UTILIZING BUSINESS INTELLIGENCE IN MANAGEMENT REPORTING IN A FINTECH COMPANY

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ABSTRACT

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Abstract

This thesis studies business intelligence and its utilization in the field of management accounting – more specifically management reporting. The research is conducted as a case study in a small Finnish company. The purpose of the research is to provide the case company with relevant framework to develop their BI and analytics capabilities to better meet the management accountants' information needs in a rapidly changing business environment.

In addition, it aims at providing the company with a range of topics to be addressed in order to enable BI&A development. To achieve the goals of this research, this thesis identifies the key factors in the current processes and ways of working that are slowing down the development of BI in the case company. In addition to summarizing the most significant challenges in the BI&A development, this thesis aims to provide development ideas and the frameworks based on which the company may build their development plan upon.

Based on the empirical evidence it was concluded that there are various underlying factors that are not necessarily directly related to BI or finance but instead they are more due to top management's strategic decisions.

The frameworks presented in this thesis hold the potential to enable the company to develop their BI&A capabilities to meet the management accountants' information needs. However, the frameworks are more suggestive in this case as the implementation in practice would require much deeper research and understanding on, for example, the roles, processes, data infrastructure, technology, BI maturity and other factors related to BI and information systems in general.

Key words
Business intelligence, management accounting, accounting information systems

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Tiivistelmä – Abstract

Tässä tutkielmassa tutkitaan liiketoimintatiedon hallintajärjestelmiä ja niiden hyödyntämistä johdon laskentatoimessa ja erityisesti johdon raportoinnissa. Tutkimus on suoritettu tapaustutkimuksena suomalaisessa pienyrityksessä. Tutkimuksen tarkoituksena on laatia case-yritykselle viitekehys, jonka pohjalta yritys voisi kehittää sen BI-työkalua ja analytiikkaa vastaamaan paremmin sisäisen laskennan tietotarpeita nopeasti muuttuvassa liiketoimintaympäristössä.

Tutkielma pyrkii kartoittamaan yritykselle erinäisiä seikkoja, joita tulisi tarkastella BI&A kehittämisen mahdollistamiseksi. Tutkimuksen tavoitteiden saavuttamiseksi tämä tutkimus tunnistaa keskeisimmät tekijät nykyisissä prosesseissa ja työskentelytavoissa, jotka hidastavat BI:n kehittämistä case-yrityksessä. BI&A kehittämisen merkittävimpien haasteiden yhteenvedon lisäksi tutkielma pyrkii tarjoamaan kehitysideoita ja viitekehyksiä, joiden pohjalta yritys voisi luoda kehityssuunnitelmansa.

Tutkielmassa esitetyt teoreettiset viitekehykset voivat edesauttaa case-yritystä kehittämään heidän liiketoimintatiedonhallinnan ja analytiikan kyvykkyyksiä vastaamaan johdon laskennan tietotarpeisiin paremmin. Tulisi kuitenkin huomioida se, että viitekehykset sellaisinaan ovat ennemminkin suuntaa-antavia, eivätkä välttämättä suoraan sovellettavissa yrityksen tarpeisiin. Näin ollen teoriaosuudessa esitettyjen viitekehysten mukainen prosessien uudelleensuunnittelu ja organisointi edellyttäisi syvällisempää perehtymistä ja tutkimusta yrityksen prosesseista, rooleista, datainfrastruktuurista, teknologioista, BI-maturiteetista sekä muista tekijöistä, jotka liittyvät liiketoimintatiedon hallintaan ja yleisemmin tietojärjestelmiin.

Asiasanat
Business intelligence, liiketoimintatiedon hallinta, johdon laskentatoimi, laskentatoimen tietojärjestelmät

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CONTENTS

ABBREVIATIONS

BI = business intelligence
BI&A = business intelligence and analytics
IT = information technology
MA = management accounting
IS = information system
ERP = enterprise resource planning
IIS = integrated information system
AIS = accounting information system
CSF = critical success factor
DW = data warehouse
OLAP = online analytical processing
ETL = extract, transform, load process
MADA = managerial accounting data analytics
ODS = operational data store
CRM = customer relationship management
KPI = key performance indicator
BSC = balanced scorecard
AI = artificial intelligence
SVM = support vector machine
ANN = artificial neural network
BBN = Bayesian belief network
NPI = Net promoter index
SME = small-medium enterprise
PDCA = plan, do, check, act model
NPS = net promoter score

1 INTRODUCTION

1.1 Research background

The significance of information has grown over the years to the state at which it is now considered as one of the most crucial resources for businesses. One of the main reasons behind this development is that management decision-making is often remarkably dependent on the information available.

According to Kaario and Peltola (2008, p. 4) not only is information an important resource but it has also gained more importance as a competitive factor for a company. Nowadays, it is not uncommon for many companies to be valued based on the information they have the ownership to. Information has become a commodity that can be measured in monetary value and traded. (Kaario & Peltola, 2008, p. 4)

In addition, for as long as information technology (IT) has existed, it could be said to have been transforming the nature of processes, businesses, industries as well as competition among businesses in general. (Porter & Millar, 1985.) In today's landscape where the significance of information is ever-increasing, new technologies are providing new ways and methods for companies to take advantage of information in creation of new competitive advantage. (Popovič, Turk & Jaklic, 2010.)

This thesis studies management accounting (MA), more specifically from the perspective of management reporting and how it can be enhanced through utilization of business analytics and business intelligence (BI) tools. The motivation for this study is based on the author's own curiosity and interest in the topic, but also on the case company's needs to better align its information management processes with MA information needs i.e. how the collected data could be utilized in driving the business and managing performance.

The main challenge the case company is facing currently is that their BI system and tools as they currently are, do not support the management accounting needs to the extent they would need them to. The case company is a private Finnish fintech (financial technology) company which provides its clients digital banking and payment services among other services related to financial management. The company is operating around Europe and employs approximately 100 people.

It can be argued that traditionally MA has mainly focused on annual control operations in stable and restricted business environments (Taipaleenmäki & Ikäheimo, 2013). Managers have needed historical information to understand the performance and to control accountability in their organization. However, MA has evolved from backward-looking control purposes to utilization of more forward-looking information systems (IS) for strategic planning, control and decision making. (Taipaleenmäki & Ikäheimo, 2013.)

It has been generally recognized that in today's increasing globalization, the companies have to compete in a more dynamic and turbulent business environments. In such environments, information management plays a critical role as a resource in both, enhancing the company's competitiveness through, for example, better informed decisions, and in gaining competitive edge over the competitors (Rouhani, 2016). For instance, companies may face more or less rapid changes in customer behavior, preferences and trends not to mention the increased importance of securities markets as financial resource allocation mechanisms (Taipaleenmäki & Ikäheimo, 2013).

For a company to meet the changing needs or demands of the markets and adjust its operations, needs to study the information and data available in the markets. In this regard, especially the development of IT has created new tools and methods for companies to gain valuable insight which may be useful in guiding and steering the company.

Moreover, operating in a dynamic environment puts more pressure on accounting information as decision makers at different levels have different requirements for accounting information. Required level of detail and analysis varies, and the dynamic operating environment increases the need of ad hoc reports. Therefore, there is a need for accounting information systems to be flexible and responsive to both internal and external changes. (Prasad & Green, 2015.)

In addition to technological development, also the work and roles of a management accountants have changed. Nowadays, a management accountant's work resembles more an in-house business consultant rather than the classic concept, the bean-counter (Dechow et al., 2006). Therefore, there is a clear need to study how technologies such as BI and information systems such as enterprise resource planning (ERP) should be combined with the management reporting processes so that the systems would support the reporting needs in an efficient manner.

Integrating stand-alone information systems provide better support for management accounting. Information systems were first created to automate accounting processes such as posting and sorting transactions (Rom & Rohde, 2007). Before the integrated information systems (IIS), each function of an organization had its own information system which operated separately from the other functions' systems (Davenport, 1998). It was not until in the 1990s when the ERP systems were introduced creating new potential for information systems to support management accounting (Rom & Rohde, 2007).

It should be mentioned that ERP systems are not the only systems to support management accounting. For example, vendors Hyperion and QPR have software packages which have implemented the balanced scorecard tool. On the other hand, a BI tool such as IBM Cognos, is an analytics tool to support, for instance, budgeting. (Granlund & Malmi, 2002.) The topic of management accounting and BI is also well-known, as it has been studied for decades by a great number of researchers but in different scopes and from different perspectives.

The research of management reporting and AIS has been studied by numerous academics. According to Huikku, Hyvönen and Järvinen (2017), it is common

for companies to implement BI systems on top of their ERP systems to enhance the utilization of the information stored in their ERP systems. However, the research focusing on utilization of BI in supporting AIS is a notably less studied topic. Furthermore, Spathis and Constantinides (2004) state that MA consists of transaction processing, reporting and decision support tasks. They argue that ERP systems alone are only effective in transaction processing but less effective in supporting reporting and decision-making. This increases the need to study BI and how it could possibly support reporting and decision-making.

Increased utilization of IT to support business processes has resulted in an extremely rapid growth in the amount of data being collected, processed and stored. Traditionally, the data used in accounting has consisted of structured data such as orders, sales, purchase orders, shipments, receivables and inventory. In general, structured information is relatively easy to process, integrate and analyze with the traditional legacy systems (old technologies or computer systems) – it is orderly and familiar for businesses. Nowadays, the technological development has brought up new innovations and new ways of gathering data (e.g. Internet of Things and sensor technology). This ultimately has led to an intense increase in the amount of data that companies are nowadays collecting. (Appelbaum, Kogan, Vasarhelyi, & Yan, 2017.)

In addition, another challenging factor for the legacy systems is the form in which the data is collected. With the more advanced data collection techniques, the data is unstructured which, on the other hand, affects directly the possibilities for analyzing the data. When the data sets are so large and unstructured that they cannot be processed and analyzed using traditional software or information systems, it can be considered as big data. (Appelbaum et al., 2017.)

Another issue companies are facing, is the integration of data and processes from various data source systems. This has led to companies having poor quality data, conflicting definitions, multiple data formats, inadequately defined business processes, and poor access to information because of the multiplicity of user interfaces and their designs. (Hawking & Sellitto, 2010.)

For data to be relevant for decision-making, the company must have the means to analyze it. In addition, the data should be as timely as possible. The problem is that, for example, ERP systems face challenges when it comes to mining the data and providing real-time reports. This, in turn, suggests that ERP systems do not provide optimal support for analytics or decision-making. BI systems, on the contrary, have been designed to examine large volumes of data and provide meaningful analyses for decision-making. In summary, BI systems are more applicable when it comes to generating ad hoc, forecasting and other exceptional reports. (Chou, Tripuramallu & Chou, 2005.)

Although BI has gained a great deal of attention among the professionals, educational offerings and research have been argued to be lagging behind (Dekkers et al., 2007). The increased pace of global competition in the market pushes companies to analyze and provide more timely and accurate information for decision-makers in order to be able to react to market changes affecting the company's business (Belfo et al., 2015).

1.2 Research objectives and limitations

The thesis will focus on studying the management reporting, information needs and the business intelligence and analytics system of the case company. The aim of the thesis is to provide the case company with frameworks to develop their BI and analytics capabilities to better support management in making data-driven decisions from the finance and accounting point of view. In other words, the goal is to find appropriate frameworks that can help the company to develop their ways of working and process performance so that they are able to benefit more from their current BI tool. That being said, this study will consider the current state of the management reporting and BI utilization of the company. The focus will be on management reporting processes and how those processes should be developed to achieve the desired state of BI tools supporting management information needs. Since BI is an IT solution, this study will also consider information management to some extent.

The research will be limited to consider only the case company in question, and the findings, therefore, cannot be generalized to further than possibly other small Finnish financial technology (i.e. fintech) companies. In addition, the research does not immerse profoundly in the technical details and features of BI systems or other information systems. Instead, the emphasis is more on mapping the feasible solutions for the company X to improve its BI utilization in management reporting by exploring what is presented in the literature regarding BI systems implementation and utilization and reflect those findings against the case company's current processes. Therefore, it is important to initially study, what are the main reasons behind the need to improve the company's accounting information systems and how is the existing BI system's support for management reporting perceived in the company. Moreover, it is also important to study what are the key obstacles and challenges in the current system and processes hindering down the BI and analytics utilization in management reporting.

1.3 Research questions and methodology

As mentioned, the purpose of this thesis is to study what opportunities there are for the case company to improve the alignment of their BI processes with the information and reporting needs of the company, and consequently improve the BI utilization in management reporting. To achieve the objectives of this study the main research question is shaped as follows.

The research question:
How the BI application should be developed in the case company so, that it would better serve the needs of management reporting?

In order to be able to answer to the above question, it is needed to study what the main expectations towards the company's chosen BI solution are. Since this thesis studies BI applications from management accounting's perspective, the focus is more on what the management and the controllers expect and how do they perceive the company's current BI solution to meet their needs and what perhaps could be improved in the current system.

The sub-questions:
1) What is the desired state of BI utilization in management reporting and what are the reporting requirements?
2) What are the potential obstacles hindering down the development of BI to achieve the desired state of BI utilization?

This study is conducted as a qualitative research. The empirical data will be gathered using semi-structured interviews and analyzed using content analysis. Considering the semi-structured interviews, it is typical for the interviewer to have a list of questions from predetermined themes for the interviewees according to which the interviews proceed. In this method, questionnaires are not used, but the interviewer may have additional questions to support the themes that are dealt with. (Tuomi & Sarajärvi, 2009.)

It should also be mentioned that qualitative research is often characterized as a study which attempts to understand or explain a phenomenon rather than to provide evidence which could be generalized. In understanding or being able to explain some phenomenon, theories play an important role. Theories do not only provide a firm and strong scientific support to one's research, but also assist in forming the theoretical framework within which the interpretations and conclusions can be made. (Tuomi & Sarajärvi, 2009.)

The reasoning behind the decision to use semi-structured interviews is that they are suitable for this type of a study. According to Tuomi and Sarajärvi (2009), in the semi-structured interviews the interviewee and the interviewer can have a

rather informal discussion on the predetermined topics, which may not only provide information on the topics, but informal discussion may also bring up information outside the predetermined topics.

This, on the other hand, may help the interviewer to gain more profound insight on the research subject and understand the phenomenon in a more comprehensive manner. Another advantage for semi-structured interviews is the fact that the interviewer can choose the interviewees. This way, the interviewer can choose to interview the persons who the interviewer believes to have the best knowledge considering the phenomenon being studied. (Tuomi & Sarajärvi, 2009.)

The study is conducted for the case company, and therefore, the interviews were initially agreed to be done at the company's premises. However, due to the Covid-19 pandemic, this was not possible, and the interviews were held remotely via a video-communication service. The interviewees in this study are experts in their respective domains, and work in positions in which they can be considered to have the best knowledge related to the research topic in the case company's context. Overall, there were three interviews of which two were with finance professionals – the business controller and the CFO. The third interview was with the Head of Brain team representing the IT community in this study. In brief, the Brain team is responsible, for example, for developing BI and analytics, but also carrying out some of the ad hoc reporting tasks.

1.4 Key concepts

In this sub-chapter the main concepts are presented and defined. The most important concepts are the Managerial Accounting Data Analytics framework, the Integrative framework of business intelligence and information processes, BI architecture and the critical success factors (CSF) in adopting BI technology.

Business intelligence as a term was first coined back in 1958 by Hans Peter Luhn in an article published in one of IBM's publications (Luhn, 1958; van der Lans, 2012). Initially Luhn (1958) defined BI as "the ability to apprehend the interrelationships of presented facts in such a way as to guide action toward a desired goal."

However, the term was not widely used until it was presented to the public by Howard Dresner of Gartner Group in the late 1980s to conceptualize a set of methodologies designed to enhance decision-making in business. Dresner's definition for BI is also the definition as we know it today. The methodologies presented by Dresner consist of fact-based systems, decision and management support systems, enterprise information system, online analytical processing tools, data mining and visualization. (Chou et al., 2005.) Possibly the most significant difference to the initial definition of BI by Luhn (1958) is that in Dresner's definiton, information technology is more involved.

According to Llave (2018), BI is a combination of processes, technologies, methodologies and architectures which main purpose is to transform raw data

into meaningful insights for decision-making. BI plays an important role in enhancing organizational performance by identifying new opportunities, potential threats and revealing new insights and also improving the decision-making processes (Llave, 2018). Similarly to Llave (2018), Torres, Sidorova, and Jones (2018) characterize business intelligence as an umbrella term for information systems that turn raw data into meaningful information to support reduce uncertainty in decision-making.

Ultimately, BI tools are designed to support decision-making through advanced analytics and depending on the available source data, BI tools can provide adhoc reports with multiple alternative visual interfaces according to the end-user's preferences. The flexibility of the user interface enables the user to access and navigate through multidimensional data, thus, providing e.g. decision-makers to create the view and graphs according to their information needs. Furthermore, BI tools give their users more insight to how their business is performing be it with customers, vendors, by product or market. (Chou et al., 2005.)

From all the above-mentioned definitions of BI can be seen, more or less, the characterization of BI as an analytical process in which raw data is turned into meaningful information through utilization of information technology to support decision-making.

As the purpose of this thesis is to bring into light how business intelligence can be utilized to enhance management reporting, it is important to define what management accounting is in this context and study.

One way to perceive management accounting is to view it as a form of service which purpose is to provide financial information to its customers i.e. decision-makers or whomever who needs management accounting information to drive their business. (Atrill & McLaney, 2009, p. 17.) To further facilitate the definition of management accounting, Macintosh (1995, p. 2) characterizes management accounting as "the process of identification, measurement, accumulation, analysis, preparation, interpretation, and communication of information that assists executives in fulfilling organizational objectives…"

In management accounting, the BI solutions are tools that allow the extraction, transformation, and loading data for analysis, and turn these analyses into reports, alerts or even scorecards to further analyze, for example, business performance. (Davenport, 2006.)

Management reporting, as part of broader concept of management accounting, can be perceived as a process in which management accountants produce management accounting information and communicate that information to higher-ups to support their decision-making. (Atrill & McLaney, 2009.)

According to Atrill and McLaney (2009) the decisions that management makes, can be divided into four categories being long-term planning and strategy development, business performance assessment and controlling, defining costs and benefits, and lastly, resource allocation. (Atrill & McLaney, 2009.) These categories are discussed in more detail in the later sections of the thesis.

Considering the content of the thesis, the terms such as data, information and knowledge are used quite extensively. Therefore, it is important from the understandability point of view to make distinctions between these terms.

According to Turban, Aronson, and Liang (2005), data can be described as parts of activities, events or, in more general, things, that can be saved, classified and stored, but data as it is, does not contain any specific meaning to its user. (Turban et al., 2005.) This is probably the most significant factor separating data from information and knowledge.

As mentioned, what separates information from data is that it is meaningful, but in addition, information is also organized and can provide its user with totally new information or confirm something that was already known. (Sherman, 2014.) Knowledge then is something that the user gains in when interpreting the information and its different meanings (Kaario & Peltola, 2008).

Understanding these above-mentioned differences between the terms will help the reader in understanding how raw data is transformed into information in the processes of a BI system.

Other important concepts to shortly elaborate on are data warehousing (DW), which acts as a data storage in the BI system but also integrates data from several source data systems to enable faster data retrieval, OLAP (online analytical processing) which is a tool for data analysis, and ETL process, which is responsible for extracting data from operative systems, transforms the data into appropriate format and then loads the data into data storages. (Hovi, Hirvonen & Koistinen, 2009.)

1.5 The structure of the thesis

The thesis consists of six chapters that are as follows: the first chapter is Introduction, in which the research background, objectives and limitations are described. The second chapter Management reporting and business intelligence aims at defining BI and also describes briefly the key elements and structure of a BI system. In addition, it also discusses BI in the management accounting domain and in what manner MA information is used to support decision-making and how information could be used to gain more competitive advantage.

In the third chapter this thesis presents the key frameworks for this thesis the first being the Managerial Accounting Data Analytics (MADA) framework, where the focus is in analytics and applications. The second framework, the integrative framework, deals with information use and development. Chapter 4 describes the research methodology in more detail from the collection of empirical evidence to analysis. Chapter 5 describes the current state of BI utilization and how the current BI tool with its analytics are able to respond to the information needs of the stakeholders in the company. Based on the results, the frameworks are used to generate development ideas. The final chapter of this thesis will conclude and evaluate the research findings and discuss the potential research topics for the future.

2 MANAGEMENT ACCOUNTING AND BUSINESS INTELLIGENCE

2.1 Defining business intelligence

Business Intelligence (BI), according to Watson (2009), can be considered, for example, as a set of technologies, tools and practices, which contribute to data collection, analysis and transformation of raw data into a more user-friendly form. On the other hand, Wieder and Ossimitz (2015) consider BI as an analytic, technology-assisted process, which collects and transforms both internal and external data to a form in which it is utilizable.

In congruence to this view of BI as a process, Lönnqvist and Pirttimäki (2006, p. 32) have defined BI as an organized and systematic process that enables organizations to acquire, analyze, and distribute information from internal and external sources relevant to their business activities and decision-making. Furthermore, Lönnqvist and Pirttimäki (2006) define relevant information and knowledge as something that describes the business environment, the organization, and its relative position to its markets, competitors, customers and economic environment.

Similarly, Chen, Storey and Chiang (2012) define BI as "the techniques, technologies, systems, practices, methodologies, and applications that analyze critical business data to help an enterprise better understand its business and market and make the timely decisions it needs." In all the mentioned definitions, the significance of analytics as a part of a BI system can be recognized. Negash (2004) states that the purpose of a BI system is to provide actionable information not only in a timely fashion but also to the right stakeholders and in a relevant form to assist decision-makers – facilitating managerial work.

In the late 1990s the concept of business analytics was introduced to highlight analytics as one of the main elements in the BI concept. One of the main purposes of BI is to enhance management decision-making by providing insight and information which can be achieved through advanced analytics. The key measures for the management accounting information, which determine the usefulness of the information, are relevance, reliability, comparability, and understandability. (Davenport, 2006.)

Negash (2004) states that the main purpose of BI is to support in strategic and operational decision-making. To be more specific, the main strategic use of BI, according to a Gartner survey, are e.g. corporate performance management, business activity monitoring and traditional decision support (Willen, 2002).

Sherman (2014, p. 14), on the other hand, describes BI as a tool to present data to business stakeholders so they can utilize it to gain knowledge. According to him, BI is the visible portion of the corporate data systems.

However, in the literature, one can find BI being referred to by different terms, which can be confusing. Often the distinction between the terms business

intelligence and analytics (or advanced analytics) is not clear and they may be mixed up in the everyday conversation. From the above definitions can be seen that almost every definition has analytics incorporated.

For example, Davenport and Harris (2007, p. 26) have defined analytics as extensive utilization of data, statistical and quantitative analysis, descriptive and predictive modeling, and fact-based decision-making and management. They further add that analytics purpose is to support and enable automated decision-making through analysis.

Therefore, analytics are part of business intelligence technologies and processes, which utilize data to support the analysis of the business operations. Furthermore, the below figure shows how analysis is positioned under the concept of business intelligence:

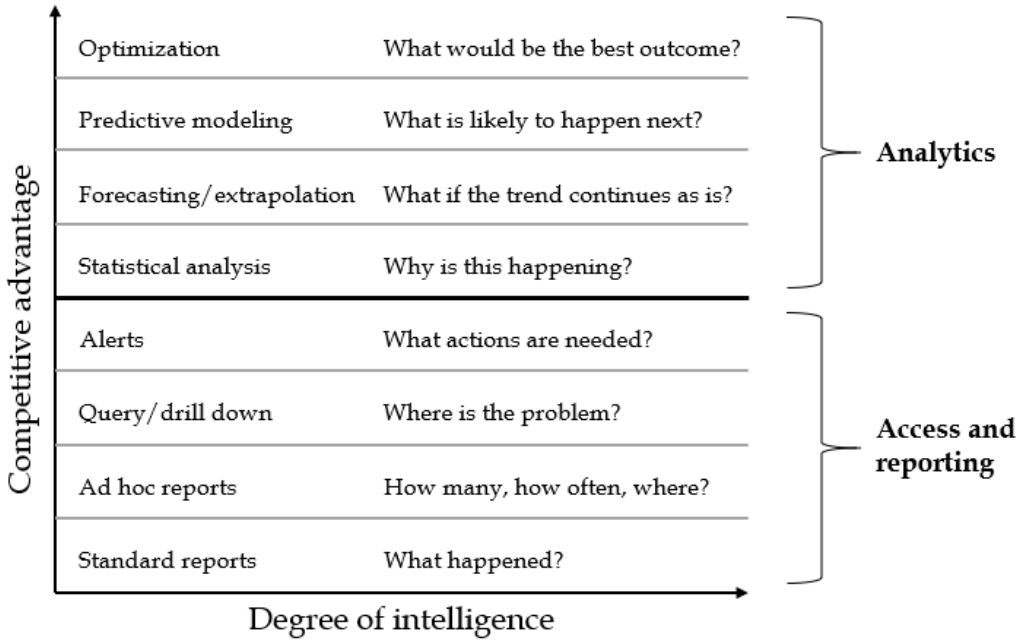

Figure 1. BI and analytics (Davenport & Harris, 2007, adapted).

2.2 BI system and architecture

Hovi et al. (2009) argue that many organizations do not have a full understanding of what data they have stored in their different systems. In general, the purpose of an IT architecture is to describe at least an organization's most relevant stored data in its entirety covering all existing systems across the organization.

A coherent architecture in which data is commonly defined and described enables different stakeholders to speak the same language, which furthermore enhances communication and prevents possible costly misunderstandings. Therefore, IT architecture can improve the semantic consistency of data and information. (Hovi et al., 2009, p. 66.)

For a company to incorporate advanced analytics, it must have a dedicated and active IT department. IT department's main purpose should be supporting both developing and maintaining the competitive advantage of the company, for example, by enabling data collection but also by finding new ways to refine, combine, and analyze data from different sources to create new value-adding information. (Davenport & Harris, 2007.)

According to Davenport and Harris (2007), companies striving to compete with analytics develop policies to ensure that the IT investments reflect the company strategy and mission. The general principles should ensure that there are no conflicts among the separate IT systems, applications should be integrated because analytics require more and more data from different parts of the company, and lastly, analytics should be incorporated in the company strategy. (Davenport & Harris, 2007, p. 197.)

For the IT system to be capable to overcome the challenges in competing with analytics, the company should integrate advanced analytics and all business intelligence technologies in its general IT architecture to enable the use of advanced analytics in the most efficient manner in terms of timely delivery of the analysis to the right recipients to enhance the timeliness and informativeness of the decisions of the management.

Davenport and Harris (2007, p. 200) have divided BI architecture into six sections:

	Tools/Layers	**Primary purpose**
1.	Data management tools	To state the acquisition and management of data source
2.	Transformation tools	For extraction, cleansing, transmission, and loading of data source
3.	Repository tools	To describe the storage of metadata and data
4.	Application tools	For data analysis
5.	Presentation tools	To describe data accessing method, display format, visualization, and manipulation
6.	Operational tools	To describe the significance of administration such as secrecy, data security, error handling and archiving

Table 1. The six layers of BI architecture (Davenport & Harris, 2007).

In the model presented by Davenport and Harris (2007), the first layer represents the tools and defines how the desired data should be collected and managed. The second layer consists of data transformation tools and processes which describe how data is extracted, cleansed, transformed and loaded – this is the ETL process which is discussed in more details in the following paragraphs.

The third layer of the BI architecture consists of repository tools which stores the data and metadata (information of data) for applications and other analysis tools on the fourth layer to use.

The fifth layer can be considered as the interface where the end-users can get their hands on the data, and furthermore, to prepare the data for visualization and presentation purposes. (Davenport & Harris, 2007.)

The purpose of the operational tools on the sixth layer is to define how data security, error handling, archiving and other, for example, confidentiality related administration tasks should be managed.

Llave (2018) argues that a typical BI architecture consists of "a data source layer, an extract-transform-load (ETL) layer, a data warehouse layer, an end-user layer, and a metadata layer." Llave (2018) continues by stating that of these layers, the data warehousing layer is one of the most important layers as it plays a crucial role in transferring the data from the source systems into a target repository. (Llave, 2018.)

However, prior to moving data to the target repository, the ETL process is needed to extract data from source systems and sent to the data staging area which is a temporary storage for data. After this, the data is transformed i.e. converted to a pre-determined, consistent format before being loaded to reports and analysis using a set of predefined set of business rules. (Llave, 2018.)

This also highlights the importance of the data warehouse as it can be considered as "the central storage that collects and stores data from internal and external data sources to support tactical and strategic decision making." (Llave, 2018.) Nevertheless, ETL is one of the most used technologies for transforming and copying (i.e. loading) data. The main purpose of ETL tool is to retrieve data from one system and move it to another. In the process, it also transforms, cleanses, and integrates the data, and finally loads it to the target data store (van Der Lans, 2012.) Data flow and process will be discussed in more details in the below chapters. The following figure describes the structure of a six-layer BI architecture presented by Davenport and Harris (2007).

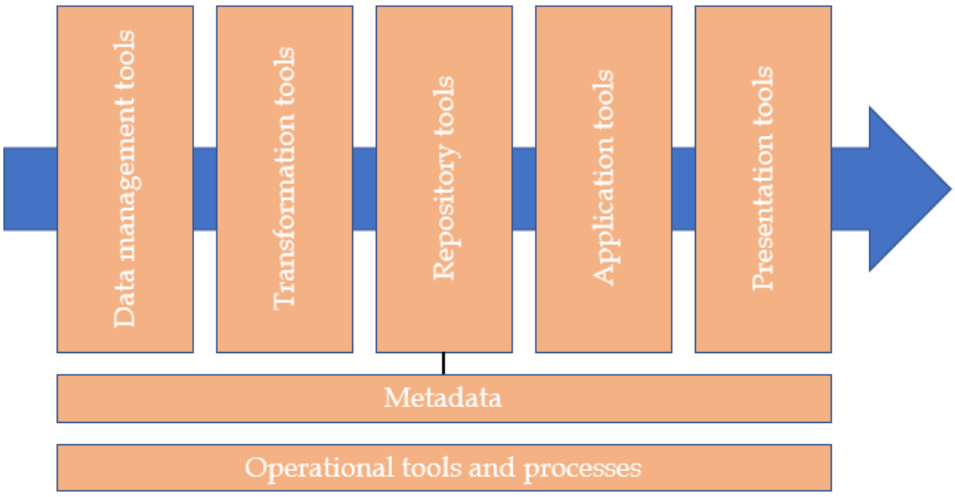

Figure 2. Basic structure of a six-layer BI architecture. (Davenport & Harris, 2007, adapted)

In general, there are several components to consider when planning data governance taking into account the data lifecycle. Nevertheless, the decisions made regarding data governance may impact greatly on the company's capabilities to compete on information. The subjects to consider in planning data management at different phases of data lifecycle are dealt with in the following subsections. (Davenport & Harris, 2007, p. 208.)

2.2.1 Data collection

This can be considered the first subject to tackle as it is the first stage of data's lifecycle. According to Davenport and Harris (2007, p. 208), for collection of internal data, the IT manager should always work in collaboration with the business stakeholders to define the minimum requirements for the collected data. The minimum criteria can be defined for example by answering to questions such as what data is needed and how the BI system could be best integrated with the business systems. (Davenport & Harris, 2007, p. 208.)

Generally speaking, there are various internal and external sources from which a company could collect its data. Davenport and Harris (2007), emphasize it is more important that the data is governed throughout the company. The reasoning for this is that only by managing the data throughout the company, can the data be uniform, streamlined, and scalable for the whole organization's use.

In addition to the above mentioned, uniform data and applications enable creating so called one unanimous truth instead of having different versions about the truth (Davenporth & Harris, 2007). The latter could possibly lead to different business stakeholders or other end-users arguing over whose figures are the truth.

BI usually requires analysts to work with both structured and semi-structured data (Negash, 2004). Although the use of semi-structured and unstructured data in analytics is increasing among companies, the data companies utilize in analytics today is still mostly structured data (Phillips-Wren et al., 2015). Structured data are relatively easy to handle as they typically have known data lengths, types and restrictions, and thus, are easy to collect, organize and query. The common sources of structured data are for example company's databases, reporting systems and operational systems, which process transactional data. (Appelbaum et al., 2017; Phillips-Wren et al., 2015.)

Nevertheless, in order to gain a more comprehensive understanding of different data types, it may be relevant to briefly explain what is meant by semi-structured and unstructured data. The basic rule is that the less structured the data is, the more complex it is to analyze and process. According to Phillips-Wren et al. (2015), the semi-structured data lack a rigid structure but similarly to structured data, they have identifiable elements and can be organized to some extent.

Unstructured data, on the other hand, is mainly in the form of human language text, vaguely defined. The sources of unstructured data are for example images, video and audio files, presentations, emails and blogs (Phillips-Wren et al., 2015). This type of data is highly difficult to analyze but as text mining and

analytics are developing, the ability to analyze unstructured data is increasing (Phillips-Wren et al., 2015).

In the literature it is not always clear what is the distinction between semi-structured and unstructured data. This is due to some researchers preferring to use the term semi-structured rather than unstructured to emphasize that most data always has some structure to it (Negash, 2004).

BI has traditionally focused more on the internal and structured data of a company. As a result of IT development and data overload, the importance of data utilization has increased. The technological advances have led to excessive amounts of data in various forms and formats that can be described as "big data", which is often described as large and complex sets of data and is fairly difficult to analyze and utilize due to its lack of structure. (Llave, 2018.)

Nevertheless, big data has been recognized to have had a significant impact on how businesses can manipulate data and utilize it in its benefit through revealing new market opportunities and creating new value. (Llave, 2018.)

In conclusion, the sources of semi-structured and unstructured data are more fragmented and complex due to consisting of multiple formats but perhaps foremost due to the large size, it is significantly more difficult to utilize compared to traditional structured data. (Llave, 2018; Negash, 2004.)

2.2.2 Data transformation and repository

The core set of processes of data integration is the data preparation, which consists of data extraction, transformation, loading (ETL), and cleansing (Phillips-Wren et al., 2015). From the lifecycle perspective, after data acquisition is completed, the data should be cleaned. The main purpose of data cleaning is to, firstly, recognize and secondly, remove the outdated, erroneous and irrelevant, meaningless data from the dataset.

According to Davenport and Harris (2007) the data cleaning step is usually the most time-consuming and costliest phase of a BI implementation project as it may account for 25-30 per cent of a BI project's total costs. (Davenport & Harris, 2007, p. 208.)

The purpose of ETL tools is to feed the many data storages of a system. However, source systems' data can lack completeness, accuracy and be difficult to access, thus, data cleansing is required to establish data integrity. The ETL tools are capable of extracting and transforming data from heterogeneous source systems and harmonize the data from various sources, the transformation process also cleaning the data by filtering out the possible semantic or syntactical errors. (Baars & Kemper, 2010; Phillips-Wren et al., 2015; Sherman, 2014.)

When the data has been extracted from primary sources, transformed to appropriate form and cleaned, it will be loaded to a data warehouse (DW) (Phillips-Wren et al., 2015). Data warehousing is the process storing and staging information, which optimizes access to data for analysis purposes.

It should be mentioned, that in some of the business intelligence systems, the data is copied to separate storage before loading it to the data warehouse. This additional, temporary and intermediate storage is known as a data staging

area. Data staging area is often used when data loading from source systems directly to the data warehouse is too complex. (van der Lans, 2012.)

Regarding data storing, Davenport and Harris (2007) argue that the management should be clear in defining when and how the data is refreshed. They must draw an operating model which has clearly defined who has access to what data and how the data integrity is ensured.

The key component for structured data storage is the core DW which is usually designed for an application independent storage of data. One of the most common challenges regarding the DW concept concerns the ETL process. Therefore, the importance of ETL process should not be taken lightly. In addition, companies should also consider running the process during non-peak times. Otherwise the process is more likely to cause time-lags to the recognition of a business event and delivering data for analysis. (Baars & Kemper, 2010; Phillips-Wren et al., 2015.)

The core DWs are usually not the direct data sources for analysis systems, instead, the DWs distribute data to smaller units known as data marts (subsets of data warehouse), which handle the application of specific data. (Baars & Kemper, 2010.) According to Phillips-Wren et al. (2015), this is due to the fact that loading requires an established data dictionary and a DW to store verified data for analyses. Data for specific purposes or business departments can then be consolidated into data marts.

The issues with time-lags have resulted in companies integrating DW infrastructures with operational systems such as ERP. This is often carried out with Operational Data Stores (ODS), which store data on a transactional level for time-critical tasks. The differences between ODS and DWs are that DWs require more effort considering e.g. data cleansing, consolidation and quality management. ODS, on the other hand, store only a limited scope of data, and thus, requires only basic consolidation or quality management enabling faster data distribution. (Baars & Kemper, 2010; Seufert & Schiefer, 2005.)

According to Negash (2004), a typical BI architecture comprises of an operational system, which acts as a source system of the data. From a source system the data is then extracted to a data warehouse from which it is then downloaded to a data mart. The needed output for BI is then pushed, usually on a scheduled basis, from the data mart to be distributed to the users either through web page user interface or through OLAP.

If a BI architecture is not designed to use data warehousing, but instead only data marts, van Der Lans (2012) suggests that the data would not be removed from the staging areas, but rather keep it as in this case the staging areas are the only storage to feed the data marts. In these cases, the data staging areas are referred to as persistent staging areas. (van Der Lans, 2012.)

2.2.3 Analysis and presentation tools

The most important tools in this layer are reporting, data mining, and OLAP tools. Reporting tools provide reports based on quantitative data and may include for example charts and other forms of visualization of data. OLAP is a tool for

interactive and multidimensional analysis of aggregated data. Data mining tools, on the other hand, are designed especially for large volumes of data. They can identify the hidden patterns in a large structured data set based on statistical methods. (Baars & Kemper, 2010.)

Yeoh and Koronios (2010) argue that BI systems implementation shares similar features with other implementation projects related to IS architecture such as ERP systems. However, compared to operational and transactional systems, BI implementation is rather unconventional project, which implies that implementation process is complex and demanding for both resources and infrastructure and have significantly different contextual elements for successful implementation compared to other information systems (Yeoh & Popovic, 2016).

The high complexity of BI architecture is due to its back-end systems originating from multiple data sources and to the high volume of data to be processed. Nonetheless, Yeoh and Koronios (2010) state that BI systems also face challenges as the underlying original back-end systems and processes may not be applicable with BI systems. On the other hand, they also argue that, for instance, the complexity of data structures must be maintained to provide an integrated view of the organization's data so that users in different departments can query for relevant data in their respect.

Overall, the tools should be designed so that they contribute to simplifying the decision-making process. Therefore in developing the tools, according to Ringdahl (2000, p. 176), the defined objectives should take into account the following:

- Enabling access to critical data obtainable in a feasible format for decision-making
- Analyzing trends, highlights, or exceptions related to market, customers and competitors
- Understanding what is driving changes in revenues or costs
- Forecasting sales revenues and costs
- Providing actionable insights to improve the business.

The latest tools available in the market allow users to interpret, model and forecast the future development of business by incorporating cross-dimension analysis into company strategy. She further argues that the generated reports should improve the overall understanding of the business without needing to understand the complexities of data behind the reports. (Ringdahl, 2000, p. 177.)

Microsoft Excel spreadsheets are an excellent example of an analysis tool. It has gained popularity due to its ease of use, flexibility to meet a wide range of analysis needs and its capability to carry out also the heavier data-handling tasks. However, Excel spreadsheets require manual work, which means that Excel is prone to human errors (Davenport & Harris, 2007, p. 213), and therefore, complex analyses may require time-consuming data validation and double-checking to ensure data quality.

An important concept considering data management is data cube. These can be perceived as a sort of data collections, which have at least three dimensions and used to arrange business data for analysis and reporting purposes. According to Davenport and Harris (2007), data cubes can be described as multi-dimensional spreadsheets. Compared to the aforementioned OLAP tools, a normal Excel spreadsheet has only three dimensions (up, down, and sheets) while OLAP tools can have seven or even more dimensions, hence, OLAP tools may be better in dealing with multi-dimensional problems. (Davenport & Harris, 2007, p. 213.)

Even analyzed data is not valuable until it is successfully communicated to the stakeholders as relevant information. Therefore, presentation and visualization tools play an important role in efficient information communication to the management. The importance of these tools is not limited to analysis purposes but also considers the continuous monitoring of the company's performance for example in the form of KPIs.

According to Davenport and Harris (2007, p. 216), a good presentation tool should enable the user to easily create at least the simpler ad hoc reports, visualize even the more complex data in an interactive manner in addition to being able to share and alarm others when there is, for example, a significant deviance or abnormalities in the data. (Davenport & Harris, 2007.)

Every now and then there can be errors with data loads or other system errors which cause data to look illogical (e.g. negative sales or, on the contrary, exceptionally high sales). In these cases, the tool should have the capability to flag the inconsistencies, which need the user's attention as the data may need manual confirmation or correction from the user.

The features of a presentation tool determine how widely the company's analyses can be utilized across the company. Generally, business stakeholders and controllers are not as tech savvy as data analysts or IT and this should be taken into account when selecting the tools for the company to acquire. The more developed presentation and visualization tools enable the users to play with data and analyze data through intuitive interfaces, which do not require deep knowledge and understanding of the tool, hence, these tools are easier for different users to adopt and use across the company. (Davenport & Harris, 2007, p. 216-217.)

Operative processes define how an organization creates, manages, and maintains data and information management applications. They aim to ensure the reliability and security of an IT system in addition to enabling scalability. Internal and external standards and practices can affect how these operative processes are shaped and implemented in a company for everyone to follow them. (Davenport & Harris, 2007.)

Regarding operative processes, especially data integrity, privacy and security are highly important sectors for a company to secure. A good example to highlight the importance of the mentioned sectors is a customer's lost credit card, which can lead to serious consequences for the company if it has neglected or

failed to secure data integrity, privacy and security. (Davenport & Harris, 2007, p. 217.)

The sections 2.1 and 2.2 presented briefly what BI systems are about, what they are meant to do. Furthermore, it also presented some of the technical solutions and processes behind a BI system. Needless to say, that there are different variations of solutions that can be put together to generate a tool for analysis and data visualization and what is mentioned in the above describes only on a general level the basic elements that a BI system can consist of.

In the next section this thesis will discuss about management accounting and its role and purposes in an organization and especially the role in supporting management decision-making – what and how management accounting data and information is used, what challenges and trends management accounting is facing.

2.3 Management accounting's role in decision support

In order to understand management reporting and why companies do it, it is important to have a broader understanding of management accounting. As described in the previous chapter, management accounting can be defined in various ways. According to Macintosh (1995) management accounting is a process consisting of identifying, measuring, analyzing, drawing conclusions, and communicating information which is relevant in the respect of supporting decision-making to drive organizational objectives. Atrill and McLaney's (2009) definition was very much in line with Macintosh's (1995) definition, but the approach was from a different angle – management accounting as a service for the decision-makers.

The range of decisions that need management level decision-making is very difficult to determine as it can be very broad depending on the scope of the business. According to Atrill and McLaney (2009, p. 15-16), business planning and control involves a wider range of decisions, which can consider, for example, the following:

- Developing new services and/or products
- Pricing and volume decisions
- Organizing financing for the business
- Decisions on operating capacity
- Changing the methods of purchasing, production or distribution

Coombs, Hobbs, & Jenkins (2005, p.14) argue that in addition to the above-mentioned features, management accounting is something that is designed to increase organizational effectiveness and is forward-looking, which also means that it is relying on estimations and forecasts of the future (Coombs et al., 2005, p. 3), but it also takes into account the past, for example, in performance analysis

where the organization's actual performance is reflected against the previous forecasts.

Management accounting information can be financial, non-financial or even both. This statement also indicates that nowadays the management accountants are required to be more than 'bean-counters'. In order for management accountants to be able to support decision-makers, they need to be able to produce useful, insightful and relevant information. At this point the difference between data and information should be defined.

In this thesis, the term data refers to raw data, which as it is, does not bring any tangible value to the decision-makers. Information, on the other hand, is considered as data to which management accountants have added value, turning the raw data into the aforementioned insightful, value-adding information for the stakeholders enabling informed decision-making. (Coombs et al., 2005, p. 4-5; Macintosh, 1995, p. 3.)

As the range of decisions by management can be very broad, it also sets certain requirements to accounting information because accounting information should support management in identifying and assessing the financial outcomes of management's decision-making. (Atrill & McLaney, 2009, p. 16.) This also means that management accounting information is very different among companies as it is highly depending on basically just management's information needs. In addition, there is no regulatory compulsion regarding production of management accounting information for businesses.

According to Atrill and McLaney (2009) management accounting in general refers to collection and analysis of financial information, generation of new information and insights for decision-makers in the company. Management reporting is the actual process in which the management accountants communicate the new information to the company's management to support their decision-making. In order for information to be useful in decision-making, accountants should be aware of for whom and for what purpose the information will be used for. The purposes of use of management accounting information can be assorted into four categories that are 1) developing objectives and plans, 2) performance evaluation and control, 3) resource allocation, and 4) determining costs and benefits. (Atrill & McLaney, 2009, p. 23.)

Managers utilize MA information in developing more accurate and appropriate plans and strategies to achieve the preset objectives of the business. MA information also plays a crucial role in both controlling and evaluating business performance. Controls are necessary in order to ensure that the actual performance is in line with the plans. Traditionally, performance has been reflected to plans through financial indicators, but lately the use of non-financial indicators has increased. If remarkable differences are found between the actual performance and the planned performance, corrective actions should be taken. (Atrill & McLaney, 2009.)

Regarding resource allocation, the MA information is usually used in decision-making considering, for example, mix of products, optimizing output levels and investing in new equipment. In general, the MA information is highly useful

when it comes to determining costs and benefits, profitability and justification of financial decisions. Managers may not always have the time to conduct calculations or they may not even have the skills in that regard. Therefore, MA information produced by accountants can be considered vital for managers' decision-making. (Atrill & McLaney, 2009.)

Additionally, the qualities in which the information can be assessed are, for example, relevance, reliability, comparability, and understandability. Relevance means that the information should have the ability to influence decision-making to solve that particular issue (Atrill & McLaney, 2009). This implies that the information should be targeted to a determined question or the needs of the manager to whom the information is produced for. Relevance also has the aspect of time. The information should be available when decisions are made. The timelier information, the better it is to support decision-making.

Reliability simply refers to information not including significant errors, which could affect the managers' trust upon the information. It is also important that the information can be compared to the previously produced information. Comparability does not only include comparing the information inside the company, but also with other companies in the similar field of business. Comparability is usually maintained by following the same accounting and measuring practices and policies over time. (Atrill & McLaney, 2009.)

The last quality of useful MA information is understandability. In this regard, it is important for the information producer to acknowledge to whom the information is produced and for what purposes (Atrill & McLaney, 2009). Neglecting this, may lead to insufficient use of information regardless of how timely, relevant and comparable the information is as the user does not understand the information provided.

This thesis focuses on finding ways to enhance the utilization of BI in management reporting, and therefore, it is important to define the concept of management accounting information system as the reporting conducted by management accountants rely significantly on the information systems of a company. According to Atrill and McLaney (2009), a MA information system's main purposes are identifying and collecting information, analyzing and interpreting the collected information, and reporting the information according to the needs of individual managers.

As nowadays the data and information becomes more and more digitized, the data ecosystem can be seen to continue exploding, thus, providing companies with larger amounts of data that may be utilized with the more traditional accounting information. (Brands & Holtzblatt, 2015, p. 2.) The increasing amount of data available creates challenges not only for the traditional management accounting information systems, but also to the management accountants' capabilities to analyze very large sets of data.

When discussing about BI and its utilization in MA, it is necessary to discuss BI's impact on management accountants' role. It has been generally recognized that the development of management accounting to which IT development has

had a great impact, has also changed the traditional role of a management accountant.

Atrill and McLaney (2009, p. 27) argue that the advancements in the IT field has enabled management accountants to give up much of the routine work related to preparing management reports, which has given management accountants more time to focus on the actual value-adding work such as analyzing the figures and take a more pro-active approach in supporting business.

This development has led to management accountants being closer to the management team and directly involving them in the planning and decision-making process. The role change means that also the requirements for skills to carry out one's responsibilities have changed. Atrill and McLaney (2009, p. 27) state that due to the new dimensions to the role of the management accountant, management accountants often are expected to work in cross-functional teams and, therefore, a certain set of 'soft' skills are necessary in order for the team work to be efficient. These 'soft' skills are, for example, social skills as part of a wider team working skills and also communication skills to enhance the capability of a management accountant to influence the other team members. (Atrill & McLaney, 2009, p. 27.)

The management accountant's role change from a traditional bean-counter to an in-house consultant has led management accountants to have a key role in achieving business objectives. Nowadays management accountants do not just feed the management with meaningful financial information. In addition to information sharing, management accountants have a more direct and active role in business planning and decision-making as business partners. This means that nowadays business controllers, in the respect of improving and driving business, have a more value-adding role than traditionally. (Atrill & McLaney, 2009, p. 27.)

In this thesis, the role change of management accountants will not be dealt with in more depth as the focus is in business intelligence systems and their utilization. However, in the end, business intelligence systems alone cannot support decision-making in its full purpose without human interference. In order to utilize the full potential of the information provided by the information system, it requires management accountants or business analysts who can support decision-makers in interpreting the information that comes out of the system.

As the role of a management accountant has shifted from the traditional bean-counter to business partnering, according to Brands and Holtzblatt (2015, p. 1), it is crucial to understand the financial dynamics more deeply than just what one can see in balance sheets and income statements. The means to face the challenges created by exploding amount of data could be found from business analytics that enables a deeper dive into what is driving the figures of the business.

To explain how business analytics could bring aid to coping with large sets of data, Brands and Holtzblatt (2015, p. 2) state that traditionally companies have mainly relied on internal data such as files and data generated by company's own ERP and other internal information systems. The traditional internal data is usually structured and can consist of, for example, travel expenses, revenue and costs data that can be retrieved from ERP systems and analyze using spreadsheets.

However, nowadays it is not just the structured data that companies want to analyze, but also the unstructured data such as tweets, videos, emails and numerous other formats of data that traditional ways do not provide an efficient way to analyze data and combine external data with internal accounting information. (Brands & Holtzblatt, 2015, p. 2.)

The following sections 2.4 and 2.5 discuss the topics of analytics and BI utilization in the field of management accounting. As mentioned, the seemingly ever-increasing amount of data creates pressure for professionals such as management accountants to cope with massive amounts of data, identify what is relevant from business point of view and make use of it by supporting the decision-makers to make data-driven decisions.

2.4 Enhancing management accounting with BI and advanced analytics

Considering the BI utilization from strategy point of view, regardless of large amounts of data being shared within a company, few studies argue that the data is not extensively leveraged on in the development of management control systems (e.g. Dechow & Mouritsen, 2005; Granlund & Malmi, 2002; Rom & Rohde, 2007).

Advanced analytics as a term may have multiple definitions, but in general it means incorporating various advanced analytic techniques in processing data to find answers to whatever questions there might be. Bose (2009) emphasizes that advanced analytics is not a technology of itself but a set of tools that are used together to generate valuable information, which can be used to predict the outcomes of a variety of solutions to a certain problem. This argument implies that advanced analytics take it one step further in supporting data-based decision-making as not only is it able to generate valuable information but also model most likely outcomes for different solutions to a problem.

The foundation for enabling advanced analytics are data integration and data mining as the more information is integrated and mined for analysis, the more accurate the analysis results are likely to be as more data allows more pattern and relationship identification among the data. (Bose, 2009.) However, Huikku and Hyvönen (2017, p. 428) highlight that the question of to what extend data should be integrated is not that simple as data integration can be costly. In their study, Huikku and Hyvönen (2017) concluded that although data integration is a key enabler, for example, in combining financial and operational forecast data, the appropriateness of the level of data integration depends on the situation and should always be evaluated from a cost-benefit point of view.

For patterns and trends recognition, for example, statistical analysis is a highly important method according to Bose (2009). In addition, without going to further details of the different methods, fuzzy logic is a technique used to manipulate incomplete data and neural networks in predictive analytics. (Bose, 2009.)

In brief, data mining is a relatively new technology for automatic pattern, relationship, change, and anomaly identification from data. According to Bose (2009), data mining is used to generate predictive modeling, for example, to predict the potential of prospects and customers in terms of revenue. Data mining can also be used in risk management by assessing the risks of fraudulent activity, bankruptcy and other problems of customers (Bose, 2009).

According to Bose (2009), one of most popular technology of data mining is text mining. Incorporation of text mining can add a new dimension to data analysis enabling companies to access the insights gained from customer data that is in the form of textual comments of surveys, e-mails, chat forums and so on, which can add richness to the more traditional numeric data analysis.

Enhancing management accounting with advanced analytics techniques can bring the company competitive advantages. With the ever-increasing competition in the business environment (e.g. Lönnqvist & Pirttimäki, 2006), it has occurred to companies that nowadays it may not be enough to focus only in acquiring new customers, but a company should put more focus on retaining especially the most profitable customers (Bose, 2009; Lee & Park, 2005). For this reason, data mining applications, properly incorporated, may provide companies crucial insights into the customer relationships as over time data mining has evolved from mere customer analytics to relationship analytics. (Bose, 2009.)

Furthermore, Bose (2009) adds that despite of the wide variety of customer retention strategies, in general they focus on financial and/or service-level incentives to build up customer loyalty. However, due to business strategy decisions some retention strategies might not strike up as feasible strategies for the company. Nevertheless, data mining can be used to analyze customer relationships and support in optimizing them, which can furthermore lead to improved effectiveness of marketing campaigns, identifying new cross-selling and up-selling opportunities to maximize sales and minimize customer loss. (Bose, 2009.)

Adopting new technological solutions may not always be straightforward and advanced analytics is no exception in this regard. Previous studies have identified few key challenges considering the adoption of advanced analytics. One of the key challenges that companies encounter is organizational buy in, which essentially means that for the adoption process to be successful, the project must have the support of cross functional teams, and most importantly, the management's support and sponsorship. (Bose, 2009; El-Adaileh & Foster, 2019; Yeoh & Koronios, 2010; Yeoh & Popovič, 2016.) Moreover, the project team must be able to create appropriate set of metrics for measuring the project's success while also ensuring that all the necessary steps are taken. As the third point for achieving organizational buy in, Bose (2009) argues that there must be appropriate incentives in place that drive and motivate the project team to success.

The second pitfall according to Bose (2009) is the implementation of advanced analytics. Due to high initial costs and in some cases a significant change in organization-wide processes and ways of working, it is crucial to be careful and thorough in the introduction of the solution. Properly managed introduction

can help in managing expectations, maintain high morale and mitigate change resistance.

Companies may also face challenges concerning regulations and data privacy. In the context of business analytics, this can mean that sensitive information on an individual, for example a customer, is revealed in an analysis. When sensitive information about a company's business operations or strategies are disclosed to an unauthorized party then it is a question of organizational privacy disclosure. (Appelbaum et al., 2017; Bose, 2009)

Regarding the data, it is also important to ensure good quality and, on the other hand, also ensure the data availability across the organization. In order to meet both criteria, an organization needs to first have clearly defined the information about the needs and values of its customers and possibly other stakeholders (Bose, 2009). Secondly, organization-wide data sharing requires appropriate controls and processes to ensure data security and privacy (Bose, 2009).

Due to the complexity of the science behind the advanced analytics, the technology itself may be somewhat challenging for users to understand or learn to use on their own. Therefore, IT specialists are needed, and users trained in order for them to understand the technology enough to utilize the systems. (Bose, 2009.) It could be said that the more advanced technology is in question, the more significant is the expertise required for system deployment for the users. This, furthermore, could put even more emphasis on establishing cross-functional teams to drive the information systems development projects.

It can also be difficult for a company to decide how advanced technology should be acquired. Technology can evolve and change rapidly, and therefore it can be difficult to decide whether the company should proceed with the most advanced and innovative technology or with a technology that is stable but will most likely be outdated sooner. (Bose, 2009.)

Choosing a system that has data analysis capabilities but in addition is able to present the output in an understandable and usable way for the users is utmost important as decision-support is one of the main purposes of analytics. By using dashboards, reports and other visualization systems information can be delivered in a concise and efficient manner to the users. (Bose, 2009.)

Regarding the implementation of advanced analytics, according to Bose (2009), there are two key factors that need to be addressed. The data quality must be high quality and ensuring that the company either has the financial resources to effectively implement and train the analysts.

Regardless of the many definitions for a successful implementation there are in the literature, in the end the company determines what is considered as success and what not. For some companies it may be enough that the IT experts or data analysts know how to use the analytics tools (Bose, 2009). However, some companies adopt new technology with the intend to have the tools available also for the less tech-savvy end-users such as management accountants, marketing experts and business managers who may not possess the level of knowledge required to understand complex data analysis but may have a profound understanding of their occupational domain. For this reason, the importance of proper

tool training should not be ignored as that could potentially leave the less tech-savvy users with a very restricted set of techniques in solving business problems in a data-driven world.

2.5 Competitive advantage from information

To understand why business intelligence solutions have gained popularity among businesses is the increasing importance of information in enhancing companies' competitiveness in their respective markets. Therefore, companies want to harness their businesspeople with the best knowledge possible. Traditionally, operational systems (e.g. ERP and CRM) have very limited reporting capabilities as they were not designed for that purpose, but rather for processing transactions. (Sherman, 2014, p. 11.)

Often times the terms data and information are used interchangeably, but according to Sherman (2014, p. 8-9), what differentiates data from information conceptually is that data is often random and not organized while information is the outcome of processed, organized and structured data and is meaningful enabling the receiver to gain knowledge (Sherman, 2014, p. 9).

In the context of data transformation and processing in a BI system, data is the source data from separate operational information systems. Information, on the other hand, is data that is moved to ETL system and transformed into information. Information then transforms into knowledge when the information in different reports is consumed by the end-users that gain knowledge from this information and makes informed decisions. (Sherman, 2014, p. 10.)

The purpose of collecting data is turning it into information and eventually knowledge. However, the amount of available data for collection is ever-increasing and it has been recognized that companies have encountered significant increases in data volume, variety, and velocity during the last few years. This has led to an increased risk in drowning in the information deluge, meaning that companies with traditional technologies and techniques are unable to cope with the extensive amounts of data. Slowed down analytics capabilities will most likely also have a negative impact on reporting and therefore lengthening the decision-making lead time. (Sherman, 2014, p.10.)

In order for a BI system to provide actionable information to its end-users, according to Sherman (2014, p. 11), the data must be clean, consistent, conformed, current, and comprehensive. Clean data simply means that the data should not be missing any relevant items or have invalid entries. Missing items and having invalid entries could lead to decision-making based on erroneous information. Usually, most of the source data is more or less dirty, and therefore, this emphasizes the importance of data cleansing processes in data warehousing (Sherman, 2014, p. 13.)

Data should also be consistent meaning that among the end-users, they all should have the same figures in their versions of a report (Sherman, 2014, p. 13). However, regardless of how clean the data is, there might still occur slight

variations in the figures due to using different calculation logic or metrics behind the resulting figures.

By conformed, current, and comprehensive data, Sherman (2014) means that in data warehousing, there is a conformed, common dimensions that allow facts and measures to be categorized and described in the same way, which ensures consistent reporting and decision-making based on the same information across the company. Data currency, on the other hand, means that the data should be as up to date as possible. Furthermore, the optimal level of currency depends on the type of decision, and therefore, varies. The data should also be comprehensive meaning that the business stakeholders should be able to have all the relevant information regarding the decision-making at hand. (Sherman, 2014, p. 13.)

To summarize, in order for a company to be able to harness BI to gain competitive advantage, the BI assimilation depends substantially on the IT infrastructure. A proper IT infrastructure will enable the company to assimilate BI into its business operations as part of the processes to enhance operational effectiveness against the competition and achieve better strategic positioning also. Moreover, this helps in facilitating management control system development, and consequently improved competitive performance. (Porter, 1996; Tallon, Kraemer & Gurbaxani, 2000.)

The basis for all strategies of a company is the top management's vision of the company's future. Therefore, the top management should have a clear vision of the company's features or characteristics which separate it from the competition. Additionally, the top management should also be able to recognize the most critical operations and processes that support these features, and the KPIs (Key Performance Indicators) used to measure these features' performance and their relation to the company's profits.

Sometimes it can be difficult to ensure that the analysts have the appropriate data available. On the other hand, it may also be a challenging task to define what, in fact, is appropriate. Obscurities in the data scope could lead to complicated situations where IT and the business stakeholders accuse each other on missing data or for collecting wrong data. Furthermore, it may not always be clear for business stakeholders what data do they exactly need to analyze a certain KPI (Davenport & Harris, 2007). Instead, business stakeholders rely on data analysts to understand their needs and collect the correct data, which could be troublesome since data analysts may lack in understanding the business.

From the above one could conclude that in addition to collecting the relevant and meaningful data, a company should collect massive volumes of data to be able to generate reliable forecasts. However, this is not as simple as one may think.

Davenport and Harris (2007) argue that there are common pitfalls for companies regarding data collection. The first pitfall is the attempt to collect all data available just to be on the safe side. In the worst-case scenario the end-users could find themselves drowning in the vast amounts of information in the tool and eventually driving them to give up using the tool.

In addition, gathering all the available data would also be very costly not to mention the required efforts to analyze and additional capacity to store the massive amount of data. Davenport and Harris (2007) suggest that one principle regarding data collection should be that the benefits from data collection should always be greater than the costs of acquisition. Furthermore, if the end-users end up abandoning the tool, the benefits of data collection and the tool could be close to none.

Therefore, it is crucial for a company to understand where its value is deriving from and what are the essential features the company's value is based on. Moreover, it is also important to recognize the operations and KPIs that support the development of the company's value and apply that understanding in defining the IT strategy to support the main operations and functions to create new value for the company. (Davenport & Harris, 2007.)

The second pitfall considers the data quality and more specifically the meaningfulness of the collected data. If a company is simply collecting all the data available, it is very likely, that a significant share of that data is not valuable for the company. Therefore, Davenport and Harris (2007) argue that a company should avoid collecting trivial data even if it was collectable with minimal effort. Collecting meaningless data could lead to a situation where additional effort is required just to separate the meaningful from the meaningless.

The sections 2.3 and 2.4 discussed on a more general level what and how management accounting data can be utilized to achieve competitive advantage through utilization of BI&A. Next chapter discusses in a bit more details of what types of analytics can be utilized providing also a framework for developing such analytics capabilities.

3 BI&A IN MANAGEMENT ACCOUNTING

Traditionally MA has focused more on reporting and analyzing what has happened. However, as in the first pages of this paper was already mentioned, MA has shifted its focus over time from backward-looking control purposes to more forward-looking planning and decision support through the utilization of new information systems (Taipaleenmäki & Ikäheimo, 2013). Analytics techniques which answer to the question what has happened, Appelbaum, Kogan, Vasarhelyi, and Yan (2017) describe as descriptive analytics. The similar term is used by Davenport and Harris (2007, p. 26) in their model of the relation between degree of intelligence and competitive advantage.

Nowadays companies have much larger variety of data sources and due to advancements of information technologies, management accountants now have the possibility to utilize advanced analytics to not only improve the forward-looking forecasting capabilities and enhance accuracy of the predictive analytics, but in addition, the most developed tools provide the means to go one step further by generating optimized solutions to business challenges. Analytics techniques that are able to draw different scenarios and propose solutions can be grouped as prescriptive analytics. (Appelbaum et al., 2017.)

Davenport and Harris (2007) did not use the exact same terminology, but their model and descriptions of different stages of competitive advantage and degree of intelligence go in hand with those of Appelbaum et al. (2017).

Bose (2009) states that advanced analytics support decision-making at various levels. On strategic level, advanced analytics can be utilized to enhance a company's competitive intelligence. Essentially this can mean, for example, identifying new market opportunities, product or service positioning and also support in launching new products and services. Regarding tactical decision-making, advanced analytics can improve, for instance, forecasting accuracy, customer acquisition and retention, and marketing campaign analysis. A company with limited resources and with an aim to increase the focus in customer relationships, advanced analytics can be a great help in customer profiling and segmentation. The purpose of profiling and segmentation is to identify customers who share similar behavioral patterns and categorizing those into groups.

This, on the other hand, can help the company to improve its resource efficiency because accurate customer profiling and segmentation enables more efficient resource allocation, for example in the respect of targeting the right actions to the right customer segment (Bose, 2009; Quattrone, 2016). Instead of promoting a certain product or service to everyone, the company can specifically aim the marketing activities towards the customers that would most likely be interested about the product or service – improved marketing accuracy and better cost-effectiveness may result in more profitable marketing campaigns.

Moreover, profound knowledge of customers and better customer segmentation can also improve the cost-effectiveness of research and development and product pricing and customer strategy creation. For companies in finance

industry, data mining can be used to support risk management by improved risk profiling of each customer. (Bose, 2009.) To sum it up, advanced analytics can improve customer profiling, which could support the company in resource allocation in terms of activity targeting, pricing decisions, and communication related strategic decisions based on certain sets of characteristics of a customer segment (Bose, 2009), which all contribute to cost-effectivity and profitability.

Finally, the operational level management may benefit from advanced analytics, for example, in capacity optimization and process analysis and development. (Bose, 2009.)

According to Appelbaum et al. (2017), the nature and scope of MA has, however, hardly changed adding that management accountants still utilize mostly descriptive analytics. Predictive analytics is used to some extent, but prescriptive analytics is used by a mere handful of management accountants. (Appelbaum et al. 2017.)

Considering the forward-looking nature of decision-making, engaging in utilization of predictive and prescriptive analytics more extensively could support, for example, better forecasting accuracy and decision-making. Therefore, one could draw a conclusion that advanced analytics with proper utilization could improve the company's business performance.

For better deployment and engagement in BI and analytics utilization in MA, Appelbaum et al. (2017) propose a Managerial Accounting Data Analytics framework (MADA), which bases on the balanced scorecard theory adapted to BI context. MADA's purpose is to give management accountants the means to improve their ability in utilizing wide-ranging business analytics to improve, for example, performance measurement and provide better quality information to support decision-making. (Appelbaum et al. 2017.)

As mentioned in the above, the MADA model Appelbaum et al. (2017) propose bases on the balanced scorecard (BSC) model introduced to the public by Robert Kaplan and David Norton in 1992. Without going to the details of the history behind the BSC model, how BSC has been integrated to the MADA framework in the BI context is that in MADA the three types of business analytics, descriptive, predictive, and prescriptive, are implemented into four performance measurement perspectives of BSC, which are financial, customer, internal processes, and learning and growth perspective.

In the subsection 2.2.1 this paper discussed briefly about big data, what is it and how it could impact on the way businesses can manipulate and utilize big data. In comparison to the more traditional transactional data in accounting, Appelbaum et al. (2017) argue that the transactional data is predictable, familiar to businesses, and has a clear structure – mainly structured in rows and columns. In this respect, big data can be perceived as highly unstructured and may also strike up as too overwhelming to work with due to possibly significantly higher volumes, variety, and data type.

However, businesses and therefore management accountants cannot ignore the fact that big data is a reality of today. According to Appelbaum et al. (2017) big data has already changed the management accountant's task. However, this

does not mean that big data has necessarily had any direct impacts on management accountant's task, but the data is analyzed and manipulated by, for example, data scientists or analysts. Therefore, the impact can be considered as indirect. On the other hand, the data requests for the data analysts often come from management accountants, thus, one could argue that also management accountants need to understand what kind of source data the data analysts are dealing with.

Regardless of data type, the most essential is that the data is high quality. By high quality, Appelbaum et al. (2017) mean data, which is complete, precise, valid, consistent, and timely and relevant for supporting decision-making. They also add, that high quality data is an important business resource and asset for companies and can also have a significant impact on business' performance.

Nevertheless, high quality data alone is only half of the value. In order to have truly valuable analysis and accurate forecasts, businesses must also incorporate appropriate analytical approaches (Appelbaum et al. 2017).

In the next subsection, this paper describes the three types of analytics presented by Appelbaum et al. (2017) in more detail to bring more clarity to how these different types differ from each other.

3.1 Descriptive, predictive, and prescriptive analytics

As already mentioned in the above, descriptive analytics answer to the question what has happened and is, therefore, backward-looking in its nature. According to Appelbaum et al (2017), it is also the most commonly used type of analytics among businesses. Descriptive analytics, also known as business reporting, are used to summarize the historical performance, which forms the comparison point for future performance. The purpose of descriptive analytics is to describe the past and identify opportunities, and on the other hand, problems related to the business by answering to questions such as what and why something happened (Appelbaum et al., 2017; Delen & Demirkan, 2013). Furthermore, descriptive analytics can be used to create continuous alert systems by monitoring e.g. different ratios or creating trend analysis of historical data. (Appelbaum et al., 2017.)

Common features for descriptive analytics are the use of descriptive statistics in analysis and the use of KPIs and different kinds of dashboards to visualize the data (Appelbaum et al. 2017).

Based on the statements of Appelbaum et al. (2017), one could characterize, for example, the monthly reports which show the previous month or quarter's performance can be considered as descriptive and, in general, the analyses conducted based on solely historical data, are all descriptive analyses.

Moving towards more forward-looking analytics, predictive analytics are the next in line answering to the question what could happen. Predictive analytics also use historical data as the base, but in addition, it brings in also, for example, statistical analysis, forecasts, and predictive and probability models, which use historical data as the basis for probability calculations for future events.

(Appelbaum et al., 2017; Delen & Demirkan, 2013.) This type of technology often requires a wide set of algorithms, visualization tools, flexible data exploration and manipulation capabilities to produce accurate models (Bose, 2009).

The third and final classification of analytics, according to Appelbaum et al. (2017) and Delen and Demirkan (2013), is prescriptive analytics, which answers to the question what should be done based on the results of the descriptive and predictive analysis. Appelbaum et al. (2017) describe prescriptive analytics also as an optimization approach as it aims to give the optimized recommendations to what should be done in order for a business to reach the targeted outcome.

The prescriptive analytics ability to prescribe depends on the volume and the type of data available for analysis – the more varied data, the likelier it is for the solution proposals to be prescriptive according to Appelbaum et al. (2017). What this basically means is that the larger the available data set is, the more comprehensive is the analysis, and therefore the results, or solution proposals, can be considered prescriptive and valid.

Therefore, the idea that the more data there is available in terms of volume and variance, the more valid the results are, drives the change in utilization of data sources. The traditional quantitative data from company's internal systems, used for example in descriptive and predictive analytics, may not be enough, one might need to consider extending data set to qualitative data from both internal and external sources (Appelbaum et al., 2017).

Based on the results from descriptive and predictive analytics and the available source data, prescriptive analytics use mathematical and operational optimization models to simulate most likely outcomes, identify uncertainties and provide solutions which aim to mitigate, for example, risks and adverse forecasts – of course taking into account also the business rules, thresholds, and other constraining factors. (Appelbaum et al., 2017.)

According to Appelbaum et al. (2017), prescriptive analytics can improve the prediction accuracy considerably, thus, the quality of simulating different scenarios would also improve. Accurate scenarios can help the decision-making if the decision-maker is able to trust the simulations and that they are truly based on the best information available. If decision-makers can fully trust the given scenarios, this makes decision-making a more straight-forward process as the comprehensive analyses based on extensive amount of data would have mitigated the number of open questions relevant for the decision-making (Delen & Demirkan, 2013).

From the above it can be concluded that prescriptive analytics is a complex combination of unstructured or semi-structured qualitative and structured quantitative data and techniques. Appelbaum et al. (2017) argue that most of the advanced business analytics techniques have relied on methods such as statistical data analysis. Nowadays, the research, and to some extent practice, there can be seen a shift to more advanced techniques such as machine learning, artificial intelligence (AI), deep learning, text and data mining. The main difference, according to Appelbaum et al. (2017), is that these new techniques do not make statistical assumptions based on the underlying data.

Regardless of complex analytics, the results ought to be visualized in an easily understood manner for management to be able to grasp the so-called big picture quickly without having to put too much effort to just understand what a graph is actually demonstrating. Appelbaum et al. (2017) state that albeit the system is expected to facilitate complex predictions and optimizations, the expectation towards management accountants to communicate the findings in a clear and understandable manner remains.

3.2 Managerial accounting data analytics

This section reviews the MADA framework and the three aforementioned types of analytics in the context of BSC and more specifically from BSC's four perspectives that are: 1) financial perspective, 2) customer perspective, 3) internal process perspective, and 4) learning and growth perspective.

As previously mentioned, the MADA model is a framework for implementation of data analytics in MA based on BSC model. Appelbaum et al. (2017) begin with breaking down MA into three classifications being 1) cost accounting, 2) performance measurement, and 3) planning and decision-making. To make a clear distinction between the three categories, Appelbaum et al. (2017) define cost accounting as reporting activities in which management accountants use internal data to produce financial reports of the organization. Financial reporting, which is mainly backward looking in its nature summarizing the historical performance of a certain time period, the most common analytics applied is descriptive (Appelbaum et al. 2017).

Performance measurement, on the other hand, focuses on the analysis, interpretations, and insights of the business operations and processes. In performance measurement the data mainly consists of company's internal data (Appelbaum et al. 2017), but it is known that some companies may use external data as benchmark against which they may reflect their own performance upon.

An easy example of such benchmark is market size data. Market size is a measure that some companies compare their own growth against to assess how their business is growing in relation to the whole industry – indicating whether they are increasing their share of the market or not. On the other hand, if the market is shrinking, the company is able to assess their performance against the total market.

For performance measurement, management accountants can use predictive analytics by, for example, inputting the results from descriptive analytics into algorithms to generate predictions of future performance. (Appelbaum et al. 2017.)

Finally, planning and decision-making is about combining the findings from cost accounting and performance measurement to generate relevant, timely and accurate information to support management's decision-making. For this purpose, Appelbaum et al. (2017), propose the utilization of prescriptive

analytics, which can add external data on top of the results from descriptive and predictive analytics to generate optimized solution proposals for decision-makers.

The use of external data varies depending on the industry in which a company is, but according to Appelbaum et al. (2017), it is common for companies to use substantial amount of external data together with internal data in decision-making.

3.2.1 Financial perspective

The financial perspective of the BSC model, which was presented in detail to the public by Kaplan and Norton in 1992, focuses in measuring the financial performance of an organization. Without diving deeper to the background of the model, the main reasoning for financial perspective to be one of the four perspectives, is that the ultimate goal of a profit-seeking company is to generate shareholder value to its owners and the BSC model provides a comprehensive set of tools to measure the financial performance in the respect of past performance and the measures for future performance drivers. (Appelbaum et al., 2017; Olszak & Ziemba, 2003; Sharma & Djiaw, 2011.)

The results from financial performance analysis conducted, can be presented to the management. In this regard, Appelbaum et al. (2017) argue that the interactive tools would enable accountants to present the results more efficiently. However, it is likely that there is no difference in the efficiency when talking specifically about the presentation itself. The benefits of interactive tools are realized when management accountants need to enable management to review the results by themselves. In this case, if the company is utilizing interactive tools, the management is able to toggle and, for example, change the comparison time periods or the data points against which they want to compare.

In this respect, the interactive tools allow more flexibility for management to conduct their own high-level analyses, and therefore, can be considered more efficient compared to the traditional presentation and visualization tools when it comes to supporting decision-making.

Predictive analytics can be used in the financial perspective to forecast the future performance. To generate forecasts, some companies use algorithms, which, according to Appelbaum et al. (2017), can either be supervised or unsupervised. Supervised algorithms are, for example, support vector machines (SVM), artificial neural networks (ANN), and Bayesian Belief Networks (BBN), but this thesis does not discuss these in further detail. (Appelbaum et al., 2017.)

Essentially, the difference between supervised and unsupervised algorithms is that supervised algorithms require datasets with output to develop a model for prediction. Unsupervised algorithms do not have such requirement, but instead, they use classification to create data clusters and may reveal the possible relationships between data clusters. However, Appelbaum et al. (2017) argue that unsupervised algorithms are not suitable for financial predictions as most of the predictions are based on historical data.

From the findings of the descriptive and predictive analytics, prescriptive analytics can be used to generate optimized solutions with their most likely outcomes (Appelbaum et al., 2017). The techniques used in prescriptive analytics may seem similar to the ones in predictive analytics, but the important difference is that prescriptive analytics aim to find the optimal solution from the variety of outcomes of predictive modeling. In addition, prescriptive analytics enables summarizing the non-financial information of the financial perspective. For example, by analyzing news articles and social media, a company may be able to find new opportunities, for example, in the form of new markets, products, and customers (Appelbaum et al., 2017; Sharma & Djiaw, 2011). These new opportunities can then be converted into additional revenue, which on the other hand, can increase the shareholder value, which is the core of the financial perspective of BSC model.

3.2.2 Customer perspective

In the BSC framework, customer perspective explores the business from the customers standpoint as how the company meets the needs of the customers in terms of quality, cost, time, and performance and service. Ideally, the company would achieve the desired level of performance and service fast, with minimal costs while maintaining high quality to create customer value. (Appelbaum et al. 2017.)

Descriptive analytics can be used to produce a comprehensive understanding of the current situation of customer KPIs (Appelbaum et al., 2017). For example, analysis on retention rates, conversion rates, and net promotor index (NPI) can be used to assess the customer satisfaction level about the company's services and products (Sharma & Djiaw, 2011). Furthermore, in a digitalized world, the role of social media should not be underestimated as a source of data. If incorporated well, the findings from social media can turn out to be highly valuable and insightful for the company. According to Appelbaum et al. (2017), companies use, for example, customer ratings and feedback from websites, but nowadays, text mining enables users to extract data from various other platforms such as Facebook and Twitter feeds, in other words, text mining enables the use of unstructured data sources (Bose, 2009; Delen & Demirkan, 2013).

Predictive analytics could be used to generate estimates of each aspects of customer perspective. Appelbaum et al. (2017) state that company's historical data and the externally collected unstructured data could be used, for example, to train artificial neural networks model to predict the time between the point when the customer's order is received and the point when the service or product is delivered to the customer. This could give the company a better understanding of the delivery chain and possibly the capability to point out possible bottlenecks, which are impacting the delivery time. Appelbaum et al. (2017) also give an example of where text mining is used to analyze data from social media to predict information considering product features, competition, and market adoption. (Appelbaum et al., 2017.) Being able to predict customer needs could potentially give the company significant competitive advantage against competitors.

From the results of the descriptive and predictive analytics, prescriptive analytics could then be used to generate the optimal levels of quality, time, costs, and performance and service (Appelbaum et al., 2017). If the company decides to improve in customer satisfaction, it means that it needs to launch better, high-quality products or services faster (Appelbaum et al., 2017; Olszak & Ziemba, 2003). However, this often means that the costs increase. Prescriptive analytics could be used to find the "sweet spot" or the threshold at which the invested money would outweigh the potential benefits from the investment – taking into account all four aspects together rather than viewing each of them separately. This allows management accountants to analyze the relationships between the four factors and simulate how the components affect the customer measures concurrently (Appelbaum et al., 2017).

Furthermore, according to Appelbaum et al. (2017), prescriptive analytics would be able assess which actions would lead to the highest return in revenue. The challenge with the traditional business analytics would be estimating the financial impacts based on qualitative data, and therefore, these impacts are often based on assumptions made on historical data and experience.

With the advanced analytics techniques of prescriptive analytics, the assumptions could possibly be more accurate as the tool would have the means to handle large amounts of data, and the more data there is available, the more comprehensive the analysis would be.

3.2.3 Internal process perspective

In the BSC's internal process perspective, the focus is in the company's business processes and the KPIs can be measuring things such as employee skills and productivity, cycle time, and quality (Kaplan & Norton, 1992), but can also measure KPIs such as employees' job satisfaction and intention to stay with the company.

A well performing information system gives the management accountants a good visibility into the workforce through the preset KPIs, which can generate meaningful and valuable information for the management to make decisions, for example, regarding human resource allocation and optimization (Appelbaum et al., 2017; Khedr, Abdel-Fattah & Solayman, 2015). Moreover, this type of analysis may be able to point out underlying issues that need to be addressed to improve employee job satisfaction.

According to Appelbaum et al. (2017), management accountants can use descriptive analytics, for example, in determining each employee's overall efficiency through a combination of different KPIs and characteristics. Text mining could be handy in recognizing employees that are not satisfied with the company (Appelbaum et al., 2017). This could be achieved, for example, through analysis of what employees are writing about the company, but more importantly how they are talking about the company for example on company intranet platforms. For internal processes, descriptive analytics can use process mining to extract workflow processes to enable the illustration of different processes existing in the company. (Appelbaum et al., 2017.)

Based on the historical data i.e. the findings from descriptive analytics, management accountants can use predictive analytics to predict the development of each process, for example, from the aspects of the four main KPIs suggested by Kaplan and Norton (1992), and locate the underlying issues that may be causing inefficiencies in the processes (Appelbaum et al., 2017).

However, according to Appelbaum et al. (2017), the prediction models tend to deteriorate if not maintained appropriately. This can be the case for example when a company expands and business operations may become more complex, but the factors affecting internal processes are not included to the prediction model leading to an inadequate prediction model (Appelbaum et al., 2017). Therefore, it would be important to have a separate KPI to measure the prediction models historical performance, for example, in the respect of prediction accuracy, and make modifications to the model once the accuracy is on a decreasing trend.

Process mining can be an effective tool to help management accountants gain understanding of how transactions flow in a process and simulate the process' performance in different situations (Appelbaum et al., 2017). Based on the insights the management can then decide on how a process should be optimized. Moreover, management accountants would be able to generate predictive reports of all employees, which would not only help employees to improve their understanding of the current performance of internal processes, but also understand the future expectations towards the internal process performance in terms of quality, productivity, cycle time, and skills. (Appelbaum et al., 2017.)

Traditionally, the decision-making on complex problems has relied on the findings from descriptive analyses and practical experiences (Appelbaum et al., 2017). However, prescriptive analytics enable extracting more specific information, for example, using programming or Pareto optimization. Appelbaum et al. (2017) argue that these methods can be used to transform the complex decision-making process into optimization models, which aim to find the optimal solution in terms of skills, transaction processing complexity (productivity and cycle time), and quality. This could streamline the decision-making process and shorten the time from management receiving the information to the point when the decision is made.

3.2.4 Learning and growth perspective

Companies need to have the capability to adapt to the continuously changing markets and customer needs to be able to compete and grow in today's business environment. In the business context, the adaptation capability essentially refers to a company's ability to learn, improve and innovate (Kaplan & Norton, 1992). These skills do not consider only learning how to improve the existing products or to innovate new products and services (Appelbaum et al., 2017), but they can also consider learning to improve, for example, the current ways of working, workflows and processes and innovating totally new and more efficient operation models.

Learning, improving and innovating capabilities and their relation to customer value creation is exactly what the learning and growth perspective measures (Appelbaum et al., 2017). Process efficiency enhancements can contribute either directly or indirectly to the customer value creation. The more efficient processes or the higher ability to innovate new products a company has, the more value it can, in principle, create to for the customer by being more responsive in meeting changing customer needs (Appelbaum et al., 2017).

Descriptive analytics can be applied to learning and growth perspective as tools that illustrate how much a company is focusing on innovating new products and services and also how employees are dealing with new challenges (Appelbaum et al., 2017), which may depend on how employees are able to learn new things and overcome the challenges.

One of the basic metrics for measuring a company's emphasis on innovation is comparing the research and development (R&D) expenses in relation to total expenses. Furthermore, Appelbaum et al. (2017) argue that descriptive methods enable an organization to evaluate and monitor the employees' learning process. This may become helpful when estimating for example the total effort required when investing in a new information system – in addition to the purely monetary value invested to acquire the system, the management accountants are able to estimate how much time the training and deployment requires, and possibly convert that into monetary value to generate a more comprehensive business case calculation.

Investments of today are expected to bring benefits in the future. Therefore, according to Appelbaum et al. (2017), it is highly important that a company is able to obtain an accurate as possible understanding of the outcomes of the current investments in regard of innovation and employee learning. This is understandable as innovation work often require substantial amount of time and effort and therefore can be costly projects. Learning, on the other hand, may be more or less connected to the organization's culture, thus, a company's approach in facilitating new learning opportunities may shape the organizational culture. Organizational culture, on the other hand, may not be something that can be easily changed overnight and might have a significant impact on how the organization functions internally and how it appears to the external stakeholders.

According to Appelbaum et al. (2017), prescriptive analytics can help management accountants to find optimal solutions to support the top management in deciding which strategy to take regarding learning and growth. For example, machine learning algorithms, which are one of the prescriptive analytics methods, can be used to train models to combine multiple different factors such as innovation, customer satisfaction and revenue, and generate solution proposals that would be optimal when taking into account all the individual factors in different scenarios. (Appelbaum et al., 2017.)

3.3 The integrative BI framework for information development

According to Watson (2009), the concept of critical success factors (CSF) was popularized by Rockart in 1979, and the concept became an essential component in executive information systems. The similar idea to CSFs, are the nowadays commonly known KPIs (Key Performance Indicators) of which function is basically to measure and monitor performance. In the context of BI, CSFs can be considered as a set of task or procedures which must be acknowledged to ensure BI systems successful implementation and function.

Great efforts have been made to formalize common, generalizable critical success factors (CSFs) for BI implementation. For example, Yeoh and Koronios (2010) have attempted to develop a BI CSF framework through BI and IS literature. They explore CSFs for BI through three main dimensions, which are organization, process, and technology. The critical success factors on the organization level are a committed support and sponsorship from the management and a well-established business case with a definite vision. Processes, on the other hand, require a user-oriented change management, and an approach based on development.

Regarding technology, Yeoh and Koronios (2010) and Appelbaum et al. (2017) argue that there are two most dominant CSFs for management accountants. Firstly, the technology must meet the criteria of a business-driven, scalable and flexible technical framework. This would enable sustainable quality and integrity of the data, which is the second dominant CSF for management accountants.

On the other hand, Ariyachandra and Watson (2006), basing on their analysis of CSFs for BI implementation, point out two key dimensions, which are process performance, and infrastructure performance. Whereas the process performance can be evaluated in the respect of budgets and time-schedules, the infrastructure performance can be assessed by both, the quality of the system, and the quality of information (Silesia et al., 2012).

As aforementioned, BI system implementation has been recognized to share similarities with other information systems' implementation. Thus, it can be concluded that the CSFs are, for the most part, are the same also. However, Hawking and Sellitto (2010) argue that there is one specific unique factor for BI systems successful implementation, which is BI's needs to integrate data from different source systems – the more source systems, the more CSFs are needed.

In addition, the process of implementing a BI system in a SME is not the same as implementation in a large organization. Thus, it is worth mentioning that most of the current literature and studies on BI implementation are focused on large organizations, and therefore, do not necessarily meet the needs of SMEs (Silesia et al., 2012).

Regardless of the size of a company, according to Brands and Holtzblatt (2015), the implementation project should always start with defining what the company want to achieve with business analytics – setting the requirements for the tool and also see how the tool would support the company's mission and

strategies. Clearly stating the objectives and focus points will ensure that the implementation is following the right track and is in line with the pre-determined high-level view provided by the management team. (Brands & Holtzblatt, 2015.)

Other enablers for successful implementation and continuous development of business analytics or BI tools are organizational structure, cross-functional teams, sufficient business analytics framework and plan, and of course selecting the right business analytics solution and defining a proper training strategy.

Adjusting the company's organizational structure is important in deployment because if the structure is too centralized, it will not enable flexibility in developing and managing business analytics due to a centralized structure's fixed models. On the other hand, if the structure is too decentralized, the approach, governance, and internal control of data might lack in consistency. Therefore, it would be best to combine the attributes from both structures to ensure effective and agile development and management. (Brands & Holtzblatt, 2015, p. 11.)

The top management could, for example, select the business analytics tool that will be implemented and come up with a deployment strategy, which will be carried out by the cross-functional teams with appropriate level of autonomy so that they are able to develop and manage the business analytics in a flexible and agile manner. (Brands & Holtzblatt, 2015, p. 11.)

Cross-functional teams are vital for business analytics implementation for few reasons. Firstly, management accountants are obviously needed when implementing business analytics for finance. Without management accountants the team would lack the knowledge and understanding of the company's financial processes, activities nor know how data should be analyzed in order to support management decision-making.

Members from IT department are also a must because without their knowledge in e.g. data sources, data links and many other IT technical solutions, the finance members of the team would not be able to set up proper data flows to business analytics applications or build dashboards nor reports. (Brands & Holtzblatt, 2015, p. 11.) Management accountants know what information is relevant in supporting management decision-making and should also know how the information should be communicated using different visualization techniques. In cooperation, finance can bring valuable insight to how information should be analyzed, presented, and most importantly, what should be analyzed and presented. IT function then turns these into actual solutions in business analytics applications.

Establishing a business analytics framework and plan is also one of the key requirements for a successful business analytics implementation project. This phase includes creating a detailed plan defining not just the framework, but also translating the defined business objectives and requirements into business analytics models, which further helps in identifying what data is needed to populate the models. In addition, the detailed plan should also cover the dashboards and reports that are required to summarize analysis. (Brands & Holtzblatt, 2015, p. 11.)

In the planning phase it is important to ensure that the plan actually has defined all the characteristics and data requirements so that business analytics meet the business requirements and achieve the set analysis objectives. Developing an erroneous analysis that does not meet the business needs but instead giving incorrect analysis or an analysis too complex for the end-user to understand and thus prone to misinterpretation can lead to poor decision-making. (Brands & Holtzblatt, 2015, p. 11.)

According to Appelbaum et al. (2017) there are numerous academic studies on negative impact to business due to poor data quality. Studies found that unidentified poor-quality data used for business planning and forecasting can have a significant impact on a company's economy (Appelbaum et al., 2017). Furthermore, Appelbaum et al. (2017) add that the effect of poor-quality data only magnifies as the volume of data increases, therefore, ensuring good data quality should be one of the key focus areas.

After planning comes the actual implementation and testing of the business analytics system. From the management accountants' perspective, the most important tasks are reviewing and validating that the analytics models are using the right data, analysis is providing accurate outcomes which meet the preset business requirements. Finally, when the tool has been successfully implemented, it is much likely that the business needs will change over time and therefore is important to draw a plan for not only governance, but also for revision and continuous development of the business analytics models and the tool in more general. (Brands & Holtzblatt, 2015, p. 12.)

Appelbaum et al. (2017) also identify data sharing and security as one of the main concerns regarding system implementation. Essentially, this concern derives from sharing information that, firstly, consists of multiple data types, and secondly, is gathered from multiple source systems. This may result in issues with data privacy with any report that include sensitive customer or employee specific information. To prevent these kinds of issues, Appelbaum et al. (2017) argue that there are two approaches for data privacy governance; data access restriction and data anonymization. Data security is an organization wide concern (Appelbaum et al., 2017), but one should not limit the utilization of a BI tool solely because of data security concerns as the means to mitigate the risks exist.

In general, in the academia, numerous frameworks for BI development exist. However, from the process perspective, many of the existing frameworks lack the important aspect which is the development of information, according to Dekkers et al. (2007). They argue that most frameworks have neglected the alignment of the two cycles of the process of the information usage and development, and how the cycles are linked to each other.

Consequently, they developed an integrative framework, which is more comprehensive in the respect of both process cycles. In their framework, Dekkers et al. (2007) have incorporated the PDCA (Plan-Do-Check-Act) model which was originally presented by Deming in 1982. The reason why Dekkers et al. (2007) have chosen PDCA cycle is because it covers the critical tasks for continuous development, and it was designed to focus on satisfying customer needs. In the case

of BI, it is important to be able to continuously assess the information needs of the customers, who in this case, are the information users.

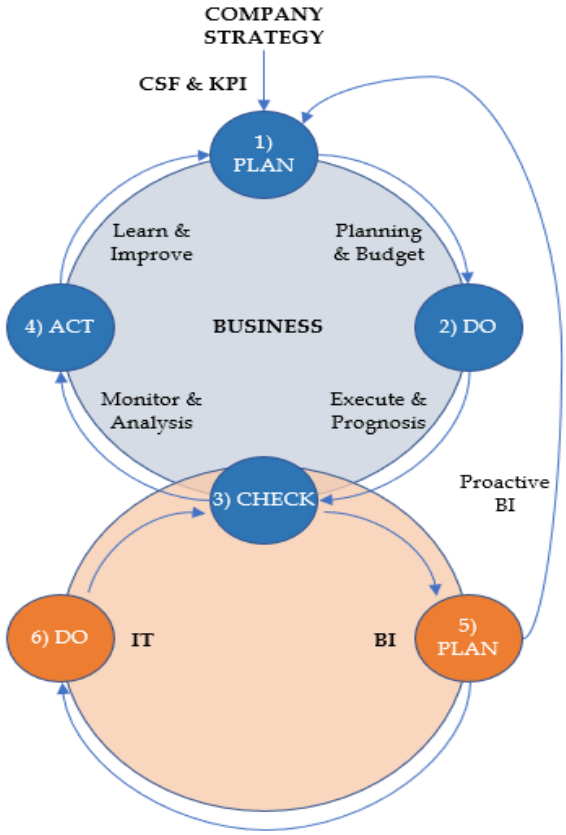

Figure 3. The integrative framework (Dekkers et al., 2007).

As mentioned, the framework consists of two PDCA cycles – one for information usage, and the other for information development. The first, the use of information, cycle consists of four phases: Plan (1), Do (2), Check (3), and Act (4). The second, the development of information, cycle consists of only two phases Plan (5) and Do (6). The phase which connects the two cycles, is the Check (3) phase. (Dekkers et al., 2007.) On the other hand, the model could also be considered to consist of business framework and IT/BI framework.

As the company's strategy forms the basis for planning, in the Plan (1) phase the business strategy is implemented in the form of products, services, and processes. This phase involves determining the KPIs and setting targets for them, organizing planning and allocating budgets. The planned processes are then carried out in the Do (2) phase. (Dekkers et al., 2007.)

After the execution phase comes the Check (3) phase in which the processes' performance is reviewed. In order to be certain, that the processes are functioning accordingly, a company must have the means to monitor the performance of the processes. For this purpose, the company has to gather data from different

sources and develop reports in which the results of comparing the processes' KPIs to the preset targets are also included.

Assuming that all required data for assessing the performance of the processes is available, the first intervention takes place at the Act (4) phase. In this phase, the company can obtain insights from the analysis conducted in the Check (3) phase and decide on what actions need to be taken to improve or adjust the processes to achieve the preset targets. The outcomes of the Act (4) phase is used for learning and as feedback to the planning process in the Plan (1) phase and new cycle starts. (Dekkers et al., 2007.)

However, if the required data is not available, the (business) users cannot determine the performance of the processes. This creates a demand for new information, which launches the cycle of information development – the second intervention. The second cycle starts with the phase Plan (5) in which the information needs of the business users are determined and assessed and the plan to satisfy these needs are created. The development actions to the reports, and possibly to the BI system architecture also, are then carried out in the Do (6) phase. (Dekkers et al., 2007.)

The below figure is a process chart of the information development cycle according to Dekkers et al. (2007).

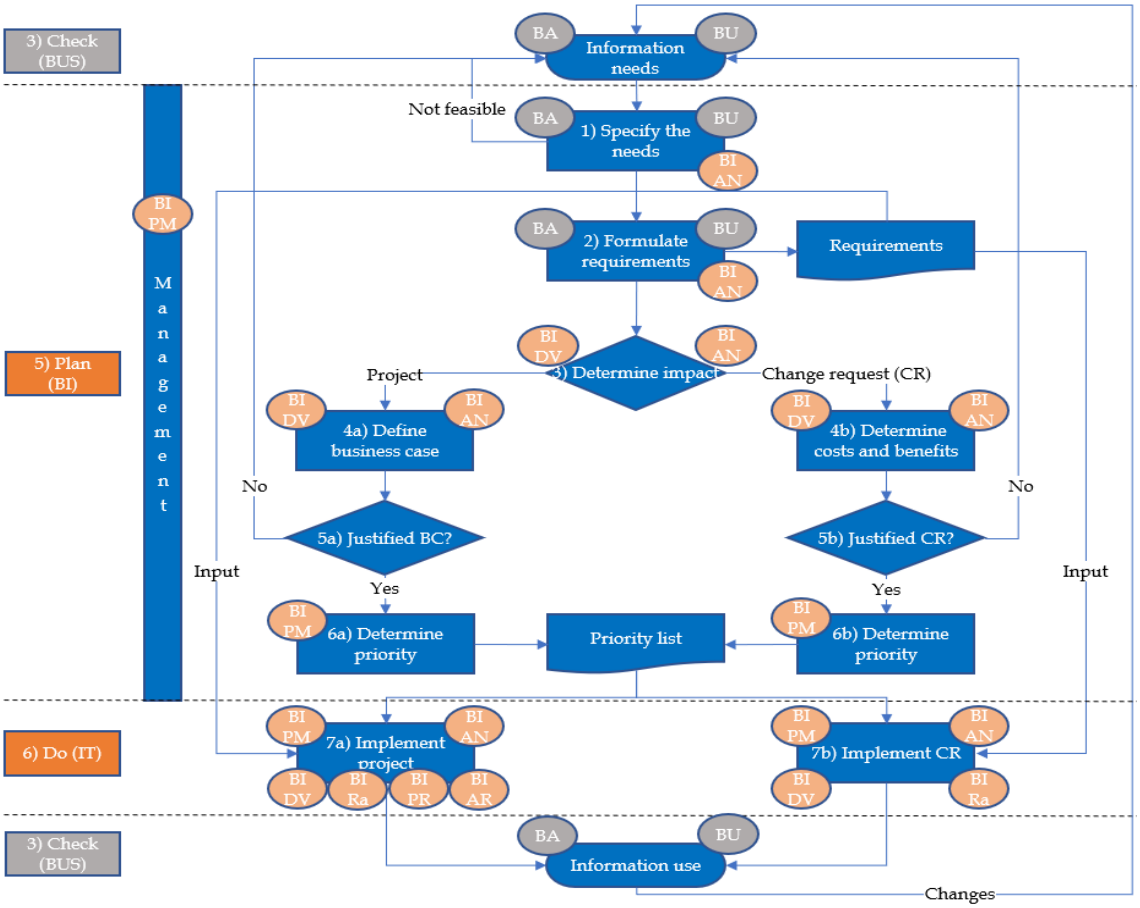

Figure 4. The integrative BI framework for information development (Dekkers et al., 2007, adapted)

As mentioned in the above, the information needs from business users will act as a trigger for the information development process cycle. The process then continues to specification of the needs where a BI analyst would join the discussion with the business users to assess whether the information need is feasible to be carried out or not. If the need is considered relevant and feasible, the request will continue to formulation and documentation of the requirements.

In the third step of the process chart, the impact of the development work is estimated by the BI developer and BI analyst. If the impact is considered significant meaning that the development requires establishing a project, the next step is defining the business case and evaluating it. If based on the business case the project is justified, the following step is determining the priority of the project, which is done by the BI program manager. The IT team will then complete the planned items in the priority list according to each task's priority. The implementation phase is carried out by the IT with the support of BI program manager, BI analyst, developer, and other experts in the BI domain. The process advances following the same steps if the impact is considered smaller and can be handled as a change request instead of creating something totally new.

If the results of the implemented project or change request is approved by the business users, the process will continue and return to business cycle (information use process).

The frameworks discussed in this chapter can provide a comprehensive framework for BI&A development in an organization. The MADA framework focuses more on the analytics capabilities side of things and how data can be applied for different analysis purposes whereas the integrative framework adds the information development perspective into the discussion. Without development work there would not be data to be analyzed, and on the other hand, development without a use case would most likely be useless and waste of resources. Therefore, the two frameworks can be considered to complement each other.

4 METHODOLOGY

4.1 Qualitative case study research

Qualitative research is often characterized as a study which attempts to understand or explain a phenomenon rather than to provide evidence which could be generalized. In understanding or being able to explain some phenomenon, theories play an important role. Theories do not only provide a firm and strong scientific support to one's research, but also assist in forming the theoretical framework within which the interpretations and conclusions can be drawn. (Tuomi & Sarajärvi, 2009.)

In this research the case study method was considered as the most appropriate as the subject of research can be considered as one case (BI&A utilization in management reporting) which consists of multiple events and processes. According to Hirsjärvi, Remes and Sajavaara (2004), a case study does not necessarily aim to explain possible correlations between different phenomena, test hypotheses or make predictions, but rather describing the research subject in a systematic, accurate and truthful manner. Therefore, it can be said that case studies do not aim for generalization of the research results, hence, this method is often selected when one wants to gain deep understanding of the research subject and take into account also the context related to the subject.

4.2 Semi-structured interviews in empirical evidence collection

The qualitative data was gathered using semi-structured interviews and analyzed using content analysis method. The purpose of the interviews was to explore and identify how the current processes of BI and analytics meet finance team's information needs.

Considering the semi-structured interviews, it is typical for the interviewer to have a list of questions from predetermined themes for the interviewees according to which the interviews proceed. In this method, questionnaires are not used, but the interviewer may have additional questions to support the themes that are being discussed. (Tuomi & Sarajärvi, 2009.) Moreover, the themes cannot be random, but they need to be relevant and connected to the theoretical framework and the research questions.

The reasoning behind the decision to use semi-structured interviews is that they are suitable for this type of a study. According to Tuomi and Sarajärvi (2009), in the semi-structured interviews the interviewee and the interviewer can have a rather informal discussion on the predetermined topics, which may not only provide information on the topics, but informal discussion may also bring up information outside the predetermined topics.

The interviews conducted were closer to an open discussion based on the predetermined themes, but the interviewer also had a list of questions in case there was a need to facilitate the discussion. According to Hirsjärvi and Hurme (2001), one of the benefits of the semi-structured interviews is that the themes do not limit too much the interviewees answers. In another words, themes give more room for discussion and the interviewee's own interpretation of the theme, which on the other hand, can give the interviewer new insights on the themes.

Furthermore, detailed questions and strictly structured interviews may not only limit out the possible unexpected information outside the questions' scope but also may narrow down the spectrum of reactions and individual interpretations and what kind of meanings the interviewees give to each theme or open-ended question. Despite the nature of theme-based interviews being quite open and unstructured, the questions still need to aim at finding answers to the research questions and based on prior knowledge on the research subject (theoretical framework of the thesis). (Tuomi & Sarajärvi, 2009, p. 75.) In this study, the questions and themes for the interviews have been constructed based on the theoretical framework. However, according to Tuomi and Sarajärvi (2009, p. 75) the pre-determined questions' relation to the theoretical framework can vary depending on the openness of the interviews. In this study, the researcher considered it necessary to give more space for the interviewees to share their own experiences regarding the topics of discussion and allow the discussion to proceed freely as this could possibly reveal information that would not surface had the discussions been strictly limited to the pre-determined questions and themes.

According to Hirsjärvi and Hurme (2001), the meanings given by the interviewees are highly essential and that the meanings for different things are actually created in interactions with the interviewer. Structured interviews do not include interactions to the same extent as semi-structured interviews and therefore semi-structured interviews were a more logical method for gathering empirical evidence for this study.

The aim of the study is to survey how business intelligence and analytics could be developed to improve management reporting. Therefore, it also has to take into account the cross-functional collaboration between teams in the company, moreover, the collaboration between finance team and analytics team.

This, on the other hand, may help the interviewer to gain more profound insight on the research subject and understand the phenomenon in a more comprehensive manner. Another advantage for semi-structured interviews is the fact that the interviewer can choose the interviewees. This way, the interviewer can choose to interview the persons who the interviewer believes to have the best knowledge considering the phenomenon being studied. (Tuomi & Sarajärvi, 2009.)

The study is conducted for the case company, and therefore, the interviews were initially agreed to be conducted at the company's premises. However, due to exceptional circumstances with the COVID-19 pandemic, the interviews were held as video interviews through Google Meets which enabled the recording of the interviews as well.

The empirical data was gathered through three interviews of which two were with finance professionals – a business controller and the CFO of the company – and one with the Head of the Brain team. The Brain team's responsibility is to support the information and analysis needs throughout the organization.

Qualitative research does not aim at statistical generalizations. Instead, qualitative research strives to describe a phenomenon or an event, moreover, understanding specific actions and giving theoretically meaningful interpretations for those. Therefore, in a qualitative study, the number of interviewees is not necessarily critical. Instead, what is more important is that the interviewees have as much knowledge and experience as possible on the phenomenon being studied. (Tuomi & Sarajärvi, 2009.)

As mentioned, with qualitative research, it is not about the number of interviewees but rather the quality. Considering this and taking into account the research topic, it is rather clear that the business controller and CFO are the most suitable to be interviewed from finance team. Choosing to interview the Head of the Brain team is also justified as this is the team that is responsible in developing analytic capabilities and reports for finance. This means that all the reporting related requests from finance land on the Brain team's desk. Moreover, it was helpful to have the business controller's support in screening whom to interview based on their substance knowledge. Altogether there were three interviews as already mentioned in the above, but unfortunately, due to schedule related challenges some of the potential interviewees were not available for interviews. Nevertheless, considering the size of the company, the three interviewees interviewed can be considered to have vast enough knowledge of the research topic.

In addition to interviews a part of the empirical evidence are the process flow charts and descriptions of the financial reporting process and also the information system set up demonstrating the interconnectivity of separate systems. The description of the current state of reporting and utilization of BI is constructed based on the material received from the case company but also using the evidence collected in the interviews.

4.3 Theory-guided content analysis

Content analysis is one method used for systematic and objective textual analysis. According to Tuomi and Sarajärvi (2009), content analysis is one of the techniques that is used to describe visual, written and verbal material. Content analysis aims at organizing the material so that it is concise and clear but, on the other hand, does not lose the information embodied in the material. (Tuomi & Sarajärvi, 2009.)

Furthermore, content analysis can be divided according to the approaches of qualitative analysis, which, according to Tuomi and Sarajärvi (2009), are data-based approach, theory-guided approach, and theory-based approach. Due to the research subject, the theory-guided approach was considered the most suitable for this study. In this approach, it is typical that the analysis is supported by both theory and previous knowledge about the topic, but the possible theoretical

connections do not necessarily base on any specific theory (Tuomi & Sarajärvi, 2009, p. 96). Moreover, in the theory-guided approach, the influence of prior knowledge may be recognizable in the analysis. However, the purpose of the prior knowledge is not to test the existing theories, but rather it aims to discover new ways of thinking. This is due to the inference logic, which in the theory-guided analysis' case, is often abductive inference. (Tuomi & Sarajärvi, 2009, p. 96-97.)

In abductive inference, the researcher's thought process attempts to combine both material-based models and the theories. According to Tuomi and Sarajärvi (2009, p. 97) combining the two might have to be done with force, but sometimes they can be seen combined in very creative ways as well. Furthermore, they add that in theory-guided approach, the collection of empirical evidence is not strictly defined, and thus, the material can be collected rather freely and be reflected against the prior knowledge of the research topic. (Tuomi & Sarajärvi, 2009, p. 98.)

Next will be described the process of analyzing the empirical evidence gathered for this study. As previously mentioned, the evidence was collected from three interviews with the most relevant stakeholders from the research subject point of view. According to Tuomi and Sarajärvi (2009, p. 117), in the theory-guided approach, the process follows the same steps as in the data-based approach. Furthermore, they state that before starting the content analysis, one needs to define a so-called analysis unit, which can be, for example, words, parts of a sentence or even a thought, which consists of many sentences. Often, the research scheme and the quality of the material determines what the analysis unit is. (Tuomi & Sarajärvi, 2009, p. 109-110.)

The analysis process consists of three subsequent phases. The first phase is reducing the irrelevant material from the written transcripts. In addition to trimming the irrelevancies from the material, the material can also be sliced into smaller parts and summarized. (Tuomi & Sarajärvi, 2009, p. 109.)

The step following reduction is clustering the data. In this stage, the goal is to group similar concepts and to be able to group the concepts, the original expressions are first analyzed and labeled with various concepts for identifying similarities and differences. When all relevant original expressions have been labeled with a simplified concept, the concepts can be grouped into categories. (Tuomi & Sarajärvi, 2009, p. 110.)

The final step is abstraction where the lower level categories are combined into larger, higher-level categories. This step aims to conceptualize the original expressions into theoretical concepts from which conclusions can be drawn and research question answered. Moreover, it is important that the researcher attempts to understand the interviewees from their perspective at all stages. (Tuomi & Sarajärvi, 2009, p. 113.)

Following the model described above, in the reduction phase of the analysis for this study was listening to the material and writing transcripts for each interview. After having finished writing the transcripts, the researcher proceeded to

the next step, which is reading and familiarizing with the content and trimming the material to exclude the irrelevant expressions from the material.

In the clustering phase, the researcher aimed to find patterns and similarities among the expressions. For this purpose, the transcript of each interview was split into smaller parts and sliced so that the researcher could study and start searching for linkages of the expressions in different interviews and create simplified theoretical concepts for the original expressions and categorize them to different sub-categories. The abstraction phase can be considered to take place somewhat in parallel with the clustering phase as the original expressions were converted into theoretical concepts for conclusions.

5 BI&A UTILIZATION IN MANAGEMENT REPORTING IN COMPANY X

5.1 Case: Company X

As mentioned in the Chapter 1, the case company is a fintech SME, which core business is providing financial services for their customers. In more detail, their key offering consists of online shop platforms, bookkeeping tool, e-invoicing, and payment accounts that comes with a debit card. The company was founded in 2011 with the mission to make small business owners' everyday life easier. In the early days the company employed only few people but has then expanded in size and is currently employing over 140 employees. In 2016 the company was acquired by a larger international bank, which nowadays finances the case company's business.

In general, their business model consists of a variety of pricing plans to which the customers then subscribe on monthly basis. The company has acquired licenses to operate in various countries around Europe which is their main market. For example, their business in Finland is monitored by the Finnish Financial Supervisory Authority, and therefore, it is appropriately regulated and controlled.

Unfortunately, since the company is not a listed company and is owned by the mother company, the annual revenue information is not disclosed separately. However, since it is a growth company, the focus is more in developing the business, thus, a substantial amount of the revenue is allocated, for example, to research and development, and marketing and sales development instead of supporting functions. This also implicates that the case company is highly dependent on the mother company's financing.

Moving on to the research subject, the steps from a customer being acquired to becoming a paying customer, in other words, customer acquisition funnel will be described on a high level and from management accountant's point of view as this is important part of the case company's management reporting.

Basically, on high level, the funnel can be split into three sections; first being the onboarding stage. In this phase the customer signs in and starts the account creation process by first providing all the required information about him/herself. Following this step, the case company will verify the applicants together with the company's partners as part of the very important KYC (know your customer) and KYB (know your business) verification process. If the customer is approved and verified successfully, the customer can then proceed to choose a pricing plan he or she wants to subscribe for and complete the onboarding phase.

The case company closely tracks and monitors the customers' progress in the funnel until the customer has been converted to a paying customer (subscribed for a pricing plan) after which the customer proceeds to lifetime monitoring. In the lifetime monitoring, the main focus is in how customers behave at each

stage of customer lifetime. The changes are usually customers shifting from one pricing plan to another, but in addition, the case company is also interested and monitoring how these changes occur in different customer segments.

Currently the Company X is following four main KPIs that are paying accounts, paying accounts in a specific segment which is particularly closely monitored. Both of these KPIs measure the average revenue per paying account. The third KPI is customer conversion rate, which basically measures how many of the prospective customers the company has managed to convert into paying customers. The fourth main KPI is NPS (Net promotor score) which is used to monitor customer satisfaction.

In addition to the above, the company also has supporting KPIs to monitor customer related costs and profitability. For example, Cost-per-account (CPA) is used to monitor the marketing costs relation to the number of opened accounts in a month. With the CPA information and conversion rate, the management accountants are able to calculate the customer acquisition costs (CAC), which tells how much costs occur from acquiring one paying account.

CAC and be then compared against customers' expected lifetime value (LTV) estimates to calculate various ratios for different customer segments. Based on the calculations, the company attempts to, for example, forecast the future cash flows and make strategic decisions considering which segments to focus in.

The next section will describe the current state of management reporting and BI utilization in the case company. Furthermore, it deals with data quality in the systems, management reports, business analytics and capabilities and also the challenges and pitfalls for all of these.

5.2 Current state of management reporting and BI&A utilization

5.2.1 System architecture and data

The BI and analytics theories and frameworks presented in the previous chapters suggest that advanced analytics could give companies important competitive advantage when big data (unstructured data) is used. The case company, however, is not utilizing any unstructured data or even external data in their analyses for management reporting at the moment.

The below figure demonstrates the current structure and connections of the different information systems of the Company X. The most important elements from the thesis' point of view are the information the BI tool extracts from the Service Fee Engine (SFE), Opsware, which is the company's customer relationship management tool (CRM), and ERP.

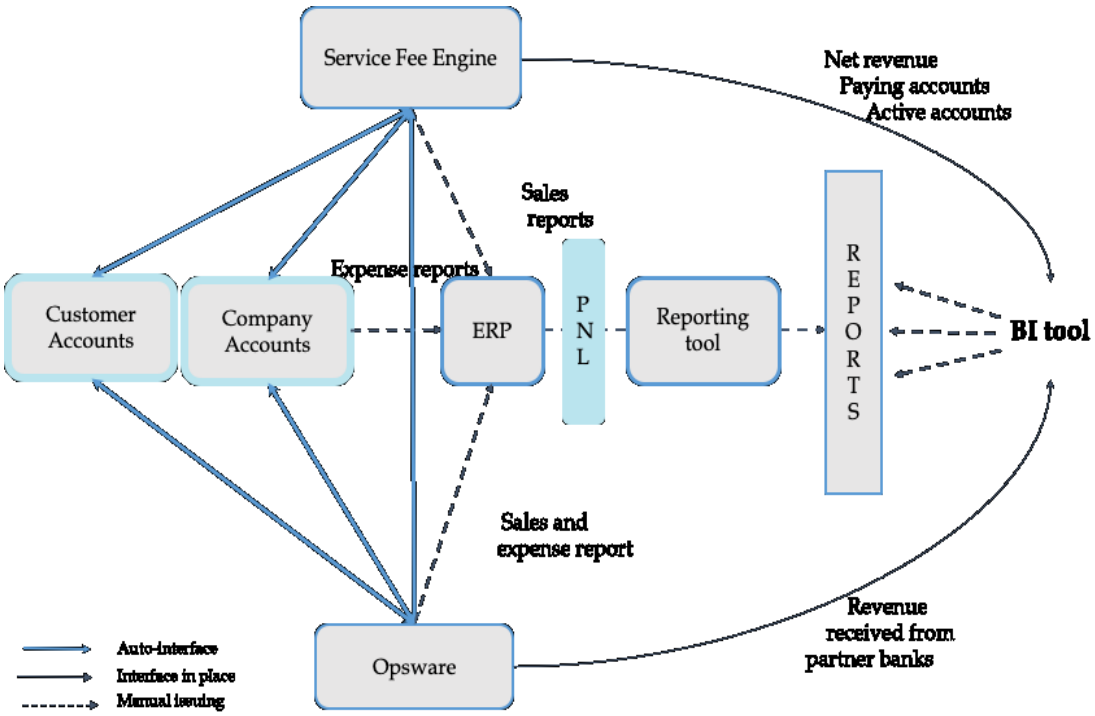

Figure 5. Current data flow for financial reporting in the case company

In the current setup, the BI tool uses ETLs to extract the data from SFE (revenue from active and paying accounts) and CRM (customer behavior, pricing plan and other customer account related data) but does not have the capability to extract the data in ERP. What this means in practice, is that every month, the controller pulls the needed reports from the BI tool, extracts manually the data from ERP and reporting tool, and then manually put the reports together.

According to the controller, it would be ideal if this process could be streamlined so that putting the reports together would not require manual labor, but instead the BI tool could use ETLs to extract data from ERP and the reporting tool automatically as well (illustrated in the below figure).

"The sales data flows automatically because the fee engine feeds that data automatically to the BI system and I can get the data almost in real-time. What is missing is the expense data and that is not loaded to the BI tool so what we do is we compile the reports so that we take one part of the data from the BI tool and another part from the ERP. We still have not managed to get these systems to talk with each other." (Business controller, 2020.)

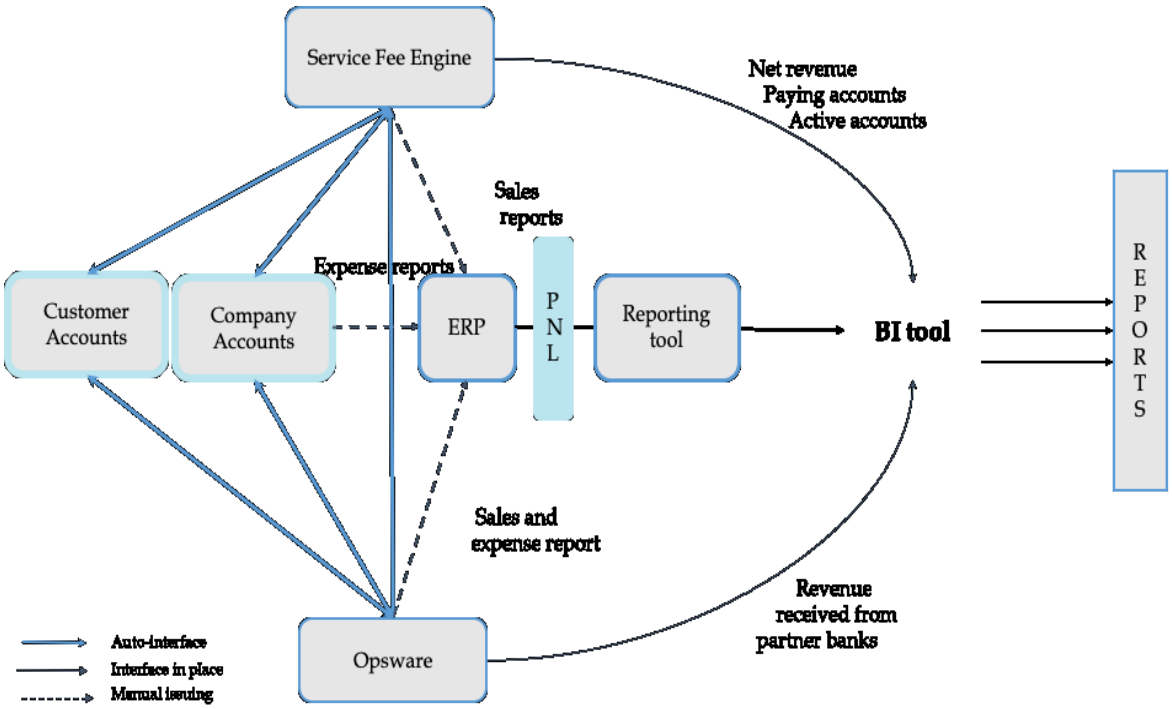

Figure 6. Desired data flow for financial reporting

In theory, the Brain team has the capabilities to establish the connection between the BI tool and ERP, but due to the sensitive nature of the ERP data, there are major concerns about sensitive data being displayed in the BI tool. The reason why this is a concern, is that in the case company, the BI tool is in organization-wide use. It was a management decision to have full transparency in the data and give full access to all members of the organization, meaning that everyone has the same access rights. The reasoning behind the decision to have all the data in the BI tool available for everyone is that it, for example, reduces the time to make and implement decisions as the assumption is that all employees have access to same data, which eliminates the risk of a team or an individual to argue that they were not aware of certain decisions being planned as everyone is equally informed.

Furthermore, the fact that the company wants to promote full transparency may pose limitations to full utilization of the BI tool's capabilities in terms of reporting and analysis scope. This is acknowledged in the company, but the management's view is that information symmetry across the employees outweighs the utilization of BI in its full potential, and therefore the sensitive information is handled elsewhere and not in the BI tool.

According to finance, the data quality has been good, meaning that there is rarely a need to amend the raw data. The Head of Brain agrees that in general the data quality is good, but depending on the task, the effort required to put the data together for an ad hoc report can be significant. This is because the data repository and infrastructure were not initially designed to enable flexible reporting, therefore, the question may not be whether the data quality is good or bad, but rather whether it is fit for varying needs or not. Moreover, the system

developers emphasize tool performance over analytic capabilities, which is reflected on how the data is stored in the repository.

"We rarely need to manually correct the data afterwards. In that sense, the data quality has been good. In addition, if we made manual corrections and someone saw the original report, we would have to use the time [in result review meetings] to explain why we had to make the corrections. It's all very good data quality, we don't need to do manual tweaking on the data itself." (Business controller, 2020.)

"If we notice a clear error in the data, we do not make changes by ourselves, but add a side-note in the report." (CFO, 2020.)

"We will sometimes have quite a big challenge to give the data that the business controller and the CFO want because the way that things were started. What I want to emphasize is that the amount of work needed to put in to get this [the requested data] presentable. The quality of data is good, but it's not made for data analysis, so we break our heads a little bit more to make that presentable to different stakeholders." (The Head of Brain, 2020.)

Finance does, however, recognize that there are some improvements needed to ensure data consistency and confidence. According to the business controller, in the month-end reporting process there are clear cut-off days for month-end closing. However, it is not always clear when the data showed in reports have been updated. Therefore, from time to time there are reports or dashboards, which are partially populated with the latest data, while in other reports the data might be old, but it may not be distinct to the user.

"For example, I give you a figure for Finnish customers that are in pricing plan X, and you use that later for your own purposes. Later, you will check the figure with me, and I ask the Brain team to confirm the figure, but surprisingly they give a totally different number, which means that I have to manually check or ask the Brain team to manually check the data." (Business controller, 2020.)

"One table might get refreshed during the night and the second may be updated at the same time as the first table, but then the third might be updated with latest data in the middle of the day and the fourth table can be updated only when the third has been updated. Due to these possible dependencies we have to know when the data loads are scheduled and whether the data has been updated or not." (Business controller, 2020.)

"I don't really see bottlenecks in our reporting process, instead, for example, if we have multiple tables or charts in a dashboard and they are not updated at the same time, it can confuse us an awful lot that the data is not consistent." (CFO, 2020.)

From the above can be concluded that there could be a need for better planning process. As the Head of Brain states that currently the team does not have the time to think and plan ahead meaning that they have to work reactively

instead of being proactive. This can have a significant impact on the Brain team's workload as if the current data design does not fit the requirement, the team needs to build workarounds to reclassify the data.

5.2.2 BI&A in management reporting

When talking about management reporting, at least in this case, there is a need to create distinction between the more routinized, relatively standard format managerial accounting reports and the so-called ad hoc reports. In the Company X, the monthly reports' key takeaways revolve around the main KPIs mentioned in the previous section.

Considering the purpose of this study, there is no need to go further into the details of each row shown in these month-end closing reports. Instead, the focus is more on exploring the company's current analytic and reporting capabilities to meet the vast variety of ad hoc reporting needs as ad hoc reporting has been described as one of the most time and energy consuming and challenging type of reporting in the company.

Shortly put, most of the factors hindering down the responsiveness to ad hoc requests are related to resource scarcity. Furthermore, this puts more pressure to prioritizing tasks and prolongs the ad hoc reporting lead times further. Some challenges are considered to derive from communication and terminology related matters as different departments or teams in the organization may use same concepts and terms to describe different things.

For finance, the process of ad hoc reporting usually starts with specifying the requirements and communicating the query to the Brain team. The Brain team's responsibility is to create the requested ad hoc report. The official way of requesting ad hoc reports from the Brain team is using the company's ticket system. The Brain team will then process the tickets in two-week sprints. In this respect, finance is somewhat privileged as the ad hoc requests from finance are treated with urgency meaning that they are often prioritized and brought forward in the ticket system.

According to the Head of Brain, the ticket system can be hard to manage from time to time. In general, the system functions well, but the amount of the tickets may become overwhelming from time to time. This is due to stakeholders requesting for something that has already been done before, but maybe just in different format. Sometimes there are difficulties to understand what exactly is being requested in the ticket. Therefore, the team has recognized a need to organize the ticket system better.

"I'm trying to make it [the ticket system] simpler for everyone. I want to create a forum where anyone can go and put whatever they want and it [the requests] will come as a list to me. I don't want to create tickets out of tickets because I will end up with a backlog no one can manage. This list will treat them [each request] separately then create a ticket for that – yes or no there's a need for it. Because very often these requests are already done, or we have that [what is requested] but in a different format. The ticket

system works pretty well, but it's also very easy to get lost in the amount of the tickets so we need to organize that a little bit better." (The Head of Brain, 2020.)

Moreover, taking a change request to production environment takes a lot of time as there are multiple steps such as data engineering, building the prototype, which then needs to be tested and validated before building the needed ETL. All in all, according to the Head of Brain, it is a long process, which requires time. On the other hand, the business information needs are changing on fast pace meaning that by the time the change request process is finished, there are already new change requests. Therefore, it is not feasible to take on all change requests as it would lead to inhumane workload especially for the data engineers.

"Some of our prototypes we are still using, we have not yet created the ETLs and they [stakeholders] will ask me for something completely new. Then we create a new prototype for stakeholders, but we will not ask that prototype to have an ETL built until after one month. We need to first see how that prototype is performing because what can happen, and happens very often actually, is that in the industry we are, the requirements will change every month so I don't want to give something to the data engineers that in the next month they would need to iterate again." (Head of Brain, 2020.)

The process of creating something new is already time-consuming and due to the long lead time, the report may already be outdated at arrival. The CFO agrees with the above by stating:

"We have massive amounts of data, but the question is also whether we are requesting the data in an understandable way. This can be very consumptive for the Brain team as the requesting stakeholder might think they need only one data point when in reality they would need multiple. Brain team executes the request only to see that this is not what the stakeholder needed and it can be very frustrating and exhausting as the requests always need to be specified, built [ETLs], and processed in sprints and in the end the result is not what the requesting party needed." (CFO, 2020.)

From finance team's point of view, most of the challenges are related to follow-up questions as these often require diving deeper into the data and possibly even combining the available data in new ways but since the process of developing something new is rather lengthy as described by the Head of Brain earlier, the lead time to answer the follow-up questions can be long. In short, the current data design and infrastructure does not enable flexible reporting and analysis at the extent that finance would desire.

"In addition to the dashboards the analytics team send to me, I also want that someone has analyzed the numbers a bit so that I can immediately get a hold of what is going on. Instead of having five people sitting and thinking about what explains the results, we would get the dashboards with some pre-analysis with explanations for the results. At the moment this is not possible due to resources but also skills and knowledge…we have quite a young analytics team." (CFO, 2020.)

This, on the other hand, means that the current ad hoc reporting capabilities of the BI tool may not be, in terms of flexibility, on a level that it could serve the business stakeholders' information needs in a timely manner to support decision-making effectively. Furthermore, according to the CFO, there is an increasing demand from management to have different views, dashboards and in general they need deeper understanding of different events and phenomena. This further adds more pressure for the company to develop its data infrastructure and tools to support more flexible data manipulation and organization to enable more flexible reporting.

According to the business controller, at the moment, the level of analysis is not poor but there is definitely room for improvement. In general, analyzing the reports requires a significant amount of time and effort. She further states that having the key KPIs displayed in one dashboard would already make her job easier. Moreover, with the current analysis capabilities the controller is not able to easily identify the key drivers impacting the figures in the reports.

"We have ideas on how to improve the BI tool so that we could have just one dashboard consisting of the key KPIs, for example, of the different phases in the customer acquisition funnel." (Business controller, 2020.)

5.2.3 Decision support

So far, in the Company X, the BI tool has mainly served the purpose of information sharing and visualization of data. The tool has been used to generate more or less standardized reports providing the end-users with some level of capability to manipulate data and generate their own reports. According to all stakeholders interviewed, there is still a lot of potential in the tool yet to be recognized in terms of decision support.

However, the interviewees also recognized that there are few factors slightly hindering the benefit realization. Firstly, the tool is relatively new and, therefore, there are functionalities that are yet to be discovered and utilized. In addition, according to the Head of Brain, the lack of planning in advance what data is stored and how it should be stored makes it challenging to ramp up new analysis in a timely manner to meet the demands of the stakeholders.

Regarding decision-making specifically, the CFO and the business controller both state that there is a need for more deep-dive analysis. Currently the tool does not necessarily enable finance users to drill down into the data so that they would be able to come up with deeper analysis of some KPIs and clearly recognize the drivers of the figures.

"As a controller it is my job to think how we can increase our revenue. To do that, I need to know how our staff can scale up to meet our value propositions to our customers

to gain in revenue so that I'm able to cover all the expenses and salaries. Combining all this data so that the tool would enable me to analyze that when a customer is behaving according to a certain pattern, I would be able to easily point out the focus areas and plan the actions. These are the kind of questions that better integration between BI and accounting systems could solve, but I'm not sure how to do that." (Business controller, 2020.)

This prevents, for example the business controller from being able to answer the business stakeholders' follow-up questions on the monthly results as detailed and accurate as she would need to. Thus, there is no option but to conduct high-level analysis based on assumptions instead of facts.

"As long as the discussion is on high level, it is clear, but if I'm asked what is the impact of our three most recent marketing campaigns to the customer behavior or how it shows in the customer activity or in the number of new customers, it gets difficult. I am still able to calculate on high level, but the deep-diving is missing." (Business controller, 2020.)

"You are able to barely meet the deadlines but then someone asks why some figure is the way it is, and you are like…I don't know, maybe we should have one resource that would focus on analysis. The schedules are tight so there is no time left for analyzing the figures which, after all, is the key thing to move forward." (CFO, 2020.)

According to the Head of Brain, the Brain team does support finance to some extent in digging behind the numbers. Finance is able to answer to most of the follow-up questions about the month-end results as the reports are comprehensive enough for the simple questions. However, sometimes there can be relatively big deviations between the month actuals and forecasts. In these cases, the task falls on Brain team's desk to find out the explanations to where the deviances are stemming from.

"We are not directly participating in the month-end closing unless there are questions about the figures. Most of the time they [finance] know because some of the information is in the reports, but we may have some discrepancies. For example, we collect less fees on online stores, but we didn't see the number of stores decreasing so why is that, is there a problem with the report, is the data correct or not. And there will be action from finance asking can we spend more time try to figure out with them why our revenue decreased or increased." (Head of Brain, 2020.)

"Whenever we need to sort of dive into the reports, look into what happened and what changed, then the Brain team is in very high demand." (Business controller, 2020.)

Finance highlights that there is also a need for more predictive analytics. Most of the current analysis done in the company are backward-looking. The CFO states that while backward-looking is important to see how we have performed historically and how our performance has been developing, the decisions

made today are not made for events of yesterday, but they consider tomorrow and the future in general. Therefore, we need to put more focus on predictivity and forecasting capabilities.

"From our point of view, perhaps the most important thing is that we can identify trends so that in decision-making we can consider where we are headed towards so that we can adjust accordingly. Historical data is important, but if we only look into the history, that does not work." (CFO, 2020.)

Currently the visibility to financial results during a month period is poor. In addition, in the month-end result review meetings the focus is too heavily on the historical performance. If the visibility to the resulting performance of the period was better, the management would be able to focus more on the future instead of looking back as at the moment.

"Adding more predictivity to the BI tool so that we are not only able to set the expectations but also to monitor whether we will be able to meet our goal or not. In addition, if we were able to increase predictivity, we would not have to wait until the month-end to start thinking about the next month. Increasing the real-time monitoring could allow us to focus more on the coming instead of focusing mainly on the past." (Business controller, 2020.)

The analysis that is currently done by the Brain team is mainly text analysis, for example, on NPS comments. For analysis, the Brain team will use BI tool to extract data and conduct the analyses. However, the amount of analysis done at the moment is low, but there is intention to increase analysis work. The main reason for the narrow scope of current analysis is that the data points needed for most analysis cases are unknown or inexistent because the data is either not being collected or the data is collected but not stored in applicable format. Due to this, the Brain team is not able to support to the desired extent in forecasting certain measures and conduct predictive analyses.

Moreover, the Head of Brain states that it is difficult for them to provide full support to all stakeholders requesting for support.

"Our team consists of five employees including me and we wouldn't be able to provide all the different reports and analyses for each department to make the best decisions." (Head of Brain, 2020.)

The Head of Brain further adds that his team's goal is to spread the knowledge about the IT solutions and data so that stakeholders would be able to create their own reports and dashboards and conduct their own analyses – achieving the state where the BI tool can function as a self-service tool.

BI also has another role regarding decision-making in the case company. Not only does it support decision-making by giving the management insights of the business, but it also supports the justification of the management decisions as mentioned in the previous sub-section. Information availability for all employees

and enabling them to be up to date to whatever is going on in the company and its business, significantly cuts down the time and effort for management to reason their decisions to the staff.

Information availability also means that the employees can find the answers to whatever questions they might have by themselves meaning that there will be fewer overlapping questions about the same topic to the management. Furthermore, information transparency across the organization is also considered to enable faster implementation of management decisions throughout the organization.

5.2.4 Other factors impacting BI&A utilization

All stakeholders interviewed recognized that lack of resource is the single most significant factor slowing down the development of both BI and analytics. Due to the fact that the Brain team's resources are heavily committed to carrying out the day-to-day tasks means that there is less time to focus on the development work. The Head of Brain highlights that Brain team does not only support finance, but also all the other teams in the organization. Therefore, the different ad hoc requests and questions already take up a substantial amount of the capacity.

In order to free up the Brain team's capacity for development, the Head of Brain states that the amount of questions and inquiries need to be reduced. In practice, according to the Brain leader, this means that the company needs to increase the data-awareness among all employees. Raising data-awareness and knowledge about data and how it is structured could improve the users' capability to run more queries themselves as kind of a self-service without having to contact the Brain team could free some of the Brain team's capacity for development work.

"Ideally, the company would have a data culture that would allow them [stakeholders] to understand how the data is displayed and they would be able to use the BI tool in a more autonomous way. So, what we want to do and try to achieve is to provide enough knowledge to the main stakeholders to enable them to create their own reports, dashboards, and do their own analyses." (Head of Brain, 2020.)

There have been attempts to increase the users' knowledge and data-awareness in the company. However, the measures taken seem to have not been effective. The Brain team leader argues that currently there is not even time to do proper planning in advance let alone focusing more on development. He further adds that the current reactive approach to doing things is highly consuming.

According to the Head of Brain they have held training sessions with the goal to train the users to use the tool themselves in a more autonomous way, however, the results are only moderate.

"We have had introduction and training sessions for the users, but the stakeholders' participation was not so good. Data people are not finance oriented and that is why we do

not necessarily understand how things are connected, the relations of different data points and why they are related to each other." (Brain team leader, 2020.)

Furthermore, all interviewees also agreed that there is room for harmonizing the terminology used in the company. Currently, multiple definitions co-exist for same concepts meaning that in different functional teams, the concepts have different meaning. Sometimes it is hard for the Brain team to understand what is actually requested in the queries due to this. In addition, the need for more proper documentation and process descriptions was perceived as an important factor to improve knowledge sharing.

"We have filters to include only the data we want, but if you ask me, and I have to ask from our data team…did I understand your question correctly so that I am able to interpret the question correctly to the data team in a way that they understand what I actually mean so that they deliver me the correct report which I can further give to you to answer your question. Anyone can answer the high-level questions such as how many customers do we have, but then I ask the team how many customers are from Finland and they give me the number of verified businesses when I wanted to know how many of our customer companies are operating in Finland." (Business controller, 2020.)

"Absolutely the terminology needs refining so that everyone understands the same concepts with same definitions. But then again, we need to also question whether we know how to ask for things, which can be adjusted when we have received the requested report and realize that this in fact is not what we requested for. At the time being, I see this as completely a resource problem as currently we do not have resources to drive harmonization." (CFO, 2020.)

"This [terminology] is not a problem in finance and Brain, this is a problem with all departments. For example, when the business controller asks about customers, she means one thing. When marketing comes to Brain and asks the same question, they are likely to refer to something else, and it [the definition] might change if you go to operations. This is challenging for us because whenever we are talking to our stakeholders, we have to stop and think "okay, I understand your question, but I'm not sure we are talking about the same thing."" (Head of Brain, 2020.)

To address this problem, the Brain team has established documentation where different concepts are defined – the data dictionary. However, the data dictionary seems to be more suitable for the developers and other staff working in the IT domain and may not be the most convenient way of finding information for the non-IT employees and, therefore, the current state of documentation is not considered sufficient enough for finance.

"We document a lot of things inside the BI tool because the tool has this feature which enables creating documents next to the thing that we just did [code] so it's just easier for us to validate things there while we are doing things. In congruence, this kind of documentation like how to do stuff and like that, we don't need because we use this tool

and, in this tool, we have the explanations there. Sometimes we write comments in the query and sometimes we have a proper readme document explaining how things are. So, we do have bunch of documentation but very specific for the developers. On company level we try to create this data dictionary which will help everyone understand what we are talking about." (Head of Brain, 2020.)

"In finance we don't have anything, no process descriptions or anything. We have data dictionary because Brain created it this year but…" (Business controller, 2020.)

The fact that there are multiple definitions for same concepts has led to a situation where Brain team does not always understand what is being requested or what they are supposed to extract from the raw data as the Brain team leader describes below.

"What happens sometimes with finance, is that we get a request for which we are not aware of what we are trying to answer. Sometimes we'll end up figuring out that we don't have what they want. Just last week we lost quite a lot of time trying to generate a graph. According to the stakeholder the numbers didn't match, but we had no idea what they should match against. What we know is this is the data that we have, and the stakeholders bring us the solution without explaining what the problem is. So, the problem is not just terminology, but communication in general." (Head of Brain, 2020.)

In general, the cooperation between finance and Brain is on decent level. According to the Head of Brain, the teams complement each other with their respective expertise, and since finance and Brain have been cooperating closely, the cooperation is productive. However, based on the interviews, there is room for argument whether finance should participate more in the development of BI and analytics.

"We know a lot about the data but very little about the business or how accounting works. They [finance] don't know about the data. About the cooperation, when finance is asking us for something, and we tell them that whether what they are requesting for exists or not, or maybe that something exists but is in a different format. We do have discussions about what is needed, what is possible and how should we look at things. We challenge each other and sometimes we manage to convince the other that we should look at things differently. Usually the requests from finance are doable, but most of the time not within the timeframe they want." (Head of Brain, 2020.)

"In terms of development, we are not prioritized, which creates the challenge that if the development team does not want to develop that [BI and analytics] at all, there is not much we can do ourselves. We can try to push them to do something but cannot influence so much." (CFO, 2020.)

"And when we need developing so that we get what we want to the BI tool and visible for us, and if development is not done, then we are left without" (Business controller, 2020.)

"Let's say that we can live with the current system, but whenever there is a hiccup in the system, the development team says they never want to see the system again – practically refusing to fix the issue. Then we are stuck with the issue and so far, we have been able to continue using the tool but no one seems to want to develop it further, it's not on anyone's list to develop nor does anyone want to take the responsibility on that." (CFO, 2020.)

According to the CFO, the greatest challenges with the current BI tool are the issues related to tool performance. At the moment, the tool is very slow, continuously recurring technical issues, which means that there are constantly investigations on the performance, and reboots, which take place somewhat often and therefore have an impact on the tool availability for the users.

To summarize, this study identifies few development topics that need to be addressed before the company can start developing their analytics capabilities further. This is because it seems that running the daily tasks and executing the current ad hoc tasks already take all the capacity available from the Brain team. To enable the Brain team to develop BI&A with other IT experts in the IT domain, it is likely that the stakeholder autonomy must increase for Brain team to free some of the capacity to development work. In the next section this thesis discusses in more detail what could be developed in order to enable advanced analytics development. This thesis aims at providing the case company the high-level frameworks for developing their information management and use, but also a framework as to what kinds of analytics could be utilized in theory.

5.3 BI&A development ideas to support management accounting

From the previous section it can be concluded that there are numerous challenges and questions concerning BI and analytics utilization in the case company to which the theoretical framework of this thesis may be able to answer. Nevertheless, it should be kept in mind that the purpose of this study is not to provide specific action recommendations but rather give the company and the main stakeholders of this study some food for thought and ideas on how data analytics capabilities and BI could be developed to increase the benefits from these advanced technologies and techniques. Nonetheless, this thesis aims to also summarize the most significant pain points that are hindering the cross-functional collaboration and performance in terms of reporting and decision-support.

Appelbaum et al. (2017) provided a comprehensive framework for successful deployment and engagement in BI and analytics utilization in MA field by adapting Kaplan and Norton's BSC model to BI context. From MADA framework's point of view, the case company's descriptive analytics in the financial perspective is on a decent level meaning that the accountants are able to capture and measure the most vital KPIs to support business. However, as the CFO mentioned, there is a need for more forward-looking analysis. In the financial

perspective, this could be achieved through predictive and prescriptive analytics techniques and supervised algorithms mentioned in chapter 3.

Moreover, prescriptive analytics holds a significant potential in decision support by generating optimized solutions and most likely outcome predictions. In addition, prescriptive analytics, as Appelbaum et al. (2017) presents, employs not only financial data, but also non-financial data, which could improve the comprehensiveness and accuracy of generated analyses and predictions.

Increased utilization of, for example, data collected from social media, could help the case company find new business opportunities by, for example, identifying new markets, untapped customer segments and products. Identifying profitable business cases could benefit the company in the form of additional revenue and/or market share, which both contribute to increasing shareholder value, which again is the core of financial perspective in the BSC model.

The case company currently has follow-up KPIs to monitor the customer perspective of the BSC model. Most of the reporting conducted at the moment is descriptive such as conversion rates (from prospect to paying customer) and other sales and customer acquisition funnel related KPIs and NPI to monitor customer satisfaction. According to the Head of Brain, the team already is using text mining technique in some of their tasks, but on the other hand, external data sources are not in use for the time being.

This could be a potential business case for the case company to investigate further as, according to Appelbaum et al. (2017), for example, the significance of social media as a data source should not be taken lightly in the current digitalized world. They further argue that text mining enables users to extract data from platforms such as Facebook and Twitter feeds which have been proven to be highly valuable source of data for some companies to acquire customer feedback. In addition to feedback, utilizing social media as a data source could enable the company to better predict the changing needs of product features, competition, and also market adoption. Being able to predict future trends could give the company substantial competitive advantage.

As an example of a predictive analytics use case could be for example in customer conversion and retention. The case company is already measuring conversion and retention rates and adding more predictive and prescriptive analytics could enhance the capability to predict customer behavior based on behavioral patterns already in the early phase so that the company would be able to take preventive actions to keep the customer. Furthermore, prescriptive analytics could potentially increase the accuracy of forecasting customers' value to the case company's business in the future and give optimized solutions on what actions to take based on each customer's forecasted value to the business. This, on the other hand, would increase the resource and operations efficiency as the company would be able to address more precisely what resources and actions are needed and where.

Customer satisfaction can be improved in many ways – one of them is launching better high-quality products and services faster. To ensure that the financial perspective's goals do not suffer from this, it means that the company

must keep the costs at minimal while achieving the above. Prescriptive analytics would enable management accountants to analyze the four factors: quality, time, costs, and performance and service and how would they impact the customer satisfaction i.e. what would be the optimal mix of the factors to achieve the best solution for both the customer and the company.

In the discussions with the business controller it was brought up that the employee turnover is quite high in the organization leaving the company with little time to react. This means that whenever an employee changes jobs, the company may have to replace that person with a new employee. Depending on the requirements and degree of difficulty of the job, the company always has to put in resources to train the new employee. Furthermore, it usually takes time for the new employee to catch up and get to the speed of the more experienced employees. In addition, the business controller mentioned that there is very little process documentation in the organization, which could mean that the company is losing human capital (knowledge, skills) when an employee leaves the company.

To minimize to possible impacts of employee turnover, the company could consider creating KPIs to measure employee skills and productivity, cycle time, and quality. According to the CFO of the case company, they do not have a designated HR professional to specifically handle human resource related tasks. Nevertheless, this does not necessarily restrain the top management from establishing a high-level framework for workforce monitoring and analysis. This framework could be helpful in recruiting new talents and, more importantly, identifying the right people who are likely to stay with the company longer.

Employee retention may be even more important for a small company with scarce resources. In addition, the case company, according to the business controller, lack in formal process descriptions and documentation. This further increases the risk of losing valuable tacit knowledge along with the resigning employee.

Considering the internal processes, since at the moment there is very little process related documentation, the company could consider starting process mining, which according to Appelbaum et al. (2017), provides the management accountants the means to gain a better visibility and understanding of internal processes, but more importantly, enables simulating the processes in different scenarios to support internal process performance optimization.

As already mentioned earlier in the thesis, traditionally complex decision-making has relied more on professional experience and descriptive analytics. However, Appelbaum et al. (2017) state that optimization models using programming could help to find the optimal solution in terms of skills, quality, productivity and cycle time. This could streamline decision-making processes and shorten the time needed for making decisions.

Since the BI tool and the analytics embedded in the tool have already been implemented, this thesis does not consider what could have been done in the implementation phase, but it focus more on what can be done to improve the tool capabilities to better answer to the needs of the stakeholders. As mentioned earlier in section 3.3, Yeoh and Koronios (2010) and Appelbaum et al. (2017) argue

that the technology acquired should be business-driven, scalable, and flexible to enable sustainable data quality and integrity. Reflecting this statement against the case company's BI tool, one could say that the technology is appropriate.

Based on the interviews and a short demonstration of how the case company's BI tool works, it can be concluded that the current tool allows flexible analysis through combinations of different data points. However, there were contradicting views on the data quality among the interviewees. On the other hand, quality can be perceived differently – for the business controller the data might seem flawless because IT has already solved the issues before handing over the processed data to the business controller in a report.

According to the Head of Brain, the data is good quality, but then again, the concept of quality needs to be defined more specifically as although the data is good in quality, but the challenge is that the data might not be in the format that it could be utilized for some reporting or analysis purposes.

Obviously, it is not possible, nor would it be feasible, to plan and design the data so that it would fit all possible information and analysis needs as predicting all the future information needs is most likely impossible task to carry out. Therefore, it is important for a company to have a clearly defined targets for what the company wants to achieve with business analytics (Brands & Holtzblatt, 2015).

Pre-determined goals and requirements for the tool's analytics capabilities would ensure that the tool is able to support the users to execute the company strategy and mission (Brands & Holtzblatt, 2015). The CFO of the case company mentioned that BI plays in important role in steering the company towards its strategic goals by filtering the relevant information from the enormous mass of data. She further adds that the decisive stakeholder should be able to define their information needs, but so far defining these needs have been more on the "learning as we go" basis. This puts pressure to the Brain team as according to the team leader they are already operating on full capacity to deal with the daily tasks and in addition they would have to develop analytics and change data design reactively.

Since financial resources are constraining the Brain team from increasing workforce, for the Brain team to free some capacity for development work, the level of autonomy of the users needs to increase. On the other hand, higher level of autonomy often requires higher level of knowledge and skills to operate the BI tool, which brings us to the problem that there is very little commitment and interest to the training given by the Brain team to the end-users.

Reflecting the current state of BI utilization in the case company against the critical success factors defined by Brands and Holtzblatt (2015), it seems that there is a high demand for building a more comprehensive framework for business analytics and planning and defining a proper training strategy with top management's commitment and support.

From the aforementioned development areas, perhaps the business analytics framework and planning are the most crucial ones considering the key purposes of a BI tool. Although Brands and Holtzblatt (2015) state that these are key requirements for implementation, it does not necessarily mean that these

requirements are irrelevant in the operating phase. Building a proper framework for analytics and planning would enhance the translation of business objectives (strategy) into business analytics models, which could help the Brain team in identifying what data is needed to populate the models. Knowing what data is needed would most likely help in defining all the characteristics and requirements of data, and this ensures that the analysis objectives are definitely based on business requirements (Brands & Holtzblatt, 2015).

Regarding the concerns of sensitive data leaking, in the section 3.3 it was mentioned that there are means to mitigate this risk. The case company could investigate how feasible it would be to adapt data access restriction and data anonymization to improve data privacy governance to retain the possibility to utilize the full potential of the BI tool in data analysis and reporting.

For the company to reach the state of agile, more forward-looking analytics with shorter analysis lead time, the case company should consider reorganizing their internal work processes so that it would support developing the BI system towards a proactive BI as Dekkers et al. (2007) have defined. The integrative framework complements the MADA framework in the sense that the integrative framework takes into account the interconnection of the information usage process and the development process.

To summarize, as it is a strongly growth-oriented company in question that has only recently adopted a BI&A tool, there can be identified multiple of points of development. However, focusing only in the small parts could lead to a situation where the forest cannot be seen from the trees. Based on the interviews, this study identifies larger development areas which ought to be developed to provide better grounds for BI&A development and utilization.

Firstly, documentation and terminology. Addressing these topics would likely improve and increase the communication as different stakeholders would be speaking same language so to speak. Documentation here refers to process descriptions and definitions where different parts of the processes in different functions would be clearly described and explained. With documentation such as "finance for non-finance" where even just the basic finance terms and concepts are explained, would be an easy and efficient way to share knowledge. In addition, the IT function could have the basic concepts defined and explained in layman's language to share information related to data and information systems to spread data-awareness.

Secondly, iteration and developing on the go as an approach may work, but there could be a risk of running to misalignments of company strategic goals and what is being developed. Proper mid-term and long-term planning, setting out the framework for development that is based on the company's strategy will ensure that in addition to doing things right, right things are being done. This is highly relevant in order to optimize the utilization of BI and analytics in decision support.

Specifying, developing and redesigning data, testing, piloting and deploying a new KPI and building reporting and analysis can require a significant amount of time in addition to the time that is required for the stakeholders to

understand what the KPI measures and how it is reported. Development without proper planning and in rush may create needs to change the definition for the KPI afterwards, which can, on the other hand, cause confusion among the stakeholders when the generated data for that particular KPI is not consistent over different time periods.

Proper planning requires time and resources. As mentioned in the previous sections, resourcing is the single most constraining factor for the case company to focus more on development of their BI system. One of the reasons for this is that the management has decided to allocate more resources to functions that are generating revenue such as business, sales and marketing development rather than to functions that have a more supportive role in the company. This decision can be considered to be a part of a strategy that aims to growing the business.

However, one could also argue that developing analytics capabilities and business intelligence would enhance the company's capabilities to identify new business opportunities as mentioned earlier in this thesis. But in addition, advanced analytics could give finance better tools and insights that would better support business management in terms of how to drive the business to more profitable waters as, in the end, what matters is what the company has on the last row of its P&L statement. Nevertheless, having said that, development must start from the top management. When management has the ambition to develop BI and analytics, it would most likely be easier for the functions to justify their efforts to develop and push that development forward.

6 CONCLUSIONS

The purpose was to study how the utilization of BI could be further developed to improve management reporting, and more specifically, data analytics to better support decision-making – enabling more data-driven decision-making.

To reach this goal, the framework for the study was structured based on earlier studies and theories of critical success factors and how finance department and IT could collaborate to increase responsiveness and, on the other hand, reduce the lead time for ad hoc requests. Therefore, critical success factors and the integrative framework were considered appropriate for this study.

The reasoning behind this approach was that due to BI tool being a fairly new tool in the company, it might not be relevant to put all focus on how to develop reporting since it was recognized that there are underlying challenges that prevent the company from elevating the usage of BI such as data infrastructure, process inefficiency, lack of data awareness, and human resources. Some of these factors are not concerning BI systems directly but nevertheless have an impact on how much time and resources the company can allocate to improving reporting and analytics capabilities.

Furthermore, it was recognized that the finance professionals are looking forward to developing the accuracy of forecasting and that way improve the visibility into the future i.e. adding more predictiveness to their analytics. To address this challenge, the thesis presented some of the concepts by Appelbaum et al. (2017) on descriptive, predictive, and prescriptive analytics.

Most of the information, based on which the decisions are made, are delivered to the management in various forms of MA reports. From utilization point of view, the company has achieved organization-wide utilization. However, there are improvements needed in raising data awareness and basic knowledge of data and how the systems are structured and connected. This could help stakeholders to have, at least on conceptual level, an understanding of what data is available and what is not. Furthermore, it would ease the workload of the Brain team and free capacity for more value-adding work such as analyzing data and generating insights about the business.

As mentioned in the section 1.2, the goal of this thesis is not generating concrete action recommendations as direct recommendations would require more in-depth research. The ideas and suggestions described in the above should be considered as what the analytics and BI system in the case company could be to achieve what the case company desires from a BI system and its utilization. Furthermore, this thesis does not take a stand on how feasible the applications presented are for the company. However, the MADA and the integrative framework, at least in theory, may be useful for the company's planning purposes if they decide to initiate more active BI&A development. This is because based on the interviews with stakeholders from finance and IT, it was not clear whether the company has a clear framework in place for BI&A development despite of that being in the interest of the CFO at least.

The research gives an appropriate understanding of the current state of BI utilization in finance, but due to the size of the company, the Brain team does not support finance team only but the whole organization. Therefore, some of the findings may be argued whether they belong to the management accounting domain or not. Again, due to the size of the company, the finance team has wide range of responsibilities covering the whole company in terms of accounting and finance.

This research met the preset research objectives by addressing what are the key development points in the current processes and how BI system could be developed to achieve the desired state of BI utilization. During the process of composing this paper, the finance stakeholders have informed that they have already had discussions within the company to develop information use and development process similarly to the model of the integrative framework.

Although the research and findings are limited to the case company and cannot be generalized, the research, however, may be relevant for other researchers interested in the topics related to BI&A in the MA domain and fintech small-medium size company context.

Furthermore, when evaluating the validity of the results of this study, it should be remembered that the empirical evidence for this study was gathered from only three interviewees. The limited number of interviews may impose some limitations to how representative the results are for the company and how valid and relevant the findings from this study are for other similar studies.

On the other hand, the goal of this study was not to find generalizable results. Instead, the purpose was to focus solely on the case company and study how especially finance department is perceiving the current state of BI utilization and find feasible solutions to answer to challenges specific for the case company in their BI&A development. In that respect, since the case company is relatively small, the three interviewees can be considered to have deep enough knowledge and experience to give reliable and valid information with appropriate coverage about the BI&A utilization in management reporting in the case company.

As accounting information systems, business analytics and other decision-support systems evolve, they are likely to have an impact to management accountants work and therefore change the job requirements. Although, the role and job requirement changes are not in the scope of this thesis, it could be interesting to study what are the skill and knowledge requirements and expectations towards a management accountant in few years' time.

It surely is not news that controllers are expected to have knowledge of accounting information systems, but as the amount of data is increasing, companies are likely to emphasize the importance of data-driven decision-making. Therefore, management accountants as in-house consultants most likely need to develop their skills to meet the future expectations in understanding data and how to cope with remarkable amounts of data to generate insights for the management as the increasing amount of available data is likely to set challenges for management accountants to analyze extremely large sets of data (Brands & Holtzblatt, 2015, p. 2).

Furthermore, it could be argued that in order to make the most of the available data, management accountants need to have IT knowledge so that they know how to ask for certain things from IT team. Knowing what you need is important, but what could be even more important is how to communicate that need in the most effective way. In addition, as already mentioned in the section 2.3.2, in the end, BI tools alone are not enough to support decision-making but instead it, at least for now, still needs a human to interpret the data, make conclusions and tell the story to top management, which can the use the insights to turn information into competitive advantage.

In addition, as in the case of the Company X, it was identified as a clear top management decision to allocate more financial resources to the revenue generating functions rather than to so-called back-office functions that do not, at least directly, generate revenue. This is of course understandable strategic approach. On the other hand, more advanced utilization of data analytics and BI could support in discovering, for example, new markets and customer groups for the company to expand its business. Therefore, it might be worth studying what would be the benefits and risks from taking a slightly different strategic approach by putting more eggs to the back-office functions.

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