it can also be quite limiting for some users, because it was perceived to be rather resource heavy and it only supported Windows operating systems.

Finally, the group also had to study the company's current solution along with its technologies. It essentially consisted of a Smart Tracker application for mobile and an Asset View application for browser, which were responsible for tracking and measuring operations in relation to the beacons and their assets. During that time, the state of the solution was deemed to be quite rough due to its several limitations and problems. The solution managed to offer the core functions, but they suffered from various usability issues, which essentially compromised the quality of the user experience. Overall, the current solution left a lot to be desired and room for improvement.

The third phase of the project was called the integration phase, which covered the next four weeks. During this phase, the group focused to study the practical integration of each data-analytics platform through their compatibility with the REST API. Due to the limited time, the group focused on completing integration testing on at least one platform to have some concrete results to show and then continue to others if there was time to spare. In practice, the integration testing was fundamentally based on the idea of utilizing a data connector to ensure that data is being transferred from a specific source to the data-analytics platform for visualization. The group primarily set to test this on Tableau and the integration for it was eventually successful. For Tableau, the process proved out to be relatively straight-forward thanks to the readily available tutorials. The group also managed to test the integration on Microsoft Power BI, but it was not completed due to the limited time. However, the group was able to deem that the integration on Microsoft Power BI was more complicated compared to Tableau. The reason behind this was that Microsoft Power BI utilized a specialized programming language called M, which was significantly more complicated compared to the generally familiar HTML and JavaScript languages utilized in Tableau. Overall, the group was able to draw a conclusion that integration is possible in both tested options, but it would be easier in Tableau.

The fourth and final phase of the project was focused around forming the suggestion for the company, which covered the last two weeks of work. During this phase, the group essentially performed the final evaluations and documentation based on the gathered findings in order to draw justifiable conclusions between the options. Regarding the evaluations, the group still had to utilize methods that would be able define the state of each platform and their characteristics more comprehensively in order to properly distinguish them from each other. For the usability evaluation, the group decided to perform heuristics evaluation on each platform based on Nielsen's (1994) heuristics, which were able to decently highlight and define the relevant aspects contributing to each platform's state of usability in the tight timeframe. In addition, the group performed more comprehensive requirement analysis to define how well these were met in each platform. These were also highlighted in a feature table, which provided an overview of the state of fulfilling the requirements. Eventually, the final suggestion was constructed, which provided a detailed overview of the results. In the light of the complete results, the suggestion's conclusion was that Tableau would currently be the

best option to be adopted as the company's new data-analytics software. Overall, the goals of the project were accomplished well and the company was satisfied with the results.

4. Research methodology

In this chapter, the research methodology and the research process are being presented for this thesis. It begins by presenting the research questions that the thesis is centralized around and fundamentally tries to find answers for. To answer these research questions, a certain research methodology was applied, which combines both theoretical and practical approaches. The methodology consists of conducting a literature review and a case study and eventually combining their results in a deeper analysis. The following sections describe how these were applied in more detail from a process point of view and the reasoning behind them.

4.1 Research questions

The research questions of this thesis are centered around investigating the different factors and aspects around data-analytics software, which can be perceived to be relevant in the company's consideration when they are choosing to adopt data-analytics software into their operations. Answering these questions is designed to provide insight for the companies to understand the true nature of data-analytics software to evaluate their suitability in relation to their own operations, which is essentially important for making better decisions regarding their possible adoption of data-analytics software.

The research questions for this thesis are listed below as follows:

RQ1: What kind of factors contribute to a company's consideration around making a choice on a suitable data-analytics software for their operations?

RQ2: What kind of opportunities and challenges can a company face when they are choosing to adopt data-analytics software into their operations?

The research questions were formed with a specific purpose in mind. They divide the phenomenon into smaller sections of interest, which were designed to emphasize the relevant issues to consider and provide comprehensive answers for them. RQ1 focuses on identifying and evaluating the different factors that form a base for the company's decision regarding the suitability of the data-analytics software in relation to their operations. RQ2 on the other hand, focuses on studying the different effects that the adoption of data-analytics software may have on the company. This question divides the effects into opportunities and challenges depending on their nature. The opportunities represent the positive effects, which can enhance the company's operations and its results. The challenges on the other hand represent the negative effects, which can hinder or even prevent the company's chances of using data-analytics software in their operations. Figuratively speaking, RQ2 represents the different sides of a coin, which are both important points of consideration for the companies to gain better understanding of the big picture.

4.2 Literature review

The theoretical section of the methodology is covered by conducting a literature review. The purpose of this section is to present a base of knowledge for this research, which introduces the relevant concepts and how they have developed through time. This aims

to build a solid foundation to build understanding on the foreground of this thesis, which also highlights the points of interest for the research.

The first part of conducing a literature review was to search for relevant information about the topic from various scientific sources. The information sources used for this research were selected based on their reliable academic nature and a good amount of available material. Such sources were Google Scholar, Scopus and Jultika repository of the University of Oulu. To gather information in the first place, the topic had to be inspected more carefully in order to identify different keywords in the search process that have close relations to the topic. Suitable keywords in this research were particularly the concepts and processes that are relevant in relation to performing data analytics. This allowed discovering various scientific releases, which were carefully studied in order to gather enough relevant information to form the base of knowledge for this research. This process was decided not to be done systematically because the research area is quite broad and it relates to various fields of study, for example, mathematics, engineering and economics. Therefore, the required amount of information could not be collected at once by narrowing the search process into a specific set of keywords that would also result a suitable amount of scientific releases. This eventually reflects on the approach how the collected information is being presented.

The second part of conducting a literature review was to present the collected information in an orderly manner. The literature review could not be done systematically, so a more open narrative approach was alternatively deemed to be suitable. In this literature review, the collected information is presented in a chronological and cohesive manner, which is designed to form a continuum of knowledge in steps that attempts to build more understanding as it proceeds. The purpose of this literature review is to provide a general level of understanding about the principles of data analytics, which can be generalized and applied into most situations around this concept.

4.3 Case study

The practical section of the methodology is covered by presenting a case study. Case studies are commonly being used to research and create understanding about multidimensional social phenomena (Yin, 2009). In this thesis, these principles are applied into a collaborative research and development project between a real-world company and an external research group, whose objectives directly relate to the topic. The project consisted of different phases and processes, which involve various stakeholders. This setting is very fitting for conducting a case study, because it combines researching a contemporary complex phenomenon, which is also affected by various social dynamics. In addition, a research and development project shares practical similarities to a case study from a research point of view, because they both fundamentally involve similar steps having to do with designing and performing the research. In practice, this means that they both consider creating a distinct research design, collecting and analyzing the research data, which are eventually presented in a report (Yin, 2009). The case study in question is exploratory by nature regarding its research questions as is mostly aims to find questions for what, how and why? In this thesis, the case study utilized mostly similar steps as the walkthrough of the project, but there were also some exceptions as its results were expanded and adapted to fit the objectives of this research. The walkthrough of the case study from a process point of view is discussed in more detail below.

The first step and the starting point for this case study was creating a design for it, which fundamentally came mostly from the presented project. In this case study, the design was created around the initiative of the project, which was provided by the company in question. The initiative was essentially based on the company's specific needs, which would have distinct requirements based on their own operations. This set the base for the practical execution of the case study by shedding light on the specific steps that had to be taken in order to fulfil these requirements and goals. The case study was essentially divided into distinct segments, which represent the chronological flow of tasks and their detailed content, which eventually led to gaining the necessary results.

The second step was collecting the research data. In this case study, the collection of data was done iteratively across the whole process because of the various tasks, which essentially required distinct data to be gathered from different sources. During this case study, data was gathered from literature and different technologies, such as software and devices. Literature was primarily being used to study the phenomenon and to get acquainted with it to understand its characteristics. Literature was gathered from both scientific and verified unscientific sources depending of the subject being studied. However, the data gathered from the technologies was done through exploring and different forms of testing. The requirements were essentially used to provide direction for the necessary findings, but it is worth noting that even the requirements were eventually adjusted based on the gathered findings as they were initially deemed to be too general and limited by nature to perform proper evaluations on the different software. Adjusting the requirements was essentially done by arranging a semi-structured interview with the CEO of the company in question to get more information especially about the stakeholders and users, but also to discuss the already gathered central findings to approve their potential relevance for the company. This allowed adjusting the requirements to provide a more comprehensive base for eventually conducting evaluations and presenting results. Naturally, the requirements were evaluated through different means depending on their nature. A particular aspect, which had to be evaluated comprehensively related to usability. To tackle this issue, the case study performed usability evaluations on the different software based on Nielsen's (1994) heuristics, which essentially provide ten aspects as guidelines to evaluate the usability of the software. This approach was deemed to be suitable for the purposes of this research, because was able to provide a decent comprehension about the usability of each software at a general level and this research arguably did not have the sufficient resources to perform more systematic usability testing in official capacity. Overall, this step was meant to provide sufficient findings, which would eventually allow defining the quality of each software.

The third step was analyzing the research data. The main objective of this case study was to find an ideal solution for the company, which essentially means that one solution had to be selected above the others. Therefore, a comparative analysis was deemed fitting as it enabled comparing the different characteristics of each option against each other and the requirements. The analysis was performed by collecting the gathered findings from each software and constructing them into easily readable tables, which essentially provided an overview of them in relation to the specified requirements. This allowed the comparison to take place, where the central findings from each software can be seen side by side and compare their ability to fulfil the requirements. This was eventually utilized to draw reasonable conclusions from the comparison and their evidence.

The fourth and final step was forming the solution. The solution is essentially a collective and structured presentation of the case study's findings and conclusions. The purpose of this solution was to answer for the needs of a specific company, which were centered around the initiative of finding a suitable data-analytics software for their

operations. The solution was carefully constructed based on the gathered evidence, which also presents the reasoning behind the underlying choice. The solution itself managed to fulfil the needs of the company in question by providing a concrete answer around a suitable data-analytics software for their operations, which emphasizes the value of this research. Even though, the solution in question does not entirely answer the research questions of this thesis directly, but the vast amount of data gathered during the case study can be readily adapted to serve the distinct purposes of this thesis as a concrete example from a real-world setting.

4.4 Analysis

The final part of the methodology combines the results of the literature review and the case study under a deeper analysis in the discussion chapter. The theoretical nature of the literature review and the practical nature of the case study represent the different sides of a coin, which are equally important in this research. The purpose of this analysis is to investigate the results of each section in detail and reflect them against each other, which in turn can be used to emphasize different characteristics of the results and finally evaluate their overall impact in relation to the research questions.

As mentioned earlier, the literature review represents the theoretical side of the phenomenon, which fundamentally provides the general guidelines that can be viewed and applied universally. On the other side, the case study represents the practical side of the phenomenon, which is a unique instance. With these aspects in mind, the analysis uses different themes in the reflection to evaluate the deeper nature of the results, which eventually lead to drawing concrete conclusions based on them. The themes used in the analysis portray the relationships between each section's results and their impact. The relationships can be evaluated by identifying similarities and differences between them and whether their impact is positive or negative on the potential adoption of data-analytics software or its value. It can be seen that these issues are also particularly centered around the research questions, which essentially draws the methodology and the results together to form conclusions.

The different themes essentially serve as tools for drawing conclusions from the findings and understanding the reasoning behind them. The similarities can be used to emphasize the relationship between the sections, which creates more cohesive understanding of the phenomenon and it also adds credibility to the results. The differences can be used for multiple purposes and they tend to require careful consideration due to their more problematic nature. The differences can emphasize the uniqueness and variance among the results, which may only apply into certain situations or possibly even lead to whole new discoveries of knowledge. In addition, the differences may raise questions about the validity of certain results, which can be used to provide criticism or even corrections into certain issues. By combining the results' relationships with their impact, it is possible to make conclusions regarding the research questions. The positive effects can be associated with the opportunities of data-analytics software, because their impact is beneficial for the company. In turn, the negative effects depict the challenges, because their impact can hinder the company. Overall, the analysis aims to portray a logical combination of cause and effect scenarios, which provide better understanding of the results.

5. Results

In this chapter, the results of the research are presented for this thesis. This chapter presents the research work that was done individually around the initial project as a case study by expanding its extent and providing more comprehensive results around the phenomenon for the purposes of this research. This chapter is divided into several subchapters that represent the different steps that were taken in order to achieve specific results. Firstly, the platform studies are presented, which describes the findings from each of the studied data-analytics software at a general level. Secondly, the requirement analysis is presented, which illustrates the features and functionality that would be expected and evaluated from each data-analytics software. Thirdly, each data-analytics software's usability is being evaluated through a heuristic evaluation. Finally, the findings from each data-analytics software are being compared in a feature comparison that presents an overview of them together, which are used to draw conclusions.

5.1 Platform studies

During the platform studies phase, the purpose was to dug deeper into studying the different characteristics and features of the specific commercially available data-analytics software. The studied platforms were Tableau, Microsoft Power BI and Qlik. Naturally, the main focus of this phase was to examine these software in relation to the initially specified requirements to get a sense how these were fulfilled. However, there was also a valid chance to examine the different software more comprehensively in order to gather any other relevant findings that could eventually prove out to be useful in further analysis. Fundamentally, these findings could either be defined as pros or cons depending on their possible effect on the adoption or use of data-analytics software. Naturally, dividing them was quite simple as pros have positive effects whereas cons have negative effects. Regardless of the nature of these findings, gathering them was considered to be relevant, because they could potentially be used to draw better distinction between each data-analytics software in some cases. Overall, these findings were made from examining various sources, such as testing the actual software, reading scientific literature and browsing documentation from the internet. The findings from each software are presented individually.

5.1.1 Findings from Tableau

Table 3. Table of the pros from Tableau.

Finding (Pros)	Description
REST API compatibility	The software is REST API compatible.
Support for historical data	The historical data is supported as long as the memory resources are available.
Good visualization capabilities	There is a wide range of options for visualization.

Grouping capabilities	Grouping data and assets are supported.
Good customization capabilities	The software can be customized extensively.
Support for state of readiness	State of readiness can be presented.
Mapping and tracking capabilities	Data can be tracked and presented in real time.
Support for thresholds	Thresholds for data can be defined.
Support for troubleshooting	The problems are readily reported.
Support for templates	There is a wide range of templates.
Pleasing aesthetics	The software is visually pleasing.
Intuitive user interface	The user interface is easy to interpret.
Descriptions within visualization	Visualization contains descriptions.
Data sharing and collaboration	Data and operations can be shared between users.
Multiple operating system support	The software supports Windows, macOS and Linux operating systems.
Multiple platform support	The software supports desktop, mobile and browser operations.
Multiple data source support	Various data sources are supported.
Embedding capabilities	Visualizations can be embedded into external sources.
Good performance	The software has good performance.
Good security	The software manages its security.
Good reputation	The software has good reputation.
Good community support	The community provides extensive support regarding various issues.

Table 3 presents all the pros that were discovered from Tableau. By looking at the entire set of pros, Tableau certainly seems like a very robust software. First and foremost, Tableau was compatible with the REST API, but it also provided extensive support for various servers and custom APIs, which helps adapting it into the users' purposes. From the operations' point of view, Tableau faired very well by presenting a good level of performance and data handling capabilities. There were no noticeable issues with handling large amounts of complex data, which could be processed and filtered fluently within the visualizations. In terms of the actual user interface, Tableau seemed very polished by being able to offer an intuitive user interface with understandable

descriptions in each option and this was also done in a visually pleasing manner, which supports the practical use of the software. In addition, Tableau also presented an impressive level of support from the community, which provided plenty of easily accessible information to support both learning and troubleshooting. There were no problems with finding the required information regarding any issue. One thing that particularly stood Tableau out from the other options was the extensive flexibility it offered. It was able to provide support for most common operating systems and platforms, which essentially makes it a viable option for different bases and forms of use.

Table 4. Table of the cons from Tableau.

Finding (Cons)	Description
Packed user interface	The user interface is rather packed with different options.
Relatively expensive	The software does not have a free version and the advanced versions are expensive.
Switching between software	The users commonly have to operate between multiple systems.
Confusing product catalog	Understanding the product catalog's different options is difficult.
Relatively slow learning	The learning curve can be quite steep.
No Finnish support	There is no support for Finnish language.

Table 4 presents all the cons that were discovered from Tableau. Most of the problems with Tableau had to do with the offering. Firstly, the product catalog was quite confusing in a sense that it was difficult to distinguish different configurations from each other based on the presented descriptions. This may lead to questions about the overall viability and making the right choice for specific users. Secondly, even though Tableau was considered to be an advanced software, but its features came with a relatively high price. Depending on the configuration, Tableau could cost between 35 to 70 dollars monthly per user, which made it quite expensive generally and the most expensive option out of the three examined software. The overall price from the licences can get quite high depending on the amount of users, which may be an issue for some companies depending on their on their use for the software and their resources. There were also some minor issues regarding the ease of use. Even though, Tableau was arguably considered to be the easiest to use out of the three, it does not mean that it is generally easy to use. The user interface of Tableau was generally intuitive to use as long as the users know what they are supposed to do. The problem is that inexperienced users may easily get confused because of the overwhelming amount of features and options. In addition, the general operations cannot only be handled within Tableau, which requires the users to switch between different software, for example to process or transmit the data. However, it is worth noting that this was a general issue for the all of the examined software, but it surely emphasizes the complexity of use. Even though there was support to help manage these issues, learning the extensive potential of Tableau can prove out to be quite slow.

5.1.2 Findings from Microsoft Power BI

Table 5. Table of the pros from Microsoft Power BI.

Finding (Pros)	Description
Rest API compatibility	The software is REST API compatible.
Support for historical data	The historical data is supported as long as the memory resources are available.
Good visualization capabilities	There is a wide range of options for visualization.
Grouping capabilities	Grouping data and assets are supported.
Good customization capabilities	The software can be customized extensively.
Support for state of readiness	State of readiness can be presented.
Mapping and tracking capabilities	Data can be tracked and presented in real time.
Support for thresholds	Thresholds for data can be defined.
Support for troubleshooting	The problems are readily reported.
Support for templates	There is a wide range of templates.
Pleasing aesthetics	The software is visually pleasing.
Descriptions within visualization	Visualization contains descriptions.
Queries within visualization	Queries can be made on the visualization.
Data sharing and collaboration	Data and operations can be shared between users.
Multiple platform support	The software supports desktop, mobile and browser operations.
Multiple data source support	Various data sources are supported.
Embedding capabilities	Visualizations can be embedded into external sources.
Good reputation	The software has good reputation.
Good community support	The community provides extensive support regarding various issues.
Good personalization capabilities	The software can be personalized to a fair extent.

Simple product catalog	The product catalog is easy to understand.
Relatively cheap	The software has a free version and the advanced versions are decently priced.
Open development	The software supports open development.
Finnish support	The Finnish language is supported.

Table 5 presents all the pros that were discovered from Microsoft Power BI. At a first glance, the amount of pros is quite impressive and shows a lot of promise for the features. For a start, Microsoft Power BI was compatible with the REST API and various other custom APIs, which makes it highly customizable and adaptable for various uses. However, some of these APIs were only supported in the more advanced versions of the software and not the free one. In terms of the integration, the software is designed to work well with the Microsoft ecosystem, which is understandable given its origin. This provides an extensive base of use with lots of support and collaboration. The community around it was very active, which was also emphasized by a special notion that the actual developers also provide support for the common users. The collaboration between the users and the developers is also expanded by the feature of open development, where the users can take part in the development of the software. This certainly helps with developing the software further in the direction that serves the interests of the users. In terms of the product catalog, Microsoft Power BI had some advantages over the other options. The product catalog was easy to understand with simple options that are easily distinguishable from each other. In addition, the software had a free version available for everyone, but even the advanced versions were fairly priced around 10 dollars monthly per user. This made it a more accessible option for companies with a tighter budget. In terms of functionality, Microsoft Power BI had a feature, which allows the users to perform queries on the data and gain some insight without separate interpretation. As a distinct feature, the software also supported the Finnish language in addition to many other, which can be desirable for some Finnish speakers.

Table 6. Table of the cons from Microsoft Power BI

Finding (Cons)	Description
Limited operating system support	The software only supports Windows operating systems.
Limited data handling capabilities	The free version has limited capabilities in handling data.
Limited operating capabilities	The software does not support multiple scripting languages.
Switching between software	The users commonly have to operate between multiple systems.
Confusing user interface	The user interface places some functions confusingly and they lack description.

Relatively slow learning	The learning curve can be quite steep.
Privacy issues	Publishing data has some security issues.

Table 6 presents all the cons that were discovered from Microsoft Power BI. Firstly, the software can be described as a double-edged sword, because some of its pros can also be seen as cons for some users. As the software is tightly designed around the Microsoft ecosystem, it was significantly limited in terms of its supported operating systems. It only supported Windows operating systems, which is generally a significant obstacle for some users operating with macOS or Linux. The mobile version supported other operating systems like Android or iOS, but this arguably represents a small portion of use. In order to use the software in other operating systems, the users would have to utilize virtual machines to overcome the issue. In terms of the actual operations, the software had some distinct limitations. The free version was limited to handling files that do not exceed two gigabytes in size, but there was no restriction in the advanced versions. In terms of the user interface, it was thought to be visually pleasing, but it also had some quirks. Similarly to Tableau, Microsoft Power BI was also quite packed, but the problem was emphasized by some poorly placed features and the lack of descriptions within them. This can hinder the overall usability of the software by confusing the users and eventually resulting problems. It was also noticed that the software had some privacy issues regarding its reporting. The software came across a problem during the reporting, because it was difficult to share the data with other users in a way that also ensures the privacy of the use. Therefore, the security of the software could be questioned, which can also be a particular issue for the companies.

5.1.3 Findings from Qlik

Table 7. Table of the pros from Qlik.

Finding (Pros)	Description
REST API compatibility	The software is REST API compatible.
Support for historical data	The historical data is supported as long as the memory resources are available.
Good visualization capabilities	There is a wide range of options for visualization.
Grouping capabilities	Grouping data and assets are supported.
Good customization capabilities	The software can be customized extensively.
State of readiness	State of readiness can be presented.
Mapping and tracking capabilities	Data can be tracked and presented in real time.
Thresholds	Thresholds for data can be defined.

Troubleshooting	The problems are readily reported.
Templates	There is a wide range of templates.
Pleasing aesthetics	The software is visually pleasing.
Descriptions within visualization	Visualization contains descriptions.
Queries within visualization	Queries can be made on the visualization.
Data sharing and collaboration	Data and operations can be shared between users.
Multiple platform support	The software supports desktop, mobile and browser operations.
Multiple data source support	Various data sources are supported.
Embedding capabilities	Visualizations can be embedded into external sources.
Good performance	The software has good performance.
Good security	The software manages its security.
Good reputation	The software has good reputation.
Relatively cheap	The software has a free version and the advanced versions are decently priced.

Table 7 presents all the pros that were discovered from Qlik. Much like Tableau and Microsoft Power BI, Qlik offered a robust solution with a wide range of features that serve the purposes of the users. The software was compatible with the REST API along with other custom APIs, which support adapting the software. Qlik also allowed performing queries on the visualization, which is not only beneficial for creating insight, but also for the interaction between the data and the user. Visually, Qlik was considered to be quite pleasing with a clean user interface. In terms of the offering, Qlik offered a free version, but its advanced versions were also decently priced around 15 dollars monthly per user, which falls in the middle between the other software. In addition, Qlik had an advantage over the other options by being able to manage the privacy issues well. The software allowed assigning distinct roles for different users, which affected their ability to alter and view the data. This helps ensuring that data is only handled by the rightful users.

Table 8. Table of the cons from Qlik.

Finding (Cons)	Description
Confusing product catalog	Understanding the product catalog's different options is difficult.
Limited community support	Support from the community can be

	difficult to find in some cases.
Limited operating system support	The software only supports Windows operating systems.
Confusing transitions between views	The transitions between different views are hard interpret and follow.
Resource heavy operations	The software requires a lot of computing resources and puts a fair strain on the machinery.
Challenging learning	The learning curve is very steep.
Switching between software	The users commonly have to operate between multiple systems.
No Finnish support	There is no support for Finnish language.

Table 8 presents all the cons that were discovered for Qlik. One of the major issues with Qlik was its difficulty of use. The reason for this was that Qlik could only be operated through scripts, which showed some resemblance to R programming language. This form of operation requires extensive technical expertise, which can be challenging to learn. Tableau and Microsoft Power BI also supported scripts, but the fundamental difference was that these two primarily leaned toward the drag and drop form of operations, which is arguably more intuitive for most users. The common operations were further complicated by the notion that the transitions between different views in the user interface were hard to follow. In terms of the performance, Qlik was considered to be quite a powerful tool, but its operations seemed to demand a lot of computing resources. This may not be a huge issue in most cases if the computers in use represent the relatively current state of technology, but anything else might affect the overall performance. Qlik also presented some significant limitations in terms of the supported operating systems. Similarly to Microsoft Power BI, it only supported Windows operating systems, which further hinders the overall flexibility of use. In addition, a particular notion regarding Qlik was that solving problems can also be quite challenging compared to the options. Even though, Qlik had a relatively active community around it, the needed information about problems was not easy to acquire in many cases. Overall, Qlik seemed to put a lot on the users' shoulders by being a rather specialized and challenging tool to master in common use.

5.2 Requirement analysis

After the platform studies phase, there is arguably a pretty good comprehension about the different aspects of these platforms. However, examining the collection of findings from the different platforms in relation to the initial requirements also raised a very important issue to the table. By looking back at the initial requirements of the project in table 1 and table 2, it became quite evident that these would not be enough to perform a comprehensive analysis on the discovered features. Firstly, the nature of these initial requirements was quite general in a sense that they mostly related to the main features and functionality that are commonly found in most currently available data-analytics software. Secondly, some of these requirements were mostly specified in a question of having a certain feature or functionality, but there was no way of accurately measuring

or comparing the state of them. Thirdly, the sheer number of initial requirements was quite limited as there were only twelve of them in total. Overall, these issues together remarked that it would be very difficult to properly differentiate the data-analytics software from each other and draw justifiable conclusions in a deeper analysis. Therefore, it was concluded that the initial requirements had to be adjusted and more had to be specified. This forced to consider what kind of adjustments and additional requirements would be beneficial for the analysis.

A good starting point for this question was to take a closer look at the initial requirements and what is missing from them. The initial requirements were specified by company, which have been defined mostly with the company's own interests in mind. A lot of these initial requirements can be seen to relate to the actual use of data-analytics software in a rather general level in a sense that they represent the interest of the entire company. What this essentially means is that these are mostly features or functionality that are to be expected of such software or their own technology in general. Most of them may directly represent their common everyday operations and it is enough that they exist in some form. For example, the REST API compatibility was a crucial requirement for the company, but it can be argued that this feature is hardly visible for most users or it is not encountered regularly in their everyday operations as a specific issue. However, the company's interests at a general level are not necessarily enough to evaluate the suitability of data-analytics software, because both adopting and using them considers a wide array of different stakeholders. Speaking of these stakeholders, it is important to understand that each person is unique in a sense that they have their own tasks and capabilities, which results that they may experience data-analytics software very differently compared to each other. In addition, these people may have needs of their own for the data-analytics software, which are not all that apparent in most cases. Therefore, the problem lies within the notion that the initial requirements focused mostly on the company as a whole and they failed to take the different stakeholders comprehensively into account. This provided a base for adjusting the requirements.

In terms of adjusting the requirements, it would naturally be beneficial to add some requirements that consider the different stakeholders. But who are the relevant stakeholders for this case? Defining all the stakeholders may be quite challenging, because the adoption and use of data-analytics software can cover a huge amount of people within the different levels of the company, but also outside of it as customers. However, the relevant stakeholders can mostly be defined broadly as users, who are in some way involved in using data-analytics software by either modifying data or viewing it. This definition essentially means that the data-analytics software has some kind of effect on the user's operations, which can either be a direct or an indirect result depending on the circumstances. Regarding the requirements, it would be beneficial to make additions that focus specifically on relevant issues that the users and the company are likely to notice during the adoption or actual use, because such issues are likely to be useful in evaluating the state of the data-analytics software either based on some metric or condition. Even though there was already a pretty good understanding about data-analytics software as a whole from the platform studies, more information about the different stakeholders was needed to make proper adjustments and additions to the requirements that will also go beyond the surface. But where can this information be gathered from?

In the pursue of this information, it was though that the company would be a good place to gain the needed information. After all, it can be expected that they know their own operations and its stakeholders better than anyone else. Therefore, an interview was arranged with the CEO of the company, who would be more than capable of answering the questions about the entire company and its stakeholders. It can be argued that CEOs are not usually preferable for such interviews because they represent the top

management of the company and they tend to be a bit distant from the common operations. However, being a CEO within a rather small company also forces the CEO to be quite involved in these operations, which makes it suitable for this case. Regarding the arrangements of the interview, the CEO was contacted beforehand, where the specifics of the interview were discussed and settled. The interview took place on the company's premise, where a private conference room was reserved for this interview specifically. The interview was conducted privately with the CEO by ensuring that the conditions were comfortable and there were no distractions. The interview was performed in a semi-structured manner, which means that there was a specific set of questions for the interview, but it also reserved a possibility of presenting more questions based on the discussion. In the beginning of the interview, it was agreed that the audio from the interview would be recorded for later listening, where the whole interview was also transcribed. Thanks to this interview, the needed information was captured and the necessary additions were made to the initial requirements. The questionnaire for this interview is also included as an appendix of this thesis.

Table 9. Table of the entire requirements for the project.

Requirement	Description
Crucial requirements	
R1: REST API compatibility.	The solution must be compatible with the REST API technology.
R2: Historical data.	The solution must be able to present historical data from a year away at least.
R3: Visualization.	The solution must be able to visualize data in some capacity.
R4: Grouping devices.	The solution must be able to present and arrange devices in specified groups.
R5: Ease of use.	The solution must be relatively easy to use even without special expertise.
R6: Customization.	The solution must be customizable to some extent to fit the use.
Nice to have requirements	
R7: State of readiness.	The solution should be able to present the state of readiness for a specified objective.
R8: Real time measurements and tracking.	The solution should be able to perform measurements and tracking in real time on specified assets and present them accordingly.
R9: Thresholds.	The solution should be able set thresholds for specific values and alert in some form if these are exceeded or not met.

R10: Troubleshooting.	The solution should be able to report any presented problems.
R11: Templates.	The solution should be able to provide templates for presenting and sharing data.
R12: Aesthetics.	The solution should be visually appealing to the user.
Additional requirements	
R13: Data sharing and collaboration.	The solution allows sharing data and collaboration between the different users.
R14: Multiple operating system support.	The solution supports many common operating systems (Windows, macOS and Linux).
R15: Multiple platform support.	The solution supports different platforms for its operations (Desktop, mobile and browser).
R16: Multiple data source support.	The solution supports utilizing data from various sources.
R17: Embedding capability.	The solution is capable of embedding data into external sources.
R18: Good performance.	The solution is capable of operating without encountering any major performance issues.
R19: Good security.	The solution is not noticeably vulnerable for data breaches.
R20: Good reputation.	The solution generally has a good reputation among its users and the industry.
R21: Good community support.	The solution has an active community, which provides support regarding various issues.
R22: Simple product catalog.	The solution has an understandable product catalog, which clearly distinguishes different options from each other.
R23: Free to use (Basic version).	The solution provides a basic version, which is free to use for every user.
R24: Finnish support.	The solution supports the Finnish language for its operations.

Table 9 presents the entire range of the project's requirements, which are divided into three distinct categories. Firstly, there are the crucial requirements. Secondly, there are the nice to have requirements. Thirdly, there are the additional requirements. The third category represents the new additions to the initial requirements, which double the total amount of requirements, which was previously an issue. Even though, these features or functionality were not entirely necessary for the company, these can still be considered to be relevant in the further analysis by extending the horizon of the varying effects of the data-analytics software. These essentially emphasized features or functionality that represent quite general interests among the company's different stakeholders and allowed considering the varying effects of using or adopting particular data-analytics software into the company's operations more comprehensively.

Overall, the list of entire requirements provided a decent base to evaluate the state of data-analytics software and their effects. However, it is worth noting that answering these required applying different approaches depending on the nature of the requirement. Some of the requirements had to be approached in a more systematic manner by applying a specific form of evaluation whereas some could be answered quite easily by examining some documentation. For example, requirements relating to usability such as the ease of use and aesthetics were evaluated through a heuristic evaluation, which allowed splitting such a broad issue into smaller relevant pieces and forming a conclusion based on all of them. There were also requirements, which were not all that simple to answer, because they were more affected by varying circumstances. For example, evaluating the performance of data-analytics software may be complicated as the performance may depend on the amount of data that has to be processed, which can be quite huge in relation to the operations of large companies. The literature provided some guidelines to evaluate such issues stating that systems should commonly be able to perform functions in less than ten seconds (Behrisch et al., 2018). Even though this notion may not always apply, it can provide some reasonable direction for the evaluation. After all, the most important thing is that all the requirements were answered through justifiable means, which provided valuable insight on the nature of each data-analytics software.

5.3 Usability evaluation

At this point of the research, there is a pretty good amount of different finding from each data-analytics software, which provides a decent understanding to evaluate them as a whole. However, there are some distinct features, which are more complex in nature and cannot be answered through simple means. Usability was considered to be a particularly relevant factor, because the actual use would eventually involve various different users with distinct characteristics. There were some findings relating to the usability among each data-analytics software, but the comprehensive state of it was yet to be defined for them. In an ideal situation this would arguably involve performing a comprehensive usability testing within a controlled laboratory setting, but this was not possible for this research due to the limited resources. However, there are also some other methods available, which would arguably be suitable for the purposes of this research to evaluate the overall usability of each software.

For the purposes of this research, performing a heuristic evaluation to each software was considered to be a suitable approach. This essentially involves utilizing ten different heuristics by Nielsen (1994), which serve as guidelines to steer the focus on particular aspects of a software that especially contribute to the state of the usability. The evaluation was done to each software in turn by firstly specifying the different heuristics and secondly performing a comprehensive evaluation on them. Evaluating these aspects was utilized to create better understanding about the usability of each software, which

was also required provide answers in relation to some of the specified requirements, such as the ease of use and the aesthetics.

5.3.1 Heuristic evaluation on Tableau

1. **Visibility of the system**

   Tableau's user interface is capable of presenting each view and the different objects within them in a clear manner, which supports the user's understanding of the current situation and the available options. The views also provide more information about the different options by having a preview function and showing descriptions by pointing the cursor over them. When the user makes a selection, the selection or view in question is highlighted after it to emphasize the transitions and their results. If the transitions either require extensive loading time or a confirmation from the user, these are also presented during the process. The flow of operations is generally managed in an efficient manner, which rarely leads to unexpected errors or harmful interruptions to the use.

2. **Match between system and the real world**

   Tableau offers a wide range of different languages for its operations, which essentially covers the majority of people around the world despite their nationality. Unfortunately, Finnish was not supported, which is understandable given the overall amount of its speakers. However, English arguably serves as a universally suitable language for most of the users. In terms of the language within the user interface, the used words are chosen with care, which supports both interpreting and understanding them for the common user. However, there is also a chance that some users may encounter problems with the used language given its technical nature in relation to data analytics or similar applications. Even though this can be problematic for some users, they can usually be solved with the easily available documentation and support, which provide useful explanations and guidance.

3. **User control and freedom**

   Tableau provides a considerable amount of power for the user by offering various ways to modify the data or the visualizations according to the user's preference. A common theme among the functionality of data-analytics software is the possibility of performing exploratory analysis, which heavily involves working through trial and error. Tableau supports this approach by providing flexible ways to work back and forth. At the same time, the user is hosted by tons of different features and options, which can be utilized depending on the objective. Generally, there are only some limitations to the available options, which are mostly designed to restrict unsuitable use rather than promoting it.

4. **Consistency and standards**

   In terms of its content, Tableau can be considered to be very precise and consistent, which can be seen in the uniform language and readily available content in multiple sources. There were no inconsistencies or gaps between the content from different sources, which increases the overall reliability and stability of the software. The only perceivable inconsistencies among the content can arguably originate from the different users' modifications on the data or their used language, which are not automatically adapted or corrected. The users

themselves are eventually responsible for interpreting these issues and making modifications based on them if they are considered to be necessary.

5. Error prevention

The errors in Tableau are primarily being prevented by asking confirmations for some functions from the user before actually executing them. This is designed to increase the user's understanding of the current state and flow of events, which in turn reduces the chances of performing something wrong or undesirable. Tableau also restricts some options from the user, which are not either applicable or suitable for the current situation. However, the users generally have a lot of freedom and flexibility to perform different functions as they wish, which may lead to some unconventional errors that can also be quite hard to detect. For example, the software cannot define the state or the overall suitability of a visualization, which naturally relies heavily on the user's own expertise.

6. Recognition rather than recall

Tableau's user interface is able to present data in multiple views simultaneously by diving these views into their own distinct tabs. These tabs have the ability to contain all of the relevant data from different views, which allows the user to freely switch between these views during the operations without having to complete a specific operation in strict sequence. The data is kept intact in different views regardless of the transitions or the process at hand, so the user is not necessarily forced to remember everything about the flow of operations. The users can essentially work at their own pace and find the necessary information during the use.

7. Flexibility and efficiency of use

Tableau offers plenty of flexibility for the users to customize the software and perform different functions according to their preference. There are various options to perform distinct functions, which cater the different level of expertise among the users. The inexperienced users can use the software in a more conventional way by following a systematic step by step approach. The expert users are provided with options to utilize shortcuts and perform more specialized functions to adapt the whole software, which in turn can better serve their advanced skillset and needs. The software can fundamentally be operated through drag and drop functions, but also with scripts. Having such flexibility can arguably increase the overall efficiency and effectiveness of the use for the different users. However, some of the more advanced features are hidden beneath the software in order to avoid confusion among the common users. Therefore, the advanced users may have to put some extra effort into searching for their desirable functions to unlock the full potential of the software. Overall, the common operations can be performed in an efficient manner due to the good performance, which rarely result interruptions to the use.

8. Aesthetic and minimalist design

Tableau's user interface may seem intimidating at the initial glance, because it is packed with different features. However, the issue is managed by dividing the user interface into various sections, which highlight the relationships among the distinct features and help making sense of the view. The content of the view is generally well-structured, where symbols and descriptions provide guidance during the use. The overlay of the user interface can be modified in many ways

by either expanding or condensing the view depending on the preference. The user interface is coupled with a rather neutral color scheme, which is quite minimalistic and effective in providing a solid base of operations by also supporting the users with limited vision. The design is supposed to support the navigation within the software, which requires getting used to at first due to its packed nature.

9. **Help users recognize, detect and recover from errors**

   Whenever an error occurs, Tableau responds immediately by presenting an error message to the user. The error messages in Tableau are presented in natural language, which do not involve any programming language. These messages are presented in a small window, which provides a short description about the state of the error and the reason behind it. This sheds some light behind the error, which can be useful in coming up with the solution and continuing with the use. However, this does not always present concrete information what the user is specifically supposed to do after the error if the reason is the only clue. Therefore, it can be considered that the users should at least have some technical expertise along with basic understanding about the current state of the operations in order to solve each issue and recover from them.

10. **Help and documentation**

    Tableau can be used to some extent without reading any instructions. However, it can be argued that most users are likely to encounter problems quickly, because making efficient and effective use out of it requires a certain skillset with a decent level of expertise. Therefore, it is crucial to provide the users with some form of support and documentation. Luckily, Tableau offers an extensive amount of easily accessible documentation and support thanks to its active community. These essentially provide reliable descriptions and instructions around many issues, which are beneficial for the users. The documentation and support come in many forms, such as text and video, which help demonstrating and explaining distinct issues. However, some users may run into problems if they have to navigate through a sea of information about a very specific and uncommon issue. Most of the required information is readily available through official sources, but there are also some unofficial ones, which may not always be entirely reliable. Therefore, the users should pay attention to the source of information and preferably stick to the official ones, which were generally very comprehensive and useful.

5.3.2 Heuristic evaluation on Microsoft Power BI

1. **Visibility of the system**

   Microsoft Power BI has a well-designed user interface, which presents the current state of the operations adequately by being able to follow the transitions trough clear indications about the views and the available options within them. During the transitions, the software always indicates if loading the data takes longer or a confirmation is required from the user in order to proceed. The software is also capable of suggesting a particular form of visualization, which could potentially be suitable for the purposes of the user. This provides some insight for the user about the possibilities regarding the current state and how it can be processed further depending on the objective.

2. **Match between system and the real world**

   Microsoft Power BI offers extensive support for various languages, which cover the needs of most of the population around the globe. English serves as the primary universal language for most of the users, but also smaller languages, such as Finnish are also supported. These languages are readily available within the software, but also in the external sources, which provides a cohesive base of operations. The language is generally presented in a clear manner, but the user interface also has some limitations. Some of the functions are highly technical by nature and the problem appears if the user is not able to initially understand them as the user interface lacks descriptions. This might result some interruptions to the use as the users may have to search for additional instructions from other sources. There are also some problems with the technical side of operations, because Microsoft Power BI utilizes a specialized programming language called M around its web data connectors, which requires further research on the language and getting used to it.

3. **User control and freedom**

   Microsoft Power BI offers a decent amount of freedom for the users to modify each view and the data according to their preference. The users can move freely between the views, which contain their available options to support the use. Some of the options may be restricted from the users if they cannot be generally applied to the objective in question. The choices can be altered quite freely after performing them by either undoing or redoing them. This is usable in situations, where the user might want to explore different options or is unsure how to proceed on a particular objective.

4. **Consistency and standards**

   The content within Microsoft Power BI can generally considered to be consistent and reliable. The large ecosystem around the software arguably helps by ensuring that the official sources have plenty of reliable documentation and support available. The wide range of languages also get support from the notion that the languages are the same within the software and the external sources, so they do not leave room for interpretations or require any translations. Eventually, these sources will arguably prove out to be useful due to the general lack of descriptions within the user interface.

5. **Error prevention**

   Microsoft Power BI proceeds to prevent errors by asking the users for confirmation before actually performing any major tasks. The software may also restrict some options from the user if they are not applicable to the current situation, which essentially reduces the chances of doing something undesirable. However, this does not necessarily apply to the visualization process, so the user has to be able to understand the objective at hand and interpret the overall situation, which may be challenging.

6. **Recognition rather than recall**

   Microsoft Power BI has an user interface, which is able to contain multiple views in it. Depending on the amount of views, these can be assigned into distinct tabs and pages, which can be opened when they are needed. The data is kept intact within each view, so switching between views does not affect the

content. This supports the user's ability to browse the user interface freely during the regular operations, which does not force the user to follow a strict pattern and it reduces the overall amount of remembering regarding each view.

7. Flexibility and efficiency of use

Microsoft Power BI can generally be considered to provide a decent amount of flexibility to the use by allowing plenty of ways to operate and customize the software according to the user's preference. The users can also personalize the data in their own views to support their distinct needs. Microsoft Power BI contains various functions, which can be utilized flexibly depending on the different level of expertise among the users and their requirements. All of the users have the basic functions at their disposal, but the more advanced users can also utilize some shortcuts and more specialized features depending on the configuration of the software in use. The software generally utilizes drag and drop operations, but it also supports running scripts. However, it is worth noting that Microsoft Power BI has limited support for utilizing various programming languages within the scripts, which may disappoint some advanced users. Overall, the software offers a good level of performance without any major shortcomings.

8. Aesthetic and minimalist design

Microsoft Power BI utilizes a pretty basic layout within its user interface, which resembles a lot of other Microsoft products. This arguably provides some familiarity to the use for some users that are already accustomed to them. The user interface is generally designed and executed in a visually pleasing manner, but there are also some problems. The user interface is generally quite packed with different features, which can be hard interpret and distinguish from each other due to the limited descriptions within them. This may lead to some confusion among the users, which may also hinder the overall efficiency of use by having to search for information from external sources.

9. Help users recognize, detect and recover from errors

Whenever an error occurs, Microsoft Power BI provides an error message for the user indicating that something has gone wrong. The messages are usually presented in small windows, which contain a small description for the error. These provide some insight about the reason behind the issue, but reacting on them in a correct manner may not be all that obvious. The messages usually indicate the source of the issue and the reason for it in a rather technical manner, which requires some expertise from the user to interpret and react on them. The software does offer a troubleshooting option, which can be helpful at times, but they are arguably rather limited in terms of solving specific issues.

10. Help and documentation

It can be expected that using Microsoft Power BI may be challenging to some users due to its technical nature and confusing user interface. Therefore, resorting to the available documentation and support is generally needed at least in some capacity. However, this is also the part where Microsoft Power BI really gets to shine due to its extensive ecosystem. The official sources provide extensive documentation and support regarding various issues, so the users will likely find the answers for their questions. The documentation contains material in various forms, such as text and videos, which can be utilized depending on the

issue. The community around it is generally large and active, which gets further support from the participation of the actual developers of the software. The users can practically engage in dialogue with the developers to express on their specific issues in order to gain concrete responds for them. However, it is worth noting that this may not provide immediate response to the issues, so getting an answer may take some time. This should naturally be taken into consideration in relation to the urgency of the issue at hand, but it is surely a valuable option to have.

5.3.3 Heuristic evaluation on Qlik

1. **Visibility of the system**

   Qlik generally has a sleek user interface, which is able to present each view and the current situation in a pretty efficient manner. The transitions between views are presented for the user as they happen, which change the views along with the available options within them. However, the transitions were also considered to be quite problematic, because they were not presented in a clear and organized manner by also emphasizing the workflow. This made following the software rather difficult at times, which may lead to problems interpreting the overall workflow of the operations and the objective. This may eventually have an effect on the state of the results due to the confusion.

2. **Match between system and the real world**

   Qlik provides a decent support to various languages, which will arguably suit the purposes of most of the users regardless of their nationality. The Finnish language is not supported with Qlik, but most of the users will not most likely have a problem of utilizing English as the universal language. The used language within the software is generally pretty understandable, but the form of operations steer it heavily towards the technical side. The reason for this is that Qlik is generally operated through scripts based on Python and R programming languages, which sets some distance between the software and the real world. This can essentially form a major obstacle for many of the common users as utilizing it efficiently and making sense out of it requires a decent level of specific technical expertise. Therefore, utilizing can generally considered to be quite challenging for the majority and it mostly resonates with the more advanced users.

3. **User control and freedom**

   Qlik can generally be operated with a fair amount of freedom, where the users can modify various parts of each view and customize the software according to their preference. The users have a good level of freedom to move between each view and alter the data within them with plenty of flexibility. Qlik also offers a feature called the exploration mode, where the users can essentially make changes on a specific visualization without affecting any other view or their data. This is a very useful feature to trying out new things freely without having to worry about messing anything else up during the process.

4. **Consistency and standards**

   The consistency of the content is managed well within Qlik and its external sources, so they can generally be considered to be reliable. The documentation

and support provide useful descriptions and instructions about various issues, but the problem with these is that the needed information can be quite challenging to locate at times. The software or its external sources are not particularly good at pointing the user into the right direction, because the information sources were generally quite disorganized and hard to interpret, which may hinder the overall efficiency of operations and the user's ability to solve problems.

5. Error prevention

Qlik primarily attempts to prevent errors by asking confirmations from the users before undertaking any significant process. The software generally mitigates the among of errors by restricting the use of some features in specific situations if they are not applicable to the current situation. In addition, Qlik also constantly monitors the current state of the operations and presents a warning if detects a possible problem, for example regarding a conflict within a view or the integrity of the data. This may help anticipating and reacting on a possible problem before it actually happens.

6. Recognition rather than recall

Qlik's user interface is particularly good at presenting multiple views at the same time, but also providing capabilities to distinguish them. The different views can essentially be divided into tabs and pages, which can be accessed freely when they are needed. The users have a decent amount of freedom to modify each view according to their preference, which allows seeing the needed data constantly. This reduces the emphasis on remembering the content of each view. The changes can be designated to specific locations, which helps assuring that the particular data is kept intact or a more comprehensive change is achieved depending on the objective.

7. Flexibility and efficiency of use

In terms of the overall flexibility, Qlik can be considered to offer a fair amount of flexibility to the use by allowing the users to customize the software according to their preference and take advantage of various features during the operations. The range of features cater the needs of both common and experienced users, which can be chosen based on the overall needs and preference. However, the overall flexibility arguable suffers a bit due to providing just the script-based operations, which is more suitable for the advanced users. Operating through scripts puts more emphasis on the user's overall expertise and the ability to understand this form of operations, which can be troublesome for the common user. Qlik does provide a lot of processing power to the operations, but its overall potential is arguably only unlocked in the hands of specific users who know exactly what they are doing.

8. Aesthetic and minimalist design

Qlik's user interface gets a lot of praise for its minimalistic design, which is also visually pleasing to the eye. The user interface can be described to be very clean, because it has a neutral color scheme and it generally minimizes the amount of distracting features in the beginning of the use. A lot of the features are initially hidden within different menus or pages, which can either be expanded or collapsed depending on the need. This helps ensuring that the user does not get overwhelmed by the presented information. Some of the needed information

may not be initially visible, but they can usually be located with the help of symbols and descriptions within the objects. The users can essentially modify the views quite freely according to their preference. However, the minimalist design may also serve as a drawback, because sometimes it may be rather difficult to find a specific issue if it is not readily presented for the user and it has to be located under several layers of menus or pages. This may confuse the user and hinder the overall efficiency of use.

9. **Help users recognize, detect and recover from errors**

   Qlik will always notify the user if an error has occurred. This is done by presenting an error message, which contains a short description of the error in question and the reason behind it. Qlik also has a feature, which allows monitoring the current situation and notifying the user if an error is likely to happen for some reason, which essentially allows detecting and reacting on issues in advance. However, the descriptions are usually quite short, so it can be challenging to grasp the full extent of the issue. Therefore, the users commonly have to rely on their own capabilities to solve the different issues. The issue is further emphasized, because finding the solution for different issues may be quite challenging as the right information sources are pretty hard to locate.

10. **Help and documentation**

    Qlik has a relatively active community, which provides reliable documentation and support regarding various issues. These are available in various forms, which will arguably come handy for the most users due to the overall complexity of use. However, the needed information is not always easy to locate, because the official information sources are quite disorganized. There are also some unofficial sources for information, but their content may not be all that reliable, which should be taken into consideration. Overall, finding the needed information may take extensive effort from the user, which can easily lead to frustration and decreased efficiency of use.

5.4 Feature comparison

After gathering all of the results, it is possible to evaluate and view them in a more collective manner, which sheds useful light on the big picture. Before doing so, the results have to be organized somehow, because they are quite scattered around different issues and the sheer amount of them may hinder the ability to see their connective red thread. This is arguably easier to see by forming an overview of the results around a specific scope. For the purposes of this research, this was done by evaluating the gathered results in relation to the table of specified requirements, which act as particular points of interest to focus on and form conclusions on. These essentially represent the interests of the company in question, which allows evaluating the overall viability of each software for their purposes. This can also be useful for the general audience by being able to see distinct characteristics of each software and the phenomenon around them to some extent.

Table 10. Table of entire requirements and their state in each data-analytics software.

Requirement	Tableau	Microsoft Power BI	Qlik
Crucial requirements			
R1: REST API compatibility.	**X**	**X**	**X**
R2: Historical data.	**X**	**X**	**X**
R3: Visualization.	**X**	**X**	**X**
R4: Grouping devices.	**X**	**X**	**X**
R5: Ease of use.	**X**	**X**	
R6: Customization.	**X**	**X**	**X**
Nice to have requirements			
R7: State of readiness.	**X**	**X**	**X**
R8: Real time measurements and tracking.	**X**	**X**	**X**
R9: Thresholds.	**X**	**X**	**X**
R10: Troubleshooting.	**X**	**X**	**X**
R11: Templates.	**X**	**X**	**X**
R12: Aesthetics.	**X**	**X**	**X**
Additional requirements			
R13: Data sharing and collaboration.	**X**	**X**	**X**
R14: Multiple operating system support.	**X**		
R15: Multiple platform support.	**X**	**X**	**X**
R16: Multiple data source support.	**X**	**X**	**X**
R17: Embedding capability.	**X**	**X**	**X**
R18: Good performance.	**X**		**X**
R19: Good security.	**X**		**X**
R20: Good reputation.	**X**	**X**	**X**
R21: Good community support.	**X**	**X**	
R22: Simple product catalog.		**X**	

R23: Free to use (Basic version).		**X**	**X**
R24: Finnish support.		**X**	

Table 10 presents an overview of the requirements in relation to the different data-analytics software and whether these were fulfilled or not. By looking at the table of features, it becomes quite clear that there are some distinct differences between each data-analytics software even if they may initially seem rather similar on paper. In order to gain answers for some requirements, different methods can be utilized to base the assessment on depending on the nature of the issue. In the light of this case and its requirements, Tableau seems to have an edge over the other data-analytics software based on the number of fulfilled requirements. Having such concrete evidence allowed creating a justifiable suggestion that eventually suited the purposes of this specific company. However, the company is naturally responsible for making the final decision regarding the adoption and use of its data-analytics software. In addition, the choice may not be as simple as it initially seems on paper, because there may also be other factors in play, which may not have anything to do with the specifications of the data-analytics software itself. It is also worth noting that the requirements and analysis were strictly designed for the purposes of this company, so they do not serve as a general guideline for every company to follow. These surely present some generally relevant issues around the adoption and use of data-analytics software, but each company has their own requirements for such projects, which cannot be roughly duplicated. Therefore, it can be concluded that each company should make their own assessment around their own needs and characteristics.

6. Discussion and implications

This chapter contains the discussion for this thesis. The discussion presents the deeper analysis for the gathered results, which are used to draw implications in relation to the presented research questions. The discussion essentially attempts to answer these questions to create better and meaningful understanding around the topic. Firstly, there is a discussion about the issues that contribute to a company's consideration around making a choice on a suitable data-analytics software for their operations. Secondly, there are separate discussions for the opportunities and challenges that a company might face when they are choosing to adopt data-analytics software into their operations. These discussions are used to draw implications from the gathered results and shed light on the value that can be gained from them.

6.1 Company's choice

In the light of this research and its results, it can be said that choosing a suitable data-analytics software for a company's operations is not a simple task by any means. Making a justified choice involves a lot of work and consideration, because the successful adoption of data-analytics software is affected by various factors and aspects. The choice should not be made lightly, because some of these effects may be quite complex and far from obvious, which can easily lead to uncertain end results. Therefore, it is important to acknowledge the existence of these issues and understand their possible effects, which is essential for finding a suitable data-analytics software that eventually serves the interests of the company. The results of this research can arguably be helpful for such objective, because it presents a concrete example from the real world, which provides insight around important points to consider and their relation to the process eventually leading to a suitable choice and the reasoning behind it.

One of the most important things that every company has to consider are arguably their requirements for the data-analytics software. The reason for this is that companies should naturally have some kind of idea about what they want to achieve adopting data-analytics software and what they are expecting of them to provide. These will naturally vary among every company, because each of them is essentially unique with their own characteristics and operations. This emphasizes that every company should approach the process with a unique perspective and their choice is eventually formed around this. However, the companies arguably have a common base around the notions that these tools are fundamentally designed to support business activities (Holsapple et al., 2014) or to solve business problems (Kohavi et al., 2002), which essentially lay the foundation for the company's central requirements. These requirements can be defined to be crucial, because fulfilling them is absolutely necessary for the company. The other requirements may not be as necessary, but they can be considered to be important to have in supporting the central operations of the company. Having various requirements with different levels of importance is arguably beneficial for the company, because these provide direction to gather findings and perform evaluations around them, which eventually help defining the choice through some reasoning. However, it is worth noting that having more requirements usually requires additional work in terms of answering them and some of them may require performing different kinds of evaluations depending on their nature.

Even though every company is unique and eventually responsible for defining their requirements and making their choices, but there is also a particular notion that this research wants to emphasize with everyone in mind. This notion is that companies should pay more attention to their users and consider the usability of their data-analytics software. The reason for this is that a lot of the gathered results clearly emphasize the users' central role in the companies' pursue of value. For example, the study by Marchand and Peppard (2013) stated that merely adopting data-analytics software does not provide any value for a company, because the users are the ones that eventually make the information valuable, where data-analytics software essentially serve as mere enablers. This emphasizes a relevant point to consider, because it is arguably in the best interest of the company that the users are able to make the best possible use out of the data-analytics software, where usability naturally plays an important role. This should not be taken for granted, because each software is different in their features and functions, which are also being experienced uniquely by each user. Therefore, it is important to understand their possible effects on the users and acknowledge that the eventual choice is not trivial by any means.

Finally, when the company's actual choice of the suitable data-analytics software is being considered, it can be said that there are several different options on the table. The current markets offer plenty of readily available options, which may prove out to be suitable for the purposes of a company. However, finding the suitable option usually requires some research work, where different options are being evaluated against the requirements and possibly even compared to each other. The purpose of this it to narrow the options based on how well they are able to fulfil the requirements, which essentially tries to discard the unsuitable options and find the suitable ones. For example, the results of the case study suggested that Tableau was the best option for the company in question, because it was able to fulfil every relevant requirement without presenting any significant limitations while also outperforming the other options. In addition, Qlik was not considered to be a suitable option for the company, because it failed one of the crucial requirements around ease of use, which provides a concrete example of the importance of usability. However, it is also worth noting that there are also other options for the companies if the commercially available data-analytics software do not meet their standards. One option is that they can create a tailored data-analytics software especially suited for their purposes. One might argue that this would be the most suitable option in terms of the features and functionality, but resorting to this option can also be rather expensive and time consuming, which undoubtedly limits its suitability for many companies. Another option is that a company can choose to not to adopt data-analytics software into their operations at a given moment if it concludes that there currently are no suitable options for it. These are all valid options to consider for a company, but the point that this research tries to make is that each company should make their own choice based on some reasoning, which essentially serves their best interests. There are also other factors that may contribute to the choice, which may be less apparent in their effects, but considering them is also important for a company. These can be presented though opportunities and challenges that a company can face at different points of time.

6.2 Opportunities

Based on the gathered results, adopting and using data-analytics software can present various positive effects on the company's operations, which can essentially be viewed as desirable opportunities for them. A good starting point to build comprehension about the different opportunities lies within the fundamental purpose of these software and what they are designed to do. This is important, because it does not only describe the selling points of these software, but it also sheds light behind the reasons for their actual

adoption and use. The literature stated that data-analytics software are designed to support business activities (Holsapple et al., 2014) or solve business problems (Kohavi et al., 2002) by increasing the overall efficiency and effectiveness of the company's decision-making processes (Chaudhuri et al., 2011). This allows the company to utilize more data in its operations instead of wasting it (Mehta & Pandit, 2018), which was also deemed to be crucial for the company's underlying objectives to increase their competitiveness and better ensure their survival (Brownlow et al., 2015). In the light of the current situation, these are important notions, because they also allow bridging the gap between information technology and the companies (Behrisch et al., 2018). The findings of Wegener and Sinha (2013) support these notions by emphasizing that these results can actually be achieved regardless of their complicated nature and their effects on the operations can be significant, which is why data-analytics software can be seen as desirable enablers for various opportunities. In contrast, it does not really make much sense for the companies to perform data analytics manually in the long run as information technology understandably provides much better tools for such tasks and the increasing amount of data is pretty much impossible to grasp to any reasonable extent otherwise. Resorting to purely manual operations will most likely just drag down the company's operations and result more unnecessary costs.

These are naturally important notions, because they are certainly desirable in the eyes of most companies. However, these arguably only represent the surface for the many opportunities, because they depict the central points of focus for the companies as means to specific ends. This emphasizes that there are also some other opportunities, which may be less obvious to achieve during the process, for example, due to their more complex nature or their effects may initially prove out to be rather subtle. Regardless of their nature, their acknowledgement is still relevant in the big picture, because their effects can possibly add up in the end as time passes and they can certainly benefit the companies operating in modern fluctuating world.

The operational core of data-analytics software can arguably serve as a source for various opportunities, because it is the place where the operations connect with their respective stakeholders. The essentially ties together with the process of creating insight through visualization, which allows presenting the complex data in a more understandable graphical form (Wang et al., 2015). This increases the users' interaction with the data (Morton et al., 2012), which will arguably also increase their chances of making better decisions due to better understanding. Naturally, this is particularly important for the managers of the companies, because they are mostly responsible for the decision-making processes. However, visualization can also present opportunities for the company when it is being utilized more collectively inside the company. Visualization can potentially be beneficial for the learning purposes, which was also encouraged by Marchand and Peppard (2013) in their fourth guideline. For example, companies can produce more personalized visualizations for the more common lower-level employees and their operations. Sharing this insight among these people can increase their overall understanding of particular operations and the reasons behind them, which in turn allows making more singular refinements to the company's operations. This also ensures that insight has a more actionable role within a company, which it is fundamentally supposed to have.

Visualization can also serve as a source for innovation. This gets support from a notion that constant technological developments are creating new ways to gather and utilize data (Zhao, 2013). This essentially provides opportunities to discover more relationships between data, which was considered to be necessary in order to process data into relevant information and eventually making it actionable (Marjamäki, 2017). The current situation can be seen beneficial for this issue, because there is no shortage of data and having more data was stated to provide better recognition for patterns and

relationships (Bose, 2009). Visualization can support the innovation process by offering flexible means to present the newly found data in a suitable and unique manner, which the company can eventually use to its advantage in a competitional setting. For example, innovation can be particularly useful for companies in their attempts of predicting their future heading within an industry, which itself offers many unanswered and relevant questions to place insight on. Nevertheless, every company arguably has an opportunity to discover new ways of utilizing data, because each of them has a unique setting of internal and external factors, which contributes to a good possibility of discovering new relationships between data that were previously unknown. In addition, the case study showed that some of the studied data-analytics software emphasized the innovation objectives by providing distinct exploratory functions, which offered a flexible base to freely perform operations on a specific set of data without hampering the overall integrity. This arguably lowers the users' threshold to try out new things, because it does not risk the primary objectives and has the possibility of discovering something useful. All in all, being able to discover new ways of utilizing data during the constantly changing times, can have positive effects on the company's decision-making processes and increase their competitiveness compared to others.

There is also a possibility that innovation can be utilized to serve the purposes of a bigger crowd of people outside of a particular company. During the case study, it was discovered that some of the studied data-analytics software made it possible for the users to participate in the actual development of the data-analytics software through the open development. This essentially means that users can communicate with the developers of the software and present suggestions about possible improvements to the software. These improvements may relate to the needs of a particular user, but they can also be beneficial to other parties if they are adopted as a part of the generally available software. This may possibly increase the overall desirability of the data-analytics software, but their effects can also be seen within an industry as more beneficial features are expressed and eventually developed to serve the needs of bigger crowds.

As the possible benefits of adopting and utilizing data-analytics software are getting more widely acknowledged, their effects can also be seen within the industries and their working environment. It was noted that companies have expressed increasing demand for employees with capabilities in data analytics, which have changed the existing job descriptions and created whole ones (Watson, 2014). This essentially provides opportunities for the people to develop their own capabilities around data analytics and make themselves more desirable in the job markets as viable employees. This opportunity gets support from the notions that people have been considered to have limited capabilities in data analytics, which is further emphasized by the constantly increasing amount of data (Morton et al., 2012). However, it is also worth noting that companies do not have to perform everything relating to data analytics all by themselves, because there is also the option of outsourcing. For example, a company may decide that is does not currently want to invest in data-analytics software in the long run or it does not have the required capabilities to make use of it, so it can hire other companies to provide the valuable insight on their behalf. This essentially presents an opportunity for companies to start providing products and services around data-analytics software, which was also the business model of the case study's company. This emphasizes that data-analytics software can provide various opportunities for both internal and external stakeholders depending on their objective.

The current situation also presents a special opportunity for the companies, who are currently considering the adoption of data-analytics software. However, this opportunity's time window may be narrower and less forgiving than the other ones. The results of Wegener and Sinha (2013) showed that only a fraction of the companies have been successful in their objectives around data analytics. This suggests that there is a

viable opportunity for many companies to gain competitive advantage over the companies through data-analytics software as their limited number makes the differentiation easier. The current situation also emphasizes that sooner the company is able to become successful with data-analytics software, it will arguably enjoy more revenues because of it. Naturally, the differentiation may become more difficult as time passes and more companies gain similar capabilities. In this case, the faster players will eat the slower ones, which may encourage the companies to at least consider adopting data-analytics software into their operations.

6.3 Challenges

Regardless of the various opportunities, there are also turn sides to adopting and using data-analytics software. These can be defined as challenges, which may have negative effects on the company's operations by forming obstacles to the data-analytics projects or even preventing them completely. The current situation by itself is quite problematic as a gap has formed between information technology and the companies, which data-analytics software attempts to bridge. This understandably presents some challenges given the overall extent and complexity of the phenomenon, which emphasize the importance of acknowledging the variety of different effects that contribute to the companies' initial decision-making process regarding the adoption of data-analytics software.

It can be expected that companies will most likely face distinct challenges throughout their projects relating to data analytics. The first challenges present themselves during the adoption process, which is not as simple and straight-forward process as one might initially assume. One of the first challenges relates to the company's decision-making process about the specific data-analytics software to be adopted. This essentially involves examining the different available data-analytics software in the market and evaluating their viability in relation to the company's needs. This was also the central objective of the case study's project, which clearly showed that this can be a challenging task. The reasons for this were that there are arguable various different options available in the market, which can be difficult to differentiate from each other. Many of them may initially seem to offer similar features and functionality, but the case study was able to discover that there are some distinct differences between them, which will arguably affect the end results. This emphasizes that it is important to acknowledge these differences and take them into account during the consideration. However, the case study also showed that it may even be difficult to differentiate the different configurations of the same data-analytics software from each other due to the confusing product catalogs. These notions emphasize the importance of careful consideration, because even the subtle differences may present significant challenges, which should not be overlooked.

Another particular challenge during the adoption process relates to the integration process, where the data-analytics software combined with the company's existing infrastructure that is also considered to be of crucial importance (Land & Crnkovic, 2003). This can be a very challenging task, because it involves fitting different technologies with each other while also ensuring their seamless cooperation (Barrett et al., 1996). Figuratively speaking, integration can be compared to building a jigsaw puzzle, which essentially has various pieces that do not automatically fit with each other. This became apparent during the case study as some of the studied data-analytics software presented restrictions in terms of compatible technologies, such as the operating systems, which will arguably pose a challenge for the integration process. The challenge of this task gets greater as the number of pieces gets bigger. This emphasizes that integration requires careful consideration and understanding about the

characteristics of each piece of the puzzle in order to ensure their seamless cooperation, which naturally affects the overall fluency of the company's operations in terms of dataflow.

The challenges are not just limited to the adoption process, because it is only the first aspect of the data-analytics project. This raises a particularly important notion that adoption does not produce any value yet nor does it guarantee any value to be gained from the data-analytics software at any point. The reason for this is that adoption only represents the process of making the data-analytics software operational within a company, but the value is eventually produced during the use, where the data is essentially being made actionable as valuable insight in the decision-making processes (Zhao et al., 2018). However, using data-analytics software can be challenging for various reasons. A lot of this has to do with the notion that using data-analytics software requires skills in both information technology and business, which are rarely met with every potential user (Frenzel et al., 2018; Kohavi et al., 2002). For example, some users may have sufficient capabilities to perform operations within the software, but they may not have the capabilities to apply the insight into distinct business activities and vice versa. Naturally, the data-analytics software cannot perform these operations automatically on behalf of the users, because these rely heavily on the users' own skills and knowledge in the long run (Marchand & Peppard, 2013). In addition, the situation is further emphasized by the notion that people usually have limited capabilities in utilizing and understanding the vast amounts of data (Morton et al., 2012; Zhao, 2013). These notions suggest that there is only a limited amount of people with the right capabilities, who are eventually responsible for creating value through using the data-analytics software. Therefore, finding or alternatively training these people may be challenging for the companies.

Using data-analytics software may also present challenges, which are not necessarily the users' fault. The reason for this is that the current software products have been noticed to be limited in terms of the quality of their usability and functionality features (Fischer et al., 2017). The results of the case study support these notions as some of the studied data-analytics software were perceived to be questionable in terms of the quality of some of their design solutions. For example, some of their user interfaces were perceived to be quite packed in features, which also lacked appropriate descriptions to support understanding and locating them. These issues may present problems for the user experiences, which are important for making efficient and effective use out of the software and eventually gaining value through it. Usability should not be overlooked, because data-analytics software already tend to be quite challenging to many users to their overall complexity, so adding their burden would not be wise.

One of the major challenges regarding the data-analytics software arguably relates the consideration about the return of investment. According to Marchand and Peppard (2013), many companies were noticed to fall short of their expectations regarding the value gained from data-analytics software, which was mostly due to their inappropriate approach to such projects. Being successful in such projects was generally considered to be quite challenging, because it was stated to depend on the cooperative effects of various factors, such as the data-analytics software itself, data, people and intentions. In addition, their complexity was emphasized by a notion that only a fraction of the companies was considered to be successful in fulfilling these. (Wegener & Sinha, 2013) This suggests that many companies will most likely run into problems during the different phases of these projects, which naturally require additional efforts to fix. These will also likely result additional costs, because fixing these problems will usually require spending money in labor or equipment to name a few. Some of these problems can arguably be quite unexpected due to the overall complexity of the phenomenon. It is also worth noting that the overall costs will not end after the adoption process as even

the general use of the data-analytics software requires constant investments to maintain it. These notions emphasize that the costs relating to data-analytics projects can easily add up to significant and unexpected amounts. This may present serious challenges for some companies, who may have initially overlooked some relevant issues regarding the data-analytics projects, which in turn may eventually hinder their expectations regarding their possible return of investment or even fail their project completely.

A final challenge regarding the data-analytics software relates to measuring the actual value gained from them. According to Larson and Chang (2016), many companies face problems in their attempts to accurately measure the value solely gained from utilizing the data-analytics software. This is an important task, because the companies will want to evaluate if their investments in data-analytics software is able yield worthwhile results. However, this is particularly difficult task for several reasons. Firstly, there are usually countless internal and external factors, which eventually dictate the state of the results. The internal factors are usually easier to define and measure, because the data from them can be obtained through the company's own operations. The external factors on the other hand are more problematic, because they may, for example, represent shifts within an industry or other unexpected events outside of the company's own influence, which cannot be readily measured. Secondly, there currently is no framework, which would provide accurate metrics and allow isolating the effects of the data-analytics software specifically. The absence of such framework makes it difficult to make an accurate assessment about the viability of the data-analytics software in relation to the company's operations, which increase the possible hesitation around performing such projects and even form an obstacle for the companies that are uncomfortable with uncertainty. Overall, these notions emphasize that the possible value from data-analytics software should not be taken for granted in any circumstances due to the significant underlying challenges that will arguably affect every company's decision.

7. Conclusions

This research was focused around studying the different factors that contribute to a company's consideration around choosing a suitable data-analytics software to be adopted into their operations. The current situation formed a base for this research by pointing out that there currently exists a gap between the information technology and the companies, where companies are undesirably wasting valuable data at the cost of their competitiveness due to their generally limited capabilities in data analytics. The results showed that data-analytics software helped bridging the gap to some extent by allowing the companies to make more use out of their data, which emphasized their role as a viable solution in the light of the current situation's problematic nature. However, it can be said that the value from adopting and using data-analytics software should not be taken for granted at any situation, because their results are being affected by various different factors, which in turn emphasize the overall complexity and extent of the phenomenon. Therefore, it is important for the companies to understand that choosing to adopt data-analytics software into their operations is not a trivial task by any means and ensuring the choice's suitability is essential for their attempts to gain value from it.

It is hard to say if the data-analytics software are becoming a necessity for every company operating in the modern world. However, it can be argued that adopting and using them may be a viable option for the bigger companies, because their relative amount of data suggests that they generally have more to lose. The results of this research point out that companies generally have various options to choose from, which can potentially prove out to be suitable for their operations. Making the choice requires a company to carefully consider various factors and their potential effects, which are supposed to steer the choice into some direction. The relevant factors are mostly centered around the company's own characteristics and requirements, which in turn may require performing different kinds of evaluations depending on their nature. The users should also be given a central role in the consideration, because they are eventually responsible for creating value through data-analytics software and they are clearly being affected by the quality of the chosen software. The opportunities and challenges are also relevant points to consider, because they essentially allow the companies to evaluate their potential capabilities to take advantage of different positive effects while also avoiding the negatives ones. Overall, the point that the results of this research try to make is that companies should approach their choice from a unique perspective, because each of them fundamentally present a unique setting in terms of the adoption and its goals.

The contribution of this research is based on raising awareness about the role of data-analytics software in the modern world, where choosing the suitable one actually matters a lot. The results of this research can potentially provide useful guidelines for the companies interested in adopting data-analytics software into their operations, which essentially increases their chances of choosing a suitable data-analytics software for their operations and eventually gaining value from it.

There were also some limitations to this research, which should be taken into account when its results are being considered. Firstly, the research was limited in terms of its case study's approach to evaluating the different data-analytics software due to its limited resources. It would arguably benefit from using more systematic and comprehensive methods regarding such tasks. Secondly, the research only considers the

process leading to a choice around a suitable data-analytics software for a company's operations, but it does not present any results regarding the actual adoption and use of the software. Thirdly, the research does not produce any framework as a concrete solution to the underlying problems. It merely presents relevant issues to consider around the phenomenon, but they can be rather limited in terms of their systematic practical applicability. Finally, it is also worth noting that some of the notions may not necessarily remain valid for a long time due to the constant and rapid technological developments in the modern world. Nevertheless, they will arguably be useful in depicting the direction of the overall development at specific points of time.

In terms of pointing out focuses for the future research around the phenomenon, it can be suggested that conducting more studies would be relevant. This would allow discovering and emphasizing more concrete results from real-world settings, which would be valuable for enriching the general understanding of the possible effects that the data-analytics software may have on the companies' operations. In addition, this would arguably be beneficial for the attempts to creating a framework, which would provide the necessary metrics to accurately measuring the value gained specifically from the data-analytics software. This would essentially allow more responsible decision-making regarding the company's possible adoption of data-analytics software, which has previously been problematic.

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Appendix A. Questionnaire for the interview

The appendix a contains the question that were presented during the interview with the CEO of the company. The following questions served as a frame of the semi-structured interview, which were presented in order by also reserving the possibility of adding further questions based on the discussion to a reasonable degree.

1. To which industries do your current customers belong in?
2. Who are some your well-known customers?
3. Does the use or management of your technologies involve any other specific stakeholders?
4. What kind of job descriptions do your potential end users have?
5. What kind of use does your technology and its services provide for the potential end users?
6. What kind of use is the data-analytics software and its services provide for the potential end users?
7. What kind of use is the data-analytics software and its services intended for within your company?
8. What kind of sensor data are your current devices capable of tracking and collecting exactly?
9. Who is eventually responsible for processing and modifying the data into a visual presentation?
10. What kind of visual elements and functionality are you expecting of the data-analytics software to provide?
11. What kind of templates are you expecting of the data-analytics software to provide?
12. What kind of customizability are you expecting of the data-analytics software to provide?
13. How relevant do you perceive the possibility of personalization of the data-analytics software to be?
14. How do you expect the history of the location data to be presented in the visualization?
15. How does the quality of your collected data support defining the state of readiness in the visualization?
16. What kind of functionality is relevant for you regarding the REST API?

17. How much storage capacity can you utilize yourselves and offer for your customers within the framework of your current infrastructure?

18. How is the expired data being managed?

19. What kind of flexibility are you expecting of the data-analytics software to provide for the different users?

20. Who do you expect to detect and react on the situations regarding the crossing of certain thresholds?

21. What kind of errors do you expect the system to be able to react on?

22. How relevant do you perceive the different requirements for performance to be regarding your own technology and the data-analytics software to be?

23. What kind of plans do you have for the future as a company?

24. What kind of estimates do you have for the scalability of your technology in the future?