LAPPEENRANTA UNIVERSITY OF TECHNOLOGY
School of Business and Management
Industrial Engineering and Management

Annika Auvinen

Evaluating Success and Maturity of Business Intelligence Implementation from Managerial Accounting Perspective

Master's Thesis

Examiners: Professor Timo Kärri
Junior Researcher Lasse Metso

ABSTRACT

Author: Annika Auvinen

Subject: Evaluating Success and Maturity of Business Intelligence Implementation from Managerial Accounting Perspective

Year: 2018 **Place:** Vantaa

Master's Thesis. Lappeenranta University of Technology, School of Business and Management, Industrial Engineering and Management, Cost Management

112 pages, 25 figures and 12 tables

Examiners: Professor Timo Kärri and Junior Researcher Lasse Metso

Keywords: business intelligence systems, implementation, critical success factors, maturity model, implementation challenges, managerial accounting

The aim of this study is to research the implementation of business intelligence (BI) systems from managerial accounting perspective. BI systems are supporting decision-making and managerial accounting by offering functionalities for budgeting, reporting and analyzing. Nearly every successful company has adopted a BI system in recent decades but despite the popularity, the failure rate of the BI implementations is even 80 per cent. The main purpose of this study is to offer the framework for the case company how to facilitate the utilization of the implemented BI systems during the changes in managerial accounting. How to measure the success of the implementation, how implementation challenges vary according to BI maturity and how to defeat implementation challenges are studied.

This study is conducted as a single case study with embedded units using both qualitative and quantitative data. Qualitative data is collected through ten semi-structured interviews including the representatives from different business units. Interviews were divided into two groups; half of the interviews concerned the implementation of the budgeting and forecasting system while half of the interviews concerned the implementation of the reporting and analyzing system. Interview results are enriched with quantitative data which consists of nine-month archival data of tickets opened by the users. Ticket data is analyzed by using a content analysis method.

According to previous researches, the success of the BI implementation can be measured by return on investment, non-concrete measures, project management measures and user satisfaction. The success of the implementations at the case company was evaluated by using project management measures and user satisfaction since they can be used for evaluating the success company-widely. Based on the implementation success and BI maturity criteria of Gartner's maturity model, the BI implementation projects at the case company are at the 2nd and 3rd maturity levels using the scale from 1 to 5. Based on the interviews and data analysis, workflow problems are the major problem type on both maturity levels. As a result of the study, the framework how to defeat implementation challenges and move up in the maturity curve was created for the case company.

TIIVISTELMÄ

Tekijä: Annika Auvinen

Työn nimi: Liiketoimintatiedon hallintajärjestelmän käyttöönoton onnistumisen ja kypsyysasteen arviointi sisäisen laskennan näkökulmasta

Vuosi: 2018 **Paikka:** Vantaa

Diplomityö. Lappeenrannan teknillinen yliopisto, School of Business and Management, Tuotantotalous, Kustannusjohtaminen

112 sivua, 25 kuvaa ja 12 taulukkoa

Tarkastajat: Professori Timo Kärri ja nuorempi tutkija Lasse Metso

Hakusanat: liiketoimintatiedon hallintajärjestelmät, käyttöönotto, kriittiset menestystekijät, kypsyysmalli, käyttöönoton haasteet, sisäinen laskenta

Työn tavoitteena on tutkia liiketoimintatiedon hallintajärjestelmien käyttöönottoa sisäisen laskennan näkökulmasta. Liiketoimintatiedon hallintajärjestelmät tukevat yrityksiä päätöksenteossa ja sisäisessä laskennassa tarjoamalla toiminnallisuuksia budjetointiin, raportointiin ja analysointiin. Lähes jokainen menestynyt yritys on hankkinut liiketoimintatiedon hallintajärjestelmän viimeisten vuosikymmenien aikana, mutta järjestelmien suosiosta huolimatta jopa 80 prosenttia käyttöönotoista epäonnistuu. Tutkimuksen päätavoitteena on tarjota viitekehys kohdeyritykselle, kuinka se voi edesauttaa liiketoimintatiedon hallintajärjestelmien käyttöönottoa sisäisen laskennan muutostilanteissa. Työssä on tutkittu, kuinka käyttöönoton onnistumista voidaan mitata, kuinka käyttöönoton haasteet vaihtelevat kypsyysasteen mukaan sekä kuinka käyttöönoton haasteet voidaan voittaa.

Tutkimus on toteutettu tapaustutkimuksena käyttäen sekä kvalitatiivista että kvantitatiivista dataa. Kvalitatiivinen data on kerätty kymmenen puolistrukturoidun haastattelun avulla ja haastateltavat edustavat kohdeyrityksen eri liiketoimintayksiköitä. Haastattelut jaettiin kahteen ryhmään; puolet haastatteluista käsittelivät budjetointi- ja ennustejärjestelmän käyttöönottoa, kun taas puolet haastatteluista käsittelivät raportointi- ja analyysijärjestelmän käyttöönottoa. Haastatteluiden tueksi on kerätty kvantitatiivista dataa, joka koostuu käyttäjien avaamista tiketeistä yhdeksän kuukauden tarkastelujakson aikana. Tikettidatan analysoinnissa on käytetty sisällönanalyysimenetelmää.

Aikaisempien tutkimusten perusteella käyttöönoton onnistumista voidaan mitata sijoitetun pääoman tuottoprosentilla, epäkonkreettisilla mittareilla, projektinhallintamittareilla sekä käyttäjätyytyväisyydellä. Käyttöönottojen onnistumista kohdeyrityksessä mitattiin projektinhallintamittareilla sekä käyttäjätyytyväisyydellä, sillä kyseisillä mittareilla voidaan mitata onnistumista yrityksen laajuisesti. Käyttöönottojen onnistumisten ja Gartnerin kypsyysmallin kriteeristön perusteella kohdeyrityksen käyttöönottoprojektit ovat toisella ja kolmannella kypsyysasteella asteikolla 1-5. Haastatteluiden ja data-analyysin perusteella työnkulkuun liittyvät ongelmat ovat suurin ongelmatyyppi molemmilla kypsyysasteilla. Työn lopputuloksena kohdeyritykselle luotiin viitekehys, kuinka yritys voi voittaa käyttöönoton haasteet ja saavuttaa suuremman kypsyysasteen.

ACKNOWLEDGEMENTS

My great journey at Lappeenranta University of Technology has come to an end. The last step of the journey was conducting the master's thesis for the company where I have a privilege to work. Writing this master's thesis has offered many rewarding moments both also some challenges which have taught me persistence and endurance. Same qualities I have learned throughout my university journey. LUT has given me excellent premises to apply academic and business knowledge into working life.

This master's thesis would not be possible without my supervisor who has provided his invaluable advices and support. Thank you also for my colleagues who offered new perspectives and interviewees who offered their valuable opinions. I wish also to thank professor Timo Kärri guiding the thesis into the right direction from the academic perspective and giving his professional advices.

Furthermore, great thanks for my parents who have supported me throughout my studies all the way from the first class. They have always encouraged me and my sister to study what we want. Special thanks for my dear friends who have made studying the best time of my life. Since the first freshman week, we have supported each other and your support was the cornerstone also during the thesis project. Even if our common journey in Skinnarila has ended, I'm sure that our friendship will last. Let the next journey begin!

Vantaa, 25th of February 2018
Annika Auvinen

TABLE OF CONTENTS

‘

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

BI	Business Intelligence
BICC	Business Intelligence Competency Center
BIMM	Business Intelligence Maturity Model
CEO	Chief Executive Officer
CSF	Critical Success Factor
DSS	Decision Support System
EBITA	Earnings Before Interest, Taxes and Amortization
ERP	Enterprise Resource Planning
ETL	Extract, Transform, Load
IT	Information Technology
KPI	Key Performance Indicator
MIS	Management Information System
OLAP	Online Analytical Processing
P&L	Profit and Loss
ROI	Return on Investment

1 INTRODUCTION

1.1 Background

The amount of data is constantly increasing (Isik, Jones & Sidorova 2011, 161) and at the same time costs of data acquisition and data storage are declining (Chaudhuri, Dayal & Narasayya 2011, 89). It enables organizations to analyze large volumes of data coming from internal and external data sources (Isik et al. 2011, 161). In order to achieve competitive advantage in the rapidly changing business environment, decision-making should be based on real-time operational data (Chaudhuri et al. 2011, 90). Business intelligence (BI) systems have been designed to fill this need. BI systems help companies in decision-making by gathering, storing, accessing and analyzing data (Wixom & Watson 2010, 14). Nowadays, nearly every successful company has acquired a BI system (Chaudhuri et al. 2011, 88) and in recent years BI-related technologies have ranked among the top digital technology priorities in Gartner's worldwide survey of IT spending (Gartner 2013). Especially, BI systems have established their position in North American and Northern European companies (Wixom & Watson 2010, 25). From the beginning of the 21st century, the role of BI systems has also remarkably strengthened among Finnish companies (Pirttimäki & Hannula 2003, 252).

Despite the popularity of BI systems, academic research is still quite rare. Recently BI technologies have gained an interest among researches but still there are significant lacks among BI research. Companies should gain many benefits through the utilization of BI but there is limited understanding whether these benefits really occur in practice (Pirttimäki, Lönnqvist & Karjaluoto 2006, 83; Audzeyeva & Hudson 2016, 30). Also, the organizational factors that affect occurring of the benefits have not gained attention among academic research (Audzeyeva & Hudson 2016, 30). There exist researches in the academic field which have identified the critical success factors (CSF) for BI implementation but still the understanding how to implement a BI system successfully is limited (Hung et al. 2016). Even the standardized framework of implementation phases is lacking which is surprising

because of the complexity of BI implementation (Yeoh & Popovic 2016, 23). Also, the failures of BI implementation are a rarely researched topic even if some studies have suggested that the BI project's failure rate can be even up to 80 per cent (García & Pinzón 2017, 48). The limited number of researches in the field of BI can be also seen in the figure 1. The distribution is based on Scopus database and is limited to the articles with the key word "business intelligence" and related to the subject area of business, management and accounting. Articles related to technology are excluded.

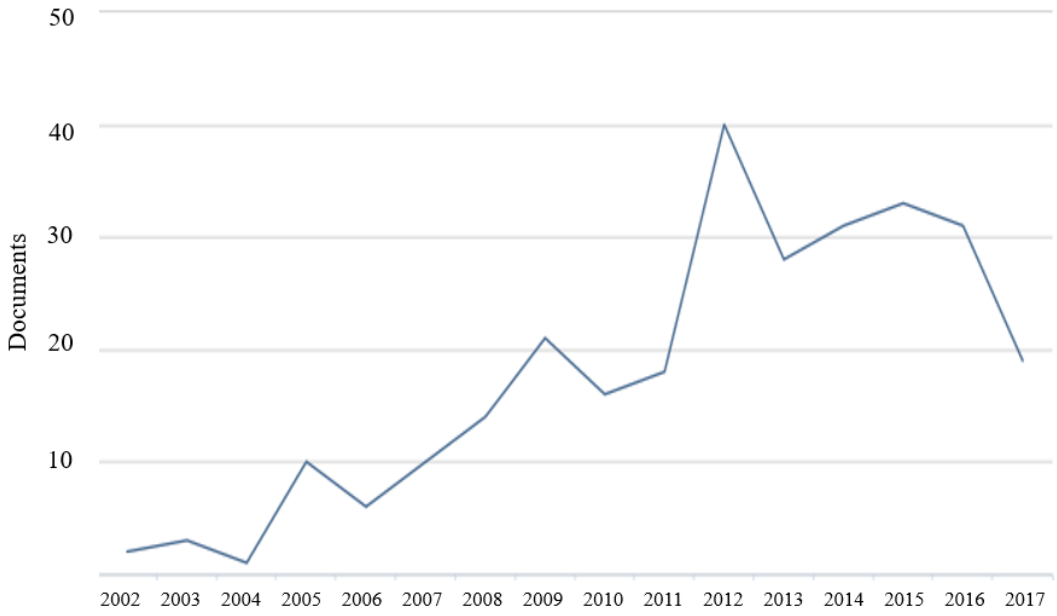

Figure 1 Distribution of the articles related to business intelligence

In the figure, we can see that the academic research about business intelligence with the business perceptive has started to emerge since the beginning of the 21st century. The first article related to business intelligence appeared in 1958 when IBM first time used the term in the journal article (Luhn 1958). However, former articles addressed the topic with more technological view. The number of published articles has developed along with the interest toward BI technologies among the companies. Still even nowadays, articles with the business aspect are published rarely despite the fact that nearly every successful company has implemented the BI system (Chaudhuri et al. 2011, 88).

This study contributes to limited academic researches about the implementation of the BI systems. Since the failure rate of BI implementation is high, this study aims to find out how the success of BI implementation can be measured. In addition, the purpose of this study is to identify how implementation challenges vary according to BI maturity. Previous researches have presented several business intelligence maturity models (BIMM) but the relationship between occurred implementation challenges and BI maturity has not been widely researched. Furthermore, previous researches have identified factors which may lead to failure of the implementation, but this study will study how these challenges could be overcome during the post-adoption phase and also avoided beforehand already during the implementation project. The novelty value of this study will be linking implementation challenges to BI maturity levels and researching the occurrence of the implementation challenges at the specific maturity levels.

The topic has been approached through the case study which is based on the BI implementations at the large Finnish manufacturing company. The company has implemented the BI portal which offers new forecasting, reporting and analyzing capabilities for managerial accounting. The BI portal consists of several systems with different capabilities and each system has been implemented as a separate project. The technological implementations of each separate projects have been already completed, but from the managerial perspective the implementations are still ongoing. During the implementation projects some challenges have occurred, which has prevented to take fully advantages of the new capabilities. However, these challenges differ between projects because projects are currently at different maturity levels. This study focuses on two separate implementation projects: the implementation of the budgeting and forecasting system and the implementation of the reporting and analyzing system. The purpose of this study is to identify whether the implementations were successful, at which BI maturity levels projects currently are and what implementation challenges projects are facing at these maturity levels. After challenges are identified this study aims to identify actions how the case company could defeat challenges and facilitate the utilization of new capabilities during the post-adoption phase. This study intends to contribute to lacking

academic research about implementation challenges at different maturity levels and successful BI implementation from the perspective of managerial accounting.

1.2 Purpose, research questions and scope

The main purpose of this study is to offer the insights for the case company how to facilitate the utilization of the implemented BI systems. This study aims to define how the success of the implementation can be measured. Additionally, this study examines how BI maturity affects the occurrence of implementation challenges and how implementation challenges at different maturity levels can be defeated. As results, the study evaluates the success of the case company's implementation projects, summarizes how challenges vary according to maturity and offers the framework how the case company can contribute to BI implementation during the post-adoption phase. Additionally, lessons learned are gathered to avoid similar challenges in the future implementation projects. In order to reach the targets of this study, three research questions were compiled. These three research questions with their respective objectives are presented in the table 1.

Table 1 Research questions and objectives

Research questions	Objectives
1. How the success of the business intelligence implementations can be measured?	• Examine whether the implementation projects were successful • Examine whether the targets of the implementations are achieved
2. How business intelligence implementation challenges vary according to business intelligence maturity?	• Identify the challenges that occurred during the implementations of the new capabilities • Examine how business intelligence maturity affects the occurrence of the challenges
3. How business intelligence implementation challenges can be defeated?	• Identify actions what can be done to facilitate the utilization of the new capabilities • Identify actions to avoid similar challenges in the future projects

Since the failure rate of the BI implementations is high, the first question aims to examine how the success of BI implementation can be measured and whether the

implementation projects at the case company were successful. Additionally, the first question aims to examine whether the case company has achieved the implementation targets. The second question considers the challenges occurred during the BI implementations. The objectives of the second question are to identify emerged challenges and understand how they are linked to BI maturity. The third question aims to identifying actions how to overcome these challenges during the post-adoption phase, which is currently ongoing at the case company, and how to avoid them beforehand in the future projects.

This study is mainly focused on the post-adoption phase after the technological implementation which corresponds to the implementation phase where the case company currently is. Thus, the technological perspective is out scoped; only factors related to data quality and business-driven infrastructure are examined. Primarily, the study is limited to managerial and process factors which affect the success or the failure of the BI implementation. In addition, even if the BI systems support decision-making in different areas of organization, this study focuses especially on the benefits BI systems are offering for managerial accounting. This study examines two separate BI projects going on at the case company. Project 1 concerns the implementation of the new budgeting and forecasting system while project 2 concerns the implementation of the new reporting and analyzing system. The budgeting and forecasting system has been available for end users longer time than reporting system, so projects are at the different maturity levels. In this study, Gartner's maturity model for business intelligence has been used for analyzing projects' BI maturity because it offers non-technical view in contrast to other maturity models (Hostmann, Rayner & Friedman 2006).

1.3 Methods and data

The execution of this study consists of three main research phases: literature review, qualitative interviews and quantitative data analysis. The first phase, literature review, gives the foundation for the empirical part by defining the concepts of BI systems, BI implementation, measurement of implementation success and maturity

models. The theoretical part is followed by the empirical part, which purpose is to collect and analyze data. As results, answers to research questions and recommendations for the case company are offered. The figure 2 illustrates the content and objectives of each phase.

1. Literature review

Content	Objectives
• Definition of BI systems • Phases of BI implementation • Success and failure factors of BI implementation • Implementation challenges • Measurement of implementation success • BI maturity models and maturity criteria	• Define the concept of BI systems and BI implementation • Understand which factors typically lead to success or failure during BI implementation • Identify typical challenges during the post-adoption phase • Define how to measure the success of BI implementation • Introduce Gartner's maturity model

2. Qualitative interviews

Content	Objectives
• Ten semi-structure interviews • BI users' experiences and opinions about the implementation projects and the implemented systems • Analysis of interviews	• Examine whether the implementations were successful • Examine whether the targets of BI implementations are achieved • Identify what challenges BI users have faced • Identify actions how to defeat identified challenges and raise the utilization rate

3. Quantitative data analysis

Content	Objectives
• Nine-month archival data of tickets opened by the users related to the implemented BI systems • Content analysis of ticket data	• Compare ticket data to challenges identified through interviews

Figure 2 Execution of the study

The theoretical part of this study is conducted as a narrative literature review which is part of descriptive research methods. A descriptive literature review aims to provide an overview description of the research topic and give a theoretical

framework for a study. In a narrative literature review previous researches are summarized to provide a synthesis of the research topic. (Salminen 2011, 6-7) In this study the latest scientific articles are used as source material in order to describe the current state of the BI research.

The empirical part of this study is executed by using an embedded single case study which is a form of qualitative research. The aim of the case study is to explore a phenomenon within a specified research context using a variety of data sources. (Baxter & Jack 2008, 544) An embedded single case study is selected as a research method because this study concentrates on researching the BI implementation projects at the case company from the perspectives of multiple business units. Data is collected using both qualitative and quantitative data sources. Qualitative data consists of ten semi-structured interviews which concerns the employees' opinions and experiences about the success of implementation projects and the current state of the BI implementations. The interview observations are supplemented with quantitative examination of ticket data which indicates the problems users are facing on a daily basis during the post-adoption phase. Ticket data is analyzed by using a content analysis method.

1.4 Structure

The first chapter of this study is introduction which presents the background and the motivation for the study. Research questions, scope and execution of the study are also presented. In addition to introduction, this study consists of seven main chapters. Chapters 2, 3 and 4 form the theoretical part, which is executed as a literature review. Chapter 5 introduces the research design and the methodology. Chapters 6 and 7 form the empirical part of the study. Chapter 8 summarizes the study. The structure of the study is illustrated in the figure 3. Additionally, input and output of every chapter are presented.

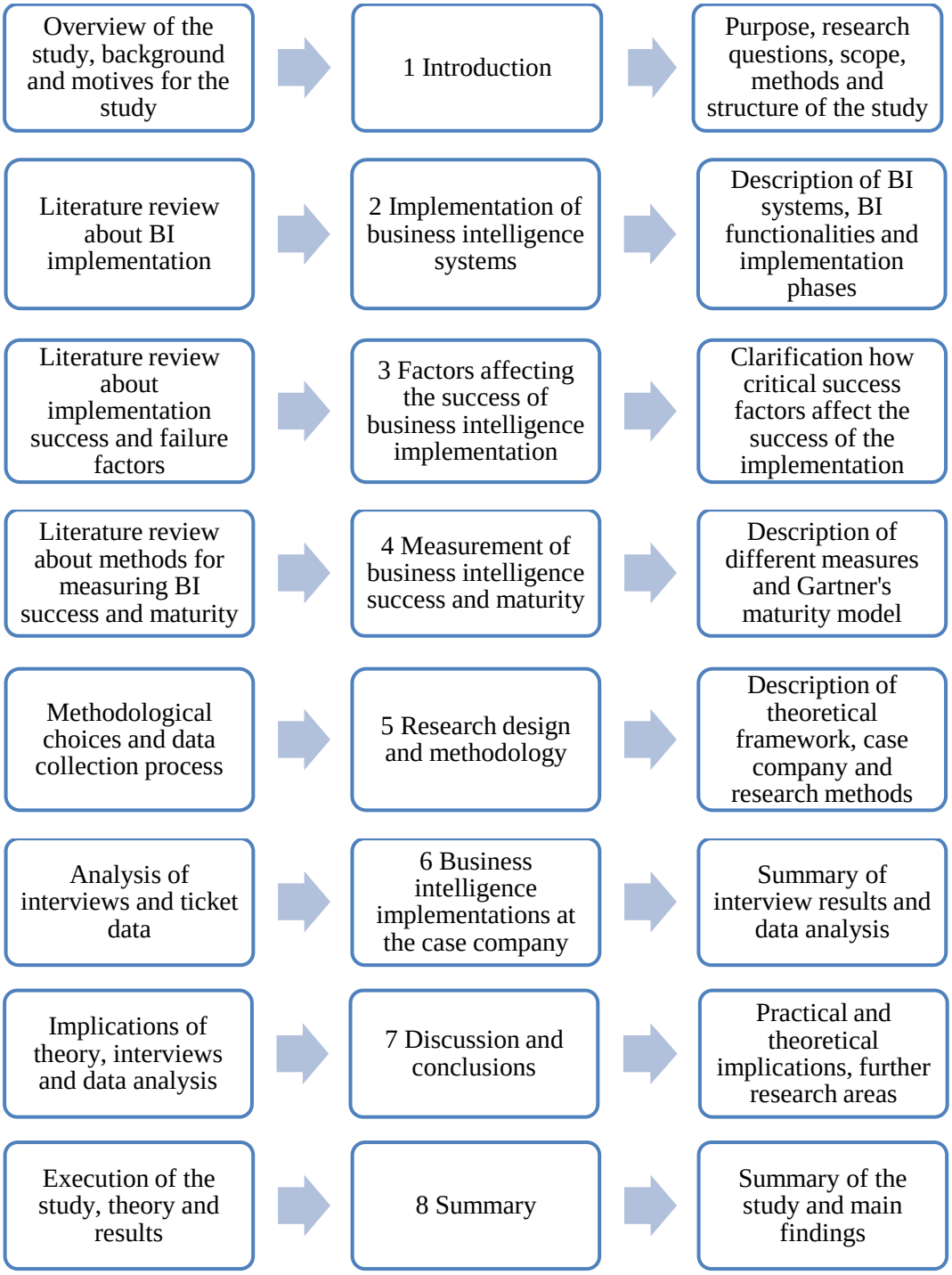

Figure 3 Structure of the study

The main aim of chapter 2 is to introduce the basic concepts of the BI systems. The basic BI environment and functionalities the BI systems are offering for managerial accounting are introduced. Additionally, typical phases of the BI implementation project are described. Thus, chapter 2 provides the foundation for this study.

Chapter 3 deepens the understanding of the BI implementation by introducing the factors which are affecting the success of the implementation. Both success and failure factors are introduced. Also, typical challenges companies are facing in the post-adoption phase are described. In chapter 4, different ways to measure the success of the BI implementation are introduced. In addition, chapter 4 concludes the theoretical part by introducing Gartner's maturity model which combines previously introduced factors.

Chapter 5 focuses on the research design and the methodology. The theoretical framework how the theory is applied to the empirical study and the research context are introduced. Also, methodological choices used in this study are justified and data collection process including the sampling and data analysis is described. Chapter 6 combines the results of the interviews and quantitative data analysis. The success of the implementation projects, the usage of implemented BI systems and the implementation challenges at the case company are analyzed. In chapter 7, theoretical and practical implications are presented and answers for the research questions are concluded. Additionally, chapter 7 discusses the reliability of the results and gives recommendations for the future research. Chapter 8 summarizes the study by combining the execution of the study and main findings.

2 IMPLEMENTATION OF BUSINESS INTELLIGENCE SYSTEMS

2.1 Concept of business intelligence

BI systems are still a quite new phenomenon, but they have gained a significant position among IT systems in companies since the beginning of the 21st century (Elbashir & Williams 2007, 45-46). Due to novelty of the BI systems, terms and practices related to business intelligence have not yet fully stabilized and business intelligence does not have a commonly standardized definition. Business intelligence can be seen as an umbrella concept which consists of various definitions (Pirttimäki & Hannula 2003, 252). Business intelligence is generally considered to describe technologies, applications and processes which aim to support users in strategic and managerial decision-making by gathering, storing, accessing and analyzing data (Wixom & Watson 2010, 14).

First time the term of business intelligence was presented in 1958 when Luhn (1958) used the term in the IBM Journal article defining business intelligence as the ability to apprehend the interrelationships of presented facts in such a way as to guide action toward a desired goal. About ten years later, in the late 1960s, first decision support systems (DSS), which are the basement for contemporary BI systems, emerged to help managers in planning and optimizing business activities (Power 2007). Finally, the term of business intelligence became more widely used in the 1990s when a Gartner analyst used the term to describe the variety of decision support applications (Wixom & Watson 2010, 13). The significant growth of BI systems has taken place in recent decades due to increasing amount of data available and declining costs of data acquiring and storing (Chaudhuri et al. 2011, 88). The various definitions of business intelligence have been collected in the table 2. Common to all definitions is the supporting role of business intelligence in decision-making.

Table 2 Definitions of business intelligence

Author(s)	Definition
Reinschmidt & Francoise, 2000	An integrated set of tools, technologies and programmed products that are used for collecting, integrating, analyzing and making data available
Pirttimäki & Hannula, 2003	An organized and systematic process by which an organization acquires, analyzes and disseminates information from both external and internal sources significant for their business activities
Davenport, 2006	Integrated systems that are linked to a data warehouse and other applications, and are designed to facilitate the analysis of stored (real-time and historical) data in support of ad hoc managerial decision-making
Power, 2007	A set of concepts and methods based on fact-based decision support systems for improving business decision-making
Stackowiak, Rayman & Greenwald, 2007	The process of taking large amounts of data, analyzing that data and presenting a high-level set of reports that condense the essence of that data into the basis of business actions, enabling management to make fundamental daily business decisions
Zeng, Xu, Shi, Wand & Wu, 2007	The process of collection, treatment and diffusion of information that has an objective, the reduction of uncertainty in the making of all strategic decisions
Ranjan, 2009	A broad category of applications and technologies for gathering, providing access to and analyzing data for the purpose of helping enterprise users make better business decisions
Mikroyannidis & Theodoulidis, 2010	A collection of techniques and tools, aimed at providing businesses with the necessary support for decision-making
Chaudhuri, Dayal & Narasayya, 2011	A collection of decision support technologies for the enterprise aimed at enabling knowledge workers such as executives, managers and analysts to make better and faster decisions
Chen, Chiang & Storey, 2012	A broad category of applications that extract and transform data from source systems, facilitate data visualization and allow users to select subsets of data along different dimensions
Find, Yogev & Even, 2017	An overarching term for decision support systems that are based on the integration and analysis of organizational data resources toward improving business decision-making

Generally, management information systems (MIS) aim to support managers in decision-making which corresponds well also with the definitions of business intelligence. However, BI systems address more complicated informational needs than traditional management information systems. Management information systems respond more specific informational needs while BI systems explore multiple problems and create general awareness. Additionally, the data processing

techniques related to BI systems are more sophisticated. (Skyriys, Kazakevičienė & Bujauskas 2013, 32-33) BI systems use multivariate analysis, multiple data sources with unstructured data and multidimensional data monitoring (Gray 2003) whereas management information systems primary use historical data (Skyriys et al. 2013, 32).

2.1.1 Components of business intelligence systems

BI systems consist of processes, technologies and applications (Wixom & Watson 2010, 14) which create knowledge useful for decision-making (Shollo & Galliers 2016, 343) by gathering, storing and analyzing data (Wixom & Watson 2010, 14). According to Negash (2004, 180) the role of BI system is to convert data into useful information and eventually into knowledge through human analysis. The recent report of DIMECC (2017, 130) further presented that when accumulated knowledge can be applied to new decision-making situations or revealing future needs, this ability can be also called wisdom. The figure 4 illustrates the knowledge creation process which eventually leads to improvement in competitiveness.

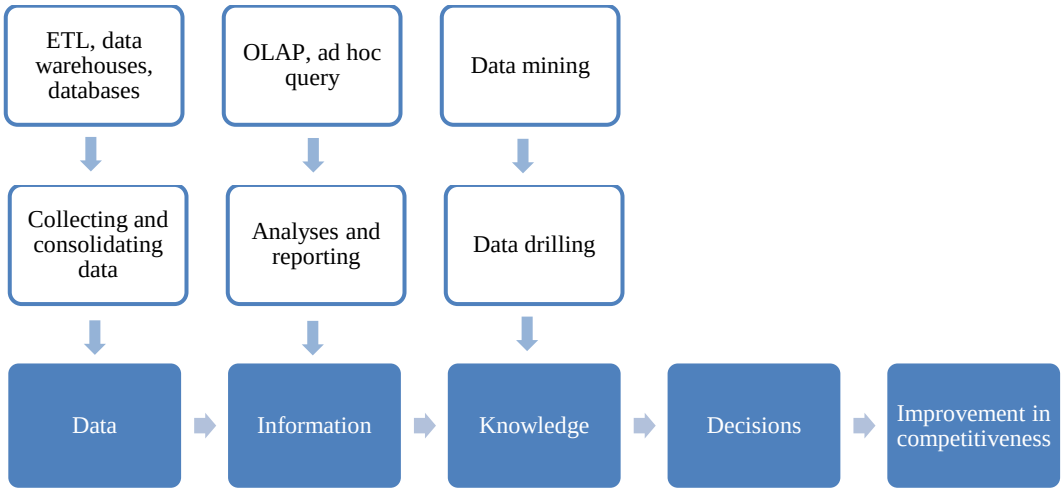

Figure 4 Knowledge creation process (based on Olszak & Ziemba 2007, 137)

The first part of the process is collecting and consolidating data. Data is collected from multiple sources both internally and externally. Typical data sources are companies' operational databases across departments, such as transactional and

ERP systems, but more and more data is also collected from internet sources, emails, Word documents and third-party sources. (Wixom & Watson 2010, 15; Chaudhuri et al. 2011, 89) The data quality and formatting between multiple sources vary which makes the integration of different sources challenging. It is also essential that data can be refreshed regularly, for example once a day, in order to get the latest data available to support decision-making. Efficient data loading is one of the key parts of BI systems which enables the real-time data for decision-making in the first place. (Chaudhuri et al. 2011, 89) This continuous process when data is extracted, transformed and loaded into the data warehouse is commonly called ETL (Wixom & Watson 2010, 15). Data warehouses and data marts are specialized databases and they are the basic components of the BI environment. Data warehouses are repositories which include enormous amounts of data for integration, cleansing, aggregation and query task. In turn, data marts also include operational data, but data marts are created for grouping and configuration of selected data, for example to support a specific business function or business unit. (Ranjan 2009, 63)

The second part of the process is analyzing and reporting which transforms data into information. The operations that enable analyses are filtering, aggregation, drill down and pivoting which are common functionalities of BI systems. Online analytical processing (OLAP) is a core technology that support these common BI functionalities which allow users to view data from multiple perspectives. (Chaudhuri et al. 2011, 90-92) In addition to OLAP, also reporting tools and ad hoc inquiring are the basic features of BI systems. Reporting tools allow users to create and execute reports they want (Olszak & Ziemba 2007, 138-139) while ad hoc visualization of data enables users to explore patterns and outliers rapidly (Chaudhuri et al. 2011, 90). In addition, dashboards and scorecards are used for offering summarized information in a visual format for a management level (Richards, Yeoh, Chong & Popovic 2014).

The last part of the process before refined data can be used in decision-making is transforming information into knowledge. Data mining engines enable much more

deeper data analysis than OLAP or reporting tools are capable of. With data mining engines users are able to build predictive analysis models instead of analyzing historical data. (Chaudhuri et al. 2011, 90) After the data is transformed into useful knowledge it can provide up-to-date information on different aspects of company activities to support decision-making (Olszak & Ziemba 2007, 136). If data is further transferred into wisdom, optimal recommendations can be created and future needs can be identified based on analyzed data (DIMECC 2017, 131). When companies are making well-informed decisions, it can lead to improvement in competitiveness (Ranjan 2009, 63). The different components, which this knowledge creation process consist of, enable the data transformation from raw data into knowledge that supports decision-making. These components construct the BI environment. The generic description of the BI environment, which compounds the different components of the BI system from source systems to end users, is presented in the figure 5.

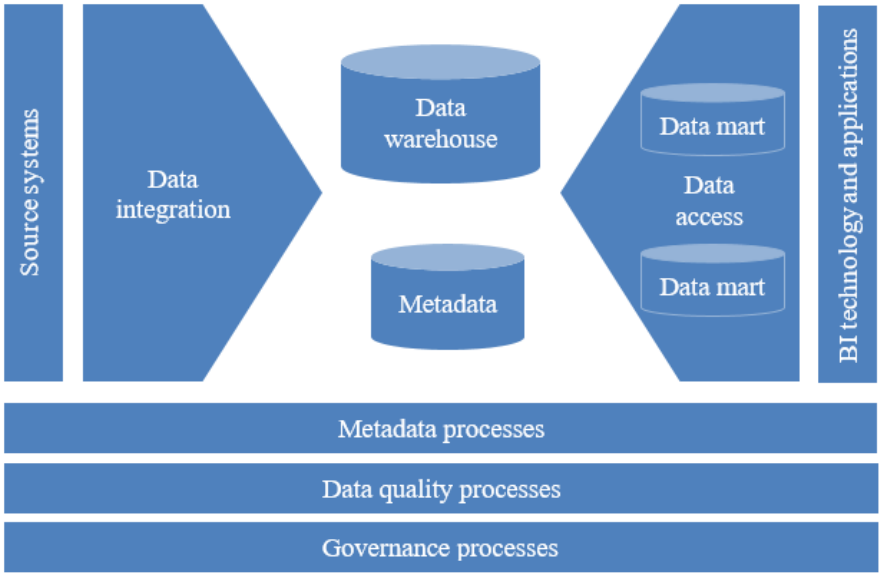

Figure 5 BI environment (based on Wixom & Watson 2010, 15)

On the left side of the picture, internal and external source systems are presented. From source systems data is transferred to data warehouses which is called data integration. Different users and applications how to access data warehouses exist on the right side of the picture. In addition to these components, the BI environment

also includes metadata, data quality and governance processes which are rather related to people than technology. Metadata provides information about other data and thus, metadata processes support both the IT people who get data in and the users who get data out. In turn, high data quality is essential in order to use data in decision-making why data quality processes need to be established. Governance processes are needed to ensure that the BI system meets organizational goals and therefore, the governance consists of people and committees. (Wixom & Watson 2010, 16) All the components and processes BI systems consist of are essential for creating knowledge and supporting decision-making.

2.1.2 Benefits and functionalities for managerial accounting

As mentioned, the main purpose of BI systems is to provide real-time information to support strategic and operative decision-making among a broad variety of company's business activities (Elbashir, Collier & Davern 2008, 135). Managerial accounting has a significant role in decision-making by offering operational and financial accounting information to managers (Appelbaum, Kogan, Vasarhelyi & Yan 2017, 30). BI systems are offering many benefits especially for managerial accounting, such as automated reporting and analyzing solutions (Mesaro et al. 2016, 3). According to the survey of Yeoh & Popovic (2016, 139), actually the common motivation why companies implemented the BI system in the first place were the functionalities which BI systems are offering for business reporting, planning and analyzing.

Due to increased competition, the role of managerial accounting has changed from conventional financial reporting and control tasks to an important participant of the strategic decision-making process (Silvi, Moeller & Schlaefke 2010, 3). The role of managerial accountants has also widened to strategic planning and business partnering and thus, managerial accountants are also called controllers (Järvenpää 2007, 100-101). According to Cokins (2013, 23) the three main tasks of managerial accountants are preparing financial statements, measuring the company's performance and providing information for decision-making. BI systems support

managerial accountants by enabling analyses based on internal or external data, structured or unstructured data and financial or non-financial data (Nielsen 2015). In addition, BI systems allow managerial accountants also to conduct predictive analyses instead of only analyzing historical data. Altogether, BI systems offer capabilities for managerial accountants to perform broader scale of analyses: descriptive, predictive and prescriptive analyses. (Appelbaum et al. 2017, 29-30) The figure 6 shows the role of business intelligence among descriptive, predictive and prescriptive analyses.

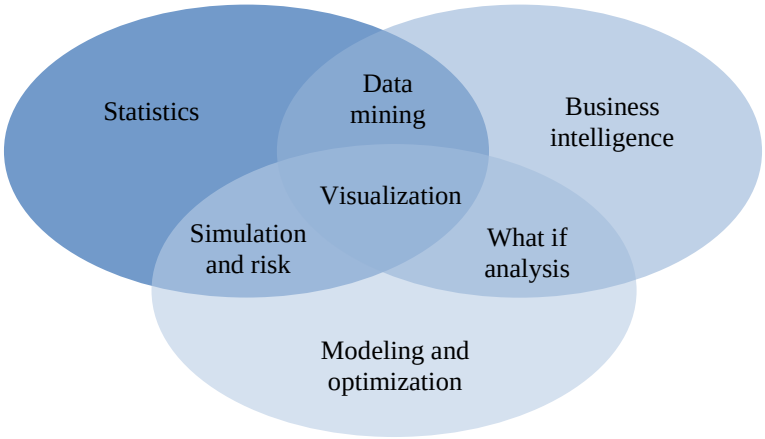

Figure 6 Role of business intelligence among descriptive, predictive and prescriptive analyses (based on Evans & Lindner 2012)

As illustrated in the figure, business intelligence has an impact on all three types of analytics used in managerial accounting. The difference between business intelligence and business analytics is the role in the decision-making. Business intelligence provide knowledge based on analyzed data for decision-making while business analytics seeks reasons why something has happened. (Wixom, Yen & Relich 2013, 111-112) Descriptive analyses are based on historical data (Appelbaum et al. 2017, 32) and it is the most common type of analytics among companies (IBM 2013). Key performance indicators (KPI), dashboards and other visualizations are typical ways to illustrate the results of descriptive analyses (Dilla, Janvrin & Raschke 2010, 1-2). In turn, predictive analyses answer the question what could happen (IBM 2013). Predictive analyses include for example predictive and probability models, forecasts, statistical analysis, scenario analysis and sensitivity

analysis. Like descriptive analyses, also predictive analyses use historical data to calculate the probabilities of the future events. (Appelbaum et al. 2017, 32) In order to identify trends and patterns from large databases, predictive analyses are using data mining tools (Ramamohan, Vasantharao, Chakravarti & Ratnam 2012, 191). Prescriptive analyses exploit the results of descriptive and predictive analyses and try to find the optimal approach (Appelbaum et al. 2017, 32). Creating all these report types requires the proper functionalities from the BI systems. Those BI functionalities which support managerial accounting are listed in the table 3.

Table 3 BI functionalities for managerial accounting (based on Chugh & Grandhi 2013, 4)

Categories	**Functions**
Data consolidation	• Integration of internal and external data • Simplified extraction, transformation and loading of data • Deletion of unwanted and unrelated data
Data quality	• Sanitize and prepare data to improve overall accuracy
Reporting	• User-defined and standard reports generated at any level • Personalized reports for any level of management
Forecasting and modelling	• Supports analytics used in predictive and prescriptive analytics which use historical & real-time data and qualitative & quantitative data
Tracking of real-time data	• Monitor current progress with defined project objectives/KPIs • Prioritize scarce system resources
Data visualization	• Interactive reports and graphics, possibly with real-time updates • Scorecards and dashboards
Data analysis	• What-if analysis • Sensitivity/optimization analysis • Goal seeking/goal supporting analysis • Descriptive analysis
Mobility	• Portability to multiple devices and formats
Rapid insight	• Drill down features that enable many layers of analysis • Dashboards that are interactive and that can monitor trends and outcomes
Report delivery & shareability	• Deliver reports in common formats such as Microsoft Office • Email reports in different formats
Ready to use applications	• Pre-built metadata with mappings defined considering performance and security needs • Pre-built reports and dashboards to support management

In summary, BI systems enable managerial accountants to create versatile reports. In addition to standardized reports, it is possible to analyze data in multiple dimensions and create optional scenarios. (Chugh & Grandhi 2013, 4) The BI functionalities make it possible for managerial accountants to report what has happened, monitor what is happening now, indicate which actions should be taken now and predict what might happen in the future (Wang 2016, 673). As results, BI systems have an impact on companies' decision-making, strategic analysis and forecasting and to perform managerial accounting tasks successfully the usage of BI functionalities is essential (Appelbaum et al. 2017, 39).

2.2 Phases of implementation project

Even if BI systems are one of the fastest growing software companies are adopting, there is still a limited number of researches about the BI implementation framework in the academic field (Chugh & Grandhi 2013, 1-2). Few previous researches have identified the phases of the BI implementation but there is not a generally agreed implementation model among academic research. However, the implementation models presented in the previous researches contain similar phases, but the order and the names of the phases are varying. Because users have a significant impact on the success of BI implementation, Olszak & Ziemba (2007) suggested that the implementation process should be divided into two major iterative phases: the creation of BI and the consumption of BI. The former concerns building the BI system while the latter is associated with end user application. The creation phase includes the technical implementation of the BI system and consists of five stages which are presented in the figure 7. (Olszak & Ziemba 2007, 139-140) Typically the creation phase takes from three to six months (Zeng et al. 2006, 4725) and requires the most part of financial and labor resources during the whole lifecycle of the BI system (Olszak & Ziemba 2007, 140).

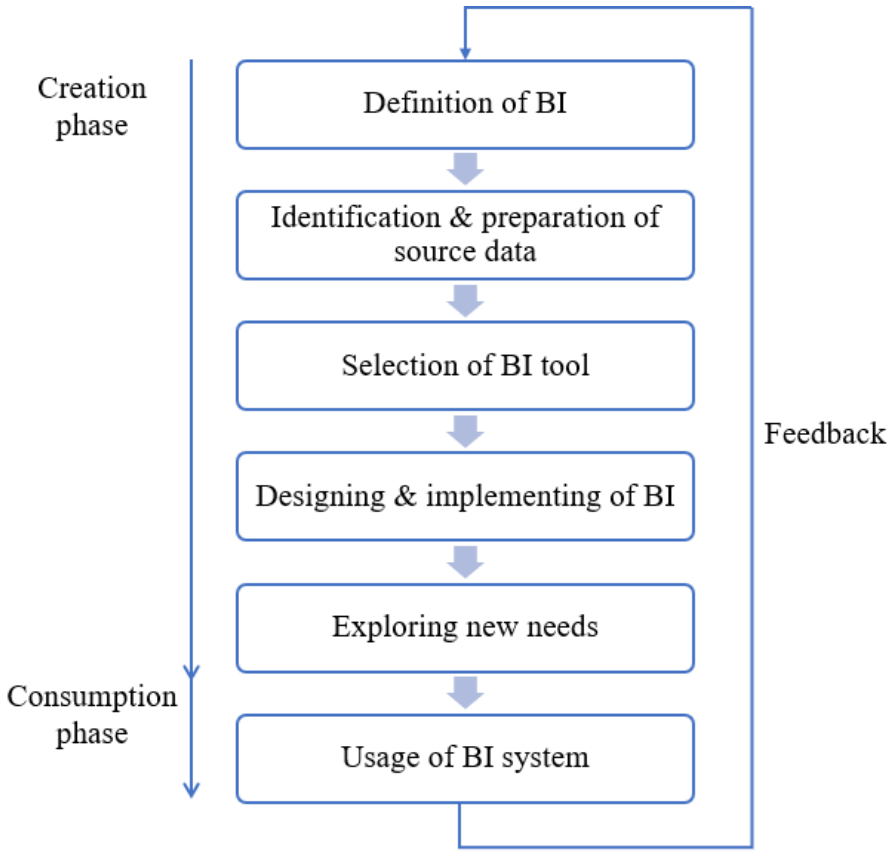

Figure 7 Phases of the implementation project

The first stage of the creation phase is the definition of BI which includes the determination of the BI system development strategies. The prerequisite of the successful implementation is the vision of the BI system which is linked to the business objectives of the company. In addition to determining the vision, during the first stage company's information needs and general requirements for the potential BI systems need to be specified. (Olszak & Ziemba 2007, 140-141) Additionally, Gangadharan & Swami (2004, 140) suggested that also the costs and the benefits solving a business problem should be agreed in the first stage.

After the strategy and basic requirements are identified, the second stage includes identifying and preparing the source data. This stage requires diagnosing all information systems and databases the company is using in order to find internal data sources for the BI system. Also, possible external data sources and the reliability of the specified sources need to be verified. In addition, the time frame

how often data should be updated need to be defined. (Olszak & Ziemba 2007, 140-141)

When requirements and data sources are defined, the third stage is the selection of the proper BI tool. The purpose of this stage is to choose the BI tool that meets the company's requirements which are defined in the earlier stages. The range of different BI systems is wide, and it varies from simple reporting systems to more sophisticated BI platforms. (Olszak & Ziemba 2007, 142) Analyzing of the functional deliverables could be done through prototyping whereby adjusting delivery requirements and expectation is possible (Gangadharan & Swami 2004, 141).

The fourth stage is called designing and implementing of BI (Olszak & Ziemba 2004, 143). First, the metadata repository need to be purchased or built. After that, a data warehouse can be built so that it takes into account metadata and business requirements (Gangadharan & Swami 2004, 141). When building a data warehouse, interconnections between data sources (Olszak & Ziemba 2007, 143) and mechanisms of data import need to be created in order to ensure that a data warehouse is systematically updated (Meyer 2001). In addition, to enable easy configuration of database related reporting and querying mechanisms, such as OLAP or data mining, creating a database design which serves as a basis for loading a BI system is necessary (Olszak & Ziemba 2007, 144). Whether the ETL tool is the best solution for that depends on data cleansing and data transformation requirements (Gangadharan & Swami 2004, 141). The designing of the customized BI system can require a lot of time in order to create individual interfaces and ensure that the whole BI system is logical and consistent (Olszak & Ziemba 2007, 143).

The last stage of the creation phase is exploring and discovering new informational needs. Because the implemented BI system gives new insight on company's information, competencies, business relations and interdependencies, new informational needs will occur. This leads to creation of new methods of information management. The discovery of new informational needs has a

significant impact on the rest of the implementation process. (Olszak & Ziemba 2007, 145) After the creation of the BI system, the actual usage of the BI system starts and Olszak & Ziemba (2007) called this phase as a consumption phase. In turn, Deng & Chi (2013) called this phase as a post-adoption phase, while in Gangadharan & Swami's research (2004) deployment and evolution stages together covered the consumption phase.

Because during the consumption phase users are involved, stages can vary depending on discretion and needs of the users. Overall, the whole phase requires initiative from users. Users need to create different types of reports and analyses, use different data repositories and interpret results to be obtained. As a result of analyzing different facts, alternative ways to solve or optimize a specific task may emerge. The final decisions of chosen ways need to be decided with co-operation of other employees and decision-makers. After the renewed practices related to the usage of the BI system have decided, it may lead to changes in a decision-making process. (Olszak & Ziemba 2007, 145)

In addition to find new practices, Gangadharan & Swami (2004, 141) added end user training and support in the consumption phase. Extensive user training enables that the BI system meets the users' needs which eventually has a remarkable impact on the success of the BI implementation. However, the implementation process is not over after the last stage. The implementation process is iterative which requires constantly new analyses of informational needs, re-evaluation of the existing solutions, optimizations and adjustments. (Olszak & Ziemba 2007, 145) Gangadharan & Swami (2004, 141) had even an own stage for this purpose called evolution. The goals of the evolution phase are measuring the success of the implemented BI system, extending the system across the company and increasing cross-functional information sharing. (Gangadharan & Swami 2004, 141)

3 FACTORS AFFECTING THE SUCCESS OF BUSINESS INTELLIGENCE IMPLEMENTATION

3.1 Critical success factors

A successful implementation of the BI system requires optimizing limited resources and focusing on the factors which have the most significant impact on the success of the implementation. These factors are called critical success factors (CSF). (Yeoh & Koronios 2010, 23) Critical success factors are defined in the academic researches as the critical areas where everything has to work correctly for business to succeed. Thus, critical success factors contribute to the successful implementation and are linked to benefits the BI systems can offer. (García & Pinzón 2017, 48) Previous researches have revealed that companies which have taken critical success factors into account from a business orientation approach while implementing the BI system are more likely to achieve better results (Yeoh & Koronios 2010, 23).

Even if previous researches have identified critical success factors and understood their importance for the implementation success, there is still a lack of researches which would give a guidance for a project team how to take these critical success factors into account in practice while implementing the BI system (Yeoh & Popovic 2016, 134). The most commonly used framework of critical success factors among academic research is the framework that Yeoh & Koronios (2010) represented in their research which introduced how a set of critical success factors affects the success of the BI implementation. Afterwards many other researches have used Yeoh & Koronios's framework as a basis for their own frameworks. The framework is illustrated in the figure 8.

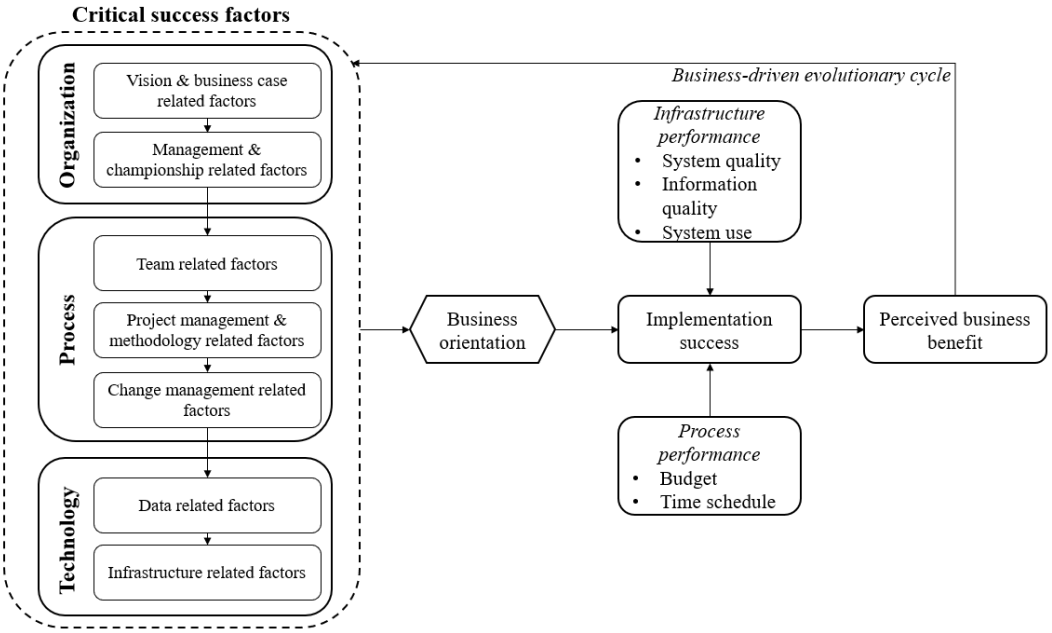

Figure 8 Framework of critical success factors (Yeoh & Koronios 2010, 25)

Yeoh & Koronios (2010) have divided critical success factors into three dimensions: organization, process and technology. These dimensions were introduced for the first time in Wixom & Watson's research (2001) which concerned the empirical investigation of the factors affecting data warehouse success. In addition to critical success factors, the framework includes the implementation success criteria which is divided into two dimensions according to Ariyachandra & Watson's research (2006): process performance and infrastructure performance. Process performance represents how well the process of the BI implementation succeeded, while infrastructure performance represents the quality of the system and the standard of output. (Ariyachandra & Watson 2006, 5-6)

Furthermore, these two dimensions involve the success variables. The success variables how process performance can be appraised are time schedule and budgetary considerations, whereas infrastructure performance can be appraised in terms of system quality, information quality and system use. (Ariyachandra & Watson 2006, 6) Time schedule describes the time period how long the implementation of the initial version of the BI system take and budgetary considerations include the costs of developing and maintaining the system to be

expedient (Ariyachandra & Watson 2010). System quality is linked to system flexibility, scalability and ability to integrate data and thus, it reflects the performance characteristics of the BI system's information processing (Delone & McLean 2003). Information quality is related to accuracy, completeness, timeliness, relevance, consistency and usefulness of information provided by the BI system (Isik, Jones & Sidorova 2013, 14). System use is described as a recipient consumption of the output of the BI system (Delone & McLean 2003). The implementation of the BI system can be seen as an organic cycle which requires continuous evaluation, modification and improvements of the BI system (Olszak & Ziemba 2007, 145). The users have a significant role in this organic cycle and ultimately users and their business units can assess the benefits of the BI implementation (Hwang & Xu 2008, 52).

3.1.1 Organizational dimension

Organizational factors are related to management commitment and leadership, alignment of the BI project goals with the organizational goals and organizational culture (Boyton, Ayscough, Kaveri & Chiong 2015, 318). The research of Yeoh & Koronios (2010) revealed that non-technical factors, including organizational and process-related factors, have more impact on the implementation success than technological factors. According to Yeoh & Koronios's (2010) framework, organizational dimension consists of vision and business case related factors and management and championship related factors.

The purpose of a clear vision is to ensure that the BI project is linked to strategic goals of the company, while a well-established business case outlines the expected benefits of the BI implementation (Boyton et al. 2015, 314). A clear vision is guiding the implementation and is needed to establish a solid business case in order that the business case faces the business objectives and needs. Therefore, a well-established business case includes strategic benefits, resources, risks, costs and timeline of the BI implementation process. It is also argued that a proper business

case will help to achieve an organizational commitment and support from top management to an implemented BI system. (Yeoh & Koronios 2010, 26)

Management and championship related factors refer to acquiring committed sponsorship for the BI implementation from management, also called management sponsorship (Boyton et al. 2015, 315). The sponsorship can be seen as a direct involvement of the business executives in the project steering committee and providing overall support to the project initiatives (Yeoh & Popovic 2016, 140). Based on Yeoh & Koronios's survey (2010, 26), it is more favorable if the sponsor comes from the business side of the company rather than from the IT side because the business side sponsors have a strong contribution to the success of the BI initiatives and an actual need of BI capabilities for a specific business purpose. The tasks of the steering committee include determining the strategic direction of the BI process and ensuring that the process is aligned with the strategic goals. For example, a steering committee is responsible for system acceptance, signing-off deliverables and recommending continuation to the next development phase. In addition, a steering committee is responsible for allocation of operating resources, such as financial resources, adequate staffing and sufficient time. (Yeoh & Popovic 2016, 140) Because a steering committee has a straight impact on resource allocation, committed management support and sponsorship are seen as the most important success factor but at the same time also as the most difficult factor to achieve (Yeoh, Koronios & Gao 2008, 87).

3.1.2 Process dimension

Process improvement plays an important role in all kinds of information system projects. Setting objectives and requirements, planning the BI implementation project and managing changes are critical factors for the successful BI implementation from the process perspective. (Boyton et al. 2015, 315) According to the framework, process dimension consists of team related factors, management and methodology related factors and change management related factors (Yeoh & Koronios 2010).

Business-centric championship and balanced team composition ensure that the implementation is aligned with business needs rather than IT assumptions (Boyton et al. 2015, 315). A champion with excellent business acumen views the BI system from the strategic and organizational perspective and is able to foresee the organizational changes. Thus, a business-centric champion has also a critical role to ensure suitable change management when organizational changes occur. Because BI initiatives concern many business units demanding extensive resources, a champion needs to collaborate with business units and a BI project team. (Yeoh & Koronios 2010, 27; Boyton et al. 2015, 315) In addition to a dedicated champion, the balanced BI project team includes experienced external consultants and an internal project team with a proper combination of technical and business expertise. Due to the complexity of the BI implementation, using external consultants especially in the early phases of the project aids to avoid costly and unnecessary pitfalls. In turn, the BI project team with business and technical skills enables that the system design is driven by business needs and these needs are drivers for the logical and customizable data architecture. (Yeoh & Popovic 2016, 141-142) Additionally, because the BI system must be responsive to the needs of the end users, they should be involved in the process especially in the testing phase (Yeoh et al. 2008, 87). The active involvement of end users may increase the acceptance toward the implemented BI system by creating them the ownership of the system (Hwang, Ky, Yen & Cheng 2004).

Project management and methodology related factors concern the execution of BI project by business-driven and iterative development approach with a limited scope and a separate budget for each iteration (Boyton et al. 2015, 315). Because the company-wide BI implementation tends to be a complex and long-term process, an iterative approach enables that the project team can focus on agreed milestones instead of struggling with the whole project and minimizes the risks associated with large-scale change projects (Yeoh & Popovic 2016, 142). Also, when the scope of each iteration is achievable and focused on the individual business unit, the delivery time will be shorter which may insert the positive response toward the implemented BI system (Yeoh et al. 2008, 88). In addition, requirements may change during the

process, so an iterative approach allows changes within the agreed time frame and resources (Yeoh & Koronios 2010, 27).

Even if a business-centric champion and an iterative approach have an important role in the user acceptance, user-oriented change management including user and management training affects critically on the success of the implementation (Yeoh & Koronios 2010, 27). The fear of change during the large-scale implementation process is normal because business rules, processes and responsibilities are changing (García & Pinzón 2017, 61). Resistance toward changes and the implemented BI system can be reduced through communication, training and supporting (Yeoh et al. 2008, 87). Training helps end users with the adoption of the new BI system and guides with the new business rules and processes, yet trainings have to be business specific using their own data instead of generic trainings in order to achieve successful results. However, even more important than training is supporting end users after the system is introduced, for example by providing consistent maintenance support upon request. (Yeoh & Popovic 2016, 143) In addition to training and supporting, user participation already during the earlier phases helps the project team to take into account their needs and demands which leads to the ownership of the BI system and reduces resistance (Reinschmidt & Francoise 2000). An efficient way to achieve the user involvement is to arrange regular workshops or meeting with business users and the project team (Yeoh & Popovic 2016, 143).

3.1.3 Technological dimension

Even if technological factors have a smaller impact on the implementation success compared to organizational and process related factors, infrastructure and data related factors contribute to the successful implementation (Yeoh & Koronios 2010, 31). It is critical that the BI solution is based on the company's business needs and context without being too complex but flexible enough to adapt to changing requirements (Boyton et al. 2015, 317). A business-driven, scalable and flexible framework is seen as a critical success factor because it enables expansions and

modifications of the BI system when informational needs are evolving (Olszak & Ziemba 2007, 142). For example, adding data sources, attributes and dimensional areas should be included in the scalable framework (Yeoh & Koronios 2010, 28).

Another technological related success factor which have a notable impact on the success of the implementation is data quality and integrity. Especially the data quality of the source systems is crucial for the successful implementation according to respondents of the Yeoh & Koronios's survey (2010, 28) because data quality affects the quality of management reports and eventually the decision outcomes. Because the BI system can have multiple source systems, the quality of the communication and integration between these multiple systems is critical to manage overall BI performance and ensure reliable results (Isik et al. 2013, 15). Additionally, in order to achieve company-wide data integrity, business definitions and business rules should be standardized between different business units (Yeoh & Koronios 2010, 26). Sustainable data integrity leads to the a single, company-wide version of the truth which is a prerequisite for data quality of the source systems (Yeoh & Popovic 2016, 144).

3.2 Implementation challenges

The recent research of García & Pinzón (2017, 48) found that nowadays the failure rate of the BI implementation projects is from 70 per cent to 80 per cent while the ordinary IT project failure rate is from 25 per cent to 40 per cent. Despite the particularly high failure rate, the reasons for the failures are rarely discussed in academic research (Boyton et al. 2015, 310). The previous chapter identified critical success factors for the implementation of the BI system. Most likely, a lack of these factors will lead to the failure of the implementation (Yeoh & Koronios 2010, 25). Thus, success factors have their inverse, the failure factors, which should be considered to understand the reasons for the failure and to avoid an unsuccessful BI implementation (Boyton et al. 2015, 310). These failure factors are represented in the table 4.

Table 4 Failure factors (based on Boyton et al. 2015, 311)

Dimension	Success factor	Failure factor
Organizational	Committed management support and sponsorship	Lack of organizational commitment to BI
	Clear vision and well-established business case	Unclear vision and scope, for example a business case does not identify metrics for success or does not exist
Process	Business-centric championship and balanced team composition	IT driven solution that has little or no business input
	Business-driven and iterative development approach	Non-business driven approach to exploration of requirements
	User-oriented change management	Changes are driven by technology Insufficient change to processes to support capture and administration of quality data
Technological	Business-driven, scalable and flexible technical framework	Technology-driven, lack of scalability and flexibility in solution
	Suitable data quality and integrity	Poor data quality with no ETL approach

As stated earlier, organizational factors play a more significant role than technological factors when considering the success of the BI implementation. Yeoh et al. (2008, 87) even suggested that organizational and management commitment is the most important factor but at the same time also the most difficult factor to achieve. When the management commitment is achieved, the BI process needs to be driven from the top-down which also helps to make business intelligence as a part of the organizational culture (Watson & Wixom 2007, 98). So, the organizational commitment is essential for the implementation success and when the commitment is not achieved it will impact on other factors affecting negatively the implementation success. The other significant cause for the implementation failure is an unclear vision. When the company is confused what they want to achieve by implementing the BI system and how it will meet their strategic goals, the implementation will fail. An unclear vision and a poorly established business case also prevent the company to see the benefits of the BI system. (Boyton et al. 2015, 312) Parr Rud (2009) identified more specifically that companies may have difficulties with the redesigning of organizational processes, management structure, measuring systems and operating business in a continually changing environment.

Even if the company has a clear vision at the blueprint stage, the vision has to be realized when implementing the BI system in practice. This means that business requirements must be the drivers for the implementation instead of technology. Yeoh & Koronios (2010) stated that indistinctly defined business needs and requirements, silo information systems with multiple truth and an information system centric approach are the main reasons for the BI failure. (Yeoh & Koronios 2010, 29) Additionally, re-engineering processes and suitable change management are prerequisites for the successful implementation. Business processes, such as financial, planning, performance monitoring, measurement and supply chain processes, need to be redesigned in order to use the implemented BI system effectively. Consequently, process engineering creates the foundation for change management because redesigned processes lead to changes in individual and organizational behavior. However, both of these factors are poorly understood by the companies and Williams & Williams (2003) discovered that a number of BI projects fail due to ineffective change management. (Williams & Williams 2003, 6-8)

As has become apparent, the BI solution needs to meet the strategic goals and business requirements, so projects which are driven by technology instead of business tend to have higher failure rates. When the project is technology-driven, the users do not understand the implemented BI system and the system cannot be changed according to changing business needs. (Yeoh & Koronios 2010, 28-30) Also, the solution on its own can lead to the implementation failure when considering data quality issues. Data quality and integrity issues are mostly due to disparate data sources systems and these problems have a straight impact on quality of reporting and analyzing. (Boyton et al. 2015, 313) So even though technological factors have a lower impact on the implementation success, they can also lead to the failure of the BI implementation.

In addition to failure factors, Deng & Chi (2013) have identified seven constructs that are related to problems with the usage of the BI system during the post-adoption phase. Deng & Chi (2013) analyzed nine-month archival data of user-reported

problems related to a new BI system in a large company. In order to integrate an implemented BI system into users' work routines, these identified problems need to be overcome. These seven identified constructs and concepts are collected in the table 5.

Table 5 Constructs and concepts of BI system use problems and causes (Deng & Chi 2013, 300)

Construct	Concept
Role authorization problem	Role assignment Role request Role update Role failure Role conflict
Reporting problem	Report availability Report navigation Report bookmarking Report export Report customization Reporting errors
Data problem	Data inquiry Data retrieval Data interpretation Missing data Incomplete data Incorrect data Duplicate data Inaccessible data Nonapplicable data
Workflow problem	Process integration Data discrepancy Data loading error
Users' lack of knowledge	Lack of know-what Lack of know-how Lack of know-why Lack of know-who
System errors	Missing system feature System malfunctioning System set-up System nonresponse System proxy issue
User-system interaction	User-system interaction

Deng & Chi (2013, 301) found based on the causal map analysis that seven identified constructs could be divided into problems and causes. Role authorization, reporting, data and workflow can be considered as the problems whereas users' lack of knowledge, system errors and user-system interaction can be considered as the

causes. Users may have a lack of knowledge related to the BI system which can lead to unsuccessful system usage incidents. For example, system access, functionality and reported data are issues users have shortcomings. Additionally, system errors, such as missing a report variable or outdated value in a configuration table, may lead to system use problems. (Deng & Chi 2013, 300) Also, user-system interaction is a cause for the system use problem even if the user cannot detect that because the BI system is working as expected. The error occurs when the system is in another state than the user assumes. For example, an unexpected data update may cause the user-system interaction error. (Nelson, Todd & Wixom 2005) These three causes lead to the system use problems.

3.2.1 Role authorization problem

Role related problems occur when the user is trying to access to the BI system and the access is denied. The access denial can appear in multiple level, not only when the user is signing in the system. For example, to view reports the user needs the access to four different level: the BI portal, the BI application, the reporting module and eventually the specific report. According to the survey of Deng & Chi (2013), role authorization problem is a common problem in the post-adoption phase. Especially, the problem concerns the access to a reporting module and a specific report. (Deng & Chi 2013, 300-301)

All three previously mentioned causes can lead to the role authorization problem. Firstly, the users have a lack of understanding the role hierarchies related to the BI system because access roles can differ from roles presented in the organizational charts. The access problems can also be caused by automatic, inaccurate input from another system which leads to outdated or updated roles in the BI system. To fix these kinds of system errors the incorrect information, for example in the role configuration table, needs to be updated. Furthermore, the user-system interaction can be a cause for the role related problems. For example, the user may be aware of his access role and the role designation from the technical perspective is correct but

still the system use problem occurs because the added layers of security will cause additional restrictions and complexity. (Deng & Chi 2013, 302)

3.2.2 Reporting problem

Reporting problems are related to an unsuccessful attempt to use the reporting features to perform tasks assigned to the users. Commonly, the problems are linked to locating a report, in other words report availability, and creating a report, in other words reporting navigation. According to Deng & Chi (2013), reporting problem is a main construct of system use problem because it prevents the effective use of the implemented BI system. Similar to the role authorization problems, reporting problems can be caused by all three identified cause factors. The most common cause is users' unfamiliarity with the features of the BI system. The users are lacking know-what and know-how about the BI reporting functionality. In addition, the users do not fully understand the associations with company's legacy reporting systems and they need to see the relationship between old and new reports to gain knowledge about the new reporting practices. (Deng & Chi 2013, 300-302)

Also, system errors and user-system interaction can cause reporting problems. Examples of system related factors, which can be the causes for reporting problems, are system time-out, slowness of the system or non-responsiveness of the system. For example, running a detailed report may cause freezing of the BI system and to avoid this problem the user needs to create a smaller-sized report with less details. In turn, the user-system interaction may lead to reporting problems when a reporting function is not working as it was designed even if the user enters correct inputs. (Deng & Chi 2013, 303)

3.2.3 Data problem

Data problems, such as missing data, inaccessible data or nonapplicable data, appear when the user is actually employing the BI reports (Deng & Chi 2013, 300) and problems refer to failures with data input or output in the BI reports. Thus, data

problems lead to data inaccuracy which is one of the main reasons for poor information quality. (Nelson et al. 2005) Similar to previous problems, also data problems can be caused by users' lack of knowledge, system errors or user-system interactions (Deng & Chi 2013, 303).

User-system interaction causes the data problems when the user lacks context-dependent or consequence-specific knowledge about the BI reports. For example, when the user is not familiar with the reporting design and fails to find what he is looking for, data problem appears. Also, the user is not capable of interpreting different consequences due to different visualization or data processing logic between a previous reporting system and an implemented BI system. In addition, the system-related errors, such as delayed data or missing numeric fields, are also the common causes for data problems. These often require further diagnosing, checking into configuration details and sometimes even modifying programming codes. Lastly, user-system interaction may cause the data problem when the input provided by the user is correctly entered and the system is running normally. However, the BI system may not have applicable data which is the most typical occurrence caused by user-system interaction. The reason behind this error situation can be that there are no data types entered according to search conditions. When the reporting is working as designed, either the user does not know what data types he should use or the person who is responsible for entering the information into the source system in the first place has not entered the information correctly. (Deng & Chi 2013, 303-304)

3.2.4 Workflow problem

Workflow problems are results from process or data integration which are not working as designed. Commonly, the integration problems are related to business processes and data sources. Observable examples of workflow problems are delayed data loading, data discrepancy across reports and data mismatching between data sources. Typically, workflow problems are caused by users' lacking knowledge about business processes and thus, transactions made by the users may

cause errors. Users' knowledge is essential for understanding the workflows and consolidation of data from multiple sources. (Deng & Chi 2013, 300-304)

In addition to users' knowledge, also user-system interaction may cause the workflow problems. When the user has gained sufficient knowledge about data integration and problems still occur the cause is user-system interaction. For example, the problem may occur when an employee has changed from one department to another, but his payroll record has not been updated accordingly. This kind of data inconsistency problem can be caused by conflicting schedules in data updates. However, as opposed to other problem types workflow problems are not caused by system errors according to causal map analysis. (Deng & Chi 2013, 304)

4 MEASUREMENT OF BUSINESS INTELLIGENCE SUCCESS AND MATURITY

4.1 Success of business intelligence implementation

Even if previous studies have identified the critical success factors as well the failure factors for the BI implementation, many companies are still struggling how to measure the success of the BI implementation. The BI success can be defined as the positive benefits the company achieved through the implementation of the BI system. Thus, the BI success measures can vary between companies depending on the targets they wanted to achieve by implementing the BI system in the first place. (Isik et al. 2013, 14) However, benefits can be tangible or intangible, so the measurability of the benefits is varying. Many of the benefits are intangible, such as support or improvement of the business processes, and measuring the monetary value can be difficult. (Pirttimäki & Hannula 2003, 253) Still, also non-financial benefits can lead to financial outcomes, such as cost savings through processes with improved efficiency (Lönnqvist & Pirttimäki 2006, 34). The measurability of the benefits has been illustrated in the figure 9.

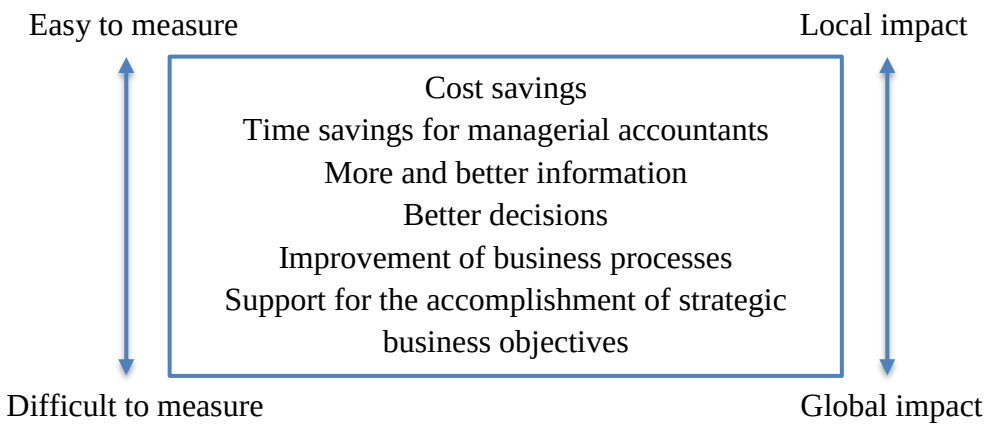

Figure 9 Measurability of the benefits (based on Wixom & Watson 2010, 21)

Tangible benefits are easier to measure than intangible benefits, but they have also a more local impact typically concerning the specific departments inside the company. On the other hand, intangible benefits are more difficult to measure, but

they have also a wider impact across the company. (Wixom & Watson 2010, 20) Because benefits and their impact can vary between different departments or business units, it is possible that different business units are using the different measures inside the company (Mohanty 2008). Boyton et al. (2015) have presented four different measurement categories for determining the success or the failure of the BI implementation: return on investment (ROI), non-concrete measures, project management measures and user satisfaction. These are offering measures for both intangible and tangible benefits. (Boyton et al. 2015, 308)

ROI is the most concrete measure suggested by Boyton et al. (2015). Even if ROI represents a quantifiable indicator it may be difficult to capture. ROI indicates the increased business value achieved through the BI implementation but at the same time verifying monetary value is not a straight forward task. (Boyton et al. 2015, 308) As Lönnqvist & Pirttimäki (2006) stated that many of the benefits achieved by the usage of the BI system are non-financial or even intangible, such as improved quality, but these benefits should result in financial outcomes. However, there may be substantial delay between emerging the benefits and realizing the financial results. (Lönnqvist & Pirttimäki 2006, 34) In turn, Ghobakhloo, Sahouri, Hong & Amirizadeh (2011, 347) suggested that ROI is one influence of improved market efficiency, internal process efficiency and financial efficiency. Similarly, Williams & Williams (2003) considered the benefits from the internal process perspective. For example, improved ability to forecast or reduced manual processing in management reporting are the benefits which could be measured in monetary value if it is possible to calculate increased revenues or reduces costs which these benefits could produce. (Williams & Williams 2003, 3)

As mentioned, most of the benefits BI systems may deliver are intangible. Thus, the success of the BI implementation can be also measured with non-concrete measures. Non-concrete measures suit better to individual business units than to the whole company. For example, a marketing department can measure new marketing channels identified or a brand department can measure brand recognition increased by using the BI system. (Mohanty 2008) The measures can be also examined from

the project management perspective. In that case, the measures are related to the measurable project targets and outcomes which are defined in the BI project's planning phase and measured in the closing phase. If defined requirements which belong to project scope are provided on schedule and budget, the BI project can be considered successful. Success of the BI implementation can be also measured by user satisfaction. (Boyton et al. 2015, 309) One way to examine user satisfaction is a user survey as Isik et al. (2011) conducted in their research about business intelligence success. The survey measured how satisfied respondents were with several aspects of their BI systems and BI overall. Additionally, they examined whether there are differences in the level of satisfaction among users from different industries, functional areas or organizational levels. (Isik et al. 2011, 166)

4.2 Maturity of business intelligence implementation

In addition to measuring the success, BI implementation can be evaluated by measuring BI maturity. The maturity describes a state of being complete, perfect or ready and in order to achieve this desired state of maturity the transformation from an initial stage to a target stage has to be progressed. Business intelligence maturity models have been developed to guide this transformation process. (Lahrmann, Marx, Winter & Wortmann 2011, 2) The purpose of maturity models is to describe, explain and evaluate growth life cycles so companies can use maturity models to define the stage where they currently are (Rajterič 2010, 49-50). Additionally, maturity models describe what kind of improvements and challenges companies will face in order to achieve a higher maturity stage (Hostmann et al. 2006). Maturity models help companies to answer such questions as where at the company is most of the reporting and analysis done currently, who is using reports and analysis, what drives BI at the company and what benefits BI is offering (Rajterič 2010, 50).

Lahrmann et al. (2011) developed a conceptualization that helps to understand different aspects which affect BI maturity. This conceptualization is presented in the figure 10. Lahrmann et al. (2011) conceptualized BI maturity based on three

concepts which are linked to each other: deployment, use and impact. The deployment includes the implementation of the BI system which is called IT artifact in the conceptualization. In addition to the BI system, deployment also considers that new capabilities and practices need to be implemented to achieve the successful deployment. As seen in the figure, the deployment leads to the usage of the BI system because without the usage the deployment has no impact. The deployed BI system, capabilities and practices need to be used by individual employees and the usage should be spread to company-wide. Eventually, the usage has an impact on both individual level and company level. For example, the usage may lead to more effective way of working and supporting business processes through the company. (Lahrmann et al. 2011, 4)

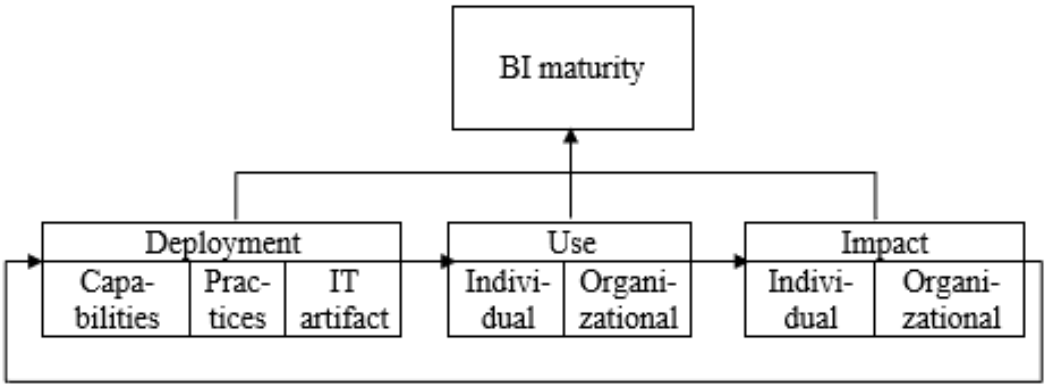

Figure 10 Conceptualization of BI maturity (Lahrmann et al. 2011, 4)

As we can see in the conceptualization, maturity models should consider also organizational and process aspects in addition to technological aspects (Popovič, Coelho & Jaklič 2009). However, because BI is such a wide area maturity models which cover both technological and non-technological aspects are rare (Rajterič 2010, 60). Overall, many BI maturity models have been developed recently but they are more focused on technological side (Lahrmann et al. 2011, 1). Especially maturity models can be found in the professional field, but empirically supported models are lacking in the scientific field (Popovič et al. 2009). Often models are also poorly documented. Because of the fact that most of the BI maturity models are poorly documented and focused on technological aspect, this study will focus on Gartner's maturity model which is well-documented and covers all three aspects:

people, process and technology. (Rajterič 2010, 55-60) Also, previously defined critical success factors, which include same three aspects, can be used for evaluating maturity levels when using Gartner's maturity model.

4.2.1 Maturity levels

Gartner has developed a well-known maturity model for business intelligence and project management to help companies to understand how mature they are regarding to BI and how mature they should be to support company's business goals. The model can also help companies to understand the incremental changes and challenges they will face in order to raise the level of maturity. Maturity improvement is multiyear journey during which the company develops its organizational competencies and technical capabilities. However, for some companies staying at the lower maturity levels might be enough to support their goals. Maturity levels may also vary between departments or processes. Gartner's maturity model consists of five maturity levels: unaware, tactical, focused, strategic and pervasive. (Rayner & Schlegel 2008) Maturity levels and typical factors related to these levels are presented in the figure 11.

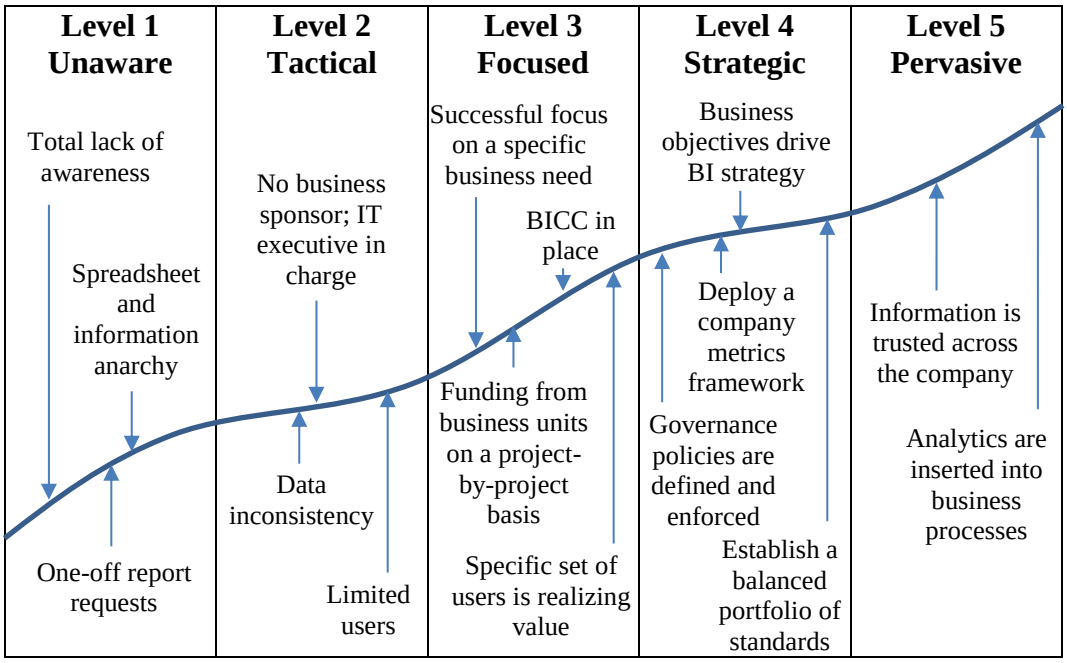

Figure 11 Maturity levels in Gartner's maturity model (based on Rayner & Schlegel 2008)

The first level of Gartner's maturity model is unaware. This is also viewed as information anarchy because lacking internal control leads to inconsistent data across departments, incorrect data interpretation and unidentified metrics. Data does not fulfill individual and departmental needs which causes constant changes. At the first level companies have not identified their vision and IT department is responsible for information management instead of business. The use of reporting tools is limited but spreadsheet and ad hoc queries are used for satisfying individual needs. The challenges companies need to overcome at the first level are identifying the business drivers and needs for supporting the BI system, getting commitment and understanding the current information management structure which includes data sources, data quality and BI architecture. (Rayner & Schlegel 2008)

The second level is called tactical level because a limited number of managers and executives use data to drive tactical decisions. Companies start to invest in BI, but they still have major infrastructure issues which cause a lack of confidence related to quality and reliability of the data. However, some users may use standard reports, but most tools, applications and data are still in silos and users are not skilled enough to use the BI system. The BI system normally has only few or no modifications, so it does not meet the company's needs. Also, common metrics are still lacking but metrics might be used on the departmental level. Overall, typical features for the tactical level are lacking organizational structure and processes, many disparate systems and struggles to answers business needs. These challenges often result in low support and insufficient funding for the BI project. (Rayner & Schlegel 2008)

The third level is focused level because the company achieves its first success and benefits related to BI and senior executives start to focus more on commitment. The primary focus is on driving business initiatives such as supporting financial reporting. However, success and commitment are only focused on the limited parts of the company. Sponsorship and funding typically come from a business unit or a department and metrics are defined to analyze departmental or functional performances. The typical feature for this level is demand for management

dashboards which aims is to improve departmental performance but is not related to the broader company goals. Users are trained to use basic functionalities of the BI system. Additionally, companies begin to build BI competency centers (BICC) which are typically focused on specific applications. Overall, at the focused level the company has realized the business value of the BI system and achieved some solid success, but still inconsistencies in metrics and goals of individual business units are common. The challenge is to extend the success to company-wide across the BI system and expand the scope of the user base. (Rayner & Schlegel 2008)

The fourth level is called strategic level because companies at this level have defined a clear business strategy for BI development with management sponsorship. Companies are integrating BI into critical business processes and making data available for employees across the company. Users start to trust data and data is used for decisions-making because data quality is defined and monitored constantly. Also, a company-wide framework for metrics has been developed which links financial goals and strategic objectives to departmental, functional or operational metrics. The main challenge at the strategic level is to develop a balanced organizational structure which is consistent with company's business objectives and strategy. Companies may also have challenges to answer changing business needs by building agility into the BI system. (Rayner & Schlegel 2008)

The fifth level is pervasive level which is the highest level of the BI maturity in Gartner's maturity model. At this level BI becomes pervasive across the business and entire corporate culture as well as a part of the business processes. The BI system is agile to answer changing business and informational need. Data quality is high so users across the company on multiple levels trust the data and they have access to data which allows them to take advantage of the BI system and make decisions based on real-time information. Because results are measurable it enables that metrics are linked directly to individual performance goals. Even if the pervasive level is the highest level of the maturity, challenges still occur. The challenge at the pervasive level is to continue being a best practices leader despite constant changes such as mergers and acquisitions. Another challenge is keeping

the strategy updated while user needs and technology are evolving. (Rayner & Schlegel 2008)

4.2.2 Maturity criteria

The maturity criteria in Gartner's maturity model are divided into three aspects: people, process and technology. Technology aspect also contains metrics. (Rajterič 2010, 55) Olszak (2013) surveyed BI maturity in selected companies by using Garner's maturity model. As a result of the survey, typical characteristics of each maturity level are defined. BI maturity criteria, which can be used for identifying company's maturity level, are presented in the table 6. In addition to people, process, technology and metrics, the scope of benefits experienced by the company is added as the one aspect into the criteria. Olszak (2013) also identified success factors which enable companies to achieve the benefits at the specific maturity level and help companies to stay at the achieved maturity level. Thus, the criteria also present which success factors companies need to focus on in order to achieve the higher maturity level.

The maturity criteria gathered by Olszak (2013) combine the factors presented in the description of Gartner's maturity model. At the unaware level, users do not know their data, business processes or how to use the implemented BI system. Due to limited use of the BI system, almost none benefits have not yet been realized. (Olszak 2013, 956) In order to move to the tactical level, companies need to identify business drivers and understand the current information management structure (Rayner & Schlegel 2008). At the tactical level, users take the first BI initiatives and BI implementation has achieved low support from senior executives. Additionally, basic business processes are identified and the BI system is used for analyzing historical data. Better access to data can be seen as a benefit. To move up in the maturity curve the company should focus on gaining support from senior management and repairing BI architecture and data quality issues. (Olszak 2013, 956)

Table 6 BI maturity criteria (based on Olszak 2013, 956)

People	Process	Technology and metrics	Scope of benefits
1st Level: Unaware			
Users do not know their own data or how to use the system	Users do not know business processes Poor data quality	Lack of appropriate BI architecture Metrics not defined Limited use of reporting	Almost none
2nd Level: Tactical			
Users take the first BI initiatives Low support from senior executives	Identification of basic business processes	Regional data warehouses Analyzing trends and past data First interactive reporting tools Metrics only on the department level	Low benefits limited to small groups of users Better access to data and static reporting
Success factors: Support from senior management, appropriate BI tool, quality of data, defined business processes and metrics			
3rd Level: Focused			
Users try to optimize the efficiency of individual business units	Standardization of business processes Building best practices in BI	Management dashboards Centralized data warehouse Ad hoc reporting and query drill down	Benefits limited to business units Improvement of internal business processes and decision-making on operational level
Success factors: Developing corporate culture based on facts, stating clearly BI strategy, implementing training system on BI			
4th Level: Strategic			
Users have high BI capabilities but often not aligned with right role	Business process management based on facts	High data quality BI strategy More complex prediction and modeling tools Data mining	Benefits for the whole company Integrated analysis for finance Improvement of decision-making at all levels of management
Success factors: Support from CEO, motivation of users for analyzing and using data			
5th Level: Pervasive			
Users' capabilities to use BI Training Users analyze and share information CEO and broad-based management commitment	Broadly supported Process-oriented culture based on facts Learning and sharing of knowledge	Company-wide BI architecture largely implemented Customized reports Business and BI are aligned and cooperative	Benefits for the whole environment Competing in BI New ways of doing business
Success factors: Strong support from CEO, all users trust in BI			

At the focused level, business processes are standardized and management dashboards, ad hoc reporting and query drill down are used. The usage of the BI system is optimized on the unit level why also benefits are limited to business units, such as improvement of internal business processes and decision-making on operational level. The success factors to improve the maturity level are developing corporate culture, stating clearly BI strategy and implementing a training system. At the strategic level, users' capabilities and data quality have reached a high level. However, user roles still need to be reviewed. The BI system includes prediction, modeling and data mining tools. Benefits are spread to company-wide and to all management levels. In order to reach the highest maturity level, support from CEO and motivation of users are key factors. At the pervasive level, all users are trained to use the implemented BI system. User roles, processes and metrics are clearly defined and BI architecture is company-wide. Benefits are concerning the whole environment and the company is able to find new ways of doing business. (Olszak 2013, 956)

However, reaching the higher maturity level can be difficult especially for the large companies because there are several challenges to overcome. Large companies often operate internationally and they have many departments working fairly independently from one another and having individual needs and working habits. Additionally, companies may have grown through acquisitions which requires technology and data integrations. Therefore, sometimes increasing the BI maturity level may not be beneficial enough to large companies. Because of the complex BI environment, moving up in the maturity curve might demand large investments. Thus, large companies should find proper sub-areas to focus on to improve their use of the BI system. (Näslund, Sikander & Öberg 2014)

5 RESEARCH DESIGN AND METHODOLOGY

5.1 Application of the theoretical framework

The theoretical framework in this study consists of three entities: the concept of business intelligence, factors affecting the BI implementation and measuring the BI implementation. How the theoretical framework applies to the empirical part of the study is illustrated in the figure 12. The empirical part is following this structure. Chapter 2 defined the concept of business intelligence and provided the foundation for this study. In order to understand the research context and the current situation at the case company, the motivations why the case company implemented the BI systems and whether the implemented BI architecture differs from the traditional BI architecture are discussed in chapter 5.2.

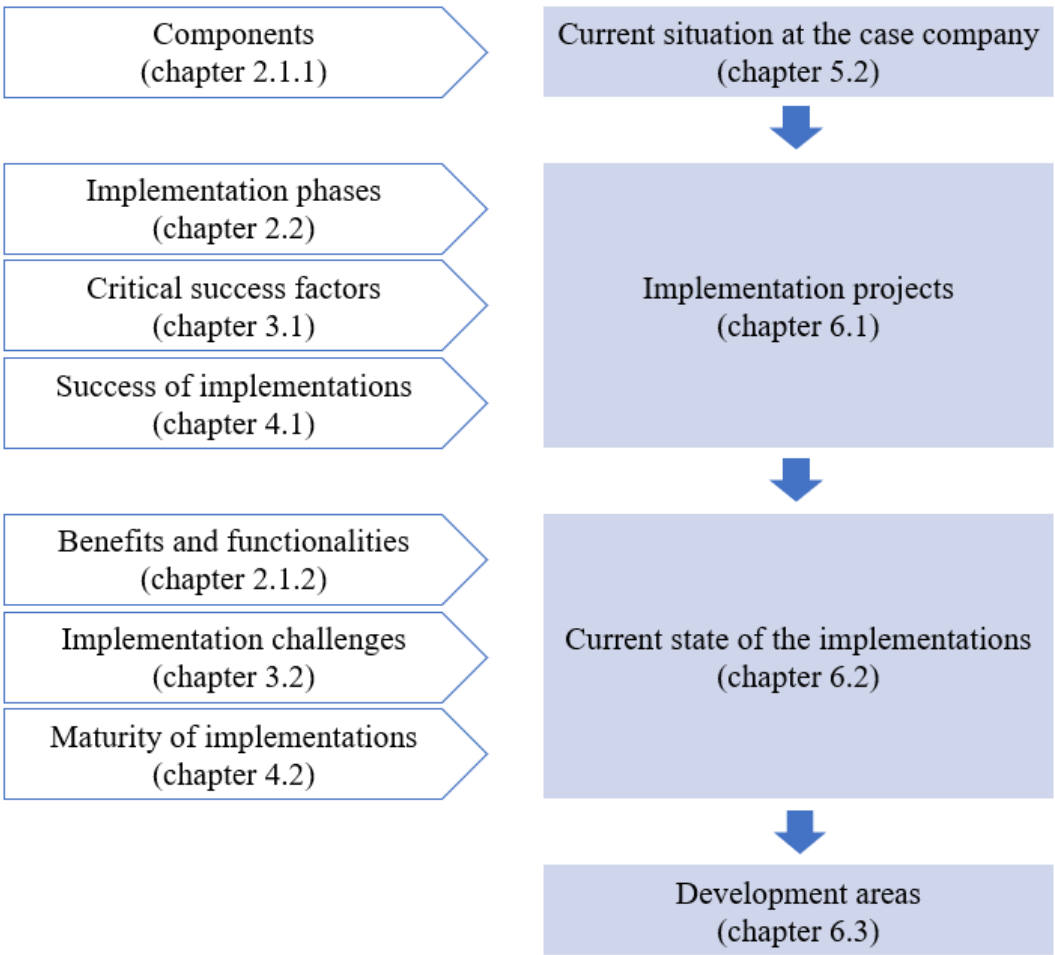

Figure 12 Theoretical framework

Chapter 6 has divided into three sub-chapters. First, the implementation projects are explored in chapter 6.1. Implementation phases, critical success factors and success measures provide the foundation for the chapter. How critical success factors were taken into account during the implementations and whether the implementations were successful are studied. The success of the implementations is measured by using the success variables introduced in the Yeoh & Koronios's framework, project management measures and user satisfaction. These measures were chosen to measure the implementation success at the case company since they can be used for measuring the company-wide success. In chapter 6.1, the evaluation of the success variables and project management measures are presented since they are closely related to the implementation projects.

Next, the current state of the implementations is studied in chapter 6.2. The common benefits and functionalities the BI systems are offering for managerial accounting were introduced in the theoretical part. Which of these benefits and functionalities have emerged at the case company is examined. Additionally, at which maturity levels the implementation projects currently are, is researched by using the Gartner's maturity model introduced in chapter 4. After maturity levels are identified, which implementation challenges the case company is facing at these maturity levels is studied. The study is based on the same implementation problem types which were presented in chapter 3 in order to enable comparison of results to previous studies. Additionally, the evaluation of user satisfaction is presented in chapter 6.2 since the results represent the current state of the implementations.

Based on the evaluations of implementation projects and the current state of the implementations, further development areas are identified in chapter 6.3. The analysis of critical success factors and implementation challenges pointed out the areas which the case company should focus on to improve the utilization rate and user satisfaction. The answers for research questions are provided in chapter 7 which combines findings of the empirical study presented in chapter 6. The execution of the empirical study including data collection and analysis processes is introduced in chapters 5.3 and 5.4.

5.2 Current situation at the case company

This study is executed as a case study in the large Finnish manufacturing company which is operating in global markets. The case company consists of business areas which are further divided into several business units. To withstand in rapidly changing business environment, the case company has grown also through acquisitions in recent years in addition to organic growth. In order to ensure growth and success also in the future, the case company has focused on the long-term development. One part of this development is to improve and streamline finance operations. Several development projects have been executed to fulfill this target and this study is contributing to one of these development projects: the implementation of the BI systems. This study focuses on two separate implementation projects: the implementation of the budgeting and forecasting system and the implementation of the reporting and analyzing system. The purpose of the implementations is to improve managerial accounting by offering new functionalities for budgeting and reporting, simplifying forecasting processes, enabling easy access to detailed information and increasing the automation of reporting processes.

Both implementations are completed from the technological perspective and the systems are available for end users. The implemented BI architecture follows the typical BI architecture introduced in chapter 2 and it is illustrated as simplified in the figure 13. Data is transferred to enterprise data warehouse from ERP system and other transactional based source systems. From enterprise data warehouse data is transferred to data marts and then to dynamic data cubes. Data is refreshed every night in order to provide the latest data available for users. Eventually, through the reporting layer the user can see the data that is transferred to data cubes. The user can either extract data through dashboards and standardized reports or create data queries from data cubes. The budget and forecast figures are entered to the budgeting and forecasting system which communicates with enterprise data warehouse and figures are transferred to data cubes so that the user can see them through the reporting layer. The implemented BI system includes basic BI

functionalities such as drill down, drill up, filtering and ad hoc queries which enable faster information retrievals to support decision-making.

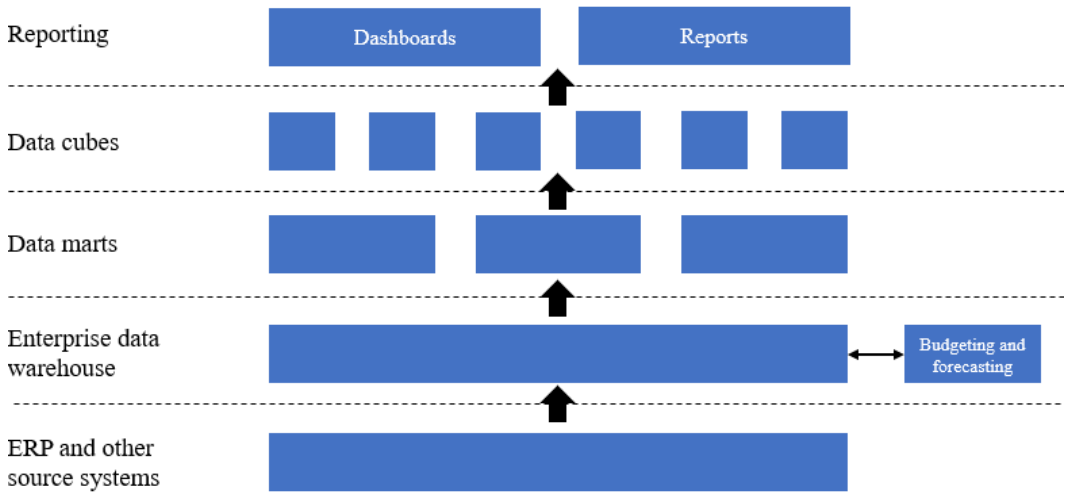

Figure 13 BI architecture at the case company

Even if the technological implementations are completed, the implementations are still ongoing from the managerial perspective. During the current post-adoption phase, the systems are available for end users, but actions need to be still taken to improve the usage of the BI systems and to increase the utilization rate. In addition to adopting the new BI systems, the changes related to managerial accounting are also occurring. The implementation of the new reporting system also brought with it a new profit and loss (P&L) calculation so the structure how profit and loss is calculated inside the company is changing. The purpose of the new P&L structure, which is used in managerial reporting, is to improve profitability management. It supports key account, category and brand management by enabling target product costing, follow-up production efficiency and accountability for the financial performance in production.

5.3 Methodological choices

This study is conducted as a case study using both qualitative and quantitative research methods. The case study is used for exploring the phenomena within a

bounded context using a variety of data sources. The subject is studied from the multiple perspectives to reveal the essence of the phenomenon and gain broad understanding of the topic. (Baxter & Jack 2008, 543) The case study can be regarded when the study focuses on answering “how” and “why” questions. Typically, the subject of the case study is a contemporary phenomenon within real life context and general circumstances of the phenomenon are studied. (Yin 1994, 1) This study concentrates on researching the case company to find out how the implementation success can be measured, how the BI maturity affects the implementation challenges and how these challenges could be defeated. The type of the case study used in this research is a single case study with embedded units because the subject is examined from the perspectives of multiple business units within one case company.

Characteristic for the case study is using multiple data sources which enhances data credibility. Possible data sources for the case study include documents, archival records, interviews, direct observations, participant observations and physical artefacts so data can be collected using qualitative and quantitative methods. (Yin 1994, 4) Qualitative methods are seen as a set of interpretive activities without a single overbearing methodological practice (Denzin & Lincoln 2011, 6). Qualitative research typically studies people, cases, phenomena, social situations or processes in their natural setting as in this study processes and users’ experiences are researched at the case company. Several methods to collect empirical data exist such as interviews, direct observation and personal experience. (Yilmaz 2013, 315) In this study, data is primary collected through interviews. The structure of the interviews and the sampling are further introduced in the next chapter.

To support empirical data collected through interviews, also quantitative data is researched. Quantitative research methods explain the phenomenon based on numerical data which is analyzed by using mathematically and statistically methods (Yilmaz 2013, 311). Quantitative data is more structured and measurable compared to qualitative data. Quantitative research can reveal trends and behaviors across data sets or study groups but does not discover the motivation behind the observed

behavior while qualitative methods are used for exploring the reasons behind the behaviors. (Goertzen 2017, 12) In this study, quantitative data consists of nine-month archival data of tickets opened by the users. Quantitative findings are compared to qualitative findings and researched whether quantitative data supports the empirical data collected through the interviews.

Ticket data is analyzed by using a content analysis method. Content analysis is defined as a research technique for making replicable and valid inferences from data to their context. Content analysis is typically used for analyzing text, but the technique can be also used for analyzing images, maps, sounds, signs, symbols and numerical records. (Krippendorff 2004, 403-404) The purpose of content analysis is to examine trends and patterns as a result of word-frequency count (Stemler 2001, 3). In this study, the contents of opened tickets are analyzed based on the titles of the tickets. The execution of content analysis is further introduced in the next chapter.

5.4 Data collection and analysis

Data is primary collected by using the semi-structured interview method. The semi-structured interviews were selected as the source of evidence to gather information from experts in different business units. Semi-structured interviews consist of standardized questions but still offer opportunities for probing and more open conversation than structured interviews. The method is used for gaining deep comprehension of the research topic and understanding thoroughly the answers an interviewee provides. (Harrell & Bradley 2009, 27) Totally ten semi-structured interviews were conducted; five interviews related to the implementation of the budgeting and forecasting system (system 1) and five interviews related to the implementation of the reporting and analyzing system (system 2). The summary of the interviewees including professional titles, working areas and roles during the projects is presented in the table 7.

Table 7 Summary of interviewees

Subject	Inter-viewee	Profes-sional title	Area	Role during the project
System 1	A	Senior Specialist	Finance & Control	Lead of the project in business area, support and training
	B	Controller	Business Control	Representative of the group, scoping and implementation
	C	Finance Director	Management	Scoping in business unit
	D	Director	Business Controlling & Planning	User role in business unit
	E	Business Controller	Controlling	Scoping and training in business unit
System 2	F	Director	Finance & Control	Coordination of testing workshops in business unit
	G	Director	Controlling & Planning	Lead of project team and scoping in business unit
	H	Senior Manager	Finance & Control	Part of definitions team and scoping in business area
	I	Finance Director	Finance & Control	Testing in business unit
	J	Senior Manager	Business Control	Lead of the reporting stream and scoping in group level

As the half of the interviews were concerning the system 1 and other half were concerning the system 2, the interviewees were selected to form two comparable groups. Interviewees' roles during the project, their current positions and their BI experience were the factors on the basis of which the interviewees were selected. Both groups included one representative from the group level, one representative from the business area level and three representatives from the business unit level. All interviewees are currently working in positions related to managerial accounting in the areas of finance, controlling and planning. Additionally, BI experience of the interviewees is also on the comparable level between two interview groups as we can see in the figure 14. Both interview groups included one new user and rest of the interviewees were either intermediate or advanced users.

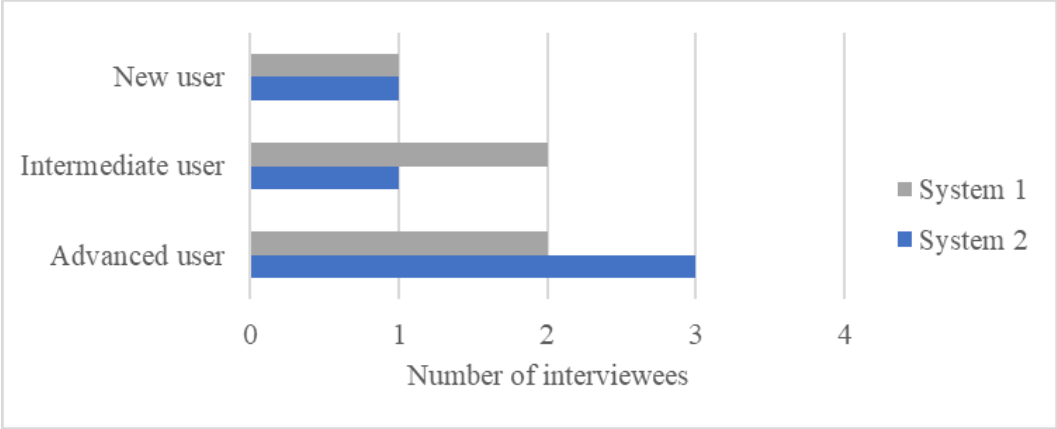

Figure 14 BI experience of the interviewees

All interviews followed the same structure which is available in the appendix 1. The structure can be divided into four main topics: the BI implementation and the success of the implementation, the usage of the BI system, benefits of the BI system and user satisfaction. However, the interviewer was able to ask further questions which were not part of the structure to gain deeper understanding. Interviewees were also allowed to express their thoughts freely outside the interview questions. Additionally, even if the interviews were based on the same structure, some of the questions could be asked in a different order because each discussion was unique. Eight interviews were performed in Finnish and two interviews were performed in English. All interviews were recorded. The duration of the interviews varied between 29 minutes to 64 minutes and the average duration was 42 minutes.

In addition to interviews, quantitative data related to tickets opened by the users is analyzed. In order to support end users with the usage and maintenance of the implemented BI systems, the case company has established the ticketing tool. If a user has a problem with any of the BI systems used at the case company, a user can open a ticket by sending an email to BI support. In November 2016 the case company outsourced maintaining BI support to an external vendor and the data has been collected since then. In this study, ticket data between November 2016 and August 2017 is analyzed in order to enable comparison whether ticket data supports the interview results. The distribution of tickets opened during the observation period is presented in the figure 15.

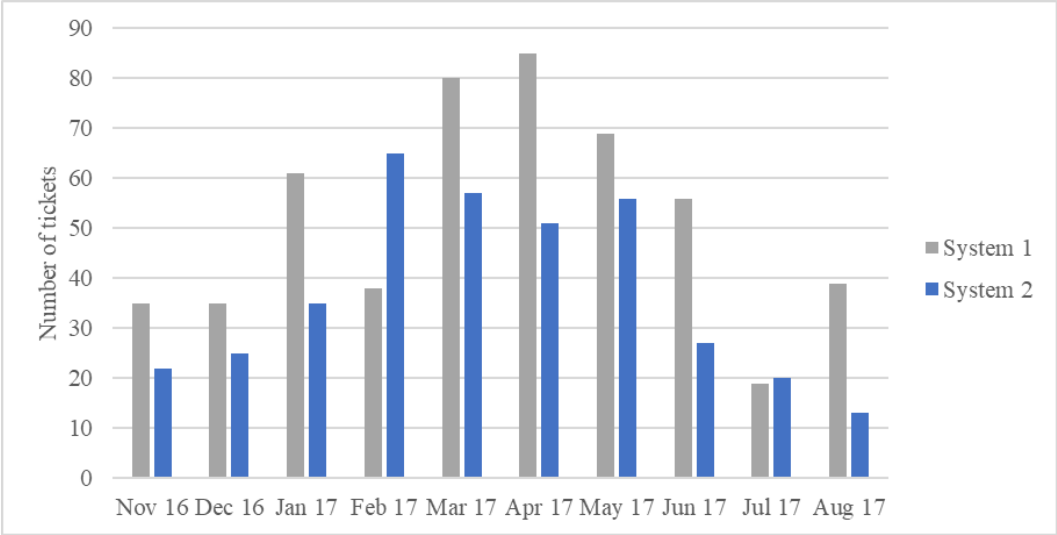

Figure 15 Distribution of opened tickets

During the observation period totally 517 tickets were opened related to system 1 and 371 tickets related to system 2. As we can see in the figure, most of the tickets were opened during the spring 2017 between March and May. Low ticket volumes during November and December might be explained by the novelty of the BI ticket system. Ticket volumes also decreased during the summer holiday period. Ticket data includes five different types of tickets: incidents, critical incidents, work orders, development and support. The distribution between ticket types is presented in the figure 16. Work orders cover the major part of the tickets related to both systems while support, critical incidents and development are covering only minor part of the tickets.

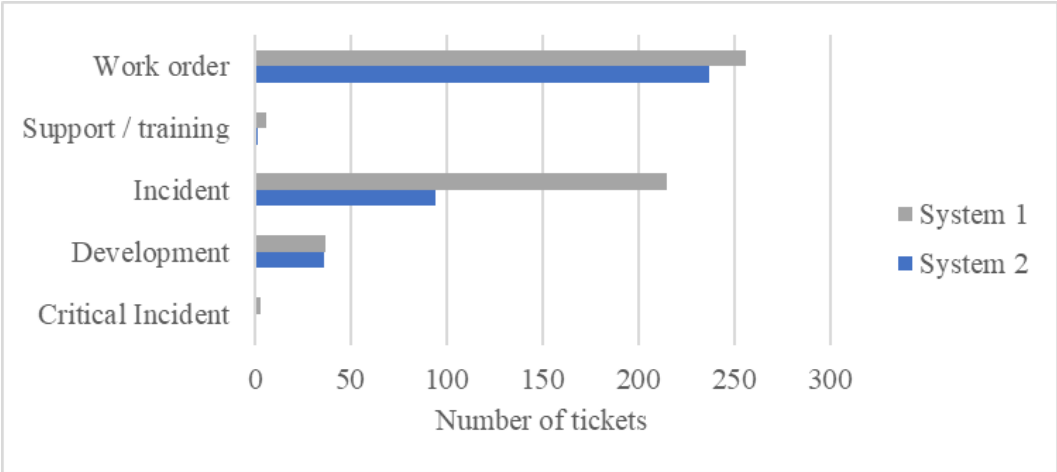

Figure 16 Distribution of ticket types

Because incident tickets represent problem situations users have faced, they are further analyzed in this study. During the observation period 215 incident tickets were opened related to system 1 and 94 incidents tickets related to system 2. A larger amount of incidents tickets related to system 1 can be explained by more active users because system 1 is currently more widely used across the company than system 2. Incident tickets are further divided into categories by using content analysis. Textual coding, which is presented in the appendix 2, is created based on frequently used words in the descriptions of tickets. Then these words are categorized to represent four problem types introduced in the theoretical part: role authorization, report, data and workflow problems. If some tickets did not include any of the words used in coding, they were excluded from the sample. Because a user can open a ticket either in English or in Finnish, coding is created both in English and in Finnish. Because the results of ticket analysis are quantitative, they are presented as percentages in charts. The results and conclusions, which are discussed in chapters 6 and 7, are based on interviews and data analysis.

6 BUSINESS INTELLIGENCE IMPLEMENTATIONS AT THE CASE COMPANY

6.1 Implementation projects

The implementation project of the budgeting and forecasting system started in the spring 2015 when technical specifications were created by interviewing each business unit and collecting their needs. The purpose was to transfer the existing forecast and budgets models of each business unit to one common system. This approach led to different solutions between business units and some unnecessary functionalities were built which have been abandoned later. The initial purpose was that soon after specifications units could test first versions of the solution but delays in other concurrent implementation projects affected the schedule of the implementation. Eventually, testing started during the fall 2015 when the system was already used first time for budgeting. In other words, units were creating budgets with the new system at the same time when they were still testing the system. During the first budgeting round, the system could not yet handle all the users which led to slowness of the system and access problems. This created some resistance toward the system, especially among the users who were not so familiar with the IT systems.

Despite some challenges, interviewees felt that the implementation project progressed overall quite well. The major problems were related to the project's dependency on other projects which led to delays and lack of resources. The other BI systems, which were implemented at the same time, work as the source systems for the budgeting system. Thus, delays in other projects affected straight to the progress of the implementation. Additionally, the concurrent implementation projects required same resources. Managerial accountants were needed for scoping and testing in many projects at the same time which increased work load and caused a lack of resources.

Also, the implementation project of the reporting and analyzing system started at the same time than the implementation project of the budgeting and forecasting system. The first phase was creating technical specifications. Interviewees felt that specifications of sales and fixed costs were created in detailed level enough and they succeeded quite well. On the other hand, the production side, which includes more calculation, was not defined in detailed level enough. Additionally, report and dashboard mock ups were already created during the planning phase even if the functionalities of the new system were not yet fully known. During the planning phase, also the complexity and diversity of source systems in different business units and business areas were underestimated.

During the implementation of the reporting system, the challenges were similar than related to the budgeting system. Many concurrent implementation projects led to thigh schedule and a lack of resources internally and externally. The lack of external resources caused that different consultants built the solutions for different business units, why gathered knowledge was not shared and the technical solutions differed between units. The lack of resources affected also to testing. Consultants could not deliver test versions on schedule and internal resources had not enough time for proper testing. Overall, the main challenges were similar in both implementation projects; concurrent projects led to the lack of resources and delays and technical complexity was underestimated.

6.1.1 Evaluation of critical success factors

How well seven implementation success factors were taken into account during the implementation projects is studied. Interviewees evaluated each factor using the scale from 1 to 5 and the summary of the evaluations is presented in the table 8. Overall, organizational factors related to management support and vision are the most successful factors while change management is the least successful factor. Other factors are on the average level. Additionally, during the implementation of system 1 most of the factors succeeded better than during the implementation of system 2.

Table 8 Evaluation of implementation success factors (1=Unsuccessful, 5=Very successful)

Success factor	System 1	System 2	Average
Clear vision and well-establish business case	4	4	4
Committed management support and sponsorship	4	3	4
Business-centric championship and balanced team composition	3	3	3
Business-driven and iterative development approach	3	2	3
User-oriented change management	3	2	2
Business-driven, scalable and flexible technical approach	4	2	3
Sustainable data quality and integrity	3	3	3

Overall, a clear vision was the most successful factor and it was successfully taken into account in both implementation projects. Both implementation projects had the clear vision especially from the company-wide perspective and it was clearly communicated. However, the business case was still unclear for many business units and what will be the benefits on the unit level was indistinct. Additionally, the business case did not identify metrics for the success which is seen as an implementation failure factor. Furthermore, the inadequate business case led to challenges in resourcing and scheduling. Overall, the vision was successful and well-communicated, but the business case had some shortcomings during the both implementations.

The other organizational success factor, committed management support and sponsorship, was also considered successful particularly during the implementation of system 1. Both interview groups felt that projects were supported especially from finance management, but general management was not involved in the projects as much as finance management. This also reflected to businesses which felt that these projects are more finance projects even if projects are strongly linked also to business and end users will be business people rather than finance people. Furthermore, interviewees felt that even if the finance management was supporting and sponsoring the projects, challenges were not paid enough attention. Targets were tried to achieve on the schedule which led to unsustainable solutions from the

architecture and process aspects especially during the implementation of system 2. In summary, the organizational factors, which are the most important factors but also the most difficult to achieve, were taken into account moderately at the case company.

Process factors were overall on the average level, but they were taken into account slightly better during the implementation of system 1. Related to business-centric championship and balanced team composition, both interview groups had similar experiences. Both implementation projects had a balanced combination of people from business side and IT side. Business people who were involved in the projects were controllers who had knowledge about operative side and directors who had more long-term view. On the other hand, IT resources were external consultants who had technical knowledge. Interviewees hoped that also the company's internal IT department would be more involved in the projects because they would have also the business understanding. Even if both project teams were balanced, they were lacking resources internally and externally. Because both BI implementation projects were running at the same time, partly the same persons were involved in both projects. Additionally, the experience and knowledge of the involved persons were not always at assumed level.

The development approach was slightly more business-driven and iterative during the implementation of system 1. During the definition phase of project 1, all the business units were involved in the planning, so the approach was quite business-driven. The initial purpose was that the approach would be iterative and soon after specifications first versions would be available for testing. However, due to the lack of resources and delays in other dependent projects the approach was not as iterative as planned. Similarly, the participants of the implementation of system 2 felt that the approach was not iterative enough due to the lack of resources. In contrast to system 1, interviewees experienced that the approach did not faced the needs of business units and project management was more IT focused than business focused.

When considering the overall grade, user-oriented change management was the least successful factor, but the challenges related to change management differ between projects. When the system 1 was introduced to the end users during the fall 2015, it still included multiple technical problems. Although, the budgets were created using the system that was not yet working properly which led to resistance toward the system. Even if afterwards most of the technical challenges have been repaired and users have received proper training, the initial resistance reaction is difficult to reverse. In addition, technical improvements are still made occasionally so the current challenge is communication about changes made in the system. On the other hand, the challenge with system 2 is that the system is not yet fully introduced to end users in all business units and due to that change management actions have not yet entirely started. Currently mainly managerial accountants are using the system for management reporting even if the system is primarily aimed for profitability analysis tool for businesses. Additionally, related to both systems roles and responsibilities are not yet clearly defined and communicated to users. Overall, the process factors succeeded moderately. The project teams were balanced, the approach was business-driven especially related to system 1 and trainings were mostly successful but lacking resources and technical problems affected unfavorably to all process factors.

Overall, technological factors were on the average level, but business-driven, scalable and flexible technical approach was the factor which differed the most between projects. Interviewees were quite satisfied with the technical approach of system 1. Most of the interviewees felt that the system is flexible and scalable enough and most of the technical problems have been defeated. On the other hand, interviewees felt that system 2 is not flexible enough. For example, when organization structure changes, some mappings need to be updated manually. Additionally, system 2 still has many technical problems which need to be fixed before the system can be widely introduced to end users. However, interviewees felt that the system is not too technical and brings a lot of benefits to businesses after technical challenges are repaired.

The technical challenges both projects have been faced affected also to data quality. However, technical problems and data quality issues have been corrected constantly and currently the data quality related to both system is already on the moderate level. Most of the data problems are currently related to data transfers between the systems. Because of the unstable data transfers users need to reconcile data between different systems which increases the working time. Both projects have also improved the data integrity because now the company has common platforms for budgeting and profitability reporting in all business units in different countries and data is accessible for everyone through one application.

6.1.2 Success variables

Interviewees were asked to evaluate the success of the implementation projects using the success variables introduced in Yeoh & Koronios's framework. The success variables were graded by interviewees using the scale from 1 to 5 and results are collected in the table 9. From the process performance perspective, interviewees evaluated that the implementations were not successful. The schedules and budgets of the both projects were exceeded. The main reason for the delay of system 1 was delays of other BI projects which were ongoing at the same time because other BI systems work as the source systems for system 1. Also, the project 2 was delayed significantly, almost two years. Even if the launch was made in the spring 2017, the system is mainly used by managerial accountants and it is not yet used by end users in the businesses. Furthermore, corrections and improvements are still being made frequently and the project mode continues even if the technical launches have been made. Because both systems were late, it also affected straight to the budgets.

Table 9 Evaluation of success variables (1=Unsuccessful, 5=Very successful)

Dimension	Success variable	System 1	System 2
Process performance	Time schedule	2	1
	Budget	2	2
Infrastructure performance	System quality	4	2
	Information quality	3	3
	System use	3	2

System quality represents the system ability to integrate data and adapt to the changes. From the perspective of system quality, system 1 is quite successful being at the level 4 while system 2 is less successful being at the level 2. Most of the interviewees felt that system 1 is flexible enough and changes in the system environment are being made constantly according to needs of the business units. However, the technical execution of system 1 included also coding errors at the beginning but these errors have been fixed during the deployment. Related to system 2, interviewees felt that the system is not always adapting to the operative changes. For example, each unit has their own mappings which need to be updated manually when changes in operative organization are occurring. Additionally, the technical architecture does not fully support the reporting which leads to slowness of reports when drilling down in more detailed levels.

Information quality is related to accuracy, timeliness and usefulness of the data which is on the average level in both systems. Interviewees gave the grade from the perspective how good the data quality currently is. This evaluation is aligned with the analysis of critical success factors. Data quality in both systems were inferior when the systems were launched but the biggest problems have been already corrected. Currently most of the problems with data are due to unsuccessful data transfers between systems.

System use describes how well the users are utilizing the outputs of the BI systems. System use of system 1 is on the average level which is correlating with the level of data quality. Users have still some uncertainty toward the system due to unstable transfers but still most of the users feel that the system is easy to use. System use related to system 2 is still on quite low level. Only managerial accountants are using the system currently even if the system is rather a business tool. Unstable data transfers also decrease the trust toward the system and users cannot yet utilize the system as planned. Overall, from the infrastructure perspective the implementation of system 1 was more successful. This is probably due to more complex architecture of system 2.

6.1.3 Targets of the implementations

Interviewees were asked to define what are the targets of the implementations and to evaluate whether these targets are achieved. The targets of the implementation of system 1 are gathered in the figure 17. The main target was building the common, company-wide platform for budgeting and forecasting. Primarily the system is intended for entering budget and forecast figures to the one common application while the actual reporting is done through the separate reporting systems. The main target is divided into sub-targets defined based on the interviews.

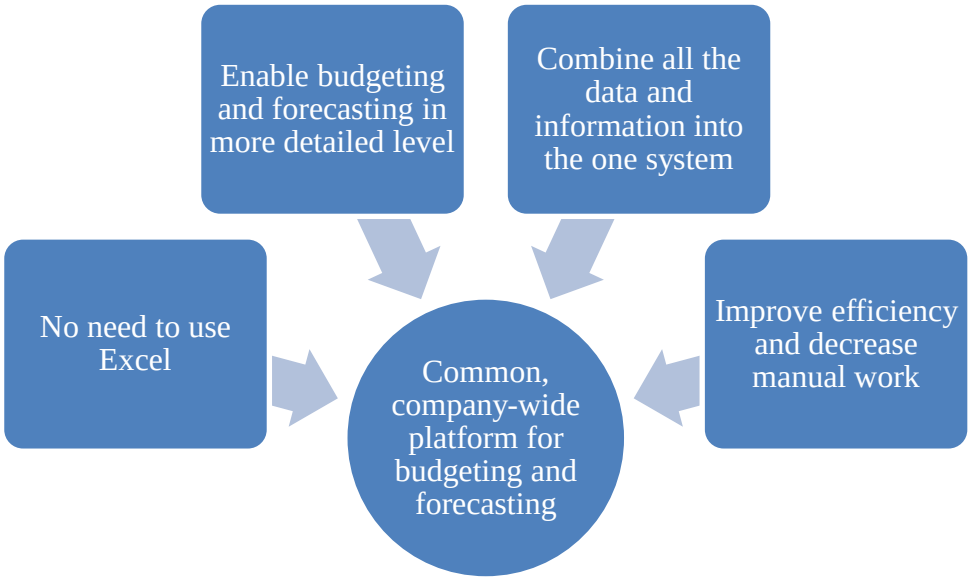

Figure 17 Targets of implementation of system 1

All interviewees mentioned that one of the targets was to get rid of budgeting and forecasting Excel files and this target is already achieved. Because budgeting is not done in Excel anymore, everyone has access to the data and process is more transparent. Transferring budgeting to the system has also enabled budgeting and forecasting in more detailed level than before which creates more value for budgeting and forecasting. One target was also to combine all the data and information into the one system. Mostly this target is achieved but due to data flow problems all the data is not yet trustworthy. In addition, the implementation of the system aimed to improve efficiency and decrease manual work. Manual work has

decreased because budgets and forecasts, which were previously made in Excel, no longer need to be combined manually. This has also decreased human errors but on the other hand, work has increased because data needs to be reconciled between systems. However, overall most of the targets related to system 1 are already achieved according to interviewees and thus, the implementation can be considered successful.

The targets of the implementation of system 2 are gathered in the figure 18. The implementation of system 2 aimed to build the common, company-wide platform for profitability calculation. Interviewees saw the targets slightly differently depending their business unit, but all the views were related to profitability from different perspectives. One of the achieved sub-targets was to establish company-wide profitability calculation which is similar and comparable between all business units. This includes similar calculation rules and common terminology which are already widely established across the company.

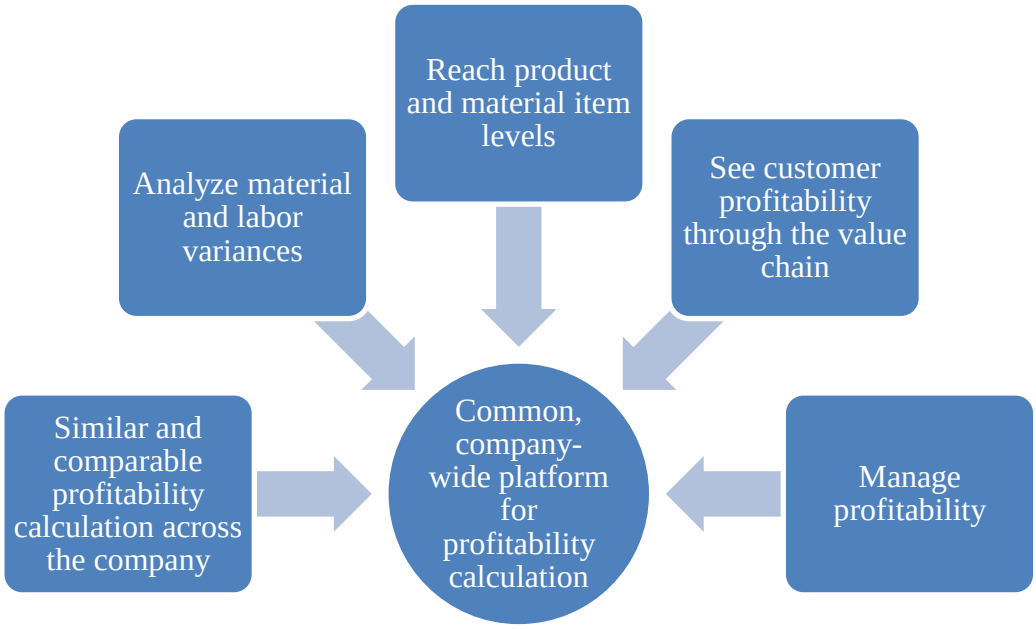

Figure 18 Targets of implementation of system 2

The rest of the sub-targets interviewees mentioned were related to the new P&L structure which was established with the implementation. The new P&L structure applies standard cost calculation which enables analyzing material and labor

variances. Conceptually also this target is achieved but due to data problems variances cannot be fully analyzed through the system yet. Furthermore, the target was to reach product and material item levels which would enable further analysis and transparency, but data does not reach this level yet. The new P&L structure also allocates logistics costs to end customers which enables analyzing customer profitability through the value chain. In the long-run this also gives the possibility to manage profitability instead of sales. Before these sub-targets can be achieved, current technical issues need to be fixed. Overall, the targets related to the system 2 are still unachieved from the technical perspective but achievements have been made from the conceptual perspective.

Additionally, the common target for both implementation projects was to decrease time consumed on creating reports and forecasts while increase time consumed on analysis and business partnering. Related to the budgeting system, three out of five interviewees felt that some time saving have been already achieved. After data loads are stabilized and users do not need to use time on reconciliation of data between systems, interviewees see that even more time savings are possible to achieve. On the other hand, time consumed on creating monthly forecasts has increased because previously the forecast was in a smaller role and only few persons were responsible for it. Now the responsibilities are focused on right persons why time has increased but at the same time interviewees thought that the forecast process is now also more valuable. However, interviewees were not yet able to estimate how much time savings are possible to achieve in the long-run. On the other hand, all interviewees thought that the new reporting system has increased working time. Reconciliation of data has increased time consumed on creating monthly reports significantly. Additionally, along with the new reporting system also the new P&L concept was launched, and business units need to create monthly reports in the new and the old format. Interviewees thought that after technical difficulties are solved, monthly schedules re-designed and roles and responsibilities defined, time savings are possible.

6.2 Current state of the implementations

During this study, the budgeting and forecasting system has been in use a little bit over two years while the reporting and analyzing system has been in use about a year. The budgeting and forecasting system is currently used for creating monthly forecasts and annual budgets. The main purpose of the system is to work as an entry application while actual reporting is made through reporting systems. The system enables forecasting and budgeting all cost types, such as fixed costs, variable costs and indirect costs as well as internal cost allocations. In turn, the reporting and analyzing system is intended to work as a profitability analysis tool for businesses but currently it is mainly used for monthly reporting. Currently monthly reporting is in the changing phase and made in two formats; in the traditional P&L structure which calculates EBITA and in the new P&L structure which calculates business profit.

6.2.1 Functionalities and benefits

The budgeting system is mainly used for entering the forecast and budget figures to the system when actual reporting is made through the new reporting system. However, even if the budgeting system is not intended for reporting, it still offers some summary views and consolidation possibilities. Additionally, a user can create different views and monitor the data from different perspectives. So, the budgeting system contains some standardized reports and possibilities for personalized reports, but dashboards or data queries are not available. Currently, the system only includes historical data and forecasts made by users, but the system does not create predictions of forecasts or budgets based on analytics. However, the first initiatives for predictive models have emerged.

The reporting system contains more functionalities than the budgeting system. Dashboards have been created for different business areas, but due to data issues and slowness of the dashboards they are not yet broadly used. Monthly reporting is based on standardized reports which are either created by external consultants or by

the group controlling team. Additionally, users can create their own reports. So, the system offers possibilities to use standardized reports or create reports and share them with other users. Ad hoc data queries are also possible, and users are already using data query functionality. Other basic functionalities, such as drill up and drill down, are also available.

Many benefits have also been gained and BI systems are offering many benefits especially for managerial accounting. As Yeoh & Popovic (2016) found that reporting, analyzing and planning are the main motivation factors why companies are implementing the BI systems in the first place, and these are also the factors why the case company implemented new BI systems. Interviewees were asked what benefits they have gained through the implementations. The benefits case company has gained are collected in the figure 19.

System 1

- No need to create budgets and estimates in Excel
- Decreasing human errors
- Possible to import budget and forecast data to other systems
- Budgeting is possible in more detailed levels
- Common platform across the company
- Scalability upwards
- Data is available and accessible through one system
- Responsibility for budgeting and forecast is deployed to the organization for the persons who are responsible for cost centers
- Transparency in forecast and budgeting processes

System 2

- No need to create reports in Excel by picking numbers manually from source systems
- Possible to raise new information to management reporting, for example related to the biggest customers
- Decreasing human errors
- Standard cost calculation
- Each unit is using the same profitability calculation
- Data is available and accessible through one system
- Possible to see customer and product profitability
- Focus on sales and profitability
- Providing information for pricing decisions
- Transparency through the value chain
- Transparency in monthly reporting processes

Figure 19 Benefits for managerial accounting

Both BI systems have generated new processes and manual work has been transferred into the systems. Budgets, forecasts and monthly reports can be created by using the implemented BI systems instead of manually entering the figures into

Excel. This change has also decreased human errors. Because now budgets and forecasts are in the system, it is also possible to import data to reporting systems and create reports which are combining actual and forecast data. Budgeting and forecasting processes are now also more valuable because budgets and forecasts can be done in more detailed level. At the same time, responsibilities for budgeting and forecasting are deployed to the right persons who are truly responsible for cost centers. The new budgeting and forecasting system also increased transparency of budgeting and forecasting processes because everyone can access the data through one interface.

The new reporting and analyzing system offers new possibilities for management reporting. For example, it enables raising the information about the biggest or the most profitable customers to management reporting. It also offers new functionalities for profitability analysis and common profitability standards across the company which also improve management reporting and decision-making. Additionally, transparency of profitability through the value chain has increased and businesses are able to see the customer and product profitability. Transparency in monthly reporting processes has also increased when data is accessible for everyone. Overall, most of the benefits are intangible so monetary value is difficult to measure but on the other hand, they have a wider impact across the company than tangible benefits. The benefits, which the case company has gained through implementations, correspond well with previous researches since new implemented BI functionalities are providing benefits for managerial accounting, especially for budgeting, forecasting, reporting and analyzing, as found in previous researches.

6.2.2 Current maturity levels

Interviewees were asked to evaluate at which level the BI maturity currently is from three aspects used in Gartner's maturity model: people, process and technology. The results are presented in the table 10. People aspect was evaluated from the perspective of users' knowhow and trust toward the system. Processes were evaluated from the perspective how well processes are re-defined and standardized

after the implementation of new systems. Technology aspect was evaluated through data quality. Technology aspect also includes metrics in Gartner's maturity model, but metrics were excluded from the evaluation because no metrics have been created yet related to performance of either systems at the case company.

Table 10 Evaluation of BI maturity

Aspect	System 1	System 2
People	3	2
Process	3	2
Technology	3	3
Total average	**3**	**2**

According to total average, system 1 is at the focused maturity level which is also supported by the comments of interviewees and maturity criteria. From people perspective, users trust the system more than previously, but they still reconcile data between systems. Process aspect is also at the focused level. Basic processes related to budgeting and forecasting are defined in company level, but individual processes may vary between business units. Additionally, governance model and access request processes are still unclear for users based on interview results. Technology aspect, especially from data quality perspective, is also at the focused level. As mentioned, data quality is already in a good level but unstable data transfers cause difficulties. In Gartner's maturity model, technology aspect also includes metrics. However, at the case company metrics have not been created yet. As stated in Gartner's maturity criteria, at the focused level the company still develops the system on a project-by-project basis and funding for projects comes from business units. This represents also the current situation at the case company. The benefits that the system is providing are already considering the whole company as well as individual business units that rather represents the strategic maturity level. Overall, based on the interview results and maturity criteria we can rightly conclude that the implementation project of system 1 is currently at the focused maturity level.

According to total average, system 2 is at the tactical maturity level. However, the level is varying between different aspects of maturity criteria. Interviewees evaluated that from people perspective, the maturity is at the tactical level. Due to

unstable data loads, users do not trust the system yet. Additionally, end users' knowhow is also in a quite low level because the system is still mainly used by managerial accountants. In Garner's maturity criteria, typical features for the tactical level are the limited number of users and lacking skills which correspond well with comments of interviewees. From the process perspective, the maturity is also at the tactical level. Based on interview results, defining processes is still in progress. Especially, the governance model including user roles and responsibilities is not yet clearly defined and communicated. Additionally, the implementation brought the new P&L reporting which increased the work load during the monthly reporting, but monthly reporting schedules are not redefined. From the technology perspective, BI maturity is at the focused maturity level similar to system 1. Users trust the data more than previously, but data still needs to be reconciled. However, interviewees' opinions about the data quality varied a lot which indicates that data quality varies between different business units. Furthermore, metrics are not defined. According to Gartner's maturity model, infrastructure problems cause data quality and reliability issues and data is still in silos at the tactical level. Additionally, processes and organizational structures are missing. These descriptions correspond well with the interview results based on which the BI maturity can be evaluated to be at the tactical level. The benefit aspect is also supporting the evaluation. Current benefits are mostly related to better access to data which is typical at the tactical level.

6.2.3 Current challenges

The challenges, that the case company is currently facing at the identified maturity levels, are studied by interviews and analyzed ticket data. This study is focused on four common problem types: role authorization, reporting, data and workflow problems. Interviewees were asked which of these four problem types they have faced. Interview results about the problems types related to the budgeting are forecasting system are presented in the figure 20. All four problem types have been emerged at the focused maturity level, where the budgeting and forecasting system currently is, but the most common problem type is workflow problems which all

interviewees have faced. Three out of five interviewees have also faced role authorization, reporting and data problems.

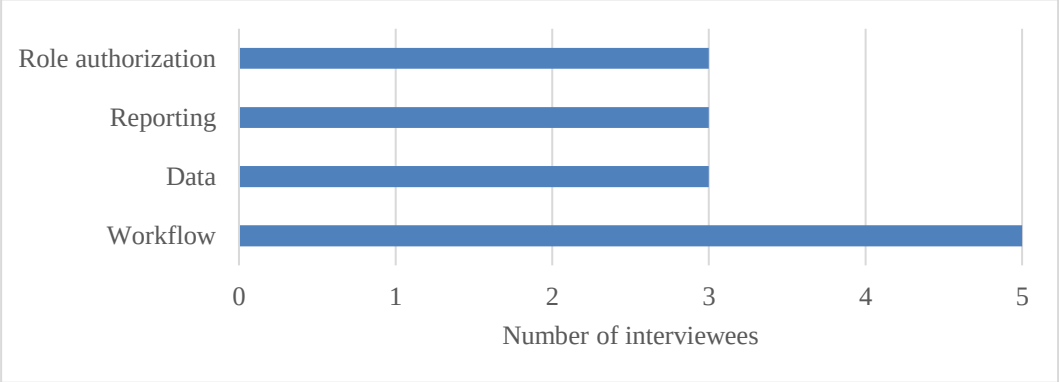

Figure 20 Problem types related to system 1

The biggest problem type related to system 1 is workflow problems which is supported by interview results and ticket data. The distribution of incident ticket types is presented in the figure 21 and as the figure shows 60 per cent of incident tickets are related to workflow problems. Based on users' observations most of the workflow problems are data loading errors between systems and between internal models of the budgeting system. Actual monthly data is loaded to the system during the monthly closing when also forecasts are updated. Nightly data loads from the source system are unstable why users are not sure when data is updated and they need to reconcile the data whether it matches with the source system. Additionally, forecast and budget data is transferred to the reporting systems every night, but transfers have difficulties why usually data is not updated next morning which complicates reporting. Furthermore, the system consists of different models which are intended to forecast and budget different types of costs and income, such as internal allocations, sales and fixed costs. Data transfers between different models have had also difficulties but major part of problems have been already fixed. Overall, the main cause behind the workflow problems is system errors. Additionally, users are also lacking knowledge of dependencies between different models and systems which leads to uncertainty when data should be updated. Thus, users' lack of knowledge may also cause a minor part of the workflow problems.

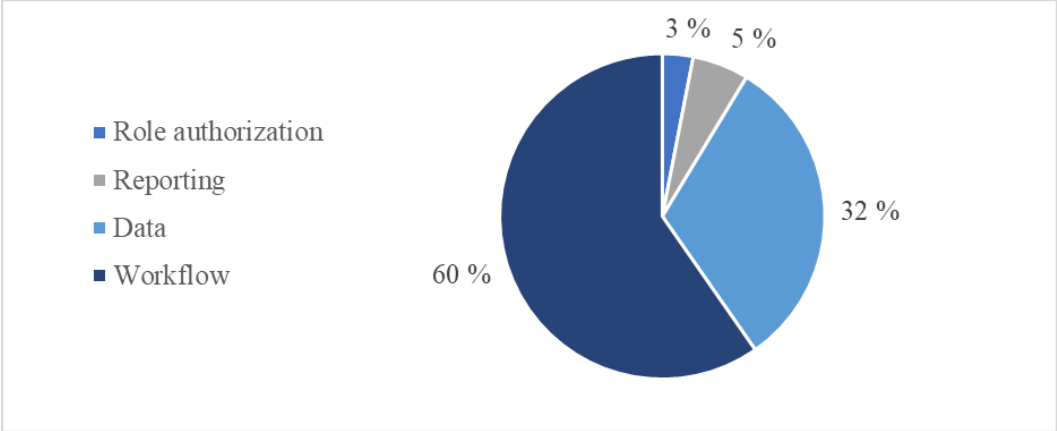

Figure 21 Distribution of incident tickets related to system 1

Based on ticket data, data problems cover also the significant part of the incident tickets, 32 per cent. According to the interviews, data problems are more occasional situations than continuous problems such as workflow problems. However, workflow problems may emerge as the data problems because the user see the incorrect figures in the system since figures are not updated. This may explain the high percentage of data related tickets. Most of data problems interviewees had faced were caused by user-system interaction when the user expected that the system was in another state. For example, information behind the cost center was incorrect already in the source system why the error ended up to the budgeting system. System errors have also caused data problems. For example, the system summed up different currencies without converting them into the same currency. The minor part of data problems is also due to lacking users' know-how because people, who are not familiar with structure of financial statements, are creating budgets once a year so data may include some accidental mistakes.

Even if both role authorization and reporting problems are covering only the minor part of the tickets, three out of five interviewees have faced these problem types. The role authorization problems interviewees have faced are related to access security. Security needs are varying between different units, since some units would need to give access rights on the cost center level, but it is not reasonable from technical perspective. Additionally, three out of five interviewees did not know their user roles which indicates that the governance model, which defines user roles

and responsibilities, is still unclear for users. Reporting problems are also closely related to workflow problems. The system is not designed for reporting and reporting should be executed by using the new reporting system. But because data transfers between systems are not stable, interviewees felt that they cannot get reports fast enough especially during the budgeting. Thus, when data flows are working correctly also reporting problems will be solved. In summary, the most significant problem type at the focused maturity level, where the budgeting and forecasting system currently is, is workflow problems which are principally due to system errors. In turn, data problems are already mainly corrected and they occur only occasionally.

Interview results about problems types related to the reporting and analyzing system are presented in the figure 22. Similar than related to the budgeting system, all interviewees have faced workflow problems but additionally all interviewees have faced reporting problems. Furthermore, four out of five interviewees have faced data problems and three out of five interviewees have faced role authorization problems. Overall, interviewees have faced more problems related to the reporting system than related to the budgeting system. This can be explained by the lower maturity level, since the reporting and analyzing system is currently at the tactical maturity level.

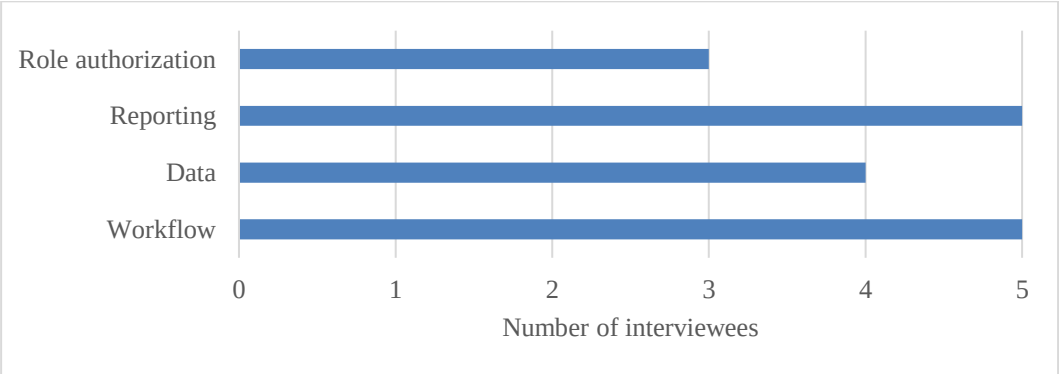

Figure 22 Problem types related to system 2

In turn, ticket data which distribution is presented in the figure 23 shows that data problems cover almost half of tickets while workflow problems cover 38 per cent

of the tickets. Reporting problems are only covering 15 per cent of the tickets and role authorization problems 1 per cent of the tickets. Workflow problems related to the new reporting system are similar than workflow problems related the budgeting system. Nightly data loads fail frequently which leads to incorrect data and other data related problems, which might explain the high share of data problems. Additionally, users are unsure when the data is updated. Overall, workflow problems are largely caused by system errors, and data problems users have faced are mainly due to unsuccessful data transfers.

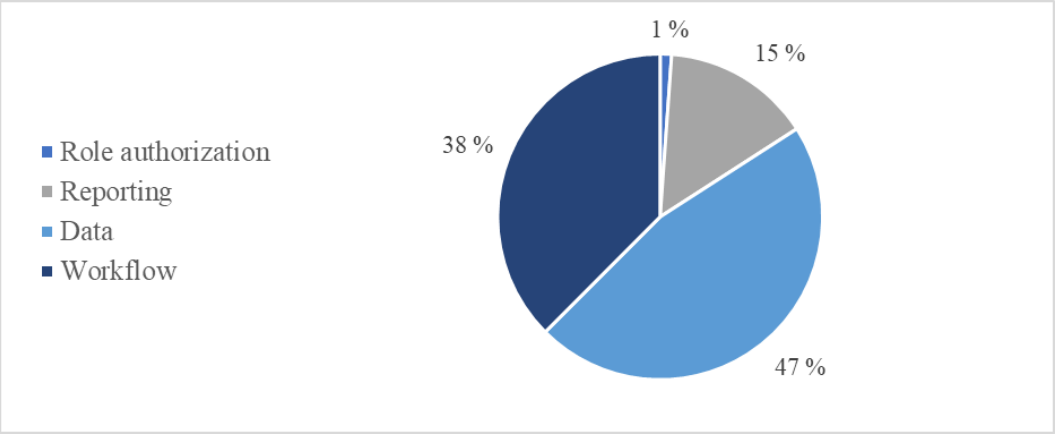

Figure 23 Distribution of incident tickets related to system 2

Reporting problems are also the major challenge according to interviews and ticket data. Because resources are currently targeted to repairing data flow problems, reporting problems are not yet focused on. Interviewees felt that the system offers functionalities which are needed for monthly reporting, but the system cannot yet be used for business analysis. The system is still lacking more detailed data and some dimensions. Additionally, dashboards cannot be used because of slowness and incorrect data why separate standardized reports are needed.

According to ticket data, role authorization problems are only covering 1 per cent of the problems. This may be due the fact that the system is not yet deployed to the businesses; mainly managerial accountants are currently using the system. Thus, the user group is still quite limited. Role authorization problems which interviewees mentioned are related to the governance model which have not yet clearly

communicated to the units. Users are not aware their user roles and what responsibilities are related to their user roles. This is also supported by the fact that three out of five interviewees were not aware of their user roles. In summary, at the tactical level, where the reporting system currently is, workflow, data and reporting problems are significant. Role authorization problems are not yet occurred because of the limited number of users.

6.2.4 User satisfaction

As Boyton et al. (2015) stated, BI success can be measured by user satisfaction. User satisfaction was evaluated by using the approach introduced in the article of Isik et al. (2011) which includes five BI satisfaction items. In order to find out how user satisfaction has been developed, user satisfaction was evaluated compared to the situation before the BI implementation and compared to targets of the BI implementation. Results are presented in the table 11. The level of satisfaction related to both systems is slightly better when user satisfaction is compared to the situation before the implementations. Overall user satisfaction related to both systems is one grade better compared to the earlier situation than compared to the targets. Additionally, users are more satisfied with system 1 than system 2.

Table 11 BI satisfaction compared to previous situations and targets

BI satisfaction items	**System 1**		**System 2**	
	Before	Targets	Before	Targets
The BI that I am using overall	3	3	3	2
How well the BI that I am using provides precise information I need	4	3	2	2
How well the BI I am using supports my decision-making	4	4	3	2
How well the BI that I am using provides information I need in time	3	3	3	2
How user friendly the BI that I am using is	4	3	3	3
Total average	**4**	**3**	**3**	**2**

Related to the system 1, users are most satisfied with precision, decision-making support and user friendliness when compared to the previous situation. On the other hand, compared to targets decision-making support is the best-graded satisfaction

item. Interviewees commented that it is a major improvement compared to the previous situation that budget and forecast information is available all the time through one common application when previously all the information was in employees' personal files. However, data transfers from source systems have still some problems which have a weakening impact on all satisfaction items. The experience of user friendliness varies a lot among user groups. Managerial accountants, who are using the system on a daily basis, find it easy to use while end users, such as cost center owners who are using the system on a monthly basis, find it a bit difficult to use. To achieve the targets, data transfers should be reliable and real-time which would also better support the decision-making.

Overall satisfaction toward system 2 is on the average level when comparing to the previous situation and under average level when comparing to the targets. Users are less satisfied with precision due to unreliable data flows from source systems. This problem is emphasized especially during the monthly reporting when reporting of monthly figures should be based on the system, but currently managerial accountants need to adjust the figures manually. Thus, users do not see the improvement in reporting yet. However, interviewees see the potential of the system when data flows are working as planned. Additionally, the improvement compared to the previous situation is that all the data is on one common system and users can access the data all over the company. Also new profitability and variance calculations have increased the understanding. Especially this is a major improvement for business area and concern levels where the managerial accountants need to combine figures from individual business units. Nevertheless, the system is not yet used as extensively as planned in businesses why the satisfaction compared to the targets is quite low. In addition, the slowness of the system affects negatively to user friendliness.

6.3 Development areas

Interviewees were asked to identify the most important development areas which would increase the usage of the BI systems and improve user satisfaction. Based on

the interviews, analyzed ticket data and critical success factor analysis two main development areas emerged: data quality and change management. These themes are common for both systems. Data quality evaluated to be on the moderate level related to both systems while change management evaluated to be the least successful success factor overall. The summary of development areas and their sub-areas are presented in the figure 24.

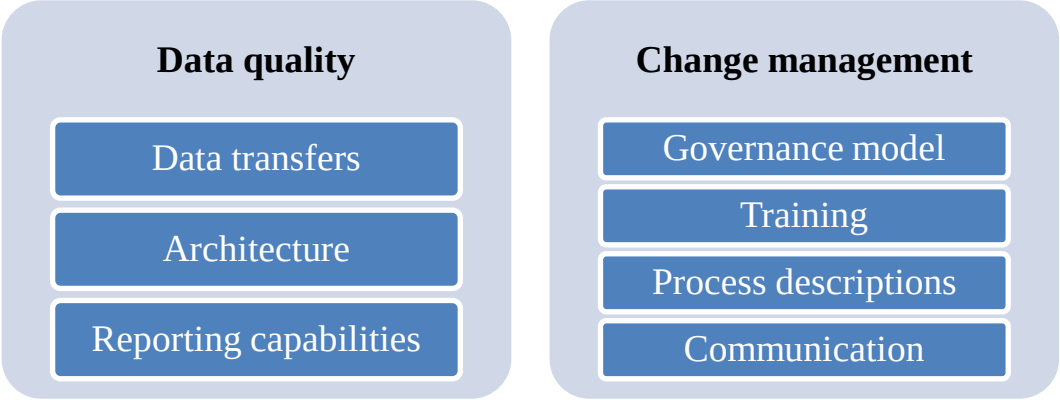

Figure 24 Further development areas

Th first main development area is data quality which can be further divided into three development areas: data transfers, architecture and reporting capabilities. Since workflow problems are the most significant problem type related to the both systems, all interviewees mentioned that stabilization of BI environment and data transfers is the most important development area. Additionally, interviewees hoped that it would be possible to execute data transfers also in the middle of the day instead of nightly loads. This would enable more up-to-date information especially during the budgeting and monthly reporting. Additionally, BI architecture is not yet supporting the reporting since downloading reports and drilling down in more detailed level cause slowness. Reporting capabilities should be also improved by fixing dashboards. Dashboards consist of multiple individual reports so one possibility is to separate individual reports behind the dashboards instead of fixing the entire dashboard.

The other main development area is change management which can be further divided into four development areas: governance model, training, process

descriptions and communication. Even if ticket data includes almost none tickets related to role authorization problems, interviews revealed that user roles and responsibilities are still unclear. Three out of five interviewees related to both systems were not aware of their user roles even if they have been involved in implementation projects. In addition to the governance model which includes user roles and responsibilities, process definitions, training and communication are also further development areas related to both systems. Related to processes, schedules of data loads should be described clearly. However, this is challenging due to unstable data loads. Additionally, process descriptions of dependencies and data flows between systems would help users to understand the architecture and the relation between the new and old reporting systems. The reporting system is also based on the new P&L reporting, so the monthly reporting schedule should be redesigned according to increased workload which is due to double reporting structure. A need for training especially related to creating reports also emerged in interviews. One solution for this could be establishing BI competence center which would help users to create optimal reports and offer training for users. Furthermore, communication related to changes and benefits the systems are offering are also part of the change management, and communication could decrease resistance especially toward the reporting system. Additionally, changes are still made frequently to both systems, so it needs to be ensured that these changes will be communicated to users.

7 DISCUSSION AND CONCLUSIONS

7.1 Practical implications

The aim of the study was to explore how the success of BI implementation can be measured, how BI maturity affects the implementation challenges and how these challenges could be overcome. These questions were explored from the case company's perspective to assist them to raise the utilization rate of the implemented BI systems and improve the usage of the implemented BI systems. In order to understand the current state of the implementations, the success of both implementation projects is evaluated. Then, the maturity levels of BI implementations and challenges the case company is facing at these maturity levels are identified. The roots of the challenges the case company has faced during the post-adoption phase originate from the earlier phases of the implementation projects. Thus, lessons learned are also gathered to understand the reasons behind the current challenges and to avoid similar challenges in the future projects. Eventually, the framework how to increase the maturity levels and defeat the challenges is presented. The results of this study are used for post-evaluation of implementation projects at the case company. Next the answers for the research questions are concluded.

Q1: How the success of the business intelligence implementations can be measured?

Previous researches have identified different ways to measure the success of the BI implementation. Yeoh & Koronios's framework defined the success variables from the perspective of process and infrastructure performance. Process success variables are measuring whether the implementation was conducted on schedule and on the budget as initially planned, while infrastructure success variables are measuring system quality, information quality and system use. One possibility is to evaluate these success variables through interviews as Yeoh & Koronios did in their initial research. The interview method was also used in this study. The evaluation

revealed that from the perspective of process performance neither of the implementations were successful, since the initial time schedules and budgets were exceeded. Furthermore, the success of infrastructure performance varied between projects; the implementation of system 1 succeeded moderately while the implementation of system 2 was less successful.

Previous researches also revealed other possible ways to measure the implementation success which are partly based on the same factors than Yeoh & Koronios's success variables. ROI, non-concrete measures, project management measures and user satisfaction can be used as the measures for success evaluation. They are measuring the success from different perspectives, so they can be used in different situations. ROI is used for measuring the monetary business value gained through implementation. It can be used for measuring whether the investment was successful. In order that ROI can be calculated, increased revenues or reduced costs need to be monetarized. However, increased revenues or reduces costs are typically actualizing in the long-run why ROI can be calculated when the BI system has been in use for a while. Non-concrete measures are mainly intended for the individual business units or departments since improvements in specific areas can be measured by using the non-concrete measures. For example, a brand department could measure how much brand recognition has been increased after the BI implementation. Project management measures are partly related to Yeoh & Koronios's success variables since they are measuring whether the implementation targets were achieved on schedule and budget. User satisfaction is measuring how satisfied users are with the implemented BI system and whether the BI system is supporting decision-making.

In this study project management measures and user satisfaction were explored at the case company in addition to the success variables, while ROI and non-concrete measures were out scoped. ROI measures monetary impacts of the implementation which will occur in the long-run and are not yet realized at the case company. Interviewees evaluated that time savings are possible, but some technical development still needs to be done before time savings can be estimated and thus,

the monetary value cannot yet be calculated. Non-concrete measures are more business unit specific and the success wanted to be evaluated company-widely. Achieving the targets was evaluated by interviews. Interviewees were asked to define the implementation targets and estimate whether these targets are already achieved. Most of the targets related to the budgeting and forecasting system are already achieved while most of the targets related to the reporting and analyzing system are achieved from the conceptual perspective but technical development still needs to be finalized. The survey of user satisfaction also gave similar results. Users were mainly satisfied with the budgeting and forecasting system and moderately satisfied with the reporting and analyzing system when user satisfaction was compared to the situation before implementations. When user satisfaction was evaluated compared to targets, the results were poorer related to both systems.

Based on the evaluation of success variables, project management measures and user satisfaction, the implementation of budgeting and forecasting system can be considered mainly successful. In turn, the implementation of the reporting and analyzing system can be considered unsuccessful. However, both systems still require some development so recommendations for next actions to achieve the targets and improve user satisfaction are introduced.

Q2: How business intelligence implementation challenges vary according to business intelligence maturity?

How implementation challenges vary according to BI maturity has not been widely studied previously in academic research. Gartner has identified few typical challenges for each maturity level which are mainly related to implementation success factors, but the occurrence of common problem types in different maturity levels has not been previously studied. In this study, the current maturity levels of BI implementations at the case company and the occurrence of problem types at these maturity levels are researched.

According to interview results, the budgeting and forecasting system is at the focused maturity level which represents the third maturity level in Gartner's maturity model. This conclusion is also supported by the maturity criteria. Even if the users trust the system more than previously, they still need to reconcile data between systems due to unstable data transfers. Basic processes are defined on a high level but in business unit level processes may vary. The targets of the implementation are also mostly achieved, and the system is offering benefits for managerial accounting on the company and business unit levels. According to interview results and analyzed data, workflow problems are the biggest challenges the case company is facing currently at the focused maturity level. Based on ticket data, 60 per cent of the problems are workflow related. Additionally, workflow problems may emerge also as the data problems which covers 32 per cent of the ticket data. Reporting and role authorization problems are in a minor part at the focused maturity level.

In turn, based on the interview results the reporting system is at the tactical maturity level which represents the second maturity level in Gartner's maturity model. The limited number of users, users' knowhow and indistinct process descriptions support the conclusion of the tactical maturity level. According to interviewees, from the technology perspective the maturity could be higher since it corresponds with the description of the focused maturity level. Users trust the system more than previously, but they still need to reconcile data. However, this conclusion only concerns current users who are working with managerial accounting, not yet end users from other functions outside of finance. Thus, it is justified that the overall maturity level of the reporting system is the tactical level. The problems the case company is currently facing related to the reporting system varied between interview results and analyzed ticket data. All interviewees were faced workflow and reporting problems while based on the ticket data, data problems cover 47 per cent, workflow problems 38 per cent and reporting problems 15 per cent of the reported incidents. The ticket data includes only 1 per cent of tickets related to role authorization problems even if three out of five interviewees were faced role authorization problems.

From the results, we can conclude that at the tactical maturity level workflow, data and reporting problems are significant while role authorization problems have not yet occurred due to a limited number of users. At the focused level, the main problem type is workflow problems, while other problem types are in a minor role. Role authorization problems have slightly increased since the user base increases in higher maturity levels. Reporting problems could also increase when maturity level increases since the usage will spread across the company and new needs will occur, but the empirical data is not supporting this conclusion. On the other hand, data problems decrease when the maturity increases. Based on the results of this study, the development of workflow problems is hard to evaluate because workflow problems are the biggest challenges at both maturity levels, where the implementations at the case company currently are.

Q3: How business intelligence implementation challenges can be defeated?

Previous researches have studied how critical success factors affect the occurrence of the implementation challenges. Based on Yeoh & Koronios's research (2010), when more than half of the seven critical success factors have been taken into account during the implementation, the implementation could be considered successful and implementation challenges are minimized. Thus, most of the challenges the case company is currently facing date back to earlier phases of implementation projects. Critical success factors were analyzed to understand the reasons behind the current challenges and lessons learned are gathered to avoid similar challenges in the future implementation projects. Based on the interview results and analysis of critical success factors, lessons learned are gathered in the figure 25 according to implementation stages. The challenges, that the case company faced during the implementations, were fairly similar related to both implementation projects. The biggest difference was the technical approach which was evaluated to be quite flexible and scalable when concerning the budgeting system as opposed to the reporting system.

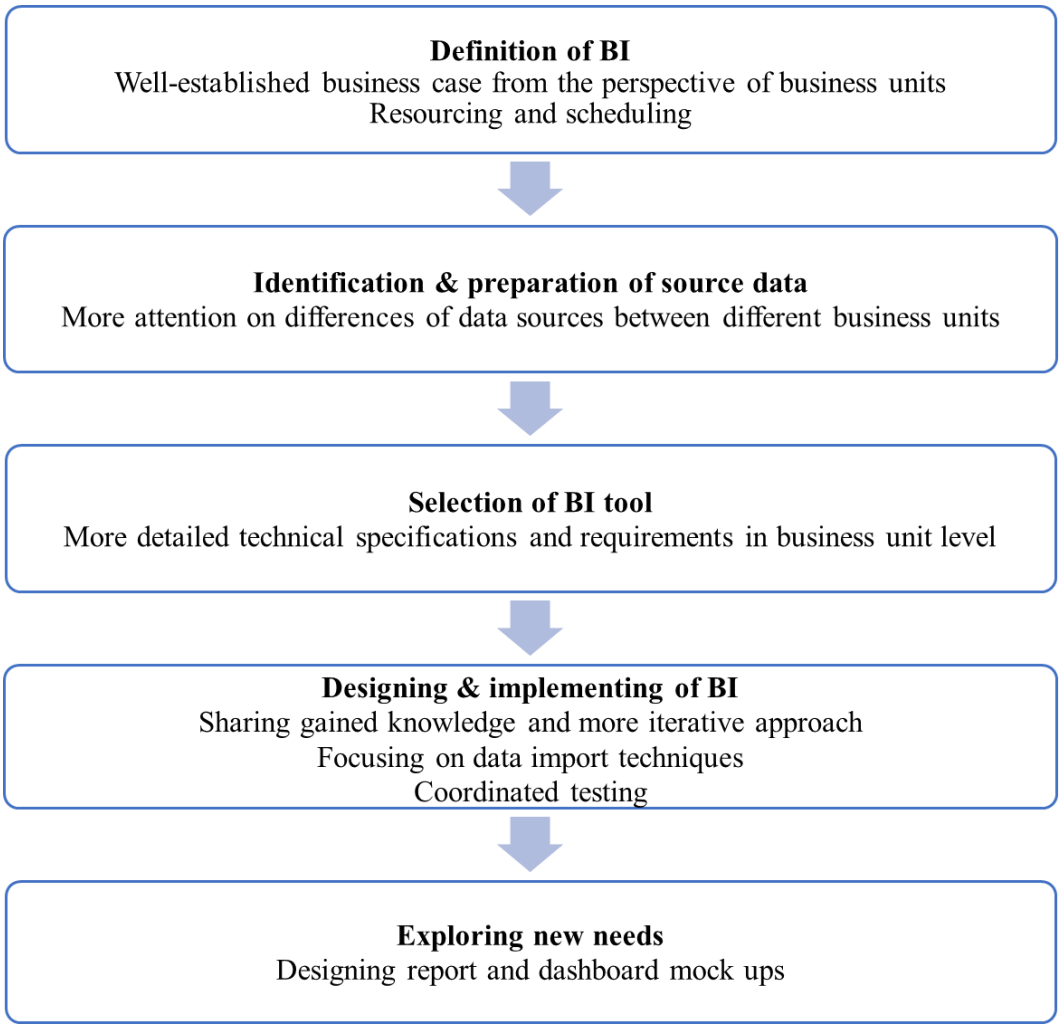

Figure 25 Summary of lessons learned

In the definition phase, the vision and the business case were created. The vision was communicated well at the case company while the business case was unclear in a business unit level. The solid business case would help business units to understand the targeted benefits similarly and commit to the implementation more strongly. Additionally, metrics for the success, which are not yet defined at the case company, could be defined on the basis of the business case. In addition, the timeline of the implementation and resources are closely related to the business case. Based on the interviews, lack of resources and tight schedules were the biggest challenges during the implementations. Many implementation projects were ongoing at the same time which led to lacking resources both internally and externally. Persons who were involved in the projects internally were mostly

managerial accountants, so the workload caused by many simultaneous projects cumulated for the same persons. Concurrent implementation projects also complicated technical side because the systems were dependent on each other, so when the one part of the implementation was late, it straight affected the implementations of other systems. Overall, the projects should be consecutive instead of concurrent which would release the resources internally and externally and reduce the dependencies of schedules on each other.

In the next phase when source data was identified, the complexity of data sources and differences between source systems were underestimated. Each business unit has slightly different source systems even if the platforms are mainly the same. Also, the operations even inside the same industry, such as distribution, can differ between countries which also affects source systems and complicates building the common platforms. In addition, technical specifications and requirements were not detailed enough especially in the business unit level and this led to changing requirements when the solutions were built. Specifications should be unambiguous and created in unit level, so it would be easier for the consultants to create the technical solutions. Complexity, differences of source systems and lack of detailed technical specifications led different solutions between business units even if the initial target was to create the common platform.

Technical solutions in different business units were built at the same time by different consultants so the gained knowledge was not shared. If the technical solution would be built step by step, the implementation would have taken more time but at the same time same consultants could have been involved and thus, the gained knowledge could be utilized. This could also decrease the data transfer problems when the solutions between business units could be built as similar as possible considering the differences of the source systems. Additionally, the approach should be more iterative. Initially, the implementations were intended to execute iteratively but due to delays the approach was not as iterative as planned. Especially, the testing phase was planned to be iterative so that soon after specifications first test versions would be available for testing, but test versions

were late. Additionally, concrete test plans were missing and during the testing workshops technical solutions were not yet in that condition that they could be tested. Users get first experiences of the system during the testing, so it is essential that the system is in the testing condition and testing is well-coordinated in order that the resistance toward the system can be minimized. An iterative approach with achievable scope and short delivery time of each iteration may also decrease the resistance toward the new system according to previous studies.

Furthermore, creating report and dashboard mock ups were the starting point for the technical specifications. So new needs were explored before the technical solutions were built even if exploring new needs is typically the last stage of the creation phase. This is also one reason which led to current technical architecture that causes workflow problems. Additionally, reports and dashboards include the views which are not relevant anymore. Also, slowness of the reports and dashboards is due to architecture of data cubes. On the other hand, some of the necessary reports were out scoped because during the specifications there was not enough knowledge about capabilities the BI systems are offering. Overall, a well-established business case, an iterative development approach and a suitable technical approach are the critical success factors the case company should pay attention in the future implementation projects.

Olszak (2013) has created the framework which critical success factors should be focused on in order to increase the maturity level during the post-adoption phase. This framework is used as a basement when the framework for the case company has been created. Overall, the themes for defeating the challenges are similar related to both system. Two main themes are change management and data quality. Based on these themes and Gartner's maturity model, the framework how the case company can defeat challenges and move up in the maturity curve is illustrated in the table 12. The budgeting and forecasting system is currently at the focused level while the reporting and analyzing system is currently at the tactical level.

Table 12 Framework to increase maturity levels

System 1	System 2
2nd Level: Tactical	
	Fixing workflow problems Improving data quality Repairing dashboards Defining processes
3rd Level: Focused	
Fixing workflow problems Prediction capabilities Training Metrics	Training Competence center Metrics
4th Level: Strategic	
Governance model	Governance model Support from all management levels
5th Level: Pervasive	

In order that the budgeting and forecasting system could move up to the strategic maturity level, some challenges need to be defeated. First of all, workflow problems need to be fixed. When data transfers are stable, this will also improve the data quality and remove reporting related problems when forecast and budget data will be transferred to the reporting system as scheduled. Additionally, the usage of the system would improve if the system includes prediction capabilities even if they were not the part of the original scope. In order that all the users are aware of all the functionalities, training system should be implemented. The case company needs to think what is the best way to arrange training, for example classroom training, e-learning materials or the combination of both. Based on the interviews, users wish especially more advanced training. In addition, since no metrics have been established yet, the case company should create metrics to measure the BI performance. In order to achieve the highest maturity level, the governance model should be well defined and communicated to users. The governance model related to the budgeting system is already created at the case company, so clear communication about roles and responsibilities would be the cornerstone.

In order that the reporting system could move up to the focused level, workflow problems need to be fixed in the first place because they affect data quality and monthly reporting processes. Additionally, remaining data issues, such as incorrect

mappings, need to be repaired. Management dashboards have been already created but due to data issues and slowness of the dashboards users do not use them. To lighten the usage of the dashboards, unnecessary views should be removed and only necessary report views should be fixed. In addition, after workflow problems are corrected, processes need to be defined and communicated. Especially, process descriptions related to monthly reporting need to be created. In order to achieve the strategic level, users' knowhow need to be ensured. One possibility could be establishing the BI competence center which would be able to help users to create reports and to train users. Metrics should be created similarly than related to the budgeting system. So that the highest maturity level could be achieved, the governance model should be created and communicated to users. Additionally, all management levels should support the new reporting system and the new P&L concept since currently they are more supported by the finance management.

The framework can be used for achieving higher maturity levels, but the case company needs to think how much it should still invest to improve the maturity. Because improving the maturity level may require a lot of resources and investments, the case company should define what are the optimal maturity levels for the implemented BI systems. Instead of striving to achieve the highest maturity level, the case company could focus on few specific areas which would improve the utilization rate and user satisfaction.

7.2 Theoretical implications

This study makes contributions to existing theories of BI implementations. Based on previous researches, most of the BI implementations fail and this study supports that finding. However, the reasons behind the implementation failures are rarely discussed in previous researches. Based on Yeoh & Koronios's (2010) survey can be inferred that when more than half of the seven critical success factors were taken into account during the implementation, the implementation could be considered successful. That finding is also supported by this study. Additionally, according to previous studies technical success factors have a smaller impact on the

implementation success than organizational and process factors. However, in this study technical approach is the main reason behind implementation challenges. The differences between sources systems were underestimated and the technical solutions vary between business units. Additionally, the technical solutions are not flexible and scalable enough to adapt operative changes. Even if technological success factors have typically a smaller impact on the implementation success, they played a major role in the case company's implementations.

This study also contributes to the research of BI maturity models. Multiple BI maturity models have been developed but how BI implementation challenges vary according to BI maturity level during the post-adoption phase is rarely researched area in academic field. In this study, the challenges at a tactical and a focused maturity levels were examined. At the tactical level, workflow and data problems are the main challenges. Reporting problems also start to emerge since the new needs occur when the usage will spread to more company-wide. Role authorization problems do not occur yet because of the limited number of users. At the focused level, the workflow problems are the dominant problem type. Occasional data and reporting problems occur as a consequence of workflow problems. Additionally, role authorization problems start to emerge since the number of users is increasing.

Additionally, this study supplements the findings of Deng & Chi's research. Deng & Chi (2013) identified four typical BI system use problems, that companies are facing during the post-adoption phase, and three causes for these problems. Based on the causal map analysis, they stated that users' lack of knowledge and user-system interaction can cause all the four problem types, while system errors do not cause workflow problems. However, in this study workflow problems were the main problem type related to both implemented BI systems and the main cause behind the workflow problems was system errors. The research design in Deng & Chi's study is similar than in this study, which increases the comparability of the results. Both studies used nine-month archival data of incident tickets as a data source. Thus, we can deduce that also system errors can be the cause for all problem types similarly as users' lack of knowledge and user-system interaction.

7.3 Reliability of the results

Guba & Lincoln (1994, 114) have identified five criteria to evaluate the trustworthiness of the qualitative study: credibility, dependability, confirmability, transferability and authenticity. In the case study design, a few elements should be considered to enhance the trustworthiness of the study. To ensure the credibility of the study research questions have to be substantiated and clearly defined. (Baxter & Jack 2008, 556) In this study research questions have been constructed based on the theory and the needs of the case company and validated with the representative of the company. The structure of the interviews with precise questions are presented in the appendix. Furthermore, the credibility is enhanced by appropriate sampling (Baxter & Jack 2008, 556). Because interviewees were divided into two groups which were asked about different implementation projects, the comparability of the results was tried to ensure by forming two interview groups which were as similar as possible. Additionally, in order to gain the comprehensive view of the topic, interviewees were selected from different business areas and business units.

In addition, one of the main principles of the case study is exploring the phenomena from multiple perspectives (Baxter & Jack 2008, 556). To support this principle and enhance data quality, multiple data sources and data types are used in this study. Qualitative data collected through interviews is used as a primary data source, but quantitative ticket data is used as secondary data source to enrich and support qualitative findings. However, even if the sampling was carefully considered, the interview sample included ten interviews, so the observations can only be analyzed approximately. It is important to remember that every interviewee and business unit has their own experiences and challenges which cannot be fully generalized to represent the whole company. If the interviewee could not answer some questions or grade asked areas because he was unfamiliar with the topic or the topic did not consider his business unit, these answers were treated as not applicable and was excluded from the summation. Additionally, personal characteristics and skills of the interviewees and the interviewer can affect to the results. On the other hand, the quantitative data sample of opened tickets represent the whole company because it

includes all the tickets opened across the company during the observation period. However, because tickets are manually opened by the users, the sample can include occasional errors.

7.4 Further research recommendations

As this study is conducted as a case study the results cannot be broadly generalized. This study offers insights how BI implementation challenges are related to BI maturity levels which is still rarely researched area. In this study, implementation challenges at the tactical and the focused maturity levels are researched. Further researches could investigate challenges at all maturity levels. Additionally, the sample in further researches could include more companies from different industries and with different sizes which would enable the comparison how challenges vary between industries and company sizes. This would enable also more generalizable results.

Additionally, the optimal maturity level for large companies is unresearched subject. Typically, the pervasive maturity level is considered as the optimal maturity level but moving up in the maturity curve demands a lot of resources and investments especially in large companies which are operating internationally and expanding through acquisitions. How much companies should invest on improving the maturity level could be further researched. In addition, how to identify the optimal maturity level could be studied.

In this study, different methods to measure the implementation success are introduced. Further researches could study how to create suitable metrics for continuous BI performance measurement instead of measuring the implementation success. How to create the suitable structure of metrics and KPIs for business unit level and for company level could be identified. Additionally, company's characteristics could be taken into account and how metrics vary according to industries and company sizes could be further researched.

8 SUMMARY

BI systems have gained an interest among companies' IT systems and successful companies have adopted BI systems to support decision-making. BI systems are offering new capabilities for budgeting, reporting and analyzing operational data and this study focuses on the BI implementation from managerial accounting perspective. This study is conducted as a case study in the large Finnish manufacturing company which has implemented two BI systems related to budgeting and reporting. The purpose of the study is to explore how the success of the BI implementations can be measured, how BI maturity affects the BI challenges and how these challenges could be defeated. The execution of the study consists of three main phases: literature review, semi-structured interviews and data analysis. The literature review gives the basis for the empirical part by defining the concept of the BI systems and introducing implementation phases, benefits for managerial accounting, critical success factors, typical implementation challenges and measurement of implementation success. Additionally, Gartner's maturity model is introduced which can be used for measuring the maturity of the BI implementation projects. In the empirical part, results of the ten semi-structured interviews and nine-month archival ticket data are presented. The results of this study are used for post-evaluation of the implementations at the case company.

The first research question was how the success of BI implementation can be measured. The previous researches revealed four main methods to measure the success of the BI implementation: return on investment, non-concrete measures, project management measures and user satisfaction. All these methods can be used for measuring both tangible and intangible benefits. The implementation success at the case company was evaluated by using project management measures and user satisfaction since they are the most suitable methods for measuring the company-wide success. Based on these methods, the implementation of the budgeting and forecasting system can be considered successful since most of the targets are already achieved and users are mainly satisfied with the system. On the other hand, the implementation of the reporting and analyzing system was less successful since

many of the implementation targets are only achieved from conceptual perspective and further technical development still needs to be done so that also technical solution is supporting the targets. The evaluation of user satisfaction is also supporting this evaluation.

The second research question was how BI implementation challenges vary according to BI maturity. Previous researches have studied the subject from the perspective of critical success factors. This study supplements previous researches by taking account also typical implementation challenges during the post-adoption phase. The implementation projects at the case company are currently at the tactical and at the focused maturity levels and the challenges at these levels were studied based on the interviews and ticket data. At the tactical level, workflow and data problems are the main problem types. Reporting problems also start to emerge, but role authorization problems do not occur yet due to a limited number of users. At the focused level, the main problem type is workflow problems. Occasional data and reporting problems may also occur. Role authorization problems also start to emerge because the user base is broadening.

The third research question was how BI implementation challenges can be defeated. Since the challenges originate from the earlier implementation phases, lessons learned were gathered in order that the case company can avoid similar challenges in the future implementation projects. Additionally, the framework how the case company can defeat challenges during the post-adoption phase was also created. The actions how the company can defeat the challenges are depending on the BI maturity level. The general framework, which is based on previous studies, consists of success factors and it was used as a basis for the company specific framework. The framework for the case company defines which areas they should focus on in order to defeat challenges at their current maturity levels and to move up in the maturity curve. Two main themes the case company should focus on are data quality and change management. However, improving the maturity level may require a lot of resources and investments especially in the large companies so the case company needs to evaluate how much it still should invest on improving the maturity.

REFERENCES

Adamala, S. & Cidrin, L. 2011. Key Success Factors in Business Intelligence. *Journal of Intelligence Studies in Business.* Vol. 1, pp. 107-127.

Appelbaum, D., Kogan, A., Vasarhelyi, M. & Yan, Z. 2017. Impact of business analytics and enterprise systems on managerial accounting. *International Journal of Accounting Information Systems.* Vol. 25, pp. 29-44.

Ariyachandra, T. & Watson, H. 2006. Which Data Warehouse Architecture Is Most Successful? *Business Intelligence Journal.* Vol. 11, nro. 1, pp. 4-6.

Ariaychandra, T. & Watson, H. 2010. Key organizational factors in data warehouse architecture selection. *Decision Support Systems.* Vol. 49, nro. 2, pp. 200-212.

Audzeyeva, A. & Hudson, R. 2016. How to get the most from a business intelligence application during the post implementation phase? Deep structure transformation at a U.K. retail bank. *European Journal of Information Systems.* Vol. 25, pp. 29-46.

Baxter, P. & Jack. S. 2008. Qualitative Case Study Methodology: Study Design and Implementation for Novice Researches. *The Qualitative Report.* Vol. 13, nro. 4, pp. 544-559.

Boyton, J., Ayscough, P., Kaveri, D. & Chiong, R. 2015. Suboptimal business intelligence implementations: understanding and addressing the problems. *Journal of Systems and Information Technology.* Vol. 17, nro. 3, pp. 307-320.

Chaudhuri, S., Dayal, U. & Narasayya, V. 2011. An Overview of Business Intelligence Technology. *Communication of the ACM.* Vol. 54, nro. 8, pp. 88-98.

Chen, H., Chiang, R. H., & Storey, V. C. 2012. Business intelligence and Analytics: From big data to big impact. *MIS Quarterly*. Vol. 36, nro. 4, pp. 1165-1188.

Chugh, R. & Grandhi, S. 2013. Why Business Intelligence? Significance of Business Intelligence Tools and Integrating BI Governance with Corporate Governance. *International Journal of E-Entrepreneurship and Innovation.* Vol. 4, nro. 2, pp. 1-14.

Cokins, G. 2013. Top 7 Trends in Management Accounting. *Strategic Finance.* Vol. 95, nro. 6, pp 21-30.

Davenport, T. H. 2006. Competing on analytics. *Harvard Business Review*. Vol. 84, pp. 98-107.

Delone, W. & McLean, E. 2003. The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. *Journal of Management Information Systems*. Vol. 19, nro. 4, pp. 9-30.

Deng, X. & Chi, L. 2013. Understanding Postadoptive Behaviors in Information Systems Use: A Longitudinal Analysis of System Use Problems in the Business Intelligence Context. *Journal of Management Information Systems.* Vol. 29, nro. 3, pp. 291-325.

Denzin, N. K. & Lincoln, Y. S. 2011. The SAGE Handbook of Qualitative Research. California, SAGE Publications, Inc. 1199 p.

Dilla, W., Janvrin, D. J. & Raschke. R. 2010. Interactive data visualizations: new directions for accounting information systems research. *Journal of Information Systems.* Vol. 24, nro. 2, pp. 1-37.

DIMECC. 2017. S4Fleet – Service Solutions for Fleet Management, DIMECC Publication Series No. 19, Tampere.

Elbashir, M. Z., Collier, P. A., & Davern, M. J. 2008. Measuring the effect of business intelligence systems: The relationship between business process and organizational performance. *International Journal of Accounting Information Systems.* Vol. 8, pp. 135-153.

Elbashir, M. Z. & Williams, S. 2007 BI impact: the assimilation of business intelligence into core business processes. *Business Intelligence Journal*. Vol. 12, nro. 4, pp. 45–54.

Evans, J. R. & Lindner, C. H. 2012. Business Analytics: The Next Frontier for Decision Sciences. [WWW document]. [referred 12.7.2017]. Available: http://www.cbpp.uaa.alaska.edu/afef/business_analytics.htm

Find, L., Yogev, N. & Even, A. 2017. Business intelligence and organizational learning: An empirical investigation of value creation processes. *Information & Management.* Vol. 54, pp. 38-56.

Gangadharan, G. R. & Swami, S. N. 2004. Business Intelligence Systems: Design and Implementation Strategies. *26th Int. Conf. Information Technology Interfaces ITI 2004.* pp. 139-144.

García, J. M. V. & Pinzón, B. H. D. 2017. Key success factors to business intelligence solution implementation. *Journal of Intelligence Studies in Business.* Vol. 1, pp. 48-69.

Gartner. 2013. Hunting and Harvesting in a Digital World: Insights From the 2013 Gartner CIO Agenda Report. [WWW document]. [referred 1.7.2017]. Available: http://www.gartner.com/imagesrv/cio/pdf/cio_agenda_insights2013.pdf

Ghobakhloo, M., Sabouri, M.S., Hong, T.S. & Amirizadeh, K. 2011. Electronic commerce-enabled supply chain process integration and business value. *Journal of Systems and Information Technology*. Vol. 13, nro. 4, pp. 344-368.

Goertzen, M. J. 2017. Introduction to Quantitative Research and Data. *Library Technology Reports.* Vol. 53, nro. 4, pp. 12-18.

Gray, P. 2003. Business intelligence: A new name or the future of DSS. DSS in the uncertainty of the Internet age. Katowice, University of Economics.

Guba, E. G. & Lincoln, Y. S. 1994. Competing paradigms in qualitative research. *Handbook of qualitative research.* pp. 105-117.

Harrell. M. C. & Bradley, M. A. 2009. Data Collection Methods: Semi-Structured Interviews and Focus Groups. Rand National Defense Research Institute. Santa Monica, California.

Hostmann, B., Rayner, N. & Friedman, T. 2006. Gartner's Business Intelligence and Performance Management Framework. [WWW documentt]. [referred 27.8.2017] Available: http://umsl.edu/~sauterv/DSS4BI/links/pdf/BI/gartners_business_intelligen_142827.pdf

Hung, S-Y., Huang, Y-W., Lin, C-C., Chen, K-C. & Tarn, J. M. 2016. Factors influencing business intelligence systems implementation success in the enterprises. *Pacific Asia Conference on Information Systems, PASIC 2016 Proceedings.*

Hwang, H., Ky, C., Yen, D. & Cheng, C. 2004. Critical factors influencing the adoption of data warehouse technology: a study of the banking industry in Taiwan. *Decision Support Systems*. Vol. 37, nro. 1, pp. 1-21.

Hwang, M. & Xu, H. 2008. A Structural Model of Data Warehousing Success. *Journal of Computer Information Systems*. Vol. 49, nro. 1, pp. 48-56.

IBM. 2013. Descriptive, predictive, prescriptive: Transforming asset and facilities management with analytics. [WWW document]. [referred 12.7.2017]. Available: https://static.ibmserviceengage.com/TIW14162USEN.PDF

Isik, O., Jones, M. C. & Sidorova, A. 2011. Business Intelligence (BI) Success and the Role of BI Capabilities. *Intelligent Systems in Accounting, Finance and Management.* Vol. 18, pp. 61-176.

Isik, O., Jones, M. C. & Sidorova, A. 2013. Business intelligence success: The roles of BI capabilities and decision environments. *Information & Management.* Vol. 50, pp. 13-23.

Järvenpää, M. 2007. Making business partners: A case study on how management accounting culture was changed. *European Accounting Review*. Vol. 16, nro. 1, pp. 99-142.

Krippendorff, K. 2004. Content Analysis: An Introduction to Its Methodology. California, SAGE Publications, Inc. 413 p.

Lahrmann, G., Marx, F., Winter, R. & Wortmann, F. 2011. Business Intelligence Maturity: Development and Evaluation of a Theoretical Model. *Proceedings of the 44th Hawaii International Conference on System Science*. pp. 1-10.

Luhn, H. P. 1958. A business intelligence system. *IBM Journal.* Vol. 2, pp. 312-324.

Lönnqvist, A. & Pirttimäki, V. 2006. The measurement of business intelligence. *Information Systems Management.* pp. 32-40.

Mesaro, P., Carnicky, S., Mandicak, T., Habinakova, D., Mackova, D. & Spisakova, M. 2016. Model of key success factors for Business Intelligence implementation. *Journal of System Integration.* Vol. 3, pp. 3-15.

Meyer, S. 2001. Which ETL Tool is Right for You? *Data Management Review*. Vol. 11, pp. 24-39.

Mikroyannidis, A. & Theodoulidis, B. 2010. Ontology management and evolution for business intelligence. *International Journal of Information Management*. Vol. 30, nro. 6, pp. 559-566.

Mohanty, S. 2008. Measuring the value of intelligence in business intelligence. [WWW document]. [referred 2.12.2017]. Available: http://lib.haifa.ac.il/extprojects/inforg/images/articles/Mohanty_Measuring-value-in-BI.pdf

Negash, S. 2004. Business intelligence. *Communications of the Association for Information Systems.* Vol. 13, pp. 177-195.

Nelson, R. R., Todd, P. A. & Wixom, B. H. 2005. Antecedents of information and system quality: An empirical examination within the context of data warehousing. *Journal of Management Information Systems.* Vol. 21, nro. 4, pp. 199–235.

Nielsen, S. 2015 The Impact of Business Analytics on Management Accounting. [WWW document]. [referred 12.7.2017]. Available: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2616363

Näslund, D., Sikander, E. & Öberg, S. 2014. Business Intelligence – a Maturity Model Covering Common Challenges. [WWW document]. [referred 10.9.2017]. Available: http://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=4463173&fileOId=4463189

Olszak, C. M. 2013. Assessment of Business Intelligence Maturity in the Selected Organizations. *Proceedings of the 2013 Federated Conference in Computer Science and Information Systems.* pp. 951-958.

Olszak, C. M. & Ziemba, E. 2004. Business intelligence systems as a new generation of decision support systems. *Proceedings PISTA 2004, International Conference on Politics and Information Systems: Technologies and Applications.*

Olszak, C. M. & Ziemba, E. 2007. Approach to Building and Implementing Business Intelligence Systems. *Interdisciplinary Journal of Information, Knowledge, and Management.* Vol. 2, pp. 135-148.

Parr Rud, O. 2009. Business Intelligence Success Factors: Tools for Aligning your Business in the Global Economy. New Jersey, John Wiley & Sons. 283 p.

Pirttimäki, V. & Hannula, M. 2003. Process models of business intelligence. *Frontiers of E-Business Research.* pp. 250-260.

Pirttimäki, V., Lönnqvist, A. & Karjaluoto, A. 2006. Measurement of Business Intelligence in a Finnish Telecommunications Company. *The Electronic Journal of Knowledge Management.* Vol. 4, nro. 1, pp. 83-90.

Popovič, A., Coehlho, P. S. & Jaklič, J. 2009. The impact of business intelligence system maturity on information quality. [WWW document]. [referred 9.9.2017]. Available: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1625573

Power, D. J. 2007. A brief history of decision support systems. DSSResources.com [WWW document]. [referred 2.7.2017]. Available: http://dssresources.com/history/dsshistory.html

Rajterič, I. H. 2010. Overview of business intelligence maturity models. Journal of Contemporary *Management Issues.* Vol. 15, nro. 1, pp. 47-67.

Ramamohan, Y., Vasantharao, K., Chakravarti, C.K. & Ratnam, A.S.K. 2012. A study of Data Mining Tools in Knowledge Discovery Process. *International Journal of Soft Computing and Engineering.* Vol. 2, nro. 3, pp. 191-194.

Ranjan, J. 2009. Business Intelligence: Concepts, Components, Techniques and Benefits. *Journal of Theoretical and Applied Information Technology.* Vol. 9, nro. 1, pp. 60-70.

Rayner, N. & Schlegel, K. 2008. Maturity Model Overview for Business Intelligence and Performance Management. Gartner Inc. [WWW document]. [referred 4.9.2017]. Available: https://www.gartner.com/doc/842813/maturity-model-overview-business-intelligence

Reinschmidt, J. & Francoise, A. 2000. Business Intelligence Certification Guide. IBM International Technical Support Organization, San Jose.

Richards, G., Yeoh, W., Chong, A. & Popovic, A. 2014. An empirical study of business intelligence impact on corporate performance management. *Pacific Asia Conference on Information Systems, PASIC 2014 Proceedings.* pp. 1-16.

Salminen, A. 2011. Mikä kirjallisuuskatsaus? Johdatus kirjallisuuskatsauksen tyyppeihin ja hallintotieteellisiin sovelluksiin. Publications of University of Vaasa, Teaching publications 62.

Shollo, A. & Galliers, R. D. 2016. Towards an understanding of the role of business intelligence systems in organisational knowing. *Information Systems Journal.* Vol. 26, pp. 339-367.

Silvi, R., Moeller, K. & Schlaefke, M. 2010. Performance management analytics – the next extension in managerial accounting. [WWW document]. [referred 9.7.2017] Available: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1656486

Skyrius, R., Kazakevièiene, G. & Bajauskas, V. 2013. From Management Information Systems to Business Intelligence: The Development of Management Information Needs. *International Journal of Artificial Intelligence and Interactive Multimedia.* Vol. 2, nro. 3, pp. 31-37.

Stackowiak, R., Rayman, J. & Greenwald, R. 2007. Oracle Data Warehousing and Business Intelligence Solutions. Indianapolis, Wiley Publishing, Inc. 408 p.

Stemler, S. 2001. An Overview of Content Analysis. *Practical assessment, research & evaluation.* Vol. 7, nro. 17, pp. 137-146.

Wadehra, A. 2007. The ABCs of Master Data Management: Architecture, Business Case, and Customer. *Business Intelligence Journal*. Vol. 12, nro. 1, pp. 33-40.

Wang, C-H. 2016. A novel approach to conduct the importance-satisfaction analysis for acquiring typical user groups in business-intelligence systems. *Computers in Human Behavior.* Vol. 54, pp. 673-681.

Watson, H. J. & Wixom, B. H. 2007. The current state of business intelligence. *Computer*. Vol. 40, nro. 9, pp. 96-99.

Williams, S. & Williams, N. 2003. The business value of business intelligence. *Business Intelligence Journal.* Vol. 8, pp 30-39.

Wixom, B. H. & Watson, H. J. 2001. An Empirical Investigation of the Factors Affecting Data Warehouse Success. *MIS Quarterly*. Vol. 25, nro. 1, pp. 17-41.

Wixom, B. H. & Watson, H. J. 2010. The BI-Based Organization. *International Journal of Business Intelligence Research*. Vol. 1, nro. 1, pp. 13-28.

Wixom, B. H., Yen, B. & Relich, M. 2013 Maximizing Value from Business Analytics. *MIS Quarterly Executive.* Vol. 12, nro. 2, pp. 111-123.

Yin, R. K. 1994. Case Study Research: Design and Methods (2nd Ed.). California, Thousand Oaks. 181 p.

Yeoh, W. & Koronios, A. 2010. Critical success factors for business intelligence systems. *Journal of Computer Information Systems.* Vol. 50, nro. 3, pp. 23-32.

Yeoh, W., Koronios, A. & Gao, J. 2008. Managing the Implementation of Business Intelligence Systems: A Critical Success Factors Framework. *International Journal of Enterprise Information Systems.* Vol. 4, nro. 3, pp. 79-94.

Yeoh, W. & Popovic, A. 2016. Extending the Understanding of Critical Success Factors for Implementing Business Intelligence Systems. *Journal of the Association for Information Science and Technology.* Vol. 67, nro. 1, pp. 134-147.

Yilmaz, K. 2013. Comparison of Quantitative and Qualitative Research Traditions: epistemological, theoretical and methodological differences. *European Journal of Education.* Vol. 48, nro. 2, pp. 311-325.

Zeng, L., Xu, L., Shi, Z., Wand, M. & Wu, W. 2006. Techniques, Process, and Enterprise Solution of Business Intelligence. *IEEE Conference on Systems, Management, and Cybernetics.* Vol. 6, pp. 4722-4726.

INTERVIEWEES

Interviewee A. Senior Specialist. 17.10.2017
Interviewee B. Controller. 17.10.2017
Interviewee C. Finance Director. 27.10.2017
Interviewee D. Director. 18.10.2017
Interviewee E. Business Controller. 18.10.2017
Interviewee F. Director. 17.10.2017
Interviewee G. Director. 17.10.2017
Interviewee H. Senior Manager. 17.10.2017
Interviewee I. Finance Director. 19.10.2017
Interviewee J. Senior Manager. 24.10.2017

Appendix 1. The structure of interviews

Background information

1. Professional title
2. Business unit

BI implementation and success of the implementation

3. What was your role during the implementation of the BI system?
4. How would you shortly describe the progress of the implementation?
5. How would you describe overall the current phase of BI implementation and maturity from the following perspectives (scale 1-5)?
    i. People: users' knowhow, trust on the system, functionalities
    ii. Processes: identification and standardization of processes
    iii. Metrics and technology: data quality, metrics
6. In your opinion, what were the goals of BI implementation? Whether these goals are achieved?
7. How BI implementation succeeded from the following perspectives (scale 1-5)?
    i. Budget
    ii. Time schedule
    iii. System quality
    iv. Data quality
    v. System usage
8. How the following implementation success factors have been taken into account during the BI implementation (scale 1-5)?
    i. Committed management support and sponsorship
    ii. Clear vision and well-established business case
    iii. Business-centric championship and balanced team composition
    iv. Business-driven and iterative development approach
    v. User-oriented change management
    vi. Business-driven, scalable and flexible technical approach
    vii. Sustainable data quality and integrity
9. Which were the biggest challenges during the implementation of the BI system?
10. What could be done otherwise during BI implementation?

Usage of the BI system

11. How would you describe your user role?
    i. New user, intermediate user or advanced user
    ii. End user, key user, super user or business solution owner
12. Which are the most important tasks you/your business unit are using the BI system?
13. Which of the following functionalities you/your business unit are using?
    i. Dashboards
    ii. Standardized reports
    iii. Self-generated reports
    iv. Ad hoc queries
    v. Other, what?
14. Are there any functionalities you would like to use but it is not possible?
15. Have you faced the following challenges?
    i. Role authorization problems
    ii. Reporting problems
    iii. Data problems
    iv. Workflow problems
    v. Other, what?
16. Which of the following areas should be changed and how in order to facilitate the implementation and the usage of the BI system? Which are three most important development areas?
    i. Change management
    ii. Training and user support
    iii. Roles and responsibilities
    iv. Metrics
    v. Data quality
    vi. Other, what?
17. Which are three most important things that would motivate you to use the BI system more?

Benefits of the BI system

18. What benefits your business unit has gained through the BI implementation compared to the situation before the implementation?
19. How the implementation of the BI system has affected your working time that you are using for creating reports/forecasts?
    i. Time has decreased
    ii. Time has increased
    iii. Not able to say
20. After technical challenges have been defeated, how your answer would change

User satisfaction

21. How would you describe your BI satisfaction compared to the situation before the BI implementation (scale 1-5)?
    i. The BI system overall
    ii. How well the BI system provides precise information you need
    iii. How well the BI system supports your decision making
    iv. How well the BI system provides information you need in time
    v. How user friendly the BI system is
22. How would you describe your BI satisfaction compared to the targets of the BI implementation (scale 1-5)?
    i. The BI system overall
    ii. How well the BI system provides precise information you need
    iii. How well the BI system supports your decision making
    iv. How well the BI system provides information you need in time
    v. How user friendly the BI system is
23. Which things have a positive impact on your user satisfaction? How about a negative impact?
24. Which are three most important things that would improve your user satisfaction?

Appendix 2. Coding used in content analysis

English coding	Finnish coding
Role authorization problem	
• Access • Logging • User	• Käyttäjä • Pääsy • Sisäänkirjautuminen
Reporting problem	
• Calculation • Currency • Customer group • Dashboard • Dimension • Drill up • Measure • Model • Operative organization • Perspective • Query • Report • Reporting	• Asiakasryhmä • Dimensio • Laskenta • Malli • Mitta • Näkymä • Operatiivinen organisaatio • Porautua ylöspäin • Raportointi • Raportti • Tiedustelu • Valuutta
Data problem	
• Cost • Data • Difference • Disappeared • Double • Figures • Incorrect • Missing • Not matching • Not updated • Sales	• Ei päivittynyt • Ei täsmää • Ero • Hävinnyt • Kadonnut • Kaksinkertainen • Kustannus • Luvut • Myynti • Puuttua • Virheellinen

Workflow problem	
• Allocation	• Allokaatio
• Application	• Ei aukea
• Attachment	• Ei avaudu
• Commit error	• Ei ole käynnissä
• Does not exist	• Ei ole olemassa
• Does not open	• Hidas
• Down	• Hitaus
• Download	• Jumissa
• Export	• Kaatunut
• From	• Lataus
• Input	• Liite
• Job	• Muistin käyttö
• Load	• Oikaisu
• Maintenance	• Prosessi
• Mapping	• Päivitys
• Memory usage	• Serveri
• Node	• Siirto
• Not opening	• Sovellus
• Not running	• Syöttö
• Process	• Työ
• Refresh	• Vahvistusvirhe
• Restatement	• Vienti
• Server	• Ylläpito
• Slow	
• Slowness	
• Stuck	
• Transferring	
• Upload	