THE ROLE OF BIG DATA IN FINNISH COMPANIES AND THE IMPLICATIONS OF BIG DATA ON MANAGEMENT ACCOUNTING

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ABSTRACT

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Abstract

Companies have massive amounts of data, which becomes valuable when analytics are applied and information is extracted from it. Big data enables companies to base their decisions facts instead of assumptions. The purpose of this study is to find out do companies in Finland utilize big data and to what extent. Implementation, application areas and experiences in decision-making context are under scrutiny. Additionally, this thesis aims to find out the impacts of big data on management accounting. This study is qualitative in nature, but has a quantitative part. The chosen method is a case study and data is gathered with a survey and five interviews.

Finnish companies are rather young in data utilization. Some companies do not use it at all, whereas some companies are in early stages or the use is relatively wide. Companies have variety of data, depending on their industry and focus areas. Companies, who are customer centric, seem to utilize big data information more comprehensively than others. Data is used both in operational and managerial level and companies want to embed it to the whole organization. Most important application areas are forecasting, improving efficiency, strategy, performance monitoring, CRM, marketing and sales. There is unanimity over the importance of big data and companies are aware of the possible benefits. It is still seen less important than traditional accounting information. The role of intelligence experts and data scientists is increasing its importance, but management accountants and business controllers are still often seen to be most relevant to management and decision-making.

Companies are often unsure how to utilize data and how to extract information and turn it into valuable insights. It is challenging to find capable employees with both theoretical and practical knowledge. It has become highly important to have analytical skill in addition to knowledge about business environment and its processes. Traditional functions are in transition and some may disappear, analytics are needed in every function. Management accountants are seen to move closer to IT and analytics. They need to move forward from traditional historical reporting to forecasting.

Key words: analytics, big data, decision making, digitalization, management accounting

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Tiivistelmä

Yrityksillä on valtavat määrät dataa, josta saadaan analytiikan avulla arvokasta informaatiota, jota yritykset käyttävät päätöksenteon tukena. Tässä tutkielmassa tutkitaan miten laajasti suomalaiset yritykset hyödyntävät big datasta saatavaa informaatiota. Kiinnostavaa on tietää miten kauan dataa on hyödynnetty, mitä käyttöönottoon liittyy ja miten merkittävänä big dataa pidetään. Lisäksi tutkitaan big datan vaikutusta johdon laskentatoimeen. Tutkimus on kvalitatiivinen, mutta siinä on myös kvantitatiivinen osuus. Metodi on tapaustutkimus. Aineisto koostuu kyselytutkimuksesta ja viidestä haastattelusta.

Osa suomalaisista yrityksistä on hyvin alkuvaiheessa datan hyödyntämisessä, osa on jo pidemmällä. Osa yrityksistä on suunnitteluvaiheessa ja osa ei hyödynnä dataa lainkaan. Tämä tutkimus osoittaa, että yritykset eivät ole hyödyntäneet dataa vielä kovin kauaa, sen painoarvo on huomattu monien yritysten kohdalla vasta viime vuosina. Dataa hyödynnetään sekä operatiivisella tasolla että johdon ja strategisten päätösten tukena. Asiakaslähtöiset yritykset, jotka ovat suoraan kuluttajien kanssa tekemisissä hyödyntävät big datasta saatavaa informaatiota eniten, sillä heillä on usein paljon dataa saatavilla. Yritykset hyödyntävät sitä eri tavoin, riippuen toimialasta ja tavoitteista. Merkittäviä osa-alueita ovat ennustaminen, strateginen kontrolli, toiminnan tehostaminen ja monitorointi sekä budjetointi. Myynti, markkinointi ja asiakashallinta ovat myös merkittäviä osa-alueita.

Big datan merkitys on kasvanut vauhdilla viimeisen vuoden aikana. Nykytilanteessa tukeudutaan usein eniten perinteiseen laskentainformaatioon, mutta lähitulevaisuudessa datasta saatavan ja ei-rahamääräisen tiedon merkitys korostuvat yritysten jokaisella osa-alueella. Talousjohtajien työnkuvasta tulee IT-painotteisempi ja työtehtävät tulevat sisältämään myös analytiikkaa. On tärkeää, että koko organisaatio toimii datalähtöisesti. Osaamisvaatimuksena on liiketoimintaprosessien ymmärtäminen käytännössä sekä kyky tulkita tuloksia ja tehdä päätöksiä niihin pohjautuen.

Asiasanat: analytiikka, big data, digitalisaatio, johdon laskentatoimi, päätöksenteko

Säilytyspaikka Jyväskylän yliopiston kauppakorkeakoulu

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1 INTRODUCTION

1.1 Background and topic

Over the past decade, the amount of data has been growing immensely, as well as electronic form of it. In 2000, around 25 % of information was electrically stored, whereas today the amount is 98 % (Cukier and Mayer-Schönberger, 2013). After digitalization, data is collected from everything around us continuously. Companies have begun to realize the possibilities that come along gathering data and analyzing it. Therefore, business analytics and the use of analytical tools have become a trend among large companies in the world (Chen, Chiang & Storey, 2012; IBM, 2012). The technological landscape has emerged and will continue emerging in the future transforming the landscape of business (Hurwitz, 2013; ACCA & IMA, 2013, 8). This has led to a data-driven era of business (CGMA, 2013).

Recently, both researchers and practitioners have shown an increased interest towards data and its usage for management, decision-making processes and strategy implementing (Hurwitz, 2013; Chen et al., 2012). The Association of Chartered Certified Accountants (ACCA & IMA, 2013) raises the question of how diverse, disparate and amorphous datasets can be managed profitably and responsibly. Companies have vast amounts of data and the question is, can it be used and made usable in business? It is said that along new big data solutions information becomes most essential capital for companies (Talouselämä, 2013).

Big data has potential to dramatically change the way companies do business and organizations use their data (CGMA, 2013; Hurwitz, 2013). Big data is being generated by everything around us continually. Therefore, it generates the possibility to develop data driven businesses that gather, store and analyze data for improving business performance and profitability as well as to solve business challenges and produce innovation. According to IBM (2012), opportunities to utilize big data technologies to improve business performance and decision-making exist in every industry. If successful, big data enables means to improve performance and productivity, in addition to increase revenue for shareholders and stakeholders (ACCA & IMA, 2013).

Gartner (2015) defines big data as “high-volume, high-velocity and high-variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision-making.” Data can be found in different forms and sources for instance social media, transactions and sensors, as well as information systems such as ERP-systems. The problem among enterprises nowadays is to find the precise information to meet the needs of the company. The core idea with big data is to find relevant data and extract information out of it to support decision-making. According to IBM (2012), big data technologies enable organizations to extract insights from data with previously unachievable levels of sophistication, speed and accuracy.

Big data has been studied comprehensively during the past years. Big data exploitation has become an increasingly important prerequisite for competitiveness among companies in different industries (Ministry of Transport and Communication in Finland, 2014). Therefore, big data solutions can create immense possibilities in various businesses processes and become competitive advantage if applied correctly (ACCA & IMA, 2013). Big data no longer exists only in the realm of technology; rather, it has spread to variety of processes and organizations in different industries and even societies (Schlegel, 2015, 12). According to Moorthy et al. (2015), big data has emerged to nearly every aspect of society. According to them previous case studies show that big data is proven to be useful for instance in healthcare, urban planning, environmental modeling, systemic risk analysis and energy saving.

The state of big data has not yet been studied widely in Finland. In 2014 and 2013, Finland was ranked number one in Networked Readiness Index, as it has an outstanding digital ICT infrastructure (World Economic Forum, 2014). Similarly, Ministry of Transport and Communication (2013) state that Finland has knowledge and capabilities as well as data reserves and communication network infrastructure in order to gather data and build competitive big data activities. This shows that the prerequisites for the newest technologies can be found in Finland. United States is said to be 2-3 years ahead of Europe (Talouselämä, 2013). Therefore, it is interesting to see what the state of big data utilization in Finland is.

Big data implications on management accounting have been studied comprehensively around the world during recent years (E.g. Griffin & Wright, 2015; Vasarhelyi, Kogan & Tuttle, 2015; Warren, Moffitt & Byrnes, 2015; CGMA, 2013; Gray & Alles, 2015). Therefore, previous research provides some insights into the subject. Data is seen to affect the whole organizational structure, most of all, the role of finance function and management accountants is seen to change (Bhimani & Willcocks, 2014). These types of studies have not yet been conducted in Finland. Therefore, it is important to know will big data have an effect on management accounting, accounting profession and other business professionals in Finnish context.

1.2 Aim of the study, research questions and limitations

The state of big data has not been studied widely in Finland. The Ministry of Transport and Communication (2014) studied the role of big data in Finland, focusing more on theoretical level rather than practical. They found that two years ago the means to collect, analyze and exploit big data were still in the state of development and transition in Finnish context. Situations change fast as technologies develop and therefore, this study aims to find out do companies in Finland utilize big data in their business processes and decision-making and to what extent. IBM (2012) conducted a study on the utilization of big data global-

ly. Comparing to that, this study aims to find out how and why companies in Finland extract valuable information from big data.

Previous studies show that big data can be useful in different business processes; it helps in improving business performance and can lead to lower costs. Therefore, it is important to know do companies in Finland utilize data with similar objectives. This thesis examines how companies apply big data in different application areas. It is interesting to see what the stage of big data maturity is, under whose responsibility big data as a function belongs to, what technologies are used, who uses, gathers or analyzes data in the companies, how important big data information is for decision-making and for management, and what challenges companies are facing after big data implementation. This study aims to survey the perceived experiences on big data implementation as well as any challenges that have emerged. Additionally, perceptions about the future and role of big data compared to other sources of information are scrutinized. Based on the information of utilization and implementation of big data, innovations and technologies can be developed in Finland. Statistical generalization cannot be made; the results however can shed some empirical light on the concept (Yin, 2014)

Furthermore, the study examines the impact of big data utilization on management accounting and the role of different business professions especially in finance function. What type of transformation of management accounting and the profession of management accountants has emerged after the era of big data? Along this possible change, requirements for accounting professionals can be constructed. Management accountants may have to acquire new competences such as ability to read and understand large data sets. The results of this study can be compared to the results of the study of ACCA & IMA (2013), who studied how big data will change accounting.

Research questions are the following:

1. *Do Finnish enterprises utilize big data? How and to what extent?*

2. *How is big data utilized in business processes, and to support decision-making and management? What experiences and challenges have emerged?*

3. *What are the implications of big data on management accounting and to the role of business professionals?*

This study is conducted as a master's thesis; therefore, certain limitations were made. Being a master's thesis, this study had some limitations with time and content. This study focuses on large and middle-size enterprises in Finland; as they are most likely applying data-driven tools in their businesses. Big data and business intelligence have been under scrutiny mainly in technological or theoretical level, rather than practical. Therefore, this study aims to survey the use of big data in practice and the focus is on the business viewpoint rather

than technological. Additionally, the aim is to point out the relationship between big data and management accounting in practice. The study does not aim to research whole field of big data or accounting. The limitation is on management accounting, rather than financial accounting, because the aim is to add to understanding on how companies in general use big data to attain organizational goals and how the increasing utilization of data affects the finance function. Master's thesis is often unable to give a thorough understanding of a matter; hence, additional research is needed to ensure the reliability of the results.

1.3 Previous research

Business intelligence, big data and IT have been studied widely in the past decade particularly after digitalization. Therefore, ways to utilize big data have been introduced and implemented. Nevertheless, company managers are often unsure of the utilization and possible application areas of big data. Chartered Global Management Accountant (CGMA, 2013), has studied big data utilization widely. They state in their report, that 51 % of corporate leaders highlight big data and analytics in top then of corporate priority matters. Similarly, ACCA & IMA (2013) have studied the utilization of big data rather widely. They predicted the future increase in adaptation of big data solutions already in 2012. In addition, they predicted 62 % growth for the impact of big data globally during the next 5-10 years. They also found many possible beneficial application areas of data.

The Ministry of Transport and Communication (2013) has conducted general studies on the existence of big data in Finland (2013) and state of big data exploitation (2014). They found that all industries and areas in Finland have possibilities to profit from big data. They studied the prerequisites for development of possible application areas and the means for better utilization of big data in decision-making. Davenport (2014) introduced how leading companies utilize data in practice with examples of various companies. Akbay (2014) studied how big data can revolutionize decision-making.

SAS Institute and Intel (2015) conducted a study regarding the adoption of big data analytics and Hadoop. They surveyed more than 300 IT-managers from the largest companies in Finland, Norway and Sweden. They found that data and analytics are increasingly important for companies in variety of industries. In this study, 92 % of all the respondents agreed that more and new data used for analytics could give them competitive advantage. 90 % of Finnish companies thought new data would be useful in order to gain competitive advantage. 76 % of Finnish companies admitted to have a need for collection of new types of data (such as unstructured) that cannot be stored in traditional databases and systems. In this survey, Finland had the highest score and it shows that Finnish companies have realized the possibilities and advantages that come along big data.

As a market leader of big data technologies, IBM has conducted several studies regarding big data utilization. They conducted a study in 2012 aiming to find out how companies globally, mostly in North America and Europe, view big data and to what extent they are currently using it. Recipients represented variety of business functions. They examined over 1000 business and IT-professionals from 95 countries. Their study showed that 47 % of the companies were planning big data activities and 28 % of the companies had already implemented an application or a pilot program. From these studies, it can be interpreted that the importance of big data is widely recognized. Davenport and Dyché (2013) introduced examples of large companies utilizing data, mostly in North America.

World Economic Forum (2014, 45) released a global information technology report, in which they introduced the risks and rewards of big data. According to their report, big data most frequently assists financial management as well as marketing, and sales. It is least valuable in human resources management. Data-rich organizations, such as retailers or telecommunications companies, are best equipped to utilize their internally generated data (World Economic Forum, 2014, 46). Moorthy et al. (2015) studied the prospects and challenges of big data and found several business benefits of big data utilization. Schlegel (2014) studied the utilization of big data and predictive analytics to manage supply chain risk. The results showed that the use of real-time information in supply chain management could increase revenue and profit. Warren et al. (2013), and Gray and Alles (2015) found ways to make use of big data in management control.

ACCA & IMA (2013, 5) has hypothesized the impact of big data on accounting profession, and claim that more strategic decision-making role of finance professional has already developed. Similarly, Warren et al. (2015) studied the implications of big data on both managerial and financial accounting. They also studied possible risks and limitations regarding the use of big data. Vasarhelyi et al. (2015) as well as Griffin and Wright (2015) conducted a research on big data implications on accounting. CGMA (2013) surveyed the changing role of management accountants, and found that they need to become more data- and IT-oriented. Additionally, Gray and Alles (2015) studied the changing roles and requirements of management accountants and came to similar conclusions. Bhimani and Willcocks (2014) studied how big data transforms accounting information, finance function as well as management accounting.

1.4 Research approach

This study is a combination of quantitative and qualitative research. Qualitative approach has more emphasis, as qualities of qualitative research are interest in details, individual factors of events, as well as causation. Additional qualities of qualitative study are interest in constitution of meanings in individual actors. (Metsämuuronen, 2005, 203) The chosen method is a case study, with some

characteristics of a grounded theory method. Case study was chosen, as it is relevant in situations when a certain phenomenon is studied extensively and in-depth with "how" and "why" -questions. Case studies do not aim to statistical generalization; however, some analytical generalization in the context could be made (Yin, 2014). Case study is a suitable method in case of limited prior research (Humphrey & Lee, 2004). A feature of grounded theory method is data-orientation in formulating the results, which is used in analysis phase. (Metsämuuronen, 2005). Case studies are commonly used in accounting research. The method is often used by accounting researchers in the UK and in Nordic countries (Lukka 2005). Recently, many Finnish studies in management accounting have been case or field studies (Järvenpää & Pellinen 2005).

The chosen method to gather the data for the quantitative part is a survey. Due to the quantitative nature of the survey method, it aims to provide some insight into the subject. Survey is useful in answering questions such as who, what, how much or how many (Yin, 2014). The aim of a survey is to describe and chart phenomenon rather than explain reasons and consequences (Buckingham & Saunders, 2004). In this thesis, the quantitative part lacks the general qualities of a quantitative study because it does not aim to generalize. Due to a small sample size and low response rate, a second part was conducted in order to expand the amount of data.

The data in the second phase of this study is gathered with interviews. Interviews are chosen in order to gain more in-depth insight into the subject of how and why companies in Finland apply big data in their business processes and utilize it in decision-making. It aims to acquire information more extensive information and create somewhat explicit picture. The aim is to get personal experiences from companies. Weaknesses of an interview as a way to gather data are for instance bias due to poorly constructed questions and prompting the interviewee to tell what the interviewer wants to hear (Yin 2014). The qualitative part aims to describe, explain and compare the phenomenon (Hirsjärvi, Remes, Sajavaara, 2006, 125). The research approach is presented more detailed in chapter 3.

1.5 Validity and reliability

Validity is achieved by using research instruments that measure what they are intended to measure. Reliability refers to the fact that same results can be produced from the same conditions each time a research instrument is used (Buckingham & Sanders, 2004, 72). In this study, response rate remained low; therefore, the results cannot be generalized. Additionally, small sample size can effect on the reliability of the study. Questionnaires are somewhat limited in the amount of information they can gather, which may also affect the reliability (Buckingham & Saunders, 2004, 44, 70). The questionnaire used in this study is rather long and therefore, respondents may be hesitant to answer the questions precisely if it seems time-consuming. If the survey form is too long, it can effect

on the results, if the respondents are not fully concentrated or have time limitation to answer the questions.

The definition of big data can be somewhat unclear to respondents even if it is explained at the beginning. Big data can be defined and experienced differently depending on the viewpoint of the respondent as well as organizations; therefore, inconsistency can occur within the responses. Some of the questions were similar with other questions and if in hurry, it may be challenging to notice the difference between questions and themes. Most of the questions did not have "I do not know" –option, and in cases of uncertainty, respondents could select any of the answers randomly, which can distort the results.

In a case study, researcher may face challenges in developing a sufficiently operational set of measures and how to measure certain social phenomena (Yin, 2014). This may endanger the reliability. One limitation of this study is that the interviewed companies were selected intentionally instead of random sampling, and therefore, the sample does not represent the whole population truthfully. When conducting an interview, interviewer may prompt or probe the respondent and cause a bias in the responses (Buckingham & Saunders, 2004, 72). This is more likely to occur when conducting Master's thesis, as the interviewer is not yet very experienced with being an interviewer. If the interviewer is not very experienced, it may be challenging to perceive when to ask additional questions and acquire more information about an important theme. Researcher always has some type of perspective through which they observe the world, and this perspective may affect the interactions and interview manner (Atkinson & Delamont, 2010). Additionally, results of a qualitative study strongly rely on researcher's interpretations.

2 THEORETICAL FRAMEWORK

2.1 Big data

2.1.1 Definition

Nowadays data can be found everywhere: social media, internet, data warehouses, digital archives and reporting systems. Machines and inanimate objects produce most of the data, rather than humans, who have done it before. Companies can collect data from various sources: credit cards, emails, company websites, social media, and business transactions, even GPS-systems. Most people have mobile devices and many companies have mobile applications, through which data can also be collected. In addition, sensors, simulations and scientific experiments can nowadays produce vast amounts of data. Some of the data is in cloud storages. Data collected from these sources is not traditional data; therefore, all of this can be referred to as big data. (ACCA & IMA, 2013, 10; IMB, 2015; Gray & Alles, 2015, 23; Moorthy et al., 2015, 89)

Laney, an analyst at Gartner (2001) introduced the widely known definition of big data, in which it is referred to as the 3 V's: volume, velocity and variety. Later, Gartner has widened the definition into 4 V's including veracity. The recent definition of IBM (2015) introduces a fifth V, value. Volume denotes to the vast amount of data and the variety of information sources. Velocity represents the speed at which new data is constantly created and processed to meet the demand of accurate information. Variety refers to the various types of data that can nowadays be used, because data often differs from common structured data that fits into table. Veracity refers to the reliability of data. As the amount and form of data widens, so does the accuracy and quality of it. Overall, value is in the core of big data, because the main interest is to gain value from the data that is available today. (IBM, 2015; Syed et al., 2013)

Big data can be defined as collecting, storing and analyzing massive amounts of data. Big data is fast data; collected, transferred and processed promptly (ACCA & IMA, 2013, 12). Nowadays, data can be recorded without much effort or awareness. Due to lowering storage costs, it is more usable to store data, even if it is not used, than to discard it. Thus, the possibility to extract valuable information out of company data expands. Big data can also be defined as a broad term for datasets so large and complex that the traditional software programs, such as Excel, are unable to store or process them (Syed et al. 2013, 2446). Therefore, new technologies have to be invented and thereby programs that can be used to analyze big data, such as Hadoop and Tableau, have emerged.

The definition of big data is wide and differs depending on the domain and user of it. Additionally, continuous technological development effects the conceptualization of big data (Huang & Huang, 2015). The definition is prone to

changes and can become more exact in the future. During recent years, big data programming models and software have been developed and are often used synonymously with big data, creating a wider definition (ACCA & IMA, 2013). In some cases, big data is seen synonymous to business intelligence (BI). In this thesis, however, they are differentiated from each other.

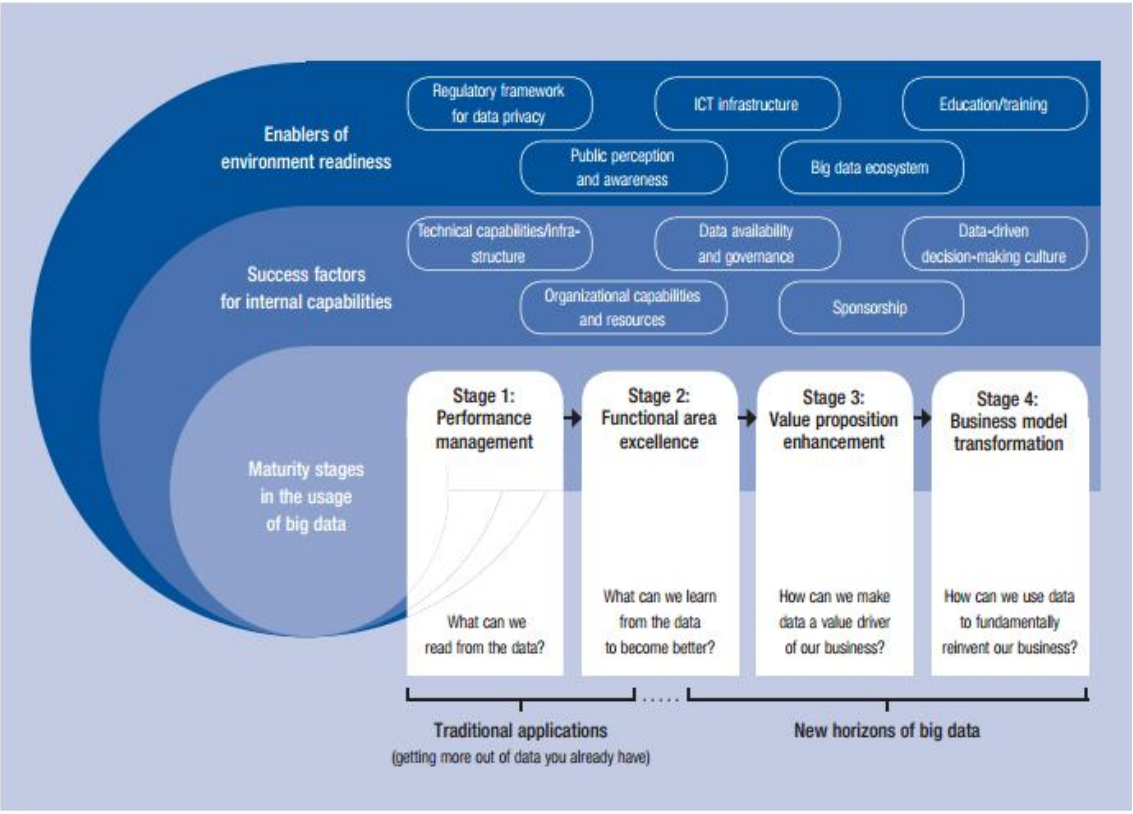
Data is nowadays collected from various sources. It can be in different infrastructures, such as cloud, or in different databases, such as rows, columns, or files (Moorthy et al., 2015, 89). Data can be divided to internal and external data as well as structured, semi-structured and unstructured. Essentially big data is unstructured data not conformed into a specific or predefined data model. Unstructured data consists of various types of human information; emails, videos, social media postings, phone calls and clicks on websites. Structured data is a database of information stored in columns and rows, readable by humans. Structured data can also be searched by data type within content. (Syed et al., 2013, 2446)

Companies can gather internal data, such as customer transactions or operational log data, from ERP-systems, master data management or business intelligence tools; hence internal data is often more easily accessible (IBM, 2012, 10). External data is collected from sources outside of the company for instance websites or social media. In addition, different types of sensors can create external data. Warren et al. (2015) emphasize the categorization of data into video, audio, textual and image data. External data is often not in a format ready for analysis, rather, it requires a process in which the required data is extracted from the sources and expressed in a structured form suitable for analysis (Moorthy et al., 2015, 89; Labrinidis & Jagadish, 2012).

When analyzed, data goes through different programs and metrics and finally, information comes out of the process. Big data technologies offer a possibility to get readable and statistical information. The information, however, still needs need to be interpreted. Interpretation is an essential part of the process and incorrect interpretations can be harmful rather than valuable. Data is available as similar for everybody, the key is to interpret the information that comes out of analyses and comprehend the value-added insights from that information. When utilizing these insights extracted from big data, decisions can be based on hard evidence rather than senses and speculations. According to McAfee et al. (2012), corporate leaders still rely too much on experience and intuition, and not enough on data. Many companies are pretending to be more data-driven than they actually are.

Companies are in different stages of applying big data. According to CGMA (2013), companies should begin the implementation by identifying their key business problems. They need to understand their business model, as well as data structures and sources. World Economic Forum (2014, 48) presents a framework for measuring the maturity of big data utilization. The framework incorporates three elements: environment readiness; internal capabilities; and the various, steadily more sophisticated ways to use big data that range from increased efficiency in existing operations to a complete change in an organization's business model. They divided the measurement system into four stages: 1.

Performance management; 2. Functional area excellence; 3. Value proposition enhancement, and 4. Business model transformation. These four stages are presented in figure 1.



Source: Booz & Company.

Figure 1. Big data maturity framework (World Economic Forum, 2014, 48)

If the company is in the first stage of maturity, it enables executives to view their own business more clearly, often utilizing mostly internal data. In second phase, organizations start to use external data more comprehensively and use for example customers' purchasing behavior, in order to predict the sales or monitor production plants. These may lead to revenue increase or advanced operational efficiency. Third phase may include innovations such as customized, real-time recommendations or the personalization of services to augment the customer experience. Organizations begin to position big data as a value driver of the business. In the final, fourth phase big data permeates the whole organization. It becomes deeply embedded within the operation, determining the nature of the business and the mode of executive decision-making. (World Economic Forum, 2014, 48)

2.1.2 Big data technologies

Data itself is unworthy but by analyzing and organizing it, data becomes valuable (Ministry of Transport and Communication, 2014). Therefore, it is essential to have capabilities and knowledge in order to benefit from data. In order to ex-

tract value from big data, optimal processing power, analytical capabilities, skilled analytics and technologies are needed. The utilization of big data requires an extensible and secure infrastructure and data foundation. For instance, a scalable storage and high-capacity warehouse as well as integration within organizational information are requisites. Mining for instance requires integrated, cleaned, trustworthy, and efficiently accessible data, declarative query and mining interfaces, scalable mining algorithms, as well as big data computing environments. Many companies have to merge big data technologies with their traditional infrastructure, which may be challenging. (IBM, 2012, 8; Davenport & Dyché, 2013; Labrinidis & Jagadish, 2012)

Big data applications attempt to unlock the potential of data using business analytics and visualization trends. Visualization is critical, as it provides a way to maintain context by showing data as a subset of a larger part of data, showing correlated variables. Visualization is also relevant to data streams that are common in a current situation, because they can help identify patterns over time. Big data technologies have evolved because big data is so large, that traditional technologies cannot process it. These big data programs, such as Hadoop and Hbase, are most often used for data processing in support of the data-mining techniques and other data science activities. The decreased costs of collecting, storing and processing datasets after the development of IT and cloud computing have also widened the available data and created demand for suitable and relevant programs. (Fisher et al., 2012, 57; IBM, 2012; Huang & Huang, 2015; Moorthy et al., 2015, 95; Provost and Fawcett, 2013, 52; Ministry of Transport and Communication, 2014).

Traditional symmetric multiprocessing (SMP) architecture became too expensive to support vastly growing data volumes. This led to the creation of the foundation for big data handling, cheaper parallelized virtual servers, which can be in cloud or on-premises. IT-companies such as IBM, Google and Microsoft can be seen as leaders in the market of providing big data applications. Some big data tools found in the market are high capacity and scalable data storage, columnar databases and Analytic Accelerators. Some programs and tools are Hadoop, Java, Developer, NoSQL databases, Map Reduce, Big Data, Linux, Hive, and Scala. Different codes can be used in the analysis as well as programming languages, such as R, Python and database-like language Pig. (Schlegel, 2014, 12, 16; Akbay, 2015, 26; Fisher et al., 2012)

The term analytics often means any data-driven decision-making. In the corporate world, an analytics team often uses their expertise in statistics, data mining, machine learning, and visualization to answer questions and solve problems that management points out. In order to support decision-making of corporate leaders, the analysts find datasets, choose informative metrics and architecture that can be computed from available data, perform the necessary computations, and report the results to CFO in a way that they can comprehend and act upon them. The emphasis of analytics also in corporate management is increasing, as analytics is seen to become a part of their duties. (Fisher et al., 2012)

Datasets are often too large for data-analysts to view and process on-hand. The need for more advanced visualization techniques, capabilities to find patterns in complexity of data and modeling capabilities have increased along the introduction of big data (Schlegel, 2014, 16; IBM, 2012, 12). According to IBM (2012), most effective strategy to utilize big data is to identify business requirements or objectives first, and then leverage the existing infrastructure, data sources and analytics to support the business opportunity. Figure 2 shows some techniques companies leverage in order to analyze data. Most commonly used analysis method is query and reporting, secondly data mining and thirdly data visualization.

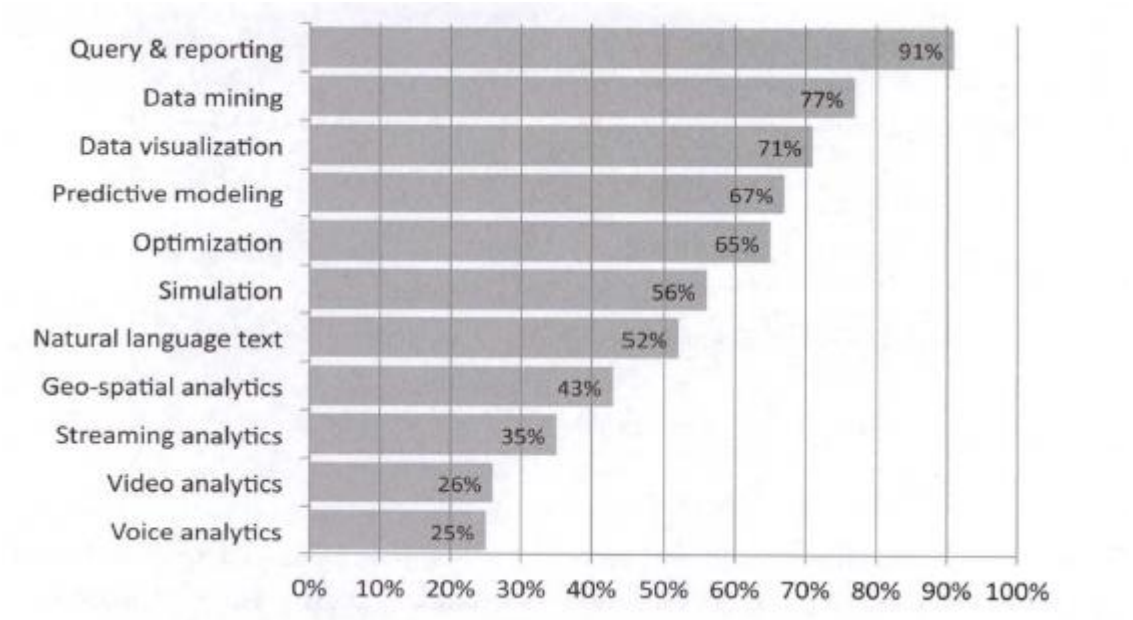


Figure 2. Big data analytics tools. (Schlegel, 2014, 15; IBM, 2012)

Big data tools go through massive amounts of digital information looking for useful correlations. With the help of increased processing power, analyzation tools can create rapid and accurate information to support decision-making (ACCA & IMA, 2013, 6; Davenport, 2014). With distributed systems, datasets from different locations can be connected by networks and analyzed accurately (IBM, 2015; Sukumar & Ferrell, 2013, 258). Vasarhelyi et al. (2015) claim that within businesses, greater value can be created when automatically gathered inside information and outside information are “bridged” together, for instance personal information, credit information and criminal records. The availability of these types of data has increased, therefore, companies could benefit greatly from utilizing it.

Business interactions record data, which often remains unused. According to Gartner, data, which companies record in their daily business processes, but do not utilize it, can be referred to as dark data. This dark data is the type of data, which company managers could exploit and acquire competitive advantage (Gray & Alles, 2015). According to Akbay (2015, 27) with applicable infrastructure and large IT department, companies could collect logs, in which business

processes can be monitored. This enables companies to quickly identify large-scale patterns and help in diagnosing and preventing problems. Big data applications capture the operations of a business, and all the information and behavior of customers is logged as interactions. These real-time interactions are combined with meaningful transactions and historical data in order to deliver business value.

2.1.3 Before and after big data

Previously, before the era of computers, company data has been mainly handwritten paper records, not easily accessible. Later, advanced technology allowed larger data amounts to be collected, stored and reused. Davenport (2014) states that company managers have been familiar with using traditional data analysis to support decisions since 1970. The internet revolutionized the state of information about 15 years ago. Due to mobile phones few years later, everything became connected. Mobile devices enabled all human knowledge to be available for everyone to use. In addition, the formation of cloud computing as well as social media affected the incurrence of big data.

Vasarhelyi et al. (2015) state that traditional accounting data in companies have been ERP data, which was acquired manually in transactions. Afterwards, scanner data enabled more possibilities to collect data e.g. in the cash register. This increased data analysis applications, including inventory control, detecting related products and individual product preferences. Semi-automatic data collection also lowered the cost of data collection. Web data expanded the analysis of customer behavior. Data collected from the internet allows following customer information, acquisition and decision process. Furthermore, after the expansion of mobile data, automatically collected data has increased vastly. Mobile data allows for instance finding the location of a customer and predicting customer behavior. (Vasarhelyi et al., 2015)

The definition of big data closely links to business intelligence (BI). However, big data was introduced later than business intelligence; hence, more studies on BI can be found. BI can be seen as some type of hypernym for big data. Davenport (2014) defines it as providing tools to support data-driven decisions, with emphasis on reporting. Yeoh & Koronios (2010, 23) defined BI as “an integrated set of tools, technologies and programmed products that are used to collect, integrate, analyze and make data available. According to Negash (2004), BI is a combination of systems that supported decision-making. The increase of internet technologies and prevalent user interface enabled the development of a more comprehensive BI, which gathers information from many systems. According to the definition of Davenport (2014), business intelligence has been introduced in 1989. Studies on BI can be found from somewhat 40-50 years ago.

A new IT-term is born already. Internet of Things (IoT), in which everything is connected. According to World Economic Forum (2014), IoT is predicted to boost the global economy massively by 2030. In IoT devices, machines, and physical objects with sensors are intelligently connected to a network,

which will create waves of data across the entire business value chain. It is estimates that less than 1 % of physical objects are connected to IP networks, but the IoT is expanding as more devices and users are connecting to IP networks every day. This increases transactions and processes online, therefore, expanding the amount of data and consequently, increasing the amount and importance of big data. One idea is to share data with different actors across industries and form data ecosystems. (Ministry of Transport and Communication, 2013; Gray & Alles, 2015, 25; World Economic Forum, 2014, 36)

2.2 Big data in business processes and decision-making

2.2.1 Forecasting and planning

During recent years, the use of big data in decision-making has been studied widely (e.g. Warren et al., 2015; Vasarhelyi et al., 2015; Gray & Alles, 2015). Therefore, ways to utilize big data have been introduced and implemented. Nevertheless, company management and executives are often unsure of the utilization and possible application areas of big data. Vast amounts of data are available; therefore, it is essential to be able to specify the necessary data and decision-relevant information. Subsequently, these will aid in solving specified problems and achieving objectives (Gray & Alles, 2015).

According to Moorthy et al. (2015), decisions that were previously based on guesswork can now be made using data-driven mathematical models. This offers a precise foundation for decision-making. Big data can be used in forecasting in different functions. Better forecasting can be made about the competitive environment, with more data and accurate analysis. Forecasts can be made about future sales and cash flow, demand for raw materials, financial situation as well as long-term trends. Similarly, sales forecasts can be made and reported to management. Thus, necessary actions can be taken based on what have been monitored. (Davenport, 2014; Gray & Alles, 2015, 23)

ACCA & IMA (2013, 7) studied future implications of big data and found that, when applying big data and utilizing specialized more valuable real time information analyzed from it, companies can create immense picture of their performance by using both financial and non-financial information. This could aid them to proceed to new directions, create new products or move to new markets. Additionally, they found that big data could generate opportunities to identify and evaluate risks and rewards of previous decisions as well as improve operating efficiency. Warren et al. (2015) suggest that big data and information could be useful in budgeting, as new budgeting practices have emerged. ERP-data can be combined with external and non-financial data and budgeting can emerge to new extent.

According to Moorthy et al. (2015, 81) by collecting for instance consumer and market data and analyzing it, companies can find out new patterns that reveal possibilities of new product features and segments. New products can be

introduced based on these patterns. By gathering large amounts of data, companies can capture behavioral trends and use the information in creating products that are more appealing or revise pricing models in order to increase sales (CGMA, 2013, 13).

According to Gray & Alles (2015, 23, 29-31) one of the most valuable types of data is data, which could aid in predicting future problems or identifying unexpected opportunities in the markets. According to them, one means to apply big data for business decision support is through sentiment analysis by monitoring comments said about the company on the internet or in social media. In case the comments turn negative or the number of complaints increases, some actions could be taken in order to avoid negative publicity and possible decrease in future sales. By monitoring customers and their social media behavior, indicators of potential issues can be noticed beforehand and management can act on them before the damage has already happened.

2.2.2 Marketing, sales and CRM

Several studies are focused on utilizing big data in marketing, sales and especially in customer relationship management (CRM). As World Economic Forum (2014, 45) report found, marketing and sales are some of the segments mostly utilizing big data. This can also be noticed from various examples. IBM (2012) conducted a study and examined the objectives for adopting a big data solution. They found that almost 50 % of the organizations studied were targeting customer-centric big data applications. Additionally, Davenport (2014) emphasizes the utilization of big data information in companies who have customer oriented approaches in their products and services. These types of companies often have vast amounts of data; they may have loyalty programs through which they gather data about their customers. Companies can also conduct customer research through which they acquire data. Data can be used to improve customer experience, to personalize products, and consequently, engage customers. (Ministry of Transport and Communication, 2013)

It seems that companies see understanding of consumers and customer behavior as a significant priority. Companies can benefit from new, real-time and more organized information about customers and provide them with required solutions, products and services as well as enhance sales. This is important in order to engage with existing and potential customers, as the competition of customer loyalty is ongoing. Big data is a powerful weapon for example in capturing consumer data directly or indirectly even with or without permission and participation. It provides enormous potential to precisely and efficiently identify behaviors, behavioral changes and target them at the individual level. Data captured from customers and their purchases can aid in making new product and service offerings. If any deviations from normal patterns about company brand or products emerge, companies can provide rapid responses to consumer reactions, shape new products, and expand to new markets. (Moorthy et al., 2015, 92; Davenport & Dyché, 2013, 6; George, Haas & Pentland, 2014)

Marketing and CRM could also benefit from the use of big data by listening to data streams and cross-reference them with customer profiles in order to provide clear perspective about their best customers (Akbay 2015, 28). Companies could find out what motivates customers to buy and offer them allocated marketing and advertising, and even special pricing models. Global Economic Forum (2014, 46) report introduces an example of a global mass merchant, who was able to increase its profit per customer by 37 % by applying advanced customer analytics, such as behavioral segmentation, to identify its best customers and provide them with personalized offers.

Big data is seen to have many possibilities in CRM. It is highly important for companies to understand consumers and to know what they want to buy and where they want to buy it. According to Bhimani and Willcocks (2014), big data enables more comprehensive analysis of business environment. Companies can gather data from their e-stores about purchasing frequencies and previous purchases of customers and predict the likelihood of certain subsequent purchases. Similarly, Moorthy et al. (2015, 82) perceived some benefits in customer relationship management. They found that in one case company, by centralizing customer information into one program, agents were able to handle more customers per day. Implementation of big data application also appeared as higher customer satisfaction and awareness. When data was centralized in one program, more of beneficial information was available. Due to that, market group could sell products to customers easier, as they had the required solutions within reach. Customer experience management was also improved and predictive analytics initiatives helped to manage risks and control with better forecasting of revenue expectations.

Davenport (2014, 47) introduces an example of a company in which recordings from call centers are processed through software in order to analyze language of customers phone calls. Similarly, Vasarhelyi et al. (2015) state, that audio data can be transcribed into text and associated with other data, such as texts and videos. If audio data is transcribed into text, certain focus areas can be found from the customer phone calls. This could aid in finding the main reasons why customers are calling to call centers. Perhaps they are facing some specified continuous problems. Based on this information, companies can for instance create info packages to instruct their customers in these types of situations.

2.2.3 Business performance monitoring and improving efficiency

According to IBM (2012), other rationales for implementing big data technologies in addition to sales and marketing were operating optimization, risk and financial management, enabling new business models and employee collaboration. It is studied and claimed that utilization of big data leads to higher productivity (Provost & Fawcett, 2013, 54). According to Schlegel (2014, 14) the prediction of customer behaviors and outcomes of proposed scenarios integrated with risk assessments allows businesses to create and test supply chain

models in real time, thereby increasing their revenue and profit. He introduces a case study in the industry of consumer packaged goods and grocery, where implementing a big data technique aided a company to adjust supply and demand issues and minimized the financial risk of write-downs and write-offs.

Akbay (2015, 28) suggests that big data could be utilized in optimizing sales in retail. Sales would be recorded and monitored and in case of low or high sales, an alert would be sent to the retailer. After this alert, they would know the need for a new delivery or for another necessary action, and therefore, be more efficient. Moorthy et al. (2015, 81) found that big data tool led to increased operational efficiency for frontline customer service agents and marketing group, better customer information availability and lower IT-costs due to centralization of data.

Big data tools can influence and improve company strategy and furthermore, supply chain management. Schlegel (2014, 15) studied big data implications on supply chain and introduced an example of Dell, who implemented a big data tool, an optimized configuration. It clustered high-selling products from historical order data, which could tell what products the company should build to order and what it should produce to stock. Tool supported their core competencies and market differentiator, and led to improved business performance. Davenport and Dyché (2013, 4) introduced an example of a company who planted sensors in their trucks and followed the routes of their drivers. Consequently, they were able to optimize their route structure and acquire significant cost reductions.

According to Davenport (2014), big data introduces a new dimension enabling companies to discover new opportunities in product development processes. He introduced an example of a company who applied big data to improve services, optimize service contracts and maintenance intervals for industrial products. This could aid in boosting sales, as maintenance can be offered to customers after they have purchased a machine. According to Davenport and Dyché (2013), companies are increasingly adding sensors into things in order to capture more data and optimize their businesses. Even a small improvement can result in great savings when adopted on a large scale.

2.2.4 Management control

Both Warren et al. (2015) and Gray & Alles (2015, 30) claim that big data could be used as a tool in management control for creating a Balanced Score Card (BSC). Managers can collect and analyze data from different areas; finance, customers, internal business processes, and learning and growth. For instance analyzing customer service calls may reveal issues in customer service. Additionally, internal emails, internet or mobile phone use during work may correlate with learning and growth. According to Bhimani & Willcocks (2014, 480) the availability of big data enables redesign of ways of organizing executive responsibilities and rewards. Big data can also be used in analyzing individual or team behavior, using sensors or badges to track individuals as they work to-

gether. Management could monitor how employees move around their workspace, spend time interacting with others or allocate to specific tasks. (George et al., 2014)

Additionally, according to Warren et al. (2015), big data information can reveal new important measures to be incorporated in management control systems. Big data could aid in discovering new motivational measurements. Consequently, new monitoring and performance evaluation could lead to increased productivity. Companies can gather and analyze data about how employees use for instance company cars or cell phones. With these types of measurements, management accountants can enforce comprehensive monitoring. They state, however, that extensive monitoring can lead to decreased creativity and lack of motivation. Increased personal monitoring may also cause legal and ethical issues. (Warren et al., 2015)

2.2.5 Challenges

If unsuccessful, big data can lead to poor decisions, and endangered data security and privacy codes. Moreover, it can damage organizational reputation and brand as well as destroy value. According to CGMA (2013), companies should begin implementation by identifying their key business problems. They need to understand their business model, as well as data structures and sources in order to succeed. Big data does not erase the need for vision or human insight. Business leaders have to be able to spot opportunities, understand market development, and propose new ideas. Adopting big data often causes transformation in organizational culture; thereby leaders have to be able to manage change effectively. (ACCA & IMA, 2013; McAfee et al. 2012)

Ministry of Transport and Communication (2013) mentioned privacy issues and data security as challenges after the emergence of big data. Much of the data gathered may contain highly sensitive or personal information. Warren et al. (2015) state that many organizations are unable to apply big data techniques due to limiting factors, such as lack of data, irrelevant or untrustworthy data, or insufficient expertise. In addition, they may be unable to access the data. It is essential to have data scientists and other professionals who are able to work with large quantities of information. Capabilities in cleaning and organizing large data sets are crucial. “People who understand the problems need to be brought together with the right data, but also with the people who have problem solving techniques that can effectively exploit them.” (McAfee et al. 2012, 67-68)

According to CGMA (2013, 2), for most companies the adaptation process to a data driven business remains unfinished. They found that most commonly businesses are struggling to bring data together from different databases, ensuring the quality of data, and getting valuable insight from data. One can simply mistake correlation for causation and find misleading patterns in the data (McAfee et al. 2012). Other challenges that emerged were ensuring that insight is used to improve performance, finding the relevant data and information,

and reporting and visualizing insights in a proper manner. Davenport (2014) claims that a clear way to apply big data in decision-making is still under construction, because the fast-flowing stream of datasets is ongoing. Data filtering needs to be done, if the amount of data available exceeds the amount that is required to perform the selected analytics.

World economic Forum (2014) also listed some obstacles in their report. One common challenge was shortage of available talent specializing in data analytics. According to CGMA (2013), companies also face challenges trying to find the relevant tools and technologies, because before selecting a tool, they should determine how they want to use data and what the objectives for utilization are. If the objectives are not clearly defined, it may cause a failure. Therefore, the chosen data and analysis methods should be consistent with the desired outcomes or problems at hand. (Gray & Alles, 2015, 26)

2.3 Implications of big data on management accounting and business professions

Management accounting uses data and information generated from accounting records to support their duties as a decision-maker. Duties of management accountants include for instance cost accounting, strategic and operational decision-making as well as supporting top management in overall decisions. An important task of management accounting is to combine corporate goals and behavior of management and employees with management control systems. Behavior-regulating devices, management control systems can be distinguished from decision-making role of managerial accounting. Management control can be defined as systems, rules, practices and values through which management directs employer behavior. (Warren et al., 2015, 400; Malmi & Brown, 2008)

According to Institute of Management Accountants (IMA), broad responsibilities of management accountants include for instance managing functions that are critical to business performance, supporting organizational management and strategic development in addition to providing accurate and insightful information in order to make better decisions. Management accountants are often viewed as reporters of historical cost information, when they should be seen as advisors of how to reduce those costs. Finance function can be seen to consist of various activities such as accounting, compliance, management and control, strategy and risk, as well as funding and resourcing. They are facing challenges and tensions today across organizational settings. Along increasingly complex technologies, some traditional accounting practices may disappear. Therefore, managerial accounting and finance function are facing a transition phase. (Gray & Alles, 2015; Smith and Payne, 2011)

According to Gray & Alles (2015, 25-30), management accountants should expand their value adding activities and improve their relevance to their organizations. In order to do so, they should move to extended data sources

and explore additional data analytics tools. Additionally, they predicted that management accountants have to expand the amount of data they are using in today's competitive, complex and global market. They suggest that in order to be proactive and the catalyst for the change, management accountants should improve their data analytics competency. Nowadays, because of the decreasing time that is available for waiting how the markets evolve, management accountants need to be able to make consistent decisions promptly. Therefore, it is essential for them to identify the important and necessary internal and external data the company should collect and analyze. (CGMA, 2013, 20-23; ACCA & IMA, 2013, 6; Gray & Alles, 2015)

According to CGMA (2013) BI and big data -tools enable accountants to get more involved in the application of business, take more proactive role and strategic position in companies and become more visible. They also state in their report that, in order to acquire a more strategic role, they should increase their data analysis skills. Thus, they are more active in converting the potential of data into real commercial value. According to them, management accountants will need to co-operate more closely with their colleagues in IT who capture much of the data; the data scientists who most commonly perform analysis on data; and with business leaders who ensure new ideas are turned into concrete action. This requires financial professionals to have a broader range of management skills: clear communication, the ability to lead and influence, and a strategic understanding of the business.

According to ACCA and IMA (2013) whilst big data creates possibilities for businesses, it simultaneously reshapes accountancy and finance professions. It can potentially embrace the traditional accounting profession or create new opportunities and functions. It will most likely bring accounting department closer to technology. Clayton (2013) also states that CFOs should collaborate with CIOs and benefit from big data analytics more efficiently. ACCA and IMA (2013) suggest the formation of new professionals such as chief finance and technology officer (CFTO) or chief finance and information officer (CFIO), where the individuals have both technological and financial capabilities.

New qualities and capabilities are already required from management accountants. Big data will require development of new metrics and accounting standards as well as development of various new skills (ACCA & IMA, 2013). According to ACCA & IMA (2013), management accountants need forward-looking data analytics for a complete evaluation of the potential benefits and consequences of alternative actions and decisions. According to CGMA (2013, 2), the role of finance professionals around big data is to aggregate outcomes so they can be converted into insightful reports. Therefore, new qualities and capabilities, such as ability comprehend data and information extracted from it, are required. CGMA (2013, 4) also state in their report that qualities of a CFO with data-capabilities are for instance, ability to understand relevant data, knowledge about customers' demand, ability to use complex data, endurance of uncertainty as well as ability to interpret data in multiple ways. ACCA and IMA (2013) estimates that employers need to have deep analytical experience

whereas managers need to become data-literate. There seem to be an evident change in the requirements and competencies of various business professionals.

Pickard and Cokins (2015) claim that accountants have lacked the skills to uncover strategic insight from financial data they create. They also state that accountants should have more understanding of and abilities to apply advanced data mining and analytics techniques in order to increase their scope of influence and perform their responsibilities with more impact. It is also suggested by Gray & Alles (2015, 25, 30) that management accountants should move away from analyzing primarily traditional data in Excel and contribute more to data analytics technologies. They should move onto non-financial data and more inferential statistics as well as predictive and prescriptive analytics. Learning new technological skill and developing better semantic understanding of business processes are essential in reaching these objectives. According to Bhimani and Willcocks (2014), changes in IT causes a change in information collection and analysis for management and control activities.

Management accountants or business controllers are often unaware of the data and analytics that are merely on their responsibility in the company. Therefore, Gray & Alles (2015) introduce the term data fracking, which could belong solely to management accountants, as data analytics tools are seen to belong to statisticians and predictive analytics to management. The idea in data fracking is to gain value from data that was previously considered unusable. The goal is to find decision-specific data rapidly and apply analytics to it, rather than waiting for the relevant data to be available as accounting data. This data fracking could provide management accountants with required tools and motivation. Subsequently, management accountants could fulfil the broadening roles, which IMA had also acknowledged.

According to McKinsey Global Institute, there will be shortage of talented employees with the necessary knowledge of data analytics and IT (Clayton, 2013, 24). This could stand out as a problem, unless companies can find talented people, outsource their big data activities or unless they can educate their staff themselves. According to Clayton (2013) the first step to tackle the challenges that come along big data, would be to hire the right personnel with required competences. He emphasizes the role of big data as CFOs new best friend. Clayton (2013, 25) also claims that: “The more insight and understanding CFOs can gain about their business through big data, the more they can help their organizations meet vital business objectives. With a clear and actionable view into big data, CFOs can help increase efficiency, improve collaboration and alignment between finance and the business, improve organizational agility and foster innovation.”

3 RESEARCH APPROACH

3.1 Research method

This study is a combination of quantitative and qualitative research. Qualitative approach has more emphasis, as qualities of qualitative research are interest in details, individual factors of events, as well as causation (Metsämuuronen, 2005, 203). Qualitative research looks deep into social life enabling the modifications of research procedures to fit the situation and the people in it, whereas quantitative research counts occurrences across a large population and relies on established research instruments (Holliday, 2007, 5). However, it is hard to make a strict distinction between the two approaches, as qualitative research always includes elements of quantitative study and vice versa. Qualitative research develops from anthropology and sociology and emphasizes the importance of understanding human affairs and the necessity to study the subjective qualities that govern behavior. Qualitative study relies heavily on interpretations and freedom for choices; thereby the researcher must be prepared to explain every decision made. (Holliday, 2007, 2, 7-8) The research has a subjectivist approach, as it constitutes of subjects' understanding of their world (Humphrey & Lee, 2004, 45).

The chosen method is a case study, with some features of a grounded theory method. It could be referred to as grounded theory case research (Humphrey & Lee, 2004, 45). Case study is relevant in situations when certain circumstances with "how" and "why" -questions are studied and when a certain phenomenon is scrutinized extensively and in-depth (Yin, 2014). A feature of grounded theory method, which is used in this study, is data-orientation in formulating the results (Metsämuuronen, 2005). Case studies have been criticized for producing only practical, context-dependent knowledge, which is less valuable than theoretical and statistical knowledge, and that generalization cannot be made based on an individual case. There is a need for both approaches and it is argued that it is essential also to look at individual cases, as case knowledge is central to human learning. (Flyberrg, 2006, 5). Case studies have become more common in managerial and organizational accounting studies during the 21st century. This has led to an access to key corporate and institutional decision-makers. (Humphrey & Lee, 2004)

A survey method was chosen for the initial part. The survey used can be defined as a social survey, in which the information is gathered about a specific group of people who represent the selected sample. In this study, the sample constitutes of Finnish enterprises. Survey describes and explains phenomenon by focusing on the attributes, attitudes and actions of people. When conducting a survey, the aim is to answer questions such as "who", "what" and "where" (Yin, 2014). Survey aims to measure a phenomenon and the results are often presented with statistics (Buckingham & Saunders, 2004, 13, 44).

For this study, the survey method was used to explore the subsurface of perceptions towards big data. Traditionally, the aim of a survey is to generalize information about groups. In this study, however, the survey does not aim in generalization, as the sample size is too small. The disadvantage of a self-administrative questionnaire is generally low response rate, in particular, in e-mailed questionnaires. If the amount of questions is too vast, participants can be hesitant to answer the questionnaire. Therefore, a covering letter is crucial and prefaces the reasons for the study. (Buckingham & Saunders, 2004, 70, 73)

Due to limited amount of responses in the first part, a qualitative method was chosen to expand the amount of data. For the second part, the chosen method to gather the data is an interview. The purpose of qualitative interviewing is to derive interpretations and to understand the experiences of respondents (Atkinson & Delamont, 2010). Therefore, the attempt is to get more in-depth information and to explain how and why big data tools are implemented and utilized as they are in the companies. The interest is also to see consequences of decisions and actions, and to acquire information about experiences companies have faced in their context. The aim is to understand context, people and interaction.

Interviews are adaptive in nature and enable the modification of questions during the interview. From semi-structured interviews, a focused interview was chosen, and the objective is to understand the respondent's point of view rather than to generalize. Open-ended questions are more invitational to the interviewee as they allow more narration to the interviewee and therefore detailed information can be elicited (Skinner, 2012, 23). Additional questions can be asked as the need for them appears along the interview. Therefore, interviews are conducted more as a conversation as supplementary questions could be asked relating to the answers. (Hirsjärvi et al., 2006; Skinner, 2012, 8)

3.2 Data

3.2.1 Survey

The data for the initial part of this study were gathered with a standardized self-completed questionnaire. Sampling, designing of questions, and data collection were conducted earlier by another researcher. Therefore, this study focuses on the analysis of the data. Initially, an online questionnaire was sent to recipients via email. The questionnaire was send to 1200 participants, 41 of whom answered by the end of the given time period. The respondents were asked to answer the questions themselves and were given a link to the survey form. The survey was conducted in February 2015. The questionnaire has 38 questions, nearly half of which concern big data and the other half business intelligence. The focus of this study is on big data; therefore, the responses concerning BI are analyzed in another study (Nykänen, 2015).

The questionnaire has 17 questions concerning big data and these questions are relevant to this study. Most of the questions are closed questions and they have predetermined range of values from which the respondents are able to choose. Most commonly, the possible answers are presented on a Likert scale, which has answers from 1 to 5, where 1 is “not important”, 3 is “somewhat important” and 5 is “very important” Predetermined answers enable measurement and comparison of responses, as the contents of possible answers are limited. In some questions participants are also allowed to choose the option “other”, if the predetermined answers are not suitable. Not many questions have “I do not know” –option, which might cause the recipient to choose any of the answers randomly if none is suitable.

The definition of big data is often unclear; therefore, to avoid misunderstandings, in this survey big data is defined as “any collection of datasets so large and complex that it becomes difficult to process using on-hand data management tools or traditional data processing applications. Its characteristics typically include “3V’s”-volume, variety and velocity. Big data analytics refer to the process of collecting, organizing and analyzing large sets of data to discover patterns and other useful information for decision-making.” With this definition, big data was differentiated from BI. The survey questions are presented more closely in chapter 4.

3.2.2 Interviews

Company managers such as CFOs and CIOs were contacted in order to find the appropriate interviewees. The aim was to interview people that are highly involved in the implementation process and were aware of the utilization of big data as well as benefits and disadvantages. Around 50 emails were sent, and approximately 10 answers were received. Some companies were not using big data and therefore, were unable to give an interview. Some of the candidates were contacted via networks and with the help of the instructor of this study, as they knew who are already utilizing data. Eventually, five people from five companies were interviewed during March 2016. All of the interviewed companies answered anonymously.

The interviewed companies were all from different industries. Therefore, the results can be compared within industries. The interviewees had different titles and responsibilities in the organization, and therefore, had different focus areas in their company. The interviews were conducted in the company premises. It was also possible to do them via Skype or phone, but face-to-face interviews were preferred among the interviewees. Interviews were recorded in order to minimize the loss of data and for the purpose of later transcription and analysis. The duration of the interviews was 25-60 minutes. Themes and areas of interests were decided earlier, but same focus areas were scrutinized in all of the interviews, whereas some changes in order and formation occurred.

Interest areas of the interviews were for instance the stage of big data maturity in the company, the rationales for adopting a big data tool, experiences from implementations and any positive or negative practices that have ap-

peared along the implementation. The interviewees were also asked who in the company is responsible for big data as a function and what the application areas are. In addition, the impacts of big data on management accounting and the requirements of business professionals were surveyed. The questions are presented more detailed in chapter 4.2. The interviewees were able to tell about experiences from their company's perspective. The focus areas were rather wide and the interviewees were not able to answer properly to all of the questions. If the person was head of customer insight, they were uncertain of the consequences of big data implementation in the controlling or management function. Consequently, this limited the amount of data and possibilities to acquire information of all desired areas.

3.3 Analysis method

For the initial part, quantitative data analysis was used. The data from the surveys were analyzed by determining the frequency distributions as well as mean of the responses. Answers from survey are divided into a table and percentages of each response are calculated. Additionally, correlation between certain variables was measured in order to find any interrelations. Most of the measures in the survey are nominal and ordinal; therefore, not many measures of dispersion were able to calculate. Thus, the analysis remained rather shallow especially in defining correlation. Excel and SPSS were used in the analysis phase.

The data from the interviews were analyzed by first organizing and delineating the data. Data-oriented content analysis was used for analyzing the interviews, as new information would be found because the subject had not been under scrutiny before. Some patterns and themes were coded in order to find the essential definitions and facts that were under scrutiny. The data were divided under different subheadings; themes were similar to theoretical framework. Pattern matching was done in order to find empirical evidence to patterns proposed in theory (Yin, 2014). Quotations were enclosed to the results as they support the reliability of the study (Ruusuvuori & Tiittula, 2010).

4 EMPIRICAL FINDINGS AND ANALYSIS

4.1 Background information

4.1.1 Survey

At the beginning of the questionnaire, the respondents defined their area of responsibility in the organization as well as other background information regarding industry, yearly turnover, amount of employees, strategy of the company, and the level of uncertainty in the company. Majority, 17 (41 %) out of 41 respondents were in top management, 10 (24 %) were in IT-section, mostly IT-managers, and 5 (12 %) were in finance department; CFO or business controller. 4 (10 %) worked in marketing and 4 (10 %) in business development. One (2 %) respondent worked in sales department.

The companies who answered to the survey operated in variety of industries, which are categorized in table 1 below. Majority, 15 (36,59 %) out of 41 companies operated in manufacturing industry. 4 (9,76 %) companies operated in transportation and storage, 3 (7,32 %) in consulting and research, 3 (7,32 %) in construction, and 3 (7,32 %) in information and communications. 2 (4,88 %) companies operate in retail trade and wholesale, 2 (4,88 %) in financial and insurance, and 2 (4,88 %) in administrative and support service. Accommodation and food services as well as electricity, gas and steam were both the industry for 1 (2,44 %) company. 4 (9,76 %) companies operated in another industry, which was not mentioned in the predetermined options.

Industry	N	Percentage
Manufacturing	15	36,59 %
Transportation and storage	4	9,76 %
Consulting and research	3	7,32 %
Construction	3	7,32 %
Information and communications	3	7,32 %
Retail, trade and wholesale	2	4,88 %
Financial and insurance	2	4,88 %
Administrative and support services	2	4,88 %
Accommodation and food services	1	2,44 %
Mining and quarrying	1	2,44 %
Electricity, gas and steam	1	2,44 %
Other services	4	9,76 %
Total	41	100 %

Table 1. Industries of companies who answered to the survey.

The mean of approximate yearly turnover was 690 million euros and the companies employed average of 2300 people. The amount of employees varied

greatly, as some companies were small and only employed around 20 people, whereas some had over 5000 employees. However, almost 80 % of the companies were large, as their yearly turnover exceeded 50 million euros and they employed over 250 people.

4.1.2 Interview

The interviewed companies can be divided into same industry categories as the companies in the survey phase. Two of the companies operated in manufacturing industry, one in electricity, gas and steam, one operated in retail, trade and wholesale, and one in financial and insurance sector. Yearly turnover varied between 500 and 10000 million euros. The turnover was divided into categories in order to secure the anonymity of the respondents. The companies employed between 500 and 15000 employees. Therefore, all of the companies were large. The interviewees had different titles; Head of reporting and analytics, Head of customer insight, Head of consumer market insight, Head of digital platform development, and CIO. The interviewees were focused on data utilization and the use of certain type of data. None of them was CFO or controller, and therefore, the emphasis was not merely on management accounting viewpoint. Companies are referred to as Company A, B, C, D and E. General information about interviewed companies are shown in table 2.

Company	Industry	Turnover m€	Employees	Interviewee
A	Manufacturing	2000-5000	5000-10000	Head of reporting and analytics
B	Electricity, gas and steam	500-2000	500-1000	CIO
C	Retail, trade and wholesale	5000-10000	10000-15000	Head of customer insight
D	Financial and insurance	500-2000	5000-10000	Head of digital platform development
E	Manufacturing	500-2000	1000-5000	Head of consumer market insight

Table 2. General information about interviewed companies.

4.2 Maturity and importance of big data

The first survey question concerned the maturity of big data (BD) in the studied companies. As table 3 shows, majority, 32 % answered that BD is not used and it is not planned to be used. Secondly, according to 29 % of the respondents BD is considered or planned to be used. In 22 % of the companies, BD is in pilot or early stages and in 17 % of the companies, applying BD is relative regular and wide. Finally, in none of the companies BD were extensively used or in full maturity.

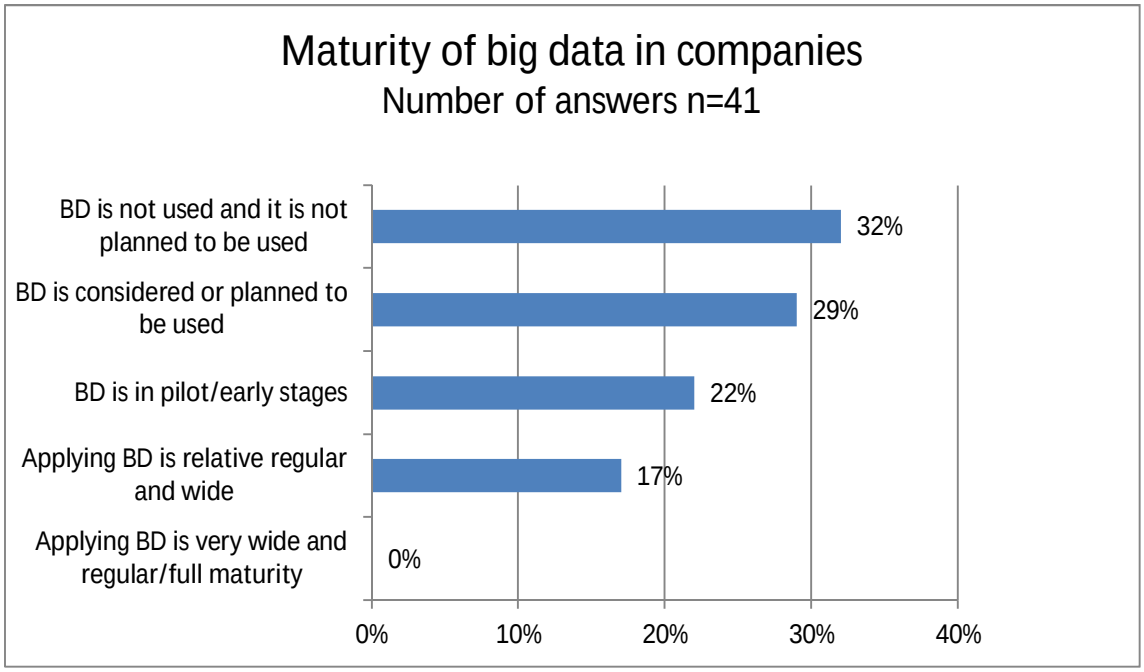


Table 3. Maturity of big data in surveyed companies.

This result conflicts with other studies that have shown that companies are actively adopting big data. Surprisingly, 1/3 of the companies said that they are not using or planning to use BD. This could indicate that Finnish companies are at least actively talking about big data, but have not yet taken concrete action towards implementation. Additionally, some companies may be hesitant to implement big data technologies, if they are unsure how to benefit from it and whether it will deliver what is expected. Size of the company may effect to the utilization as well, large companies have more resources and thus, could be more likely to use BD and analytics.

Additionally, there is variation between and within industries. In manufacturing industry, majority, 7 out of 15 companies answered that BD is not used and not planned to be used. Three companies answered that they consider using BD, whereas 4 companies were already in pilot stage. One company was already utilizing BD rather widely. In transportation industry, one company was not using BD, two companies had plans to use BD and one company was already applying BD relatively widely. According to the results, in the industry of consulting and research one company did not use and did not plan to use BD, whereas one company was in pilot/early stage and in one company the utilization was relatively wide. In construction industry, one company did not use BD, whereas two companies were utilizing it relatively widely.

In information and communication industry, one company had planned to use BD, one company was in pilot stage, and in one company utilization was relatively wide. In retail, trade and wholesale, one company considered using BD and one company was in pilot stage. In financial and insurance sector, both two companies were considering/planning to use BD. Within administrative and support services, one company was not using and did not plan to use BD,

and one company was considering/planning to use it. Company operating in accommodation and food services was using BD relatively widely. The company in mining and quarrying did not use and had no plans to use BD. The company in the industry of electricity, gas and steam had considerations or plans to begin to use BD. In other industries, which were not mentioned earlier, one company was not using and had no plans, one company had plans, and two companies were utilizing BD relatively widely. These results indicate, that industry does not explain why some companies are utilizing BD more widely than others are, and why some companies do not even consider utilizing big data.

At the beginning of the interview, companies were asked to define their big data maturity on the scale of 1 to 5. "1" is in pilot or early stages and "5" is in full maturity. None of the interviewed companies had reached the stage 5 and fully utilized BD. This is similar to the maturity of the surveyed companies. It seems that not many Finnish companies are yet in full maturity phase. In the interviews, most of the companies had not used BD for a long time. It could be interpreted that Finnish companies are young in exploitation of big data. Many companies, however, have recognized the importance of BD and are adding resources to it. The survey was conducted in spring 2015 and many of the interviewed companies would have been in different stages or not utilizing data at all, one year ago. Therefore, some of the surveyed companies could have begun to use data more comprehensively after they answered to the survey. It could be that if interviewed or surveyed again after a few years, many companies would be in the final stage of maturity.

From the interviewed companies, Company A is in stage 2 or 3 with internal data usage and between 0-1 with external data. Company B is also in stage 2-3. Company C is in stage 3 and utilizes data rather widely, but has still many plans for the future. Company D is in stage 1 and utilizing BD the least. Company E is in the highest stage between 3 and 4. Comparing to World Economic Forum (2014) data maturity framework, which was introduced in chapter 2.1. Company A and B are in the phase of defining what they can read from the data to become better. Company C and E are in similar situations, they already know what they are doing, but are still figuring out, how to make data a value driver for their business and how to expand to new horizons of data utilization. They both are moving towards the last stage, where data utilization could reinvent their whole businesses. Company D is in the process of defining what they can read from the data and what they can learn from it to become better.

"What is the business motivation? The services that we would like to develop or enhance with big data are yet undefined." (Company D)

Secondly, the interviewees were asked to define what BD is in their organization. None of the interviewed companies has used BD for a long time. Some of them have had large data assets, but due to many reason, they have not been utilized. For company A, data is still mostly internal data. They have cen-

tralized ERP, which gathers data from business operations, customers, orders and deliveries under one program, which enables more profound analysis. The company has massive amounts of internal global data, which is widely used. They have recognized the importance of external data and have plans to begin to use it as well. External data for them is generated by sensors in their sold machinery; IoT was mentioned in this context. According to the interviewee, social media data is not relevant for their company or industry. With external data, they are in the phase of determining the technical framework. The utilization of data is rather new as it began only one year ago.

For company B, data consist of customer data; for instance purchases and requirements. Additionally, plants and processes produce data every second. They also utilize weather data in analysis, since weather is essential part of their business and affects for instance fuel consumption. The amount of data is immense, but it is not utilized nearly as widely as it could be. They have actively utilized data from their plants for one year. Company C has large data assets, as they have gathered data for several years. Company C operates in an industry, in which customer data is in the core of business and it is seen highly important. They have the largest variety of data sources: internal and external customer data, open-data, product-data, social media, internet and mobile data, as well as profitability data. They are in a breaking point with data usage, as they have noticed the potential that comes along big data. The interviewee prefers to refer to all their data as smart-data.

"We are trying to see data very widely, whether it is our own internal data, external data, even open-data or something else. Big data definition covers it all in our context." (Company C)

According to the interviewee from Company D, they do not have much data, which could be referred to as big data. They have however, noticed possible ways to collect data and have some pilot projects. It is typical for their industry to have lots of digital information, due to some reasons the data is not utilized. There could be many types of possible application areas. They have created infrastructure and platforms, in which they could gather large amounts of data and analyze it. They could use sensors especially in insurance business. The finance industry may be traditional and unsure of the ways to benefit from their customer data. The interviewee from Company D is rather hesitant about big data from the ethical viewpoint and has speculations about who is entitled to collect data. The interviewee emphasizes the possibility to share data with other companies and build data ecosystems.

This has been under discussion globally and in Finland (Marjamäki, 2014). Company E, on the other hand has massive amounts of data, most of which is consumer and market data. They are interested in customer behavior and attitudes, as well as purchasing habits. They have gathered data from a long time span and gather data for instance via research. They have utilized data for several years. However, they have used consumer and market data combined for approximately one year.

In the next phase, the survey was aiming to find out the importance of big data for management in general, both currently and in the near future within 3-5 years. In order to compare the results, the importance of business intelligence (BI) information as well as importance of more traditional management accounting, business controlling and financial information for management was surveyed. According to the answers in table 4, traditional information is most important both currently and in the future.

Current importance of BD information for management:

	Not important 1	Somewhat important 2	Moderately important 3	Important 4	Very important 5	Mean
Importance of BD information	5 %	29 %	29 %	34 %	2 %	3,00
Importance of BI information	0 %	15 %	22 %	4 %	10 %	3,59
Importance of MA / business controlling / financial information	0 %	4 %	32 %	29 %	29 %	3,78

Future importance of BD information for management:

Importance of BD information	0 %	12 %	20 %	41 %	27 %	3,83
Importance of BI information	0 %	2 %	12 %	56 %	29 %	4,12
Importance of MA / business controlling / financial information	0 %	2 %	20 %	41 %	37 %	4,12

Table 4. Importance of BD for management in general.

The importance of BI is seen bigger than the importance of BD both currently and in the future. BI is seen almost as important as traditional information in the near future. This could result from the fact that the concept of BI has been introduced to companies before BD and they have been familiar with it earlier, wherein BD has become known in businesses later. Therefore, some companies can be further with BI-applications than with BD. These results indicate that the importance of both BI and BD will increase in the future. This is consistent with previous studies and assumptions.

Overall, the importance of more basic information such as management accounting, business controlling and financial information is most important source of information, both currently and in the future. These results contradict with what is advocated in previous studies in which the importance of BD is highly emphasized. This could stem from the fact that some of the respondents were middle-size companies and may not have the resources to utilize BD or BI information. Additionally, surveyed companies may not be customer-centric

and thus, not emphasize big data, as was mentioned in the previous studies (e.g. Davenport, 2014; IBM, 2012).

According to the interviews, BD is often seen as a competitive advantage in the company. Company A feels that they have to be in this; otherwise, they are out of the competition. There is a sense of urgency when it comes to BD.

"We have to move forward and we have to be fast. That is why we simply decided to build this platform, which enables us to gather data. In addition to that, we are currently figuring out how to benefit from it. We are moving forward in many fronts with this, we even have separate projects around this matter." (Company A)

Due to changing markets, competitive situation and customer demand, utilizing BD is a matter of life and death for Company C. Information should be easily accessible for everyone. The insight needs to be distributed efficiently with different visualization tools. For Company B, background for utilization was to optimize operational processes and to increase and improve automatization in their plants. They have great plans for the future.

"We hope to teach our machines through machine-learning how to make decisions without human presence." (Company B)

Knowledge management was a theme that emerged from the interviews when discussed about the reasons for implementing BD tools. Knowledge management was a main reason for company C to begin to use data. They want their decisions to base on data and hard evidence. Information needs to be real-time and connectable, so it supports decision-making most efficiently. Similarly, Company E mentioned knowledge management to be in the core of their strategy.

4.3 Ownership, technology and methods

In the next survey question, the respondents were asked if their BD analysis was conducted in the company. 24 (59 %) out of 41 companies answered that analyses was conducted by the company itself, whereas 17 (41 %) answered that BD analyses is not conducted by the company. Most of the companies who answered "no" to this question, were companies who are not utilizing BD, therefore, the results are rather unreliable. Ten of the companies who conduct analysis in the company mentioned they had recruited specialists (such as data scientists) for analyzing data. Of those 24 companies, that conduct analysis in the company, in 15 companies BD activities are centralized and in 9 companies BD activities are decentralized. These results indicate that it is most common to conduct analysis in the company and to centralize it.

If the recipients answered "yes" to the previous question, next question asked them to specify by whom BD is owned as a function in the company. 24

companies answered that they conduct analysis in the company, however, 26 companies answered to the next question, which shows that not all respondents read the questions carefully enough. Table 5 illustrates the distribution between the answers.

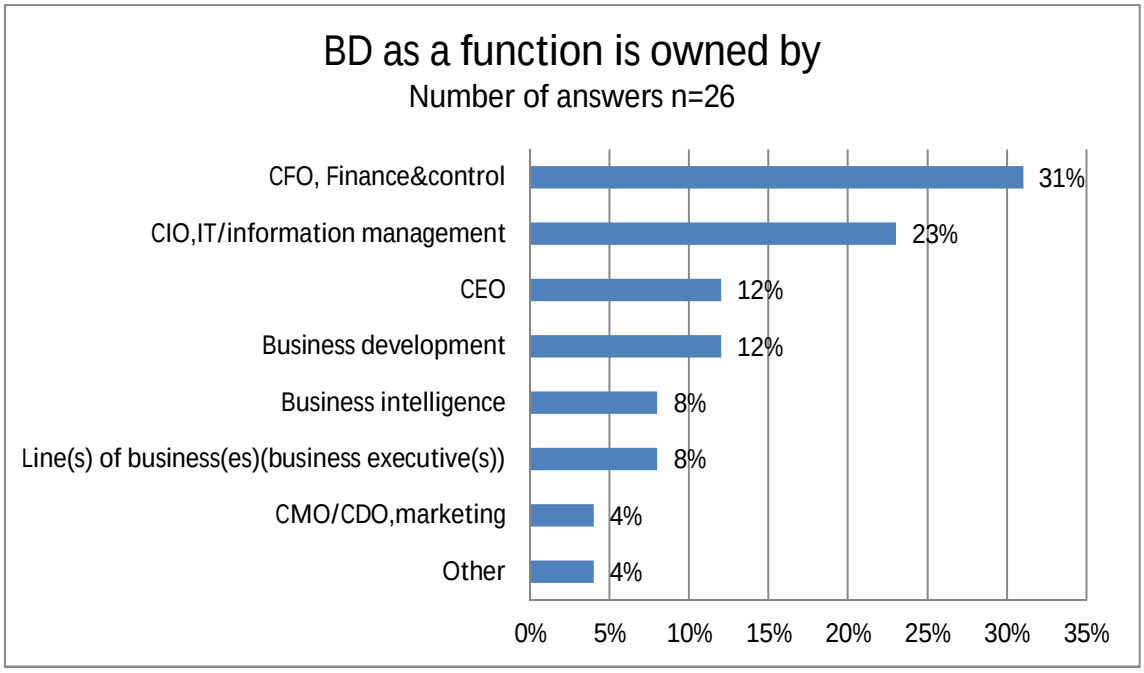


Table 5. Who owns big data as a function in the company?

26 out of 41 companies responded to this question and most commonly, in 8 (31 %) of the companies the chief financial officer (CFO), finance department or control was responsible for BD. This supports the finding of CGMA (2013), who stated that finance department often has a great role in big data activities and finance is most commonly part of analysis as well as translation of insight into tangible business outcome. Secondly, in 5 (23 %) companies CIO or IT-department was responsible for BD. In 3 (12 %) of the companies, CEO was the owner and in 3 (12 %), Business development had the responsibility. Both BI and lines of business(es) or business executives had the responsibility of BD in 2 (8 %) companies. Marketing department, CMO or CDO was responsible for BD as a function in one (4 %) company. Some other function, such as master data management, had the responsibility for BD in one (4 %) company. These results are in line with previous research as most commonly big data belongs to finance, IT or top management. The answers vary between industries and the results do not show any specific way to organize BD within certain industry.

Similar to the survey question, interviewees were asked to define who has the main responsibility of big data in their companies. All of the informants reported that BD as a function is not specified in their company and does not solely belong under the responsibility of one function; rather it is currently under construction. This could result from the fact that, the interviewed companies had not been using data for a long time. There were lots of questions and undefined matters, when it comes to data and analytics. The survey results

showed that BD as a function in most cases belong to CFO, finance and control function, which supports the findings of CGMA (2013). In the interviewed companies, finance function was not responsible for data and analytics; rather it was more under IT. Data or insight teams and functions had also been formed in some of the companies. Finance function still relied on traditional data and they did not own BD as a function in any of the companies. In the interviewed companies, data and analytics were not under one big data –function, rather they were scattered to many different functions.

For company A, ownership and roles around data utilization are unspecified. Their low stage of maturity may be one explanation for this.

"We are currently establishing our technical framework but also clarifying how to make data available and how to analyze it in the first place. This whole operating model is unspecified, but it will be defined probably during this year." (Company A)

Defining the operating model for external data utilization and defining organizational aspects are strongly on the company agenda. Currently, 1000 people from different functions and units in the company are using BD information. The main users, however, are and will be business units. People from all functions have access to the data and can analyze it themselves as the need occurs. In company B, CIO and IT-department has some responsibility of big data. Business functions own their own data, but it is challenging to define the ownership of external data.

Company C is in a very similar situation, as they are in the stage of defining the roles around BD. They have a competence-center around customer data, where they analyze much of their customer data. They aim to connect as many different data sources as possible. According to the interviewee, everyone should try to benefit from data and utilize it in decision-making in all levels. Similarly, in company D, data, analytics and information capabilities are scattered all over the organization. Different functions use and analyze data in different situations. In company E, customer insight function analyzes and gathers most of the data. They position the unit somewhere between IT and business areas.

"At the moment, information specialists are in our team. We understand the structure of information, the models and forms, as well as its effects and utilization. But our aim is that everyone would be the best user of information in their own tasks." (Company E)

In Company E, the idea is to get information easily accessible; therefore, everyone can benefit from it and support their decisions with information and facts. Overall, the ownership and organizational structure of big data is not clearly defined; it depends on the context. The aim is not to restrict big data capabilities and analytics to one function. In this survey, not all companies were utilizing BD; therefore, they are unable to identify any responsible parties. Big data as a function may also belong to several different functions.

Next survey question asked if BD is an outsourced activity and is conducted by external services or subcontractors in the company. 8 (20 %) of 41 companies said BD to be outsourced, whereas 80 % said that BD is not outsourced. This question is rather contradictory as in earlier question 41 % answered that BD analyses was conducted by the company itself, but in this question 80 % answered that big data is not outsourced. These questions could have been explained more detailed in the survey, in order to ensure valid responses. The case may be that some activities are conducted in the company and some are outsourced.

The interviewed companies were in similar situations; some are outsourcing activities, such as analysis, whereas for some companies it is essential to keep analysis in the company. In company A, some of the activities are outsourced, for example in some pilot projects the use of data-analysts. They see outsourcing of some BD activities a possibility in the future. Similarly, company B outsourced data-scientists in one project, to analyze their customer retention. Being in the early stages of utilization, in company C, big data capabilities were rather decentralized as many people have access to the data. The idea, however, is to centralize it in order to create synthesis.

According to company C, data, information and knowledge management need to be in the core of the business, and need to be conducted inside the company, as it is competitive advantage. Some resources, however, could be outsourced. Analytics resources are currently centralized in one function, as in the early stages of maturity it is better to keep them centralized due to synergy. The aim, however, is to expand resources and place analysts to different functions in order to benefit the most from data. Company E has a market insight–team, in which most of the data is analyzed. They aim in embedding utilization to the whole organization. Overall, the results indicate that it is most common to own BD and conduct analysis in the company, rather than to outsource it. In addition, it is most commonly centralized rather than decentralized.

Next survey question was an open question and aimed to find out what big data technologies and methods companies are exploiting. Only 11 answers were given to this question. It seems that many different technologies are used, as various companies provide different tools, from which companies can choose. Some of the tools mentioned were:

"All what IBM is able to offer"

"Microsoft tools"

"CRM, statistics, information gathering"

"SAS, WebFocus, and Microsoft"

Some of the recipients were not using anything yet, or were in the early stages of considering options. Some were unsure of the methods used in their company. This could indicate that the person who answered to the survey was not

familiar with big data from IT-perspective and was unsure of the utilization and technologies used. As noted earlier, most of the companies are still in the early stages of utilization and therefore, have not yet completed implementation.

Similarly, all of the interviewed companies are using various programs and have different technological capabilities. Some had strong IT and some needed to create completely new platforms in order to implement big data tools and technologies. Company A uses variety of programs, such as Hadoop. Implementation has required them to create new technical platform. They have capable sensors in their machinery, which are not yet utilized. Company B uses algorithms trough which data is analyzed. They are using programming language R for one project in addition to sync-power, which is customized program for their industry.

Company C has made data easily accessible for everyone. They want to get information closer to the end-user, with visualization, dashboards, dynamic reports and self-service –tools. They are also using R as well as SAS. They are doing different modelling and anticipate immense opportunities and development in the future, when technology develops. Company E is using for instance Tableau and SQL-SPSS -modeler in analysis and data warehousing.

4.4 Application areas

4.4.1 Experiences from implementation and perceived benefits

In the next survey question, the importance of certain BD application areas in the companies was scrutinized. The alternative answers were presented on a Likert scale, from 1-5, where 1 means “not important” and 5 means “very important”. The results, as shown in table 6, indicate that in current situation big data is seen to be most important, either “very important” or “important”, in core processes of businesses in management level.

	Not important 1	Slightly important 2	Moderately important 3	Important 4	Very important 5	Mean
Strategy: planning and decision-making	15 %	17 %	20 %	29 %	20 %	3,22
Strategic control	15 %	12 %	27 %	27 %	20 %	3,24
Sales and marketing	15 %	20 %	22 %	22 %	22 %	3,17
Creating new business models	15 %	20 %	34 %	15 %	17 %	3,00
Transforming management processes	20 %	24 %	37 %	10 %	10 %	2,66
Managing risk	22 %	12 %	32 %	24 %	10 %	2,88
Optimizing operations	5 %	22 %	17 %	40 %	17 %	3,41

Allocating resources	20 %	27 %	29 %	20 %	5 %	2,63
Maximizing insight, ensuring trust, improving IT economics	17 %	22 %	24 %	32 %	5 %	2,85
Product / service development decisions	15 %	20 %	22 %	37 %	7 %	3,02
Logistics / distribution channel decisions	22 %	22 %	22 %	29 %	5 %	2,73
Budgeting / physical investment decisions	17 %	27 %	27 %	17 %	12 %	2,80
Forecasting	10 %	15 %	20 %	37 %	20 %	3,41
Budgeting and annual planning	10 %	20 %	24 %	29 %	17 %	3,24
Other (n=8)	25 %	0 %	63 %	13 %	0 %	2,63

Table 6. Current importance of BD in certain possible application areas in your company.

The most important application areas support the findings of previous studies. The mean is highest, 3,41, in optimizing operations; improving process efficiency. Only 5 % thought it is “not important”. Forecasting is also highly important (mean 3,41), only 10% said it to be “not important”. Mean is 3,24 in strategic control: monitoring and performance measurement, as well as budgeting and annual planning. Majority of companies thought they are “moderately important” or “important”, whereas 10-15 % thought they are “not important". Additionally, BD is “important” or “very important” in strategic planning and decision-making (mean 3,22). In addition, sales and marketing, which include pricing as well as acquiring, growing and retaining customers, regard BD information to be “very important” (mean 3,17). Similarly, previous research of World Economic Forum (2014) showed marketing and sales to be one of the segments mostly utilizing BD.

Other areas, to which BD is important, are making product or service development decisions (mean 3,02) and creating new business models (mean 3,00). In the areas of risk management: countering fraud and threats, maximizing insight, ensuring trust and improving IT economics (mean 2,85), and making budgeting / physical investment decisions (mean 2,80), the importance of BD is seen “moderately important” or “slightly important” in most companies. Application areas that are seen least important are making logistics or distribution channel decisions, allocating resources and transforming management processes, in which the mean is 2,73; 2,63 and 2,66.

These results indicate that companies are utilizing BD quite differently and the emphasis of certain application area varies between companies. Some areas are clearly more important than others are, such as forecasting and optimizing operations. These results further support the findings of Davenport

(2014), and Gray and Alles (2015), according to which forecasting can be made in variety of levels and processes in companies. It may also be that when companies are in certain stage of maturity, they are utilizing BD more in specific application areas.

Secondly, the respondents were asked to evaluate the future importance of BD in the same possible application areas, in order to compare the answers of the previous question. Table 7 shows some changes in the scale of importance.

	Not important 1	Slightly important 2	Moderately important 3	Important 4	Very important 5	Mean
Strategy: planning and decision making	7 %	2 %	20 %	34 %	37 %	3,90
Strategic control	5 %	5 %	20 %	39 %	32 %	3,88
Sales and marketing	5 %	5 %	24 %	27 %	38 %	3,90
Creating new business models	2 %	7 %	27 %	32 %	32 %	3,83
Transforming management processes	5 %	7 %	44 %	27 %	17 %	3,44
Managing risk	7 %	7 %	37 %	37 %	12 %	3,39
Optimizing operations	0 %	7 %	24 %	46 %	22 %	3,83
Allocating resources	10 %	15 %	32 %	27 %	17 %	3,27
Maximizing insight, ensuring trust, improving IT economics	7 %	7 %	41 %	24 %	20 %	3,41
Product/service development decisions	2 %	10 %	27 %	44 %	17 %	3,63
Logistics/ distribution channel decisions	12 %	5 %	32 %	37 %	15 %	3,37
Budgeting/ physical investment decisions	5 %	10 %	41 %	29 %	15 %	3,39
Forecasting	0 %	5 %	22 %	27 %	46 %	4,15
Budgeting and annual planning	5 %	5 %	24 %	34 %	32 %	3,83
Other: (n=6)	17 %	0 %	50 %	33 %	0 %	3,00

Table 7. Future importance (after 3-5 years) of BD in certain possible application areas.

Almost all of the areas that are “moderately important” in the current situation are said to be “important” or “very important” in the near future. This

indicates that companies are aware of increasing pressure to utilize data. The importance of big data in forecasting is seen to be most significant also in the future. The mean increased from 3,41 to 4,15. Almost ½ (46 %) of the respondents thought, BD will be "important", whereas none thought BD would not have any importance in this area. Second most important areas are strategic planning and decision-making (mean 3,90), sales and marketing (mean 3,90), and strategic control (mean 3,88). The increasing importance of BD in sales and marketing is evident, mean increased from 3,19 to 3,90.

Thirdly, optimizing operations, creating new business models, as well as budgeting and annual planning are considered increasingly important in the near future. Compared to current situation, the importance of BD in creating new business models will increase the most of these three areas. The results also indicate that, BD will be increasingly important in making product or service development decisions. Mean increased from 3,02 to 3,63. The importance of BD in allocating resources is seen the least important both currently and in the future. The distribution of responses is rather scattered in many areas, which could indicate that companies have different perspectives about future when it comes to BD utilization or they are unsure of the possible application areas. Anyhow, most important application areas could be discovered from the data. Taken together, these results suggest that forecasting is most important both currently and in the future. Other areas in strategic and management levels are second in addition to sales and marketing.

Similarly, interviewees reported areas in which big data is utilized in their context. Results show that in all of the five companies, BD was used more comprehensively in operational level than in management level. These results are somewhat conflicting with the survey findings, in which BD was important in management and finance, such as strategic planning and decision-making, strategic control in addition to budgeting and annual planning. The interview results indicate that, big data is initially utilized in operational level and along higher maturity level, it is adopted in management and strategic decision-making. Most important application areas in the survey were optimizing operations; improving process efficiency, and forecasting, which are seen highly important for interviewed companies as well. Company A, BD is not used as comprehensively in forecasting and in managerial level as it is in operational level. BD utilization is seen to be bottom-up, rather than top-down; practices go from operations to management. However, forecasting in both operations and finance department is the next big thing in Company A.

"Forecasting is the next big thing, in which we look at the whole process of forecasting, whether it is operational or financial. We are currently in the beginning." (Company A)

In Company B, big data is mostly used in operational level but planned to be used in management level as well. An important application area is in production; data from plants and processes is used mostly to optimize operations in production, improve cost efficiency and calculate profitable production. BD information is used for long-term strategic planning to some extent. Finance

function uses big data mostly to support forecasting. Information is a base for explaining why results differ from forecasts. Big data enables real time information and ongoing forecasting. BD utilization enables them to look forward, rather than to look back. Similarly, Company C emphasis the importance of forecasting. In. These results are somewhat align with the survey results and previous studies which showed forecasting to be the most important application area currently and in the future. Forecasting can be made in different levels and functions and thus, could be rather easily supported with big data information.

Company C intends to utilize BD information both in operational and strategic decision-making. The implementation process is further in some functions than in others. Financial management utilizes it to some extent already, but not as much as other functions. BD exploitation is strongly on the company's agenda also with management. There is a great demand for information in the company. Company E uses BD in management level and in strategic decision-making. They use it for instance in forming strategy and in forecasting demand for raw material. They are also trying to forecast what happens in the markets and consumption in order to satisfy customer needs.

"We are trying to understand consumer trends, how big they are and are they relevant to our product lines. Simultaneously, we are trying to understand the changes in consumer markets and forecast how people consume." (Company E)

After implementing data analytics tools, companies have acquired more information and can base their decisions on facts rather than assumptions. With the help of BD information, Company E can find explanation to changes and occurrences. They can analyze the effects certain actions had on the company. In addition, controllers have begun to use information from both internal and external data. They can use it in pricing and design campaigns, based on which production can be planned. The interviewee emphasizes the understanding of business processes. It is seen pointless to analyze random data, without knowing what it is and where the information could be used.

In conclusive, most interviewed companies are strongly moving to the direction of utilizing BD in management level and in strategic decision-making. Strategic decision-making, planning, as well as monitoring and performance measurement were also application areas for surveyed companies. Forecasting is clearly a common area for both surveyed and interviewed companies. However, companies seem to be in different stages and proceed at different pace. They emphasize certain application areas more than other areas, depending on the domain and objectives.

In several companies, BD is used in CRM and attaining customer-oriented approach to business. Customers are seen highly in the center, also benefitting from BD. This result support previous findings (IBM, 2012; Moorthy et al., 2015), which showed that big data is utilized extensively in CRM. Company A has strong customer focus and plans to open interface to customers. They aim to a 360-degree view, in which both the company and customers

could see their orders, deliveries and claims. They want customers to benefit from data. Based on data and information, customized products and services can be offered to customers in real-time. Company B wants to improve customer experience and retain existing customers. In the future, they plan to offer advisory services and based on data they can advise what actions to take in order to achieve certain goals.

Value for customers stood out as an important theme, companies want to place customers in the core of the business. For all companies, it is essential to understand the current and potential customers. When utilizing BD information about consumer behavior and markets, it enables companies to produce better products and services, and to offer personalized products and allocated marketing and consequently, value for customers.

"We should find relevant information from massive amount of data; connect information with service situation and consequently, create excellent customer experience and value for customer." (Company D)

Company C is moving strongly towards more customer- and data-oriented processes. According to the interviewee, the whole business is in transition due to, for instance, e-commerce and constantly broadening supply. In order to get new customers it is essential to examine demand and trends in consumer habits. They need to know what consumers want to purchase, and where they want to purchase it now and in the future. Historical purchase data combined with consumer habits and trends could be valuable in predicting demand. Previous studies (e.g. Akbay, 2015; Davenport & Dyché, 2013, Moorthy et al. 2015) also suggest that by collecting consumer and market data, companies could find out what motivates customers to buy and offer them allocated marketing and advertising, and even special pricing models. This can lead to increased sales and customer retention.

Other application areas varied between industries and objectives. Company A feels that especially with internal global data they can bring new dimensions to profitability analysis. They also intend to create new business models by means of big data information.

"We are currently in a situation in which internal global data is utilized. 3-4 years ago, the data utilization was only local. Now our platform has 1000 users globally, which means that the possible application areas are extremely versatile." (Company A)

In Company A, spare part business creates most of the data, with daily orders and deliveries. Big data in this application is used to analyze supply chain and reliability of deliveries. Purchase department uses BD to analyze deliveries and supplier reliability. Decisions about prices can be made based on the information. Maintenance business uses BD information proactively in pricing and sales in order to acquire new contracts. Based on data of machinery usage and the need for spare parts and maintenance services, they can make reliable deci-

sions when and what to offer to customers. Similarly, company B uses data proactively in decision-making of all levels.

Performance monitoring is an application area for some companies also in this study as mentioned previously for example by Schlegel (2014), Moorthy et al. (2015) and Akbay (2015). Integrated data systems enable Company A to estimate for instance customer- and machine-specific profitabilities. The information can be used to analyze business performance and to monitor whether or not they obtained set goals. Both company A and B have planted sensors, which are in pilot stage. Additionally, Company D believes they could plant sensors. IoT (Internet of Things) is relevant in this context as they could utilize data that is created through IoT. According to Davenport and Dyché (2013), companies are increasingly adding sensors into things in order to capture more data and optimize their businesses. Even a small improvement can result in great savings when adopted on a large scale.

Company C operates in retail, trade and wholesale, and therefore, uses BD information in stores. Based on BD information, they can design their stores, locations and selections. They use BD to specify customer potential, operational environment, competitors and their strategies. They are using it to make decisions in purchase-department, concept development and planning, and consequently, minimizing risks and maximizing revenues.

"There is no such area nowadays in which we did not at least try to utilize data. There is a great range in how far we are and what is the automatization of our processes, but our aim is to utilize data all the way from strategic level to operational level."
(Company C)

Company A has a project related to their global sales network, in which benchmarking between the units could be done based on the data generated from business processes in different countries. Thus, best practices can be implemented in all countries. Interviewee from Company D thinks they could use data in pricing, product development, and risk modelling in credit and insurance business. Data could be utilized in giving investment advice. In addition, marketing and product development could benefit from big data. Company E uses BD information already in product and package development.

The interview results indicate that the industry influences on the utilization of BD as well management's perception of BD. Customer-oriented companies within manufacturing and retail, trade and wholesale are utilizing BD more comprehensively than others. In Company C, management believes in data utilization, and they have recognized the possible benefits. The interviewee states that in order to fully benefit from BD, management has to believe in it, be committed and realize the value that comes along BD information. Management is the leader in the implementation process by providing resources and investments.

4.4.2 Challenges

All of the companies interviewed had difficulties in data utilization and implementation. It was seen challenging to find relevant data, to know how to use it as decision-making support and thoroughly understand the value-adding insights. Many of the findings strongly support the results of CGMA (2013), in which companies were facing challenges in extracting valuable insight from data, finding high quality data as well as ensuring the insight is used to improve performance. The results of this study are also in agreement with the findings of Warren et al. (2015) and ACCA and IMA (2013), which showed that it is seen challenging that initially companies have to determine how they want to use data and what the objectives for utilization are.

In company A, some of the challenges were indeed how to extract information out of data, and how to find relevant data. They were struggling how to gather data, how to benefit from it, and how to comprehend it. One challenge is to determine the relevance, and not get overwhelmed by the magnitude of data. Decision-making should be more data-oriented, but data is still seen to belong too much to IT. The quality of data is also seen challenging. Company B has challenges in rationalizing the utilization of data, and explaining how it is beneficial for them. There have been challenges in interpreting the data and information. What does the data really tell? Does it tell how things normally go or does it point out a deviation or problem area, which would not be noticed otherwise?

"The challenge of the implementation process is to find reasons why we should invest in this and how it is beneficial for us." (Company B)

In addition, interviewee from Company C feels, that it is essential to specify in detail how to benefit from data, how to exploit it and put the information in practice. Similarly, interviewee from Company D feels, it is essential to rationalize the reasons for data exploitation, technology implementation and to explain why certain data needs to be analyzed. For Company E, it is challenging to be able to comprehend what the information means. To not only see it, but to understand reasons and consequences and to make right decisions and actions based on appropriate insights. For Company E, the challenge is also to define how to maximize data utilization and how to use that insight as a decision-making support. In addition, a need for data visualization has emerged. It is essential to have visualization tools as well as people who can visualize and read information.

In some of the interviewed companies, IT is seen as a challenge. Resources and lack of knowledge are challenges for Company B. There is an evident need for IT-capabilities. Company D is also facing technical challenges, when determining how to move and transmit large datasets. What type of technology and architecture is most beneficial considering all the functions in the company? Company E faces challenges around IT, when they were building their technical platform.

"..IT, it is challenging to fix even the basic fundaments." (Company B)

Conversely, Company C feels they have rather good IT-capabilities and it is not seen as a challenge.

People and employees were seen as a great challenge in all if the companies. BD has caused an organizational and cultural change and it needs to be managed correctly. For Company C and E, the change in organizational culture is challenging.

"It certainly is a big change, and it is always change management. People will come and question the new ways of doing things." (Company C)

The transformation into more IT- and data-oriented company is not easy for all employees. Some people are used to old habits and are hesitant to change. In addition, it is challenging to change practices and decision-making to data- and information-based. Company A has acknowledged a need for people who can understand where data comes from, know how to use algorithms in analysis, but simultaneously understand the business and its processes. The combination of understanding analytics as well as business processes is challenging for all companies. They need people with IT-capabilities combined with BI-capabilities. Interviewee from company D thinks that it is challenging to compete with large multinational players in the market, when their data assets and capabilities are larger. Interviewee thinks there should be more regulation on who can collect certain data. Similar issues related to privacy and regulation emerged from the report of The Ministry of Transport and Communication (2014).

4.5 Implications on management accounting and professions

Majority of the people who answered to the survey were in top management, IT or finance department. They were also asked more detailed how big data affects management accounting. They had more experiences and therefore, the emphasis of this chapter is on the survey results. The interviewees were not management accountants nor from finance function and therefore, were unable to describe specifically how big data affects management accounting and the finance function or how it is utilized in that context.

In the survey, the respondents were asked how they see the future (after 3-5 years) development of BI and BD technologies and tools in relation to management accounting (MA) or financial information. They were asked to choose the closest alternative. All 41 recipients answered to this question and majority, 59 % believed that in the near future information combination would happen. In this scenario, BI and BD technologies and tools will provide information, which is additional to and separated from MA and financial information. This information, however, would be combined for example in the reporting phase

for management and decision-making. From theoretical viewpoint, this scenario would not be most probable, as integration between BI, BD, and different functions, management accounting among them, is anticipated.

32 % believed in the most advanced technological scenario, technology or system integration. In this case, BI and BD technologies and tools will be tightly integrated with MA and financial systems, which will provide integrated information for management and decision-making. This scenario would be possible according to many sources (e.g. ACCA & IMA, 2013; CGMA, 2013), which indicate that BI and BD will be used increasingly in decision-making, and decisions should base solely on data. 10 % believed there would be no integration between MA, BI and BD. In this case, BI and BD technologies and tools will provide additional information, which will remain fully separate from the MA and financial information in management and decision-making processes. This scenario seems quite unlikely, as many sources (e.g. IBM, 2012; Ministry of Transport and Communication, 2014; CGMA, 2013) claim that data and big data information unlocks many opportunities for companies and can act as competitive advantage. Digitalization, innovations and new technologies seem to lead businesses towards more data-oriented mindset.

Next question surveyed the future impact of BD on management accounting (MA). As the results in table 8 show, it was most common to think that BD will have no impact on MA.

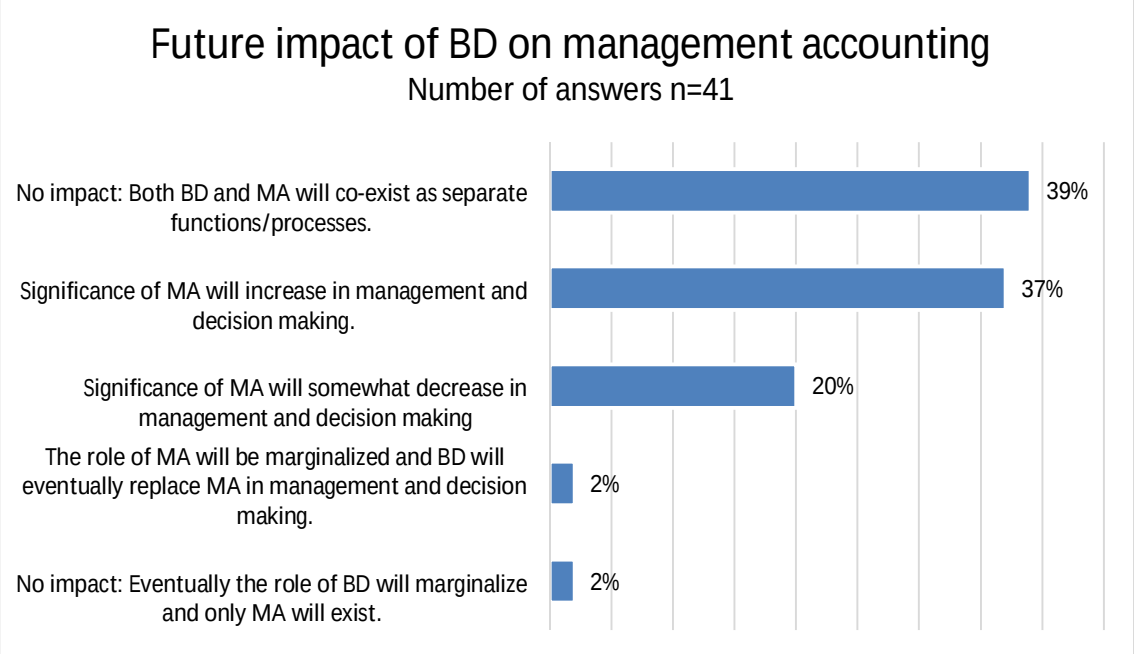


Table 8. How do you see the future (after 3-5 years) impact of BD on management accounting?

Majority, 39 % assume that in the future both BD and MA would co-exist as separate function or processes. It seems that the surveyed companies do not recognize the importance of combining BI, BD and MA information, and that MA could benefit greatly from data. On the other hand, almost the same

amount 37 % assumed that MA will be more important and the significance of MA will increase in management and decision-making. It seems that companies believe MA to be a core function and very important for management and decision-making. This shows the divergent attitudes towards BD utilization. These distinct ways to see the possible benefits of BD could stem from the fact that some companies are not utilizing BD or do not even have plans to do so in the future. It might be their assessment that BD is not beneficial.

According to 20 % of the companies, significance of MA will somewhat decrease in management and decision-making. The opinions about the future of BD and MA seem to be rather speculative. Previous studies (e.g. ACCA & IMA, 2013; Clayton, 2013) have shown that BD and MA will become closer to each other. However, it was seen highly unlikely that either BD or MA will replace one another and only one would exist. Therefore, it can be assumed from the survey results that both will prosper in the future, alongside or separately. The opinions between industries are quite scattered and companies have diverse opinions regardless of their industry.

A common view amongst interviewees is that functions, organizational structure, and organizational culture are in transition. According to CGMA (2013), finance function should work more closely with IT-department, data scientists and management. In the interviewed companies, however, the use of BD in finance function was not relatively wide. According to the interviewee form Company A, finance function is seen to be very traditional and reluctant to change its practices. It has begun to change, but is still far away from complete data-utilization. Financial accounting activities, such as bookkeeping is centralized and outsourced, whereas it is inevitable to keep focus on management accounting and business control function. A need for data analysts also in the finance function has emerged.

Similarly, finance function has begun to change in company B, as they are proceeding to automatization of monthly reporting. In Company C, finance function is changing, not a lot has accomplished yet, but the transition has begun. According to the interviewee, controlling function should be forward-looking rather than focusing on historical data. They should emphasize forecasting and evaluating different scenarios of decisions. The interviewee from company A speculates that whole functions may be reshaped in the future, and some functions may disappear. Traditional functions may stay, but separate layers, such as data-analyst layers, may exist in the future. They emphasize the importance of management accounting, financial accounting activities, such as bookkeeping can be centralized and outsourced.

Next question surveyed current and future roles of different business professionals. The roles of business analysts and intelligence experts, data scientist as well as business controllers and management accountants are under scrutiny. Table 9 shows how companies see certain roles currently and how these roles are assumed to change within the next 3-5 years.

Currently	Not important 1	Slightly important 2	Moderately important 3	Im-portant 4	Very important 5	Mean
Business analysts / intelligence experts	10 %	10 %	29 %	39 %	12 %	3,34
Data scientists	15 %	27 %	34 %	20 %	5 %	2,73
Business control-lers / Management accountants	2 %	0 %	12 %	63 %	22 %	4,02

In the near future (3-5 years)	Not important 1	Slightly important 2	Moderately important 3	Im-portant 4	Very important 5	Mean
Business analysts / intelligence experts	2 %	5 %	17 %	39 %	37 %	4,02
Data scientists	5 %	12 %	37 %	27 %	20 %	3,44
Business control-lers / Management accountants	0 %	5 %	12 %	49 %	34 %	4,12

Table 9. How the overall role of the following professionals for the management is seen in companies?

The role of business controllers and management accountants for management is seen most important both currently (mean 4,02) and in the future (mean 4,12). Business analysts and intelligence experts are seen secondly important both currently (mean 3,34) and in the future (mean 4,02). The role of data scientists is seen to be least important from these categories both currently (mean 2,73) and in the future (mean 3,44). However, the increase in the importance of business analysts, intelligence experts, and data scientists is bigger than increase in the importance of business controllers and management accountants.

In summary, traditional professions, such as controllers and management accountants are seen to have most impact on management. However, the increasing importance of business analysts and data scientists can be noted. These results conflict with previous studies, as many sources claim, that BD is beneficial in supporting management and decision-making. Clayton (2013) claimed big data to be CFOs new best friend. In addition, according to Clayton (2013), the key to unlock the power of BD is in hiring data-oriented personnel with IT-capabilities. It can be, however, that due to early stages of maturity, these companies have not yet seen the importance of people with analytical competences.

The opinions vary greatly between industries and there seems to be no consistency within the answers regarding industry. The answers to following sub-questions are also rather inconsistent from the industry viewpoint. It seems, that neither industry nor turnover can explain, how the importance of these roles are seen for management. It may be that the stage of maturity and the conspicuousness of BD may affect the opinions more.

Next survey question was an open question, aiming to find any changes in the future roles and major drivers for these changes. Nine answers were received to this question. It seems that some companies are aware of the required competences. There will be demand for IT-oriented analytical people who understand business as well as data and analytics. The ability to combine knowledge of business processes, analytics and information extracted from data, will be crucial in the future. Some of the answers were the following:

"BI sector needs to work more in a proactive way to simulate scenarios. Instead of watching historical data that is old. ("no can do data")",

"As data-driven business is started, also the value of those experts will rise."

"Need for better understanding of changes in business environment, customer demands, and both external and internal processes",

"The need for more analytical way to handle the existing information and the need for better forecasts and scenarios."

"Understanding data as information will be more important in the future. Also driving change based upon information is more important in the future. Both will maintain the important role of the controllers and the business analyst. Sometimes the roles will merge into one."

Similar themes and requirements emerged from the interviews. According to Company A, people need to be more data-oriented, as data needs to be utilized better. A need for new competences such as ability to read, analyze and understand data, have arisen. Company B has same requirements for employees. They have to be mathematical as well as able to understand what to look for from the data in the company context. There is a need for more pervasive knowledge, in addition to ability to explain and understand external factors. Finance as well as other functions should have knowledge of what they can do with data and how to benefit from it. There will be a need for people with theoretical background and mathematical capabilities. It is crucial to understand the business and its processes, when applying analytics, in both finance and other functions. The challenge is to combine analytics and substance knowledge.

"There will be demand for people who can understand the meaning of information in their tasks, and understand business processes. Understanding the importance of knowledge management is essential." (Company E)

In order to acquire required competencies companies need to either train their employees in the company, or acquire outsourced competences. Interviewee from company C states, that employees need to have good presentation and communication skills, in addition to analytical capabilities. It is crucial to have the capabilities to present ideas and conclusions that are based on BD infor-

mation. These results above are align with CGMA (2013) who stated that clear communication, ability to lead and influence, and a strategic understanding of the business is a requisite for business professionals. According to CGMA (2013, 2), the role of finance professionals around big data is to aggregate outcomes so they can be converted into insightful reports. Therefore, new qualities and capabilities, such as ability comprehend data and information extracted from it, are required.

The survey respondents answered how they see the future (after 3-5 years) development of the role of management accountants, business controllers or managers in the light of big data and associated technologies and tools. The answers are shown in table 10 below.

	Not likely		Somewhat likely		Very likely	Mean
The role will remain the same.	12 %	27 %	41 %	17 %	2 %	2,71
The role will be more focused into financial aspects.	17 %	39 %	39 %	5 %	0 %	2,32
The role will include also BI / BD analyses.	2 %	2 %	22 %	61 %	12 %	3,78
The role will expand due to increasing co-operation with business analysts / data scientists.	2 %	10 %	39 %	32 %	17 %	3,51

Table 10. The future (after 3-5 years) development of the role of management accountants, business controllers or managers in the light of big data and associated technologies and tools.

Most probably, the role of management accountants, controllers and managers will include also BI and BD analyses, as 73 % think that this scenario is "very likely" or "likely" to happen (mean 3,78). These results align with previous predictions in which it is assumed that the role of management accounting would converge with IT. This could indicate that changes in the perceived qualities of those professionals will change as well. According to the answers, 49 % think that it is "very likely" or "likely" that the roles will expand especially because of increasing co-operation with business analysts and / or data scientists (mean 3,51). This assumption could be very likely to happen, as previous studies (CGMA, 2013; Gray & Alles, 2015) indicate or suggest more co-operation with management accounting and data scientists. It is seen "somewhat likely" or "rather unlikely", that the role will remain the same, or the role will be more focused into financial aspects. This result show, that companies are aware that BD causes changes within the roles of business professionals and many professions become more involved with data and analytics.

Next survey question examined how BI and BD affect the required competences of management accountants and business controllers in the future, after 3-5 years. Table 11 illustrates the responses

	Not at all		Some-what		Very much	Mean
Required competences will focus on mainly financial information.	7 %	29 %	39 %	17 %	7 %	2,88
Required competences will expand into understanding business	0 %	0 %	12 %	59 %	29 %	4,17
Required competences will expand into BI and analytics	0 %	7 %	20 %	54 %	20 %	3,85
Required competences will expand into data science skills.	5 %	24 %	39 %	22 %	10 %	3,07

Table 11. How BI and BD affect the required competences of management accountants and business controllers in the future, after 3-5 years.

Majority of the respondents, 29 %, assume that BD and BI will affect the competencies "very much" and the required competences of management accountants will expand into understanding business (mean 4,17). Secondly, 20 % thinks that BD and BI affect the competencies "very much" and that the required competences will expand into BI and analytics (mean 3,85). It is not seen as likely that the required competences will expand into data science skills (mean 3,07). It is seen least likely that the competencies will focus on mainly financial information (mean 2,88).

These results indicate that it will be very important in the future for management accountants to expand their competences into understanding business above their responsibilities and that even BI and analytics skills are becoming a requirement. Additionally, these results indicate that data scientists will be needed separately in the company, and that these competences do not belong solely to management accountants.

Some assumptions of possible changes emerged from the interviews. Controller tasks move closer to understanding business, industry and business environment, rather than to produce reports on paper. All of the companies predicted that finance professionals have to be almost data-literate and that the management accountant and CFO professions will have more qualities of IT and analytics as well as understanding of business. Comprehension of business and its processes is one of the main themes that emerged from the interviews.

"There is a need for a data-analysts combined with business controller qualities and capabilities" (Company A)

These assumptions from the survey and the interviews further support previous findings (e.g. Gray & Alles, 2015; Clayton, 2013; CGMA, 2013; ACCA & IMA, 2013) according to which management accountants should move to extended data sources, improve their analytics skills, and explore additional data analytics tools. This result emerged more strongly from the interview results than from the survey results. The survey was conducted almost a year ago, which may effect on the perceptions of surveyed companies compared to inter-

views. The interviewed companies had taken major steps in data utilization within one year, and would have similarly been in different stages one year ago.

Next survey question aimed to find out the opinions about who will analyze managerial data (for example financial data, BI data, big data) in the future business life. The results in table 12 show that the likelihood for three scenarios are seen almost the same.

	Rarely	Occasionally	Sometimes	Often	Very often	Mean
Management accountants / Business controllers	7 %	0 %	24 %	46 %	22 %	3,76
Business intelligence specialists / Business analysts	5 %	2 %	24 %	51 %	17 %	3,73
Data scientists	12 %	17 %	32 %	24 %	15 %	3,12
Business managers / executives / Business owners	2 %	5 %	27 %	46 %	20 %	3,76

Table 12. In business life, who will analyze managerial data (for example financial data, BI data, and big data) in the future (after 3-5 years)?

According to the answers, 68 % think, that analysis of data in most cases "very often" or "often" will belong to either management accountants or business controllers (mean 3,76). Similarly, 68 % think that BI specialists or business analysts will analyze data in the future (mean 3,73). Almost as many, 66 %, assume that business managers, executives or business owners will be responsible for analyzing data (mean 3,76). Data scientists are seen least likely to analyze data in the future, as 39 % think they will "often" or "very often" do it (mean 3,12). These results show that companies are not completely sure of the roles around BD.

Previous studies emphasize the role of data scientists, and many companies are hiring them. Thus, they could analyze data more probably than business managers could. Nevertheless, this question concerned only managerial data, which is a rather wide concept and could actually be analyzed by managers themselves. Additionally, data-analysts could also be hired to management level in some companies, and thus, they would analyze managerial data. This result could also depend highly on the company perceptions and the types of data they are utilizing. Companies who rely merely on traditional managerial data most likely use business managers in analyzation. In addition, many companies may not have resources to hire data-analysts.

The interviewed companies highlighted that different people can analyze data as the need occurs and everybody can use information. In addition, they state that data and analytics are not centralized in one function, instead they are scattered and applied in various functions. Therefore, it could be interpreted, that when companies become more mature in their data utilization, consequently more people analyze data. Companies may also become data-oriented and almost data-literate in the future, and thus, require analytics skills from everyone.

Last survey question surveyed the possible future hybridization of professional roles. The question stem from the viewpoint of professions, roles and responsibilities (such as Business controllers, Business intelligence experts, Data scientists). "Hybridization" in this context means that same person's professional roles or duties will include elements of two or more different jobs or duties considered traditionally belonging to some other professions. Controllers work may thus include elements of business analysts' duties or vice versa."

As table 13 illustrates, not many respondents think that these scenarios are "very likely" to happen. According to these answers, there is seen to be 71 % likelihood that BI experts and business controllers are going to hybridize "likely" or "somewhat likely" (mean 3,41). BI experts and data scientists are going to hybridize "likely" or "somewhat likely" according to 69 % (mean 3,49). Probability that data scientists and business controllers are "likely" or "somewhat likely" hybridizing is the least, 58 % (mean 2,83).

	Not likely	Doubt-fully	Somewhat likely	Likely	Very likely	Mean
BI-experts and data scientists are going to hybridize.	2 %	12 %	37 %	32 %	17 %	3,49
BI-experts and business controllers are going to hybridize.	0 %	17 %	37 %	34 %	12 %	3,41
Data scientists and business controllers are going to hybridize.	15 %	20 %	41 %	17 %	7 %	2,83

Table 13. From the point of view of professions, roles and responsibilities (such as Business controllers, Business intelligence experts, Data scientists) in the future (after 3-5 years).

According to these results, BI-experts and data scientists are most likely going to hybridize. A possible explanation for this might be that those professions are rather similar, and in some companies, one person can already manage both roles. In some cases, BI-experts and business controllers can hybridize, if they are responsible for similar tasks, or if controllers rely firmly on analytics and data. The least likely scenario, in which business controllers and data scientists would hybridize, could happen if business controllers improve their analytics skills. It may be, however, that business controllers have other focus areas in addition to data science, and cannot fully commit to acquiring comprehensive data science skills.

Overall, the results from the interviews and the survey are consistent in some areas and contradict in some areas. As mentioned before, the survey was conducted in February 2015, whereas the interviews in March 2016. During this time the surveyed companies could have taken major steps in utilizing data and could therefore, have different opinions if the survey was conducted again. Overall, some type of picture of the state of big data utilization in Finnish companies can be formed from these results.

5 CONCLUSION AND DISCUSSION

Results of the study can be concluded and presented by answering to the research questions. The survey and the interviews produced different types of data, thus, the results are not fully comparable, but rather supportive of each other. First question aimed to find out:

1. *Do Finnish enterprises utilize big data? How and to what extent?*

The results of this study show that some companies in Finland are utilizing big data and some are not. Many of them seem to be well aware of the possibilities that come along big data and analytics. Companies are in different situations, some have implemented technologies and the utilization is relatively wide, whereas some companies are still in pilot or planning stage of utilization. Some companies do not even plan to pursue big data. These results show that none of the companies is yet in full maturity. However, most likely there are Finnish companies, in which the utilization is in full maturity.

IBM (2012) found that 47 % of the companies globally were planning big data activities and 28 % of the companies had already implemented an application or a pilot program. The situation seems to be somewhat similar in Finland. Finnish companies will become more mature with their data utilization when they invest time and resources to implementation and define their key objectives. Previous studies show that multinational companies, such as Google, LinkedIn and Facebook are utilizing data to great extent as they were built around data from the beginning (Davenport & Dyché, 2013). It seems likely that Finland and Europe are further behind the United States.

Most probably large companies are the ones utilizing data, as they have better resources and better means to gather and store data. It seems that companies, who have strong customer focus, and who are in direct contact with customers utilize data the most. Some companies in this study had gathered data for several years, but began to utilize it only recently. It was easier for them to begin as they already had data in their repositories. Otherwise, any explanations from industries were not found from these results. Davenport and Dyché (2013) also found that companies are in different stages of maturity, some had added new forms of data to their systems for many years, whereas some companies were only familiarizing themselves with the concept.

One interesting finding is that most of the companies have not utilized big data for a long time. The interviews reveal that utilization had begun only one year ago. Thus, it is rather new area among Finnish companies. Quite many companies were not using or planning to use big data at all. One reason could be that many Finnish companies are middle-sized and do not own as much data as they should in order to call it big. However, many companies could have begun to utilize data, after answering to the survey and would be in different stages than one year ago. Traditional accounting information is still most im-

portant for management compared to business intelligence (BI) and big data information. BI is secondly important, and big data is the least important. Companies are still relying mostly on traditional internal data, but they are aware that they should move onto more complex data utilization and emphasize external data sources also in management level. The importance of big data information for management is believed to increase in the future.

Companies are using various types of data, depending on their objectives and domain. Customer data and consumer market data are important as well as data from business processes gathered in ERP-systems. Sensor data is also utilized and planned to be utilized. Profitability data, weather data, open-data, product-data, as well as internet and mobile data, are among the mentioned sources. Companies are implementing various big data technologies, such as IBM and Microsoft, SAS, Hadoop and Tableau and programming language R. Some have more advanced infrastructure, whereas some have created a completely new technological platform. Technologies are selected to most effectively deliver what is expected and to reach set goals. Companies have large data assets but they are often unsure how to utilize them, interpret information and find valuable insights.

Companies seem to have various ways to construct big data activities organizationally. In some cases big data as a function belongs to finance function or under the responsibility of CFO. Secondly, CIO or IT-department is the responsible party, probably because analysis and warehousing often belongs to IT. In some cases, company management is responsible for big data as a function. In many cases, big data function is still under construction and the roles around it are unspecified. Big data is not restricted under the responsibility of one function; rather companies want to embed analytics to the whole organization and add analysts to support different units. Customer insight functions or competence centers have been formed around data. This area could be studied more, as some results show that big data often belongs to CFO, whereas in some companies big data has hardly no role in managerial accounting or finance activities.

It is most common to conduct big data activities in the company, as it is competitive advantage. Centralization is preferred over decentralization, at least partly. Data is often gathered in one repository and managed from there. In some companies, functions gather and own their own data and everyone can analyze it when in need of supportive information. Analysis can be conducted in that same function or in separate function by data-analysts. Overall, companies are strongly emphasizing the use of data, are increasing the utilization, and want it to be embedded to the whole organization.

Second research question:

2. *How is big data utilized in business processes, and to support decision-making and management? What experiences and challenges have emerged?*

It can be concluded from the results, that big data is utilized in both operational and management level. In many cases, the utilization has not fully reach management but it is seen as the next big thing. However, situations and application

areas vary between companies and industries. Reasons for data utilization are knowledge management, changing markets, increased competition in the markets, customer demand as well as optimizations of operations and urgency to increase efficiency and thus, reduce costs. The main application area is forecasting and optimizing operations. Forecasting can be done in many areas such as planning and predicting the need for raw materials and product orders. Production wants to be managed effectively. Many companies define improving operational efficiency as one of the main objectives when they began to use data comprehensively. Other studies, such as IBM (2012), Akbay (2015) and Schlegel (2014) have come to similar conclusions. Especially the importance of forecasting was emphasized already in previous studies. With big data utilization, companies can optimize operations and calculate production to be optimal and thus, maximize revenues and minimize costs.

Additionally, Finnish companies use big data in strategic decision-making in monitoring and performance measurement, as well as budgeting and annual planning. Profitability analysis is one application area within different levels and functions. Creating new business models is one possible application area already utilized by some companies. Companies are familiar with IoT and starting to plant sensors. Sensors gather data for instance from machinery or for insurance business. Perhaps machines could even fix themselves in the future, by gathering data about errors and consequently, minimize downtime.

Marketing and CRM are major application areas. Big data offers great advantages for companies focusing on customer centric approaches (Moorthy et al., 2015; Akbay, 2015; Global Economic Forum, 2014). Results from this study support previous results, as many companies denote that big data information enable them to uncover the habits and demand of customers. Companies have become more proactive and can react to problems even before they are at hand. They can boost sales by analyzing customer behavior and offering them products or maintenance services before they even know they have the need for it. Allocated marketing and sales, value for customers, satisfying customer needs, forecasting trends and consumer habits as well as acquiring new customers and retaining current ones have been positive consequences from data and analytics within sales, marketing and CRM.

Big data has aided companies to move towards more customized products and services, even customized pricing. Data enables companies to develop new products, move to new markets, and act proactively. Product development is one area that is becoming increasingly important in Finland. Davenport and Dyché (2013) mentioned product development also in their findings. With the help of big data information, companies can design stores to meet the demand of customers and maximize revenues. Managerial control as an application area is mentioned in previous studies (e.g. Bhimani and Willcocks, 2014; Warren et al., 2015; Gray & Alles, 2015) but it was not mentioned in Finnish context. HR is said to be area least utilizing big data (IBM, 2012), this is also the case in Finnish companies.

Companies strongly feel that big data information has enabled them to make decisions based on facts. The emphasis is on real-time information instead

of historical data. Information is real-time and connectable, so it supports decision making most efficiently. There seem to be no realms, when it comes to big data. Companies feel there are possibilities to utilize it in almost every function. Still, they are facing challenges. Warren et al. (2015), ACCA and IMA (2013), and CGMA (2013) found several obstacles and their findings are supported with the results of this study. Companies seem to be aware of the possible benefits of big data, but are unsure of the quality of data, unaware of the relevance of data and ways to interpret information and benefit from valuable insights. It is challenging to ensure the insights are used to improve business performance. Companies have been active with their big data implementation for only a year or less. Due to that, they have not yet came to full conclusion of their objectives and the reasons for data utilization. Companies have difficulties to maximize the exploitation of data. There should be a transition to complete data utilization, in which data is used to support every decision.

Big data causes an organizational change and some may be resistant to the transformation. Therefore, management has a great role in transition process. This was also stated by ACCA and IMA (2013) and McAfee et al. (2012.) Companies have not updated their competencies, and thus employees may not understand how to handle large data sets and understand analytics as well as business processes. World economic Forum (2014) also mentioned shortage of available talent specializing in data analytics as a challenge. Ethical and privacy issues can be anticipated to increase as companies become more mature, and the amount of data expands, and as more companies begin to adopt big data technologies. This was speculated also by The Ministry of Transport and Communication in Finland (2014).

Third question is the following:

3. *What are the implications of big data on management accounting and to the role of business professionals?*

The transformation into data-driven businesses has begun also in Finland and big data information is seen increasingly important in the future. However, management accounting activities or traditional accounting information is not disappearing or losing its relevance. Rather, it is supported by big data information. Most companies believe that BI and big data information will be used along with traditional management accounting and financial information. It is also suggested that BI and big data technologies would be tightly integrated to management accounting in the near future and thus provide exhaustive information to support management and decision-making. Information combination seems to be significant in the future, minimizing the likelihood of applying only one type of information.

Companies assume that in the future both big data and management accounting would co-exist as separate functions. Many companies in Finland have utilized data only for a short time and may not recognize the importance of combining BI, big data and management accounting information, and that management accounting could benefit greatly from data. The role of manage-

ment accountants and controllers is still predicted to be most important. Business analysts, BI analysts and data scientists are not as important; however, their importance is increasing. These situations and opinions change promptly and companies could already think otherwise. As the utilization of data expands, the role of data analysts and scientists will increase.

The prediction is that management accountants and finance professionals need to have more qualities of IT and analytics as well as understanding of business. It is also mentioned by Clayton (2013) that CFOs should collaborate with CIOs and benefit from big data analytics more efficiently. Management accountant tasks will include BI and big data analyses and they will work more closely with business analysts and data scientists. These support previous studies, which suggest that management accountants should move away from analyzing primarily traditional data and contribute more to data analytics as well as predictive and prescriptive analytics. (Gray & Alles, 2015; Pickard & Cokins, 2015). ACCA and IMA (2013) suggest the formation of new professionals who have the knowledge of both technology and finance. Marshall et al. (2015) emphasize that leaders should use analytic tools to facilitate innovation.

Traditional accounting activities have always affected management and decision-making, and it is challenging to move onto additional sources of information. This change however, can embrace the traditional accounting profession or create new opportunities and functions. Finance function is in transition even though it is seen to be very traditional and reluctant to change its practices. Essentially, the role of finance function and management accountants is seen to change (Bhimani & Willcocks, 2014). However, other functions are changing as well. Controller tasks move closer to understanding business, industry and business environment, rather than to produce reports on paper. It is sure, that the role of management accountants and finance professionals will not remain as it is now or has been before. It was also anticipated by ACCA and IMA (2013), who stated that whilst big data creates possibilities for businesses, it simultaneously reshapes accountancy and finance professions.

There is an evident need for analytical capabilities. Companies want data-analysts and people who can understand where data comes from, know how to use algorithms in analysis, but simultaneously understand the business and internal and external processes. Employees have to understand reasons and consequences and make right decisions based on appropriate insights. IT and analytics will include in everyone's job description. When companies become more mature in their data utilization, consequently more people analyze data. Companies may also become data-oriented and almost data-literate in the future, and thus, require analytics skills from everyone.

The implications of big data on management accounting in Finnish context seem to follow the findings of previous studies. It may be because management accounting profession, tasks and finance function are rather similar in many countries. Finland may be further behind the transition than for instance United States or UK. In order to understand comprehensively the implications of big data in organizations in Finnish context, further research is needed in many areas.

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APPENDICES

Appendix 1 Survey form

Big Data

Big data (hereafter BD) is any collection of data sets so large and complex that it becomes difficult to process using on-hand data management tools or traditional data processing applications. Its characteristics typically include "3Vs"— volume, variety, and velocity. Big data analytics refers to the process of collecting, organizing and analyzing large sets of data to discover patterns and other useful information for decision making.

21. Maturity of BD: In our company (choose the closest option): *

- ○ BD is not used and it is not planned to be used
- ◉ BD is considered or planned to be used.
- ○ BD is in pilot/early stages
- ○ Applying BD is relative regular and wide
- ○ Applying BD is very wide and regular / full maturity.

22. Importance of BD for management in general
(Not important 1 – Very important 5)

	Not important 1	2	Moderately important 3	4	Very important 5
Current importance for management					
Overall importance of BD information for management *	○	○	○	○	○
Overall importance of business intelligence information for management *	○	○	○	○	○
Overall importance of management accounting / business controlling / financial information for management *	○	○	○	○	○
Future importance (after 3-5 years) for management					
Overall importance of BD information for management *	○	○	○	○	○
Overall importance of business intelligence information for management *	○	○	○	○	○
Overall importance of management accounting / business controlling / financial information for	○	○	○	○	○

23. Current importance of BD in certain possible application areas of BD in your company

	Not important 1	2	Moderately important 3	4	Very important 5
Strategy: planning and decision making *	○	○	○	○	○
Strategic control: monitoring and performance measurement *	○	○	○	○	○
Sales and marketing: acquiring, growing and retaining customers; pricing *	○	○	○	○	○
Creating new business models *	○	○	○	○	○
Transforming management processes *	○	○	○	○	○
Managing risk; countering fraud and threats *	○	○	○	○	○
Optimizing operations; improving process efficiency *	○	○	○	○	○
Allocating resources *	○	○	○	○	○
Maximizing insight, ensuring trust and improving IT economics *	○	○	○	○	○
Making **product / service development or production decisions** *	○	○	○	○	○
Making **logistics / distribution channel decisions** *	○	○	○	○	○
Making **capital budgeting /physical investment decisions** *	○	○	○	○	○
Forecasting *	○	○	○	○	○
Budgeting and annual planning *	○	○	○	○	○
Other application area (please specify)	○	○	○	○	○

24. Future importance (after 3-5 years) of BD in certain possible application areas of BD in your company

	Not important 1	2	Moderately important 3	4	Very important 5
Strategy: planning and decision making *	○	○	○	○	○
Strategic control: monitoring and performance					

measurement *	○	○	○	○	○
Sales and marketing: acquiring, growing and retaining customers; pricing *	○	○	○	○	○
Creating new business models *	○	○	○	○	○
Transforming management processes *	○	○	○	○	○
Managing risk; countering fraud and threats *	○	○	○	○	○
Optimizing operations; improving process efficiency *	○	○	○	○	○
Allocating resources *	○	○	○	○	○
Maximizing insight, ensuring trust and improving IT economics *	○	○	○	○	○
Making **product / service development or production decisions** *	○	○	○	○	○
Making **logistics / distribution channel decisions** *	○	○	○	○	○
Making **capital budgeting /physical investment decisions** *	○	○	○	○	○
Forecasting *	○	○	○	○	○
Budgeting and annual planning *	○	○	○	○	○
Other application area (please specify)		○	○	○	○	○

Resourcing, organization and ownership

25. Conducting BD

	No	Yes
In our company **we conduct BD analyses by ourselves** *	○	○
If yes: we have recruited specialists (such as data scientists) for the duty:	○	○
If yes: in our company, BD activities are centralized	○	○
If yes: in our company, BD activities are decentralized	○	○

26. If yes: BD as a function / process is owned by

○ CEO

- ○ CFO, finance & control
- ○ CIO, IT / information management
- ○ CMO / CDO, marketing
- ○ Business development
- ○ Business intelligence
- ○ Line(s) of business(es) (Business executive(s))
- ○ Other

27. BD is an outsourced activity and is conducted by external services / subcontractors *

- ○ No
- ◉ Yes

Technology and methods

28. If your company is using BD, what technologies and methods are used?

29. How do you see the future (after 3-5 years) **development of BI and BD technologies and tools in relation to management accounting (MA) / financial information?** Choose the closest alternative. *

- ◉ **No integration**: BI/BD technologies and tools will provide additional information, which will remain fully separate from the MA / financial information in management and decision making processes.
- ○ **Information combination**: BI/BD technologies and tools will provide information which is additional to and separated from MA / financial information, but which is combined for example in the reporting phase for management and decision making.
- ○ **Technology** or system integration: BI/BD technologies and tools will be tightly integrated with MA /financial systems, which will provide integrated information for management and decision making.

30. How do you see the future (after 3-5 years) **impact of BD on management accounting (MA)?** Choose the closest alternative. *

- ○ No impact: Eventually the role of **BD will marginalize and only MA will exist**.
- ◉ Significance of **MA will increase** in management and decision making.
- ○ No impact: Both **BD and MA will co-exist** as separate functions / processes.
- ○ Significance of **MA will somewhat decrease** in management and decision making
- ○ The role of **MA will be marginalized and BD will eventually replace MA** in management and decision making.

Professions

31. How you see the **overall role of the following professionals for the management** in your company *

	Not important 1	2	Moderately important 3	4	Very important 5
Currently					
Business analysts / intelligence experts	○	○	○	○	○
Data scientists	○	○	○	○	○
Business controllers Management accountants	○	○	○	○	○
In the future (after 3-5 years)					
Business analysts / intelligence experts	○	○	○	○	○
Data scientists	○	○	○	○	○
Business controllers Management accountants	○	○	○	○	○

32. If you see some **changes in the future roles**, please name the major drivers for the change

33. In the light of BD and associated technologies and tools, how do you see the future (after 3-5 years) **development of the role of management accountants / business controllers or managers** *

	Not likely 1	2	Somewhat likely 3	4	Very likely 5
The role will **remain the same.**	○	○	○	○	○
The role will be **more focused into the financial aspects only.**	○	○	○	○	○
The role will **include also the business intelligence and / or big data analyses.**	○	○	○	○	○
The role will **expand especially because of the increasing co-operation with the business analysts and / or data scientist.**	○	○	○	○	○

34. In business life, **managerial data (for example financial data, BI data, Big data) will be in the future (after 3-5 years) analyzed by** *

	Rarely 1	2	Sometimes 3	4	Very often 5
Management accountants / Business controllers	○	○	○	○	○
Business intelligence specialists / Business analysts	○	○	○	○	○
Data scientists	○	○	○	○	○
Business managers / executives / Business owners	○	○	○	○	○

35. How BI and BD **impact on the required competences of management accountants / business controllers** in the future (after 3-5 years)? *

	Not at all 1	2	Somewhat 3	4	Very much 5
Required competences will **focus on mainly financial information.**	○	○	○	○	○
Required competences will **expand into understanding business.**	○	○	○	○	○
Required competences will **expand into business intelligence and analytics.**	○	○	○	○	○
Required competences will **expand into data science skills.**	○	○	○	○	○

36. From the point of view of professions, **roles and responsibilities** (such as Business controllers, Business intelligence experts, Data scientists) in the future (after 3-5 years) *

By "hybridization" we mean that same person's professional roles / duties will include elements of two or more different jobs / duties considered traditionally belonging to some other professions Controllers work may thus include elements of business analysts duties or vice versa.

	Not likely 1	2	Somewhat likely 3	4	Very likely 5
Business intelligence experts and data scientists are are going to hybridize.	○	○	○	○	○
Business intelligence experts and business controllers are going to hybridize.	○	○	○	○	○
Data scientists and business controllers are going to to hybridize.	○	○	○	○	○

Additional comments:

37. Please give us any other comments / opinions about the future of BD, business intelligence and management accounting (financial) information regarding the management of the companies.

38. If you wish to receive an executive summary of the results of the business intelligence study, you may leave an e-mail address below. Otherwise please leave it blank.

E-mail erno.nykanen@email.com

(0 of 10 pages)

Appendix 2 Interview questions

1. How would you define big data? What is big data in your context? How long has it been gathered and utilized?

2. What is the maturity of big data in your company on a scale of 1 to 5? If 1 is on planning stage and 5 is in full maturity.

3. Under which function does BD belong? Who is responsible for it? IT, Finance, CEO? Is something outsourced?

4. What is the background and reasons for implementation? Why did you decide to begin to utilize data? What are the objectives?

5. What kinds of tools and programs do you have? How was your technical framework and platform at the beginning? Were any changes made to it?

6. What types of data are you utilizing?

7. Who in your company uses data? Are certain functions more active or have more responsibility?

8. How do you utilize data in your company? Which processes and functions utilize information?

9. Experiences of implementation? How long has the process been? Who were involved?

10. What have been challenging in implementation and utilization? How have they been solved? Other experiences?

11. Other ways to utilize it in your decision-making support and management?

12. Has big data changed your decision-making? How?

13. What have been the outcomes?

14. Who analyzes data? Do you think it could change in the near future?

15. How important is BD information for management? CFO/controllers? Finance function? other functions?

16. How does the future of BD look in your company? How important do you see BD information compared to other information e.g. more traditional information? Is BD going to be used in other processes or departments?

17. What qualities are required from management accountants, controllers or finance professionals after the introduction of BD?

18. What are the requirements for people who use data? Has any changes emerged to the required competencies after BD? Have you hired new employees?

19. How do you see the role of management accountants in the company in the future? Overall and regarding BD? Alternatively, what kind of role do other professionals have who utilize data? Are new requirements emerging? What kinds?

20. Are there going to be new professions? What could these be?

21. Other comments or questions?