TAMPEREEN TEKNILLINEN YLIOPISTO
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JOONAS KESKINEN

ENABLERS FOR AGILE BUSINESS INTELLIGENCE – CASE SAP

Master's Thesis

Examiner: Professor Samuli Pekkola
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ABSTRACT

JOONAS KESKINEN: Enablers for Agile Business Intelligence – Case SAP
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One of the key requirements for achieving competitive advantage is to utilize gathered information more effectively than before with the help of emergent technology innovations and enhanced information management. In order to remain competitive and compete with the help of data, organizations and researchers have paid attention to a new wave of business intelligence, referred to as agile business intelligence. Agile business intelligence enables faster decision-making in faster pace than traditional business intelligence due to the emergence of new technology directions. Hence, the technology has evolved in a way that agile business intelligence can bring more value to the organizations simplifying the business intelligence architecture and enhancing data processing by utilizing operational data more effectively.

The primary objective of the thesis was to identify the key factors that enable agile business intelligence. The secondary objective was related to the benefits that agile business intelligence provides to the organizations compared with the traditional business intelligence solutions and platforms. The thesis consisted of two different parts: the first part was related to investigate agile business intelligence from the academic point of view using a systematic literature review as a research method. In this part, the definition of agile business intelligence was formalized and the different enablers and benefits were discovered based on the literature. The second part was related to investigate agile BI enablers, which were founded in internal training materials regarding the SAP landscape. Findings from the latter part were reflected on the findings from the first part drawing a synthesis between the enablers and benefit from the different parts.

The key findings of agile BI were divided into two main categories: agile methodologies and agile technologies. The first ones were related to the different agile development methods of business intelligence such as Scrum in order to organizations are able to react faster pace to the changing requirements in the business environment. The key enablers of the latter category were in-memory BI, mobile BI, cloud BI, operational BI and self-service BI. The main benefits of these enablers were related to the reduced query processing providing real-time data on decision-making, the increased flexibility of the systems and easier access to the data which facilitate more accurate and punctual decision-making. These benefits reflected on SAP BI landscape which provided the same benefits but also simplification was in a central role in SAP BI landscape which reduces the need for extract and load data from the different source systems.

TIIVISTELMÄ

JOONAS KESKINEN: Ketterän liiketoimintatiedon hallinnan mahdollistajat – Case SAP
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Yksi tärkeimmistä vaatimuksista kilpailukyvyn saavuttamiselle on hyödyntää ja hallita dataa tehokkaammin kuin aikaisemmin uusien teknologioiden avulla. Uusi liiketoimintatiedon suuntaus nimeltään ketterä liiketoimintatiedon hallinta on huomioitu sekä organisaatioissa että akateemisessa maailmassa. Suuntaus mahdollistaa eri organisaatioiden saavuttaa kilpailuetua datan hallinnan ja hyödyntämisen avulla. Ketterä liiketoimintatiedon hallinta mahdollistaa nopeamman ja tehokkaamman päätöksenteon uusien teknologisten ratkaisujen avulla. Uudet teknologiat siis tuovat lisäarvoa organisaatioille yksinkertaistamalla tietojärjestelmien arkkitehtuuria sekä tehostamalla datan prosessointia.

Tämän työn päätavoitteena oli tunnistaa tekijöitä, jotka mahdollistavat ketterän liiketoimintatiedon hallinnan. Toisena tavoitteena oli tunnistaa mahdollistajien tuomia hyötyjä ja verrata ketterää liiketoimintatiedon hallintaa perinteisesti käytettyihin ratkaisuihin. Tehty diplomityö koostui kahdesta eri osasta, joista ensimmäinen tutki ketterän liiketoimintatiedon hallinnan käsitettä ja sen mahdollistajien tuomia hyötyjä akateemisesta näkökulmasta. Tässä käytettiin tutkimusmenetelmänä systemaattista kirjallisuuskatsausta. Toinen osio liittyi SAP:n tarjoamiin alustoihin ja sovelluksiin sekä niiden mahdollistaviin tekijöihin ja hyötyihin ketterän liiketoimintatiedon hallinnan kontekstissa. Tässä osiossa hyödynnettiin koulutusmateriaaleja, kuten videoita ja käsikirjoja, joiden avulla pystyttiin muodostamaan kuva SAP:n tarjoamista ratkaisuista. SAP:n ketterän liiketoimintatiedon mahdollistajia ja niiden hyötyjä myös verrattiin ensimmäisessä osiossa löydettyihin hyötyihin ja mahdollistajiin.

Keskeisimmät löydökset jaettiin kahteen eri yläluokkaan: metodologiset ja teknologiset mahdollistajat. Metodologiset mahdollistajat liittyivät ketteriin menetelmiin ja näiden eri menetelmien hyödyntämiseen liiketoimintatietojärjestelmien kehittämisessä. Hyödyt liittyivät organisaatioiden kykyyn reagoida nopeammin muuttuvaan liiketoimintaympäristöön. Puolestaan teknologiset mahdollistajat käsittelivät muistinvaraisten tietokantojen, mobiililaitteiden, pilvipalveluiden ja operationaalisten järjestelmien hyödyntämistä liiketoimintatiedon hallinnassa. Hyödyt liittyivät nopeampaan tiedon prosessointiin tarjoten reaaliaikaista dataa päätöksenteon tueksi, tietojärjestelmien joustavuuteen sekä helpompaan datan saatavuuteen, mitkä mahdollistavat tehokkaamman päätöksenteon. Hyötyjä lopulta verrattiin myös SAP:n tuomiin hyötyihin, joista monet olivat verrattain samoja kuin kirjallisuudessa esiintyvät hyödyt. Lisäksi SAP -järjestelmien hyötynä tuotiin esiin järjestelmäarkkitehtuurin yksinkertaistaminen, mikä vähentää datan latausta ja keräämistä eri lähdejärjestelmistä.

PREFACE

I started to develop the idea for the thesis at the same time when I started to work in Capgemini in January 2016. The overall topic was easy to decide, but I needed some twist to it and thus, my mentor/counselor and I started to refine the ideas about the twist and we came up with the topic of agile business intelligence. In addition, Capgemini has a strong focus and good resources regarding SAP and it was a natural choice to focus on that area (…also my counselor might have guided me to investigate SAP landscape).

Writing the thesis has not been the easiest task to do, especially when you are trying to compress the working and the thesis writing hours into the same day. Despite the rocky road, the thesis writing process has taught me a lot and deepened my professional competence in the SAP landscape and its relations to business intelligence. Hence, the process has been a fruitful opportunity for me.

I want to thank Samuli Pekkola from Tampere University of Technology who gave me good advice for the thesis and helped me in the writing process. In addition, I am grateful to Capgemini for all the support, but particularly I want to thank two gentlemen: Tapani Tuoma and Panu Rahikka. My counselor Tapani helped me to define the thesis and gave me an introduction to SAP world. My manager Panu gave me an opportunity to reduce my workload which helped me to focus on completing my thesis.

Finally but not last, I wanted to thank my friends and family for the support. For me, your support has had the biggest impact to pursue this goal and I hold a great gratitude for that. Especially I want to thank my fiancé Marjut who has been compassionate through this whole journey, even then when it has felt insuperable.

Tampere, 10.12.2016

Joonas Keskinen

CONTENTS

LIST OF FIGURES

LIST OF DEFINITIONS AND ABBREVIATIONS

BI	Business Intelligence - A wide range of applications, technologies and processes for gathering, storing, analyzing data to help members of organizations to gain insights in order to make better decisions (Larson & Chang 2016; Lönnqvist & Pirttimäki 2006; Rouhani et al. 2012; Sangari & Razmi 2015; Watson 2009).
BW	Business Warehouse – SAP's product that is a combination of databases and database management tools that are used to support decision-making.
DB	Database - An organized collection of data. It is the collection of schemas, tables, queries, reports, views, and other objects. The data are typically organized to model aspects of reality in a way that supports processes requiring information.
DW	Data warehouse - A single logical storage that contains all the data which is needed in reporting and decision-making (Devlin & Murphy 1988). Data warehouse store the data from the different source systems, which can be distributed around the organization.
EDW	Enterprise Data Warehouse – An enterprise-wide data warehouse, which stores data from different parts of the organization.
ETL	Extract, Transform, Load - A process, where data is extracted and consolidated from the source systems. Then the extracted and cleansed data is loaded into data warehouse or data marts. After the ETL-process, data is then available for the users for utilizing the extracted data in their analysis and reporting.
ERP	Enterprise Resource Planning – An organization's IT system that integrates different business functions under one system. These functions may be related to inventory management, accounting, distribution, etc. Usually ERP system consists of a bundle of different components and applications which are gathered into one suite.
HANA	SAP related in-memory platform which offers cloud and on-premises deployment options to customers. The different applications can run on SAP HANA in order to facilitate real-time business intelligence.
In-Memory DB	In-memory database - A database whose data is stored in main memory which yields faster response times and enables more rapid decision-making. Source data is loaded into system memory in a compressed, non-relational format.

OLAP	Online Analytical Processing - A computer processing, which has a multi-dimensional element that enables users to easily and selectively extract and view data from different points of view.
OLTP	Online Transaction Processing - A class of software programs or applications which are capable of supporting transaction-oriented applications.
SAP	German IT systems vendor, which is associated with the ERP systems due to SAP is the largest ERP vendor in the market. Despite the fact that ERP seen as a flagship technology, SAP has heavily invested in BI and cloud solutions as well.
SAP R/3	The former name of the enterprise-wide ERP system produced by SAP AG, which is SAP the first system that followed a three-tier architecture.
SAP S/4HANA	The newest generation of a real-time ERP suite for digital business which is built on SAP HANA in-memory platform.
SQL	Structured Query Language – A basis in the relational databases. The language is utilized to manage data in the databases. SQL is also needed in reporting when querying the data from the database to formalize the dashboards or reports for the business purpose.

1. INTRODUCTION

In this chapter, the background of the research is introduced. In addition, this chapter is establishing the basic disciplines for the research, incorporating research questions, limitations, objectives and justifications for selected methodological choices. Moreover, in the last sub-chapter the outline of the thesis is introduced.

1.1 Research Background

Today's organizations are struggling in the complex and turbulent business environment which requires fast decision-making with a help of different IT systems. One of the key requirements for achieving competitive advantage is to utilize gathered information more effectively than before, with the help of new technology innovations and enhanced information management. According to Pirttimäki (2007), this information management consists of identifying, gathering, organizing, storing and using the relevant information which will bring more value into the organizations.

Traditionally, business intelligence systems have had a key role in supporting decision-making. According to the IBM Tech Trend Report (2011), business intelligence and business analytics are identified as one of the most important technology trends in the 2010s. Moreover, Bloomberg business week (2011) is stating that the organizations which revenue is over 100 million are utilizing some kind of business intelligence solutions in their decision-making. The importance of business intelligence is also acknowledged in a research delivered by Gartner. The research is indicating that business intelligence and business analytics markets will reach over 16.9 billion dollars in the year 2016 which will be 5.2 percent increase compared with the year 2015 (Moore 2016).

Changes in the competitive environment are forcing organization to adapt and respond quickly to the constantly changing requirements in the markets. Knabke & Olbrich (2013) describe these issues are relating to the economic changes, the new opportunities and the threat of competitors' growth. These are the drivers which are needed to take into account in order to remain competitive. The main objective of business intelligence is to support decision-making using a collected data from different sources (Krawatzeck et al. 2015; Turban 2001). Above mentioned demands are not easy to fulfill when reviewed in the context of business intelligence due to the amount of data is growing rapidly. The growth of the data is one of the reasons why it will be even more cumbersome to leverage it in the same ways and methods than before. The consequences are affecting the decision-making: it will be harder to make reasonable decisions based on the data (Chen et al. 2012). An example of the increasing data volume can be seen in

McKinsey's research which is stating that the several organizations in U.S. have stored data over 100 terabytes and the number is still growing (Manyika et al. 2011).

It can be even harder, when organizations need to find the relevant data which value can be justified at the specific moment. Moreover, the business intelligence systems are often isolated systems which utilize only a small fraction of the potential value of the data (Muntean & Surcel 2013; Sharma & Djiaw 2011; Zimmer et al. 2012) and thus the decision-making can be slow and not serving the business in a right way. Furthermore, if we are talking about the large companies the information silos are one of the barriers regarding rapid decision-making. According to Muntean & Surcel (2013), information silos can be derived from complex information architecture regarding business intelligence and the consequences could be related to the inflexible and time-consuming decision-making.

The problem is in the concept of the traditional business intelligence systems: these systems have been seen as a central repository of data supporting organizations decision-making in operational and analytical levels (Knabke & Olbrich 2013). The current concept will cause problems in terms of flexibility and data quality due to growing amount of data. If organizations are using the traditional architectural models in the field of business intelligence, the growing volume of data will increase complexity and also yield challenges for business intelligence. For example, it will be harder to ensure that the content of data, coming from multiple source systems to data warehouse, is semantically correct and also is fulfilling data quality requirements (Zimmer et al. 2012). In other words, the challenges are relating to the streamlining the development of business intelligence systems and turning data into information faster pace leading quicker insights on decision-making. The researchers have raised a concern, how the traditional BI systems are able to fulfill the new requirements and survive in the complex environment (Knabke & Olbrich 2011; Knabke & Olbrich 2013; Zimmer et al. 2012).

In order to remain competitive and compete with the help of data, organizations and researchers have paid attention to a new wave of business intelligence, referred to as agile business intelligence (e.g. Chaudhuri et al. 2011; Knabke & Olbrich 2013; Muntean & Surcel 2013; Zimmer et al. 2012). According to Deloitte's Tech Trend Report (2014), the business intelligence systems have been evolved to be more agile and versatile. Agile business intelligence is enabling organizations to utilize real-time data in their decision-making. Also, agile business intelligence enables faster decision-making in the faster pace than traditional business intelligence due to the emergence of new technology directions. Hence, the technology has evolved in a way that business intelligence can bring more value to the organizations simplifying the business intelligence architecture and enhance the data processing by utilizing operational data more effectively.

The need for agile business intelligence has been also covered in the academic research, as well as among the different service and platform providers. A good example of the need for agile business intelligence is carried out in Baars' & Hütter's research. According to their research, 90 percent of the participated organizations want to use real-time data to make rapid decisions. The desired response time was given to be from hours to days (Baars & Hütter 2015). Agile business intelligence is a quite new concept among researchers and therefore, it needs to be studied more precisely to get a comprehensive understanding about its benefits and the underlying drivers for agile business intelligence. However, there can be seen some directions already regarding agile business intelligence research: cloud-based business intelligence (Sangupamba Mwilu et al. 2015), agile business intelligence development (Collier 2011), agile information infrastructure and agile information architecture (Muntean & Surcel 2013). Furthermore, Forrester has done a research which is comparing the different agile business intelligence platforms (Evelson 2015). Hence, agile business intelligence can be seen as a new wave for the traditional business intelligence and it will provide more value for decision-making based on the real-time business intelligence. In addition, this contribution has been recognized among research at some level but also on the commercial side as well.

1.2 Objectives, Research Questions and Limitations

The primary objective of the thesis is to identify the key factors that enable agile business intelligence. The secondary objective is related to the benefits that agile business intelligence provides to the organizations compared with the traditional business intelligence solutions and platforms. Considering the research objectives, the research questions have been formalized to fulfill the objectives in a holistic manner. Hence, the research questions are stated as follows:

- *What agility in business intelligence means?*
- *What are the enablers of agile business intelligence?*
- *What are the benefits of agile business intelligence for organizations?*
- *How does agile business intelligence differ from traditional business intelligence?*

The literature is used to form a common understanding for the research. In addition, the empirical part of the study will focus on observing the specific case. The study is providing overall insight towards agility in business intelligence, but also giving more detailed understanding in the specific system landscape. Thus, the goal is to reflect the findings of the literature on the case and observe how these findings will apply on the selected environment.

The limitations of the study is relating to the benefits of agile business intelligence. Due to the concept of agile business intelligence is relatively new and its maturity is in the early stage (Baars & Hütter 2015), it is hard to evaluate exact long-term benefits for organizations which are utilizing agile business intelligence. Hence, the realization of the detailed benefits needs to exclude from the research. However, this study finds if there are some overall high-level benefits of agile business intelligence which have already been realized and also what the expected benefits for agile business intelligence are. In addition, the thesis is focusing on the specific system landscape, which affects the generalization of the results. This means, that the findings of the empirical investigation do not apply for all different business intelligence landscapes due to the limitations of the technology and the product portfolio.

The third limitation is related to the process and policies. Usually, scholars have used term “BI Governance” (e.g. Baars & Zimmer 2013) to describe rights, regulations and steering and controlling business intelligence systems. In addition, term “BI Governance” contains all the organizations structures and bureaucracy related activities, which are excluded from the thesis due to those do not affect the agility in business intelligence directly, especially if the agility is observed from the technological point of view. However, the indirect impact can be substantial (i.e. how to facilitate organizational agility), but those activities are more related to the governance and project management side and do not be that relevant to the thesis.

1.3 Research Methodology

This chapter focuses on the chosen research methodology which gives a framework for the thesis from the academic point of view. Figure 1 gives an overview of the research methodology. Under this section research philosophy, approach, strategy and methods are introduced.

Figure 1. *Research Onion (Adopted from Saunders et al. 2009)*

According to Saunders et al. (2009), the research philosophy is forming the underlying assumptions how the world is viewed by the researchers. This means that the research philosophy is giving guidelines how knowledge is obtained in the research and what are the means to gain the knowledge. However, according to Johnston (2014) the ontological and epistemological beliefs are guiding the research. Hence, these beliefs determine the accepted theory and knowledge and the means to justify the research.

Research Philosophy

There are different research methodologies which can be classified to four different classes, which are positivism, realism, interpretivism and pragmatism (Saunders et al. 2009). Many researches in the field of information systems have acknowledged that the interpretivism view is the one of the most suitable philosophy disciplines for investigating the phenomena in information technology context (e.g. Butler 1998; Cole & Avison 2007; Minger & Wilcocks 2004; Myers 1997). Many varieties of interpretivism philosophy can be utilized in the information systems research and those could be divided into sub-categories according to its tendency. According to Butler (1998) the hermeneutic philosophy has been advocated as a valid philosophy among the different researcher, especially in the context of information systems development.

Thus, the justification for selecting hermeneutics for the philosophy is relating to the fact that it has been seen as a powerful discipline for information systems research (Minger & Wilcocks 2004). Moreover, the hermeneutics is a central methodology for interpretation (Gummesson 2003). The selected philosophy is helping people in the organizations to understand how information systems are used and also provide an insight about the system development process (Minger & Wilcocks 2004, pp.104-105). Hence, the hermeneutics as a research philosophy in the field on information systems can be justified.

Research Approach

The research approach can be seen as a deductive approach. The main goal for the deductive approach is to test the existing theory (Saunders et al. 2009). However as stated earlier, agile business intelligence is a relatively new concept and there are not many research articles which are focusing on agile business intelligence as-is. Still, it is plausible to reflect the existing literature on the selected case environment and find similarities between the case environment and the literature.

Research Strategy

For the research strategy point of view, the case study has been selected as a research strategy. The main purpose of the case studies is to utilize the qualitative research methods. In addition, the case studies are related to the empirical investigation in the particular context. The main questions in which the case studies are trying to answer are "why", "what" and "how". Hence, case study strategy is often seen as an exploratory or an explanatory research (Saunders et al. 2009). According to Yin (2008), the empirical sources which can be utilized in the case studies are, for example documents, archival records, observations and interviews. In the thesis, the case study approach is selected as a research strategy due to the thesis empirical investigation is focusing on the specific business intelligence system landscape which provides results only to that specific case. According to the Gable (1994) the case study can be seen as an appropriate researcher strategy in the field of information systems due to "*The case study method allows the researcher to understand the nature and complexity of the process taking place*".

Research Choices, Time-Horizon & Data Collection methods

This thesis will utilize the multimethod choices and also is focusing on observing the particular phenomena on the specific time. In addition, the selected data collection methods are focusing on the systematic literature review. In addition, the document analysis is included to investigate the selected system landscape. A systematic literature review is identifying and interpreting available researches which can answer the research questions and the method is suitable for the scope of this research (Kitchenham & Charters 2007). Hence, the fundamental purpose of using the systematic literature

review is to summarize the researchers' findings and form a synthesis based on these findings. Usually, the literature review is called a secondary study due to it reviews the primary studies which can be associate with the research questions formalizing a synthesis in the existing literature (Kitchenham & Charters 2007).

The different types of instructions and processes how to conduct a systematic literature review can be found in the literature and Kitchenham's & Charters' method is only one way amongst many others. Nevertheless, in the most of the methods there can be seen the same patterns to conduct the review. However, some of the specific details inside the processes may vary (Bandara et al. 2011; Kitchenham & Charters 2007).

In Figure 2, the literature review process is described. Figure 2 is so called hybrid process, adopted from the Kitchenham's & Charters's (2007) and Bandara et al. (2011) researches and formalized into a framework. In the review there can be found three different phases: planning, conducting and reporting the review.

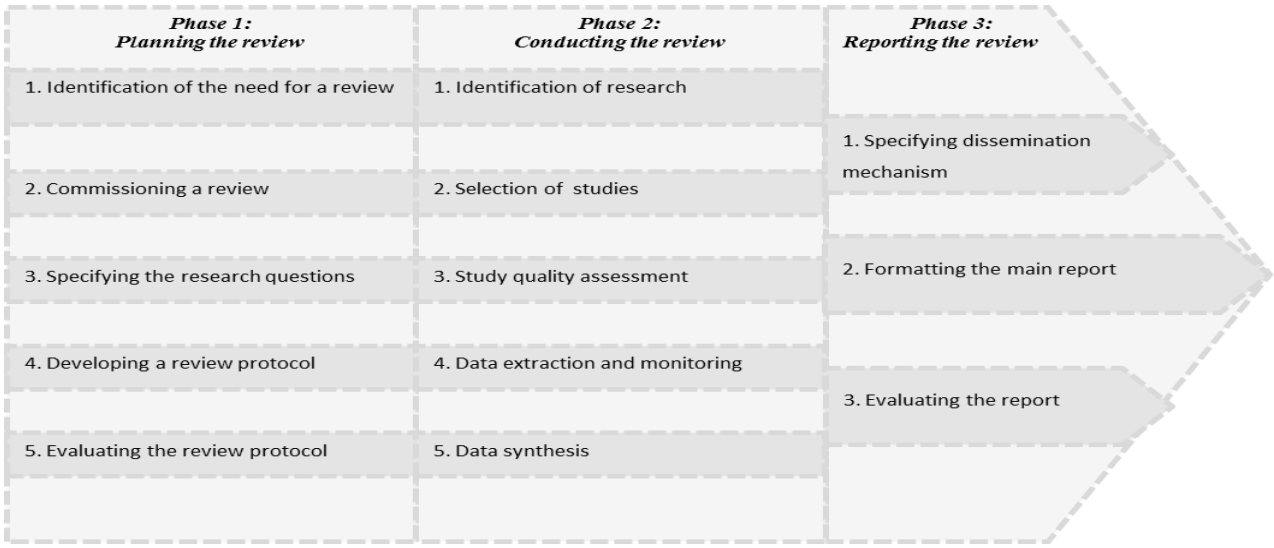

Figure 2. *Framework of the Systematic Literature Review (Adopted from Kitchenham & Charters 2007)*

The first phase is called pre-study of the research and this phase is assessing the need for the literature review and forming the research questions (Kitchenham & Charters 2007). This phase is important when researchers are assessing the need for the study. In this phase, the initial review can be done, for example outline the sources which are utilized in the literature review (Rouhani et al. 2012).

In Figure 2, the phase 2 – conducting the review includes identification and extraction the articles and preparing the analysis (Kitchenham & Charters 2007; Bandara et al. 2011). In this phase the secondary studies (i.e. existing literature reviews) are wanted to take into account in order to get more insight about the researches. The secondary studies are excluded from Kitchenham & Charters (2007) instructions but can be found in

the Bandara et al. (2011) research. The last phase is relating the delivering complementary analysis based on the findings and also evaluating the findings.

However in the thesis, all the steps of the process are not included as broadly as Kitchenham & Charters (2007) have instructed. This is due to the thesis has two different parts. Part one is focusing more on the academic point of view, giving broader insight about the field of business intelligence and its agility. The primary data sources are consisting of business intelligence based literature, which are mostly gathered from academic journals. In addition to get more comprehensive understanding about the newest trends and implementations of agile business intelligence solutions, the commercial research executed by companies and organization are included in the study.

The second part of the thesis is related to the case-study approach. This part is investigating agile business intelligence in the context of SAP and the solutions and products of SAP in the field of agile business intelligence. This section is also utilizing the results from the systematic literature review, but this part of the study is focusing more on the commercial literature and internal training materials such as e-learnings and manuals. Still, we can say that both of the parts have the systematic literature review elements, but they do not follow the process and the phases as-is. However, the different phases are giving more structural perspective and also giving some best practices how to conduct the systematic literature review.

1.4 Outline of the Thesis

This chapter is focusing on the outline and the timescale of the thesis. Outline has been divided into seven chapters with four different parts as depicted in Figure 3.

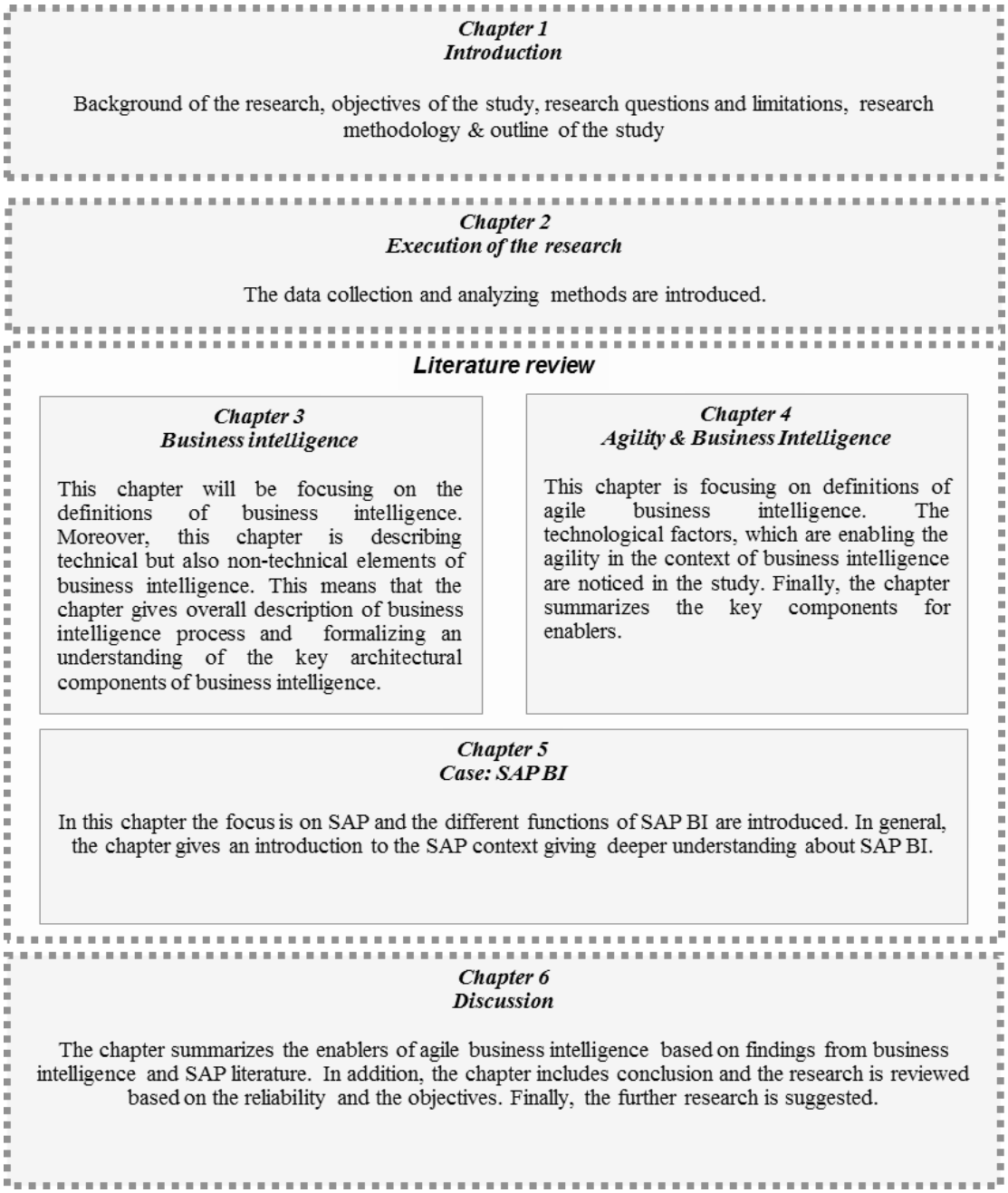

Figure 3. *The Outline of the Thesis*

The first part gives an overall perspective to the subject. In this part, the background of the research is given and objectives for the study are defined including the research questions and limitations of the research. Moreover, this part focuses more on the for-

malizing of the framework for the research. Thus, the methodological choices are introduced which give a high-level overview of the selected research methods and execution of the research.

The second chapter is contributing the data gathering and analyzing methods of the thesis. To be more precise, chapter two is giving and understanding about the research methods, which were chosen to execute the research. Hence, the chapter is introducing the data collection and data analyzing methods. In addition, the second chapter is giving more insight how the literature and the documents (manuals, e-learning materials) were selected, classified and reviewed for the research purposes.

Chapters three and four are conducting the first part of the master thesis. These chapters are based on the literature review regarding business intelligence and agility in business intelligence. Hence, the chapters are forming the theoretical fundament of the thesis, giving insight about business intelligence elements and the underlying assumptions of agility in business intelligence.

First in chapter three, the thesis delves into the term of business intelligence covering the technical and non-technical aspects of business intelligence. The latter chapter highlights the concept of agile business intelligence. This chapter is divided into different components of agility and business intelligence drawing a synthesis between these two terms, which then constructing the definition for agile business intelligence. In addition, chapter four emphasizes different success factors, found in the literature, for agile business intelligence. With these two chapters, the thesis forms an overall understanding about business intelligence and agile business intelligence and how these two concepts differentiate from each other. The main purpose of the chapter is to draw a conclusion between different factors of business intelligence and agile business intelligence. Hence, after these two chapters, the research questions are covered from the overall point of view.

The fifth chapter is mainly covered with the help of literature review and the empirical data. However, this chapter is not such straightforward than previous ones and it has also literature review dimension: the previous chapters are tackling business intelligence and agile business intelligence in general terms and chapter five is focusing on investigating the different enablers and benefits found in the literature of SAP BI landscape. The chapter is starting the second part of the study as discussed earlier, because the chapter is focusing only SAP BI landscape. In order to get a full understanding about SAP BI landscape, the methods of the empirical research already need to be taken into account at this point (i.e. observation and leverage of document analysis). This section could be appointed as empirical part of the research. Thus, chapter five is introducing SAP BI and reflects the main enablers and benefits which were found in chapter four on the SAP BI landscape.

The sixth chapter is giving an answer to the research question at a detailed level. The chapter is reflecting the research results for known theory and seeking similarities and dissimilarities in the specified context. In other words, the sixth chapter is introducing the main differences between agile business intelligence and traditional business intelligence. Enablers of agile business intelligence are summarized in general level but also in the SAP BI context. Hence, the sixth chapter is covering both parts of the study. In addition, the sixth chapter is finding divergences between agile business intelligence and traditional business intelligence. The final part of the chapter is conclusion which summarizes the key results and the key points of the study. In addition, the sixth chapter observers the research from the critical point of view: evaluating its reliability and generalizability. Also in the chapter the need for further research is acknowledged.

2. THE EXECUTION OF THE RESEARCH

Chapter 2 is describing the data collection and analysis methods of the study. The first section is giving an overall understanding about the used methods gathering data for the thesis. The second section giving more comprehensive view of the literature review process, introducing the search terms and databases for the systematic literature review. The last section describes the analyzing methods for gathered data.

2.1 Data Gathering Methods

There are two different sections in the study, which are separated from each other: the systematic literature review and empirical examination of the specific case landscape. The first section is based on the literature review of business intelligence agility, which is giving an overall picture of agility in business intelligence context. The latter part of the study is focusing on the SAP BI landscape in order to get more detailed information about how agility is enhanced with the SAP's product portfolio. The reason for the selection of SAP BI landscape was related to our organization, which has a strong knowledge of the SAP portfolio and providing a lot of training materials such as manuals and training videos in the context of SAP BI. In addition, our organization is a strong partner of SAP and it has won multiple awards of implementing SAP products for different customers (Capgemini website 2016). Hence, the first part is focusing more on the academic side of the subject and the latter part is more practical.

Systematic Literature Review

As stated above the first part of the study was relating to the literature review. According to Kitchenham & Charters (2007), the purpose of the literature review is to give a rigorous review of the research results. This means that in the literature review, the data is gathered based on the research questions of the study. However, it is important to understand the concepts or domains, which are related to the research questions (Bandara et al. 2011). Thus, to get a comprehensive overview of the phenomenon, concepts that are related to agile business intelligence are needed to take into consideration as well.

The concept of business intelligence has been studied quite lot during past fifteen years (Rouhani et al. 2012), giving a contribution to the traditional ways (such as ETL) to integrate the data from different sources to the single repository called data warehouse (Hovi et al. 2009). However, the data volumes have been growing in the past recent

years and due to the growth, different scholars have been started to investigate the new direction in business intelligence, called agile business intelligence. Hence, agility in business intelligence is a relatively new concept and therefore, there are not yet many articles, which are mainly focusing on agile business intelligence. Nonetheless, some direction of agile business intelligence can be seen in the academic research, but the concept has been more visible on the practical side relating to the applications and technologies. On the practical side, it is easier to investigate different vendors' product portfolios, which contains products that enhance agility in business intelligence (e.g. SAP HANA and SAP Fiori). Despite the lack of comprehensive academic description of agile business intelligence, it was still possible to gather data which were related to agile business intelligence and its enablers.

The first phase for the literature review included the identification and extraction the articles (Bandara et al. 2011; Kitchenham & Charters 2007). However, the initial part was relating to study the subject in order to get an overall picture of agile business intelligence functions. The initial phase was not really related to the literature review; it was more explorative studying by its nature. This meant that the focus was on the practical side such as different vendors' products regarding business intelligence agility. In the actual first phase, the secondary studies (i.e. existing literature reviews) were one of the main sources to get a comprehensive understanding about the agile business intelligence concept. However, the secondary studies are excluded from Kitchenham & Charters (2007) instructions but can be found in the Bandara et al. (2011) research. In addition, secondary data can provide a useful source of information in order to get comprehensive understanding about the phenomenon (Saunders et al. 2009).

The main data sources for the literature review were academic papers, gathered from different databases. The databases were used for accessing to the full-text articles of the journals. Databases, which were used:

- IEEE Xplore
- Science Direct
- Google Scholar
- ProQuest

The numbers of articles are showing the fact that the phenomenon is relatively new and there are not many articles found in different databases. Table 1 illustrates the number of articles found in the databases above with the search term "Agile Business Intelligence". However, Table 1 is showing the number of articles, which have produced after the year 2009. In addition, different databases containing the same articles which have not yet excluded from Table 1.

Table 1. *Number of Articles Found from the Databases*

Database name	***Article count***
IEEE Xplore	5
Science Direct	6
Google Scholar	115
ProQuest	174

For example, the search term "Agile Business Intelligence" produced only five results from IEEE Xplore database. However, there was one literature review conducted by Knabke & Olbrich (2013), which was conceptualizing the agility in business intelligence and it was formalizing a basis for the further investigations for the thesis. In addition, Muntean & Surcel's (2013) article founded with the same search term from ProQuest database and the article was giving a good overview of agile business intelligence and its enablers. Furthermore in Table 2, the different publications have divided into different years.

Table 2. *Number of Agile BI Publication Per Year*

Year	***IEEE Xplore***	***Science Direct***	***Google Scholar***	***ProQuest***
2009	1	0	3	1
2010	0	0	11	12
2011	0	0	11	30
2012	1	4	9	29
2013	0	0	9	15
2014	0	0	15	52
2015	2	0	25	22
2016	1	2	32	13

As can be seen from Table 2, the number of the publications regarding agile business intelligence increases after the year 2010. This indicates the fact that agile business in-

telligence has gained more attention in the recent years and therefore the literature review has been focused on the recent year publications of agile business intelligence.

In order to get more profound knowledge of agility in business intelligence context, the publications which used literature review as a research method were one of the good starting points to gather more relevant publications. The total amount of the publications was limited based on the language and form of the publication. The language criterion means that only publications that were written in English were included under investigation. In addition, the form of the research was related to the factor that only conference papers and academic articles were included, which meant that patents, books etc. were excluded. The third filter was related to the text availability: only full-texts were considered in the research. This was a major improvement to the search results giving more outlined results of the researches. For example, the amount of publications in ProQuest was after filtering 74. In addition with the same filter, the amount of publications in Google Scholar was reduced to approximately 70 publications as well.

The next filter was related to the researcher's own selection criterion which based on the validity of the publications for the thesis. The first criterion was related to the title of the filtered publications. If the title was related to business intelligence and agility, it would require more attention. The titles that were considered to be relevant were then moved to the "potential" folder. The criterion helped to filter out irrelevant publications and formalized a strong baseline for the used literature. For example, advanced analytics (such as predictive analytics and data mining) articles were not considered to be relevant to the thesis due to those articles did not answer to the research questions properly. The second selection criterion for the filtered publication was the abstract of the publication. The abstracts were focused on more deeply after the publications have flowed to the "potential" folder for further investigation. After the selection, the amount of so called baseline articles was reduced to ten articles which formalized a sample for the investigation. The amount of articles after filtering is shown in Table 3.

Table 3. *The Amount of Filtered Articles Founded from the Databases*

Database name	***Article count***
IEEE Xplore	3
Science Direct	1
Google Scholar	5
ProQuest	2

One of the key data gathering methods which were used was called a Snowballing method. It is a commonly used method when it is difficult to identify different aspects of the phenomenon (Saunders et al. 2009). In the method, the researcher uses leads that provide more information on the subject that is under investigation (Tuomi & Sarajärvi 2002, p. 88). The key element for Snowballing is to use the reference list of a paper or the citation to the other papers in order to identify new useful research papers (Wohlin 2014). In the thesis, the method proved to be a good solution for identifying different research papers and get more comprehensive understanding about agile business intelligence literature. Snowballing could benefit not only look for the reference list and citations but also complement it in a systematic way of looking for the place and the context where the writers of the papers use the citation (Wohlin 2014). The Snowballing process is described in Figure 4.

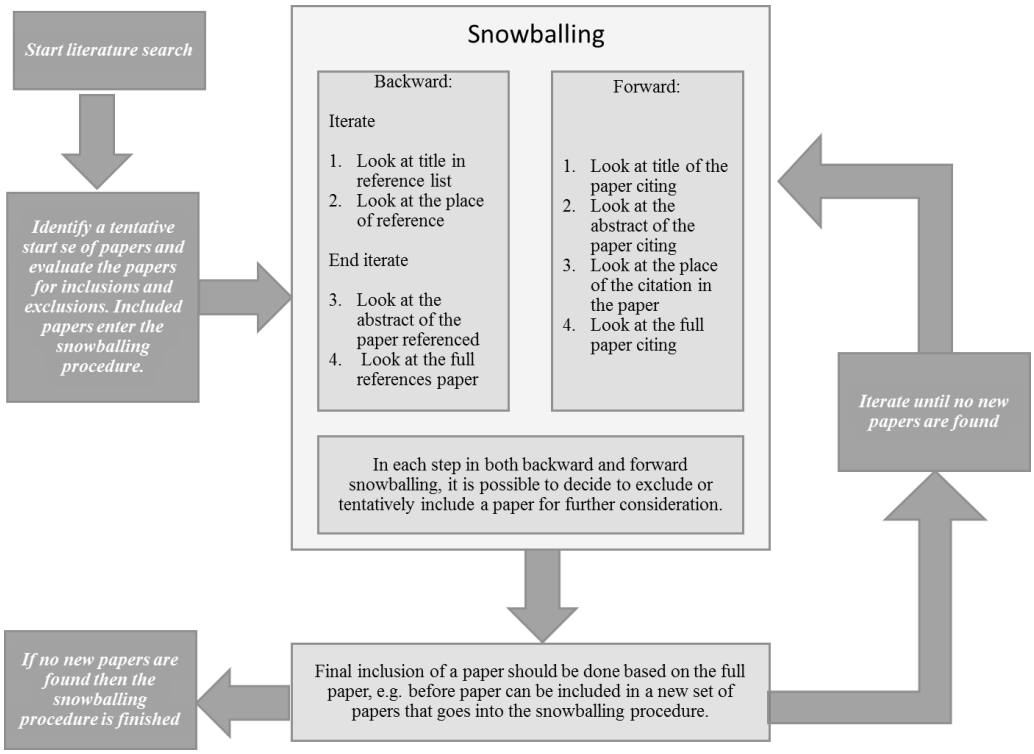

Figure 4. *Snowballing Process (Adopted from Wohlin 2014)*

The process starts with the sample gathering of the papers. In this thesis, the sample was evaluated with the topic of the paper and the abstract of the paper. There are two ways to conduct the Snowballing process which are referred to backward and forward Snowballing (Wohlin 2014). In the thesis, the main process was called a forward Snowballing, which refers to identifying new papers based on those papers which are under investigation in the first sample. The method helped to review different definitions of agility in the information systems and business intelligence context. These definitions have gathered in Table 5 (introduced in Chapter four). The definitions helped to investigate further the enablers and those enablers could be then reflected on the definitions.

Hence, enablers were investigated if those are contributing the definitions of agile business intelligence.

Overall it can be said that the method was a suitable data gathering method, especially if the subject or the phenomenon is quite new and the researcher wants to get more comprehensive understanding about its components. The method showed that there are many factors (such as mobile BI and Cloud BI) that are relating to the concept of agile business intelligence. These factors have been introduced in the third chapter. With the Snowballing method it is easier to get leads about the topics around the phenomenon as described above and hence it can generate more specified search terms for the research (Wohlin 2014). In the thesis, the forward Snowballing helped to refine search terms in order to get more specific content for the research. For example, the search term "Agile Business Intelligence" that was mentioned above gave an overall description of the publications. However in order to get more detailed information, the refined search terms needed to take into account. The used search terms to get more profound information about the enablers were formalized based on the sample but also on the literature, which have founded with the Snowballing technique. The used search terms were:

- "CLOUD" AND "BUSINESS INTELLIGENCE"
- "IN-MEMORY" AND "BUSINESS INTELLIGENCE"
- "MOBILE" AND "BUSINESS INTELLIGENCE"
- "REAL-TIME" AND "BUSINESS INTELLIGENCE"

The search terms above gave detailed information about the enablers in the agile business intelligence context. The founded publications were mainly academic, but also contained commercial publications conducted by different IT vendors or consultant agencies. This gave a better picture about the technologies such as in-memory databases.

Empirical Investigation

The systematic literature was the first part of the study, which gave an understanding about agile business intelligence and the different enablers which enhance the agility in business intelligence. The second part of the thesis was related to the empirical investigation of business intelligence agility in the SAP BI landscape. The first part for data gathering was related to the investigation of SAP in general, including the investigation of the SAP's product portfolio. In general terms, the overview was formalized by investigating SAP's website, which gave a brief introduction to the SAP BI landscape and product portfolio.

The second part of the empirical investigation was related to our organizations internal training materials in the SAP context. The materials were gathered from SAP portal, where access is provided by our organization. The materials were in the form of the

training videos and handbooks giving introduction for SAP's different components in the context of business intelligence. Furthermore, those materials contained different learning rooms, giving more insight about the newest trends in the SAP context including different handbooks, which were utilized in the thesis. The training materials such as handbooks and videos were context specific, which meant that one handbook was relating to the one product of SAP or a couple of the components of SAP products. Hence, analyzing the material was quite time-consuming due to the data was qualitative by its nature.

The empirical investigation was not only limited to the SAP portal, which provided training videos and handbooks. To get more holistic view of the SAP BI landscape, the different commercial publications were taken into account which included comparison between the different business intelligence vendors and their BI platforms in order to get the more objective opinion of the different enablers in SAP system landscape. In addition, to get more non-biased understanding about the SAP BI landscape, the research included publications that were produced by other organizations than SAP. The search terms that were used to get more non-biased information were:

- "SAP HANA" AND "BUSINESS INTELLIGENCE"
- "SAP HANA" AND "IN-MEMORY"

The data sources for empirical investigation were selected based on the SAP BI landscape and therefore it was natural selection to utilize the organization's material bank to get a deeper understanding about different enablers for agility in the SAP BI landscape. However as stated previously, commercial researches are included in the investigation due to organization's training material may give the biased results of SAP possibilities to enable agile business intelligence.

2.2 Analyzing Methods

As stated above, the data sources constitute of qualitative content including handbooks, videos and academic papers. The analyzing method that has been chosen for the thesis constitutes of a content analysis. The content analysis can be related to the hermeneutics due to philosophy suggests ways to understand qualitative data (Mayers 1997). With the content analysis, the data sources can be organized and classified systematically without losing any critical information (Tuomi & Sarajärvi 2002, p. 105). Traditionally content analysis has been used to analyze texts, but according to Bell (2001, p. 15) the analyzed text is determined according to the source or media, which means that text does not need to be in written format. Hence, the video content can be analyzed using the content analysis as well.

The content analysis can be done in the deductive way, which means that the theory is tested in the specific context (Tuomi & Sarajärvi 2002, pp. 95-99). In the thesis, this approach is suitable due to the first part investigates the literature in agile business intelligence context, which then is reflected on the SAP landscape. According to Anttila (1998), content analysis can be a powerful tool, which can provide new information and insight in the research context. In addition, the qualitative investigation is based on interpretation where the gathered data is dismantled into different components and then reconstructed to logical entities (Tuomi & Sarajärvi 2002). This has proven to be a suitable approach in the thesis where the articles were reviewed and then classified into different components of agile business intelligence enablers.

The first part of the content analysis was related to the sample papers, which founded using the search terms mentioned in the previous section. The sample papers are read carefully through and the citation to the other papers are examined in the context of agile business intelligence. Once relevant citations were found, then the titles of the referred articles were evaluated. If the title of the cited paper was insufficient for decision-making, the abstract of the citing paper is studied more detail manners (Wohlin 2014). Usually, the abstracts of the papers are giving an introduction of the paper in order to get comprehensive understanding about the content of the paper.

The second part related more detail analysis of the selected papers: while reading the papers, the main points were highlighted from the papers. This helped further classification of different aspects of agile business intelligence. However, the classification was done after the full paper was read and selected for the review. A useful strategy is to include feature maps, tree constructions, content maps, taxonomic maps or concept maps (Wohlin 2014). This meant that the different aspects of agile business intelligence were mapped into a concept map. Before the mapping, the different papers were classified to the different folders based on the enablers that the publications were contributing. The used folders were:

- “Mobile BI”
- “Agile Architecture”
- “Overall Concept of Agility in BI”
- “Cloud BI”

This helped to construct the concept map which was based on the different enablers and aspects of the agility in business intelligence. In addition, the classification gave a better overall picture of the different enablers and it was easier to revise the articles which were classified based the enablers.

When the enablers for agile business intelligence from the academic point of view were identified, then those enablers were reflected on SAP BI landscape. The selected training materials were based on the literature review of the overall concept for agile busi-

ness intelligence due to the training materials are related to the different components of SAP. The analysis of the material followed the same principles as in the literature review. However, the subjects of handbooks and videos were studied first which gave an overview of the material. The material classification was also based on the concept map, which gave a baseline for investigation in SAP landscape. When the analyzing the videos, the key points were summarized of the video on the paper.

The content analysis and Snowballing have proven to be suitable methods of conducting the research in the thesis. However, the problems of bias can be huge due to all the gathered data is based on the researcher's own selections and evaluations (Saunders et al. 2009). For example, the relevancy of the certain academic papers was based on the researcher's own justifications, which may cause bias in the research results. In addition, the training materials are SAP-oriented, which may give too optimistic picture of the SAP BI enablers for agile business intelligence. However, all the gathered researches were critically evaluated based on the research objectives and research questions and this may reduce the bias of the result and the selected studies (Kitchenham & Charters 2007). In addition, when the SAP BI landscape was investigated, the third-party publications were taken into account due to those may give more objective view of agile business intelligence in SAP BI landscape.

3. BUSINESS INTELLIGENCE

This chapter gives an overall picture of business intelligence activities which are related to the usage of terms in business intelligence. At more detailed level, the different concepts and terms are related to the descriptions of the traditional business intelligence architecture, processes and overall understanding about the business intelligence concept. Thus, this chapter is defining what traditional business intelligence means giving an insight of its basic components.

3.1 Defining Business Intelligence

Business intelligence, usually referred as a BI can be seen as an umbrella term for the various terms, tools, techniques, technologies and processes. The term business intelligence was introduced by Howard Dresner, whose definition of the business intelligence was relating to the *means to explore, access and analyze data, located in a specific repository called data warehouse.* The goal was that the analyzed data will generate insights which will help on decision-making. The different aspects of business intelligence include data warehouse ad-hoc queries, reporting, online analytical processing, called OLAP (Nylund 1999). Hence, business intelligence can be seen as an umbrella term and there is not an unambiguous explanation for the term business intelligence.

Although, Dresner's concept was introduced almost 30 years ago, the underlying objectives and assumptions are nowadays still the same: the main objective for business intelligence is to support and enhance decision-making using the collected data from different sources (Krawatzeck et al. 2015; Turban 2001). According to Rouhani et al. (2012), there can be seen two different approaches towards business intelligence:

1. Managerial approach, which focus is on the improvement of the decision-making from the management point of view.
2. Technical approach, which is focusing on more in the business intelligence tools that support decision-making process

Data is one of the most valuable resources for an organization in order to make reasonable decisions and thus, it is forming a baseline for the decision-making (Rouhani et al. 2012). Hence, business intelligence can be seen as a data-driven approach to make decisions. Instead of the above, classifications are seen as different directions, which can be a complement of each other: the technical approach can be interpreted as an enabler to the enhance decision-making and fulfilling the managerial approach. So, if business intelligence observed from the comprehensive point of view, BI can be seen as a pro-

cess in which the raw data is gathered, analyzed with the help of technology and used on decision-making (Sangari & Razmi 2015).

The term business intelligence can be characterized as a vague term that does not have unambiguous definition for business intelligence and therefore, the similar terms can be found, which are related to business intelligence. For example, in the North America, the researchers have discovered that competitive intelligence, referred as CI is used to describe the external sources of information and the term BI is seen as a technical-driven concept (Cottril 1998; Moss & Atre 2003; Vibert 2004). On the other hand, European literature emphasizes business intelligence to be an umbrella term for different terms such as CI, market intelligence (MI) and strategic intelligence (SI) (Rouhani et al 2012). However, terms MI and SI have narrower purposes than business intelligence, where market intelligence is related more to the concept of marketing and sales while strategic intelligence encompasses the organization's strategic position and its direction in the future (Pirttimäki 2007). Hence, these terms are used in more specific context than business intelligence. According to Pirttimäki (2007) some of the scholars discuss and contribute competitor intelligence which aim is to gather and analyze information about the competitors from the external data sources. In Figure 5, the different terms, competitor intelligence, competitive intelligence (CI) and business intelligence (BI) relations have been introduced.

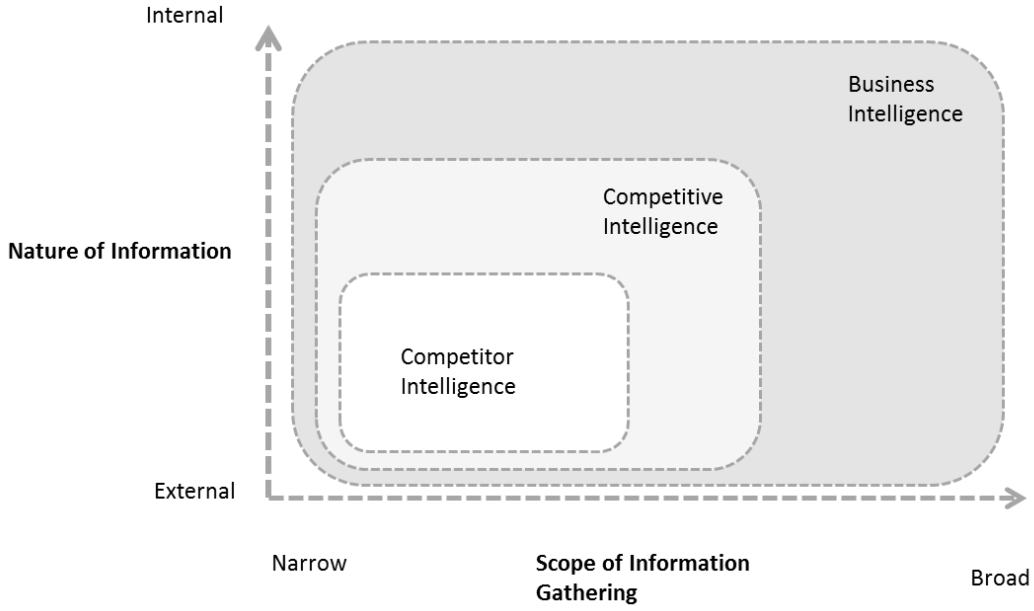

Figure 5. *Relations Between Competitor Intelligence, CI and BI (Adopted from Pirttimäki 2007)*

Competitive and competitor intelligence are focusing on mainly on the external environment, but however as can be seen from Figure 5, the content of business intelligence, is more extensive than the others. Competitor intelligence is seen as a sub-concept for CI due to CI is considered involving competitive and market information in addition to

competitor information (Obeidat et al 2015; Pirttimäki 2007). According to Miller (2001), the term competitive intelligence is wider: CI includes competitor information but also information about organization's own positioning in the markets. Hence, this means that the CI definition is not only consider external information but internal as well which indicates that definition is then more closely related to business intelligence definition. This is one of the justifications, why the BI concept is seen as an umbrella term for many others as discussed previously.

Organizations need internal and external data for the decision-making. However, the data can be characterized to be qualitative or quantitative by its nature. Structured data can be characterized as a quantitative data which can be directly processed with computing equipment which means reporting, data mining or OLAP tools. Traditional business intelligence has been heavily relied on structured data, which is analyzed more traditional methods (Isiki et al. 2013). According to Baars & Kemper (2008) this is the easy part and the challenge will be in analyzing the unstructured data, for example customer's emails, web pages with competitor information and sales force reports. Due to increasing number of the BI applications, the analysis of unstructured data is needed more than in the past and thus, usage of unstructured data can be seen nowadays as a critical component (Isiki et al. 2013). Figure 6 compresses the different BI aspects in the shape of a cube, where three different dimensions can be seen: information source, information subject and information type (Hannula & Pirttimäki 2005).

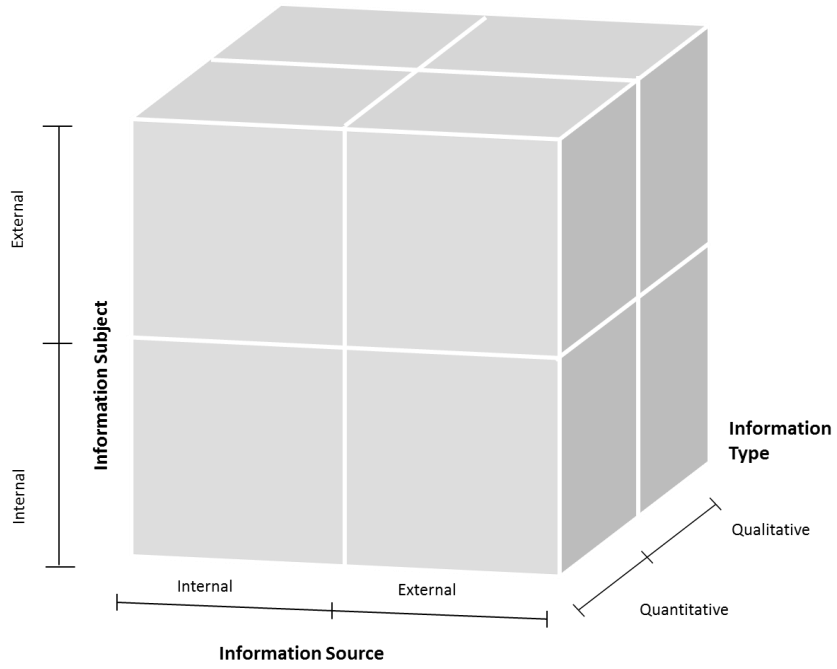

Figure 6. *Information Cube of BI (Adopted from Hannula & Pirttimäki 2005)*

Z-axis is referring to the information type, which can be classified as qualitative or quantitative information. (Hovi et al 2009). Quantitative information means information is located in different information systems of organizations, such as Enterprise Resource Planning (ERP) system or Customer Relationship (CRM) systems. This type of information can be seen as a basic source for business intelligence due to it is characterized as structured and numerical information. This type of information is stored in the relational databases and data warehouses, which enables information integration from multiple sources (Hovi et al. 2009). In addition, quantitative information can be gathered from external information sources (X-axis) such as stock prices which are also numerical data, but gathered from outside of the organization (Hannula & Pirttimäki 2005). The example can also be related to the information subject (Y-axis): if gathered stock prices are not related to the company itself, then it is seen as external information. Numerical information is the basis of business intelligence systems and usually the data is aggregated and constructed into OLAP cubes (Isiki et al 2013).

The second aspect of Z-axis is related to the qualitative information, which has been classified as unstructured, containing information about the competitors and the markets (Hannula & Pirttimäki 2005). Sources for this type of information are usually related to the external sources such as newspapers, market research reports (Hovi et al. 2009; Isiki et al. 2013), but according to Figure 6 information sources for qualitative information can be internal as well (Hannula & Pirttimäki 2005). Moreover, this type of data usually has not been stored in the traditional ways to the data warehouse due to it cannot be aggregated or extracted in the same ways than quantitative data (Isiki et al. 2013). Qualitative information can be linked with Pirttimäki's (2007) definitions of the competitive intelligence. In addition, these characteristics have been recognized on behalf of other scholars as well (Hannula & Pirttimäki 2005; Lönnqvist & Pirttimäki 2006; Rouhani et al. 2012; Watson 2009). Hence as per Figure 6, information has multiple dimensions and organizations need both internal and external information with the quantitative and the qualitative elements of itself but also from its competitors in order to make comprehensive decisions in the business context.

As a conclusion can be said that the term business intelligence can be examined from the different perspectives and the definition has different meanings based on the demographic elements. This means that business intelligence can have different meanings in the different geographical locations, which is causing lack of coherency in the general definition. However, the term business intelligence can be seen as an organized and systematic process by which *"organizations acquire, analyze, and extract information from both internal and external information sources in order to enhance their decision-making and thus, acquired and analyzed data will lead to the insights"* (Lönnqvist & Pirttimäki 2006; Rouhani et al. 2012). Thus, business intelligence is relating to the information and knowledge describing the business environment, the organization itself,

and its situation in relation, to its markets, customers, competitors, and economic issues (Rouhani et al. 2012).

In this thesis business intelligence is defined as *a wide range of applications, technologies and processes for gathering, storing, analyzing data to help members of organizations to gain insights in order to make better decisions* (Larson & Chang 2016; Lönnqvist & Pirttimäki 2006; Rouhani et al. 2012; Sangari & Razmi 2015; Watson 2009). Hence, this means that business intelligence goal is to support decision-making inside the organization and the term is not limited only for the internal data sources but covers the external data sources as well.

3.2 Business Intelligence Process

Usually, business intelligence can be seen as a systematic process of leveraging data on decision-making (Sharma & Dijaw 2011). Hence, business intelligence consists of the different set of sub-processes which enable the efficient decision-making. These sub-processes including acquiring, analyzing and leveraging the information from internal and external information sources in order to achieve more effective decision-making inside the organization (Lönnqvist & Pirttimäki 2006).

The traditional business intelligence solutions and processes are serving managers in order to make better and faster decisions at strategic, tactical and operational levels. This process is described as a cycle among different researchers (Laihonen et al. 2013; Lönnqvist & Pirttimäki 2006; Pirttimäki 2007; Rouhani et al. 2012; Vitt et al. 2002) The business intelligence cycle can be seen in Figure 7.

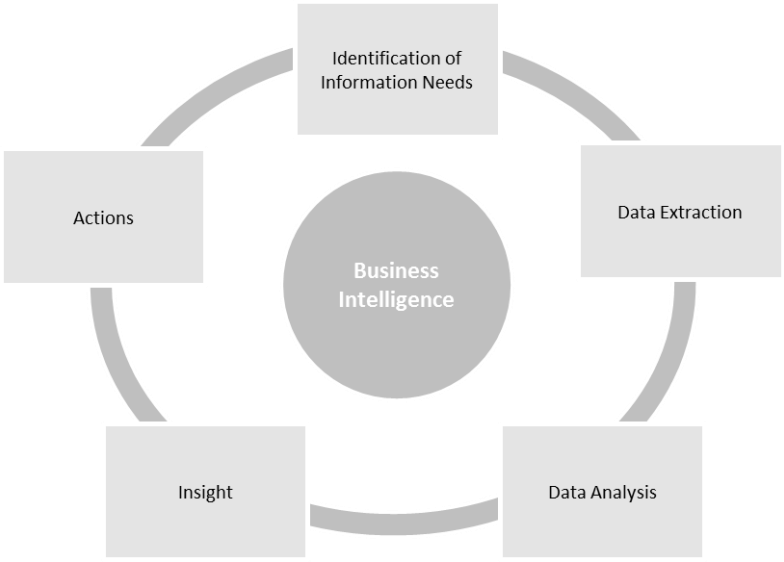

Figure 7. *BI Cycle (Adopted from Laihonen et al. 2013; Vitt et al 2002)*

Figure 7 is describing different steps of the business intelligence cycle. The first phase in the cycle is the identification of information needs. In the first phase, the necessity of needs is identified (Lönqvist & Pirttimäki 2006). According to Laihonen et al. (2013), the first phase is critical due to in this phase the unwanted information is filtered out, which means organizations do not store irrelevant data into centralized repositories. Furthermore, the accurate identification facilitates the more efficient usage of information as well (Lönqvist & Pirttimäki 2006). This phase is also really important when the data volumes are really high, because with specified information needs, organization can also reduce their data management cost and simplify their database structures.

The second phase is the data extraction where the wanted data is extracted from multiple heterogeneous information sources. Traditionally, these information sources contain explicit, structured information which is usually quantitative by its nature (Laihonen et al 2013). The extracted data is stored in the centralized repository where the data is organized and indexed around different subjects and data models which are meaningful to the users. The third phase is called the analysis where the extracted information is analyzed by using the business intelligence tools and reports.

Data which is extracted from the different sources and analyzed with the different business intelligence tools leads to insights (Vitt et al. 2002, p. 34). These insights are usually the means to improve organizations operations. According to Choo (2002), these actions usually lead to the adaptive behavior which means organization is corresponding for the changing competitive environment. In addition, BI cycle can be seen as a continuous cycle which intention is to improve the performance of organizations constantly with different iterations.

3.3 Business Intelligence Architecture

According to Thierauf (2001), building the appropriate data and information infrastructure and architecture that are related to data warehouse and data marts are essential for business intelligence functions. The typical business intelligence architecture on an enterprise level consists of an enterprise data warehouse (EDW), including smaller data marts, which consolidate data from different operational databases of source systems. The term data warehouse was introduced by Devlin and Murphy in 1988. According to Devlin & Murphy (1988), the data warehouse is single logical storage that contains all the data which is needed in reporting and decision-making. Hence, the data warehouse is a centralized repository where the data is stored. According to Turban (2001), the goal for the data warehouse is to establish a data repository that makes operational data accessible and after the data is stored into the data warehouse, it can be utilized on decision-making. In addition, scholars have been using terms data warehouse and data warehousing, where the first is describing the central repository defined by Devlin and Murphy (1988) and the latter is describing the whole process in which data is processed

into more suitable and coherent form and then it will be more feasible for decision-making (Chaudhuri & Dayal 1997; Hovi et al. 2009; Ong et al. 2011; Watson & Wixom 2007).

Moreover, the different scholars have acknowledged data warehousing process to be one of the key success factors for business intelligence. Hence, many different researchers identify BI architecture to be the key component for business intelligence (Baars & Kemper 2008; Balaceanu 2007; Chaudhuri & Dayal 1997; Chen et al. 2012; Dayal et al. 2009; Hovi et al. 2009; Ong et al. 2011 Shariat & Hightower 2007). However in this thesis, the term data warehousing is referring to the business intelligence architecture (or BI architecture), which means that the focus is on the whole process turning data into information and not only storing the data into the data warehouse. Furthermore, BI architecture landscape can vary a lot due to diverse information system landscape in organizations and BI architecture has been described in many different ways in the current literature (Shariat & Hightower 2007). Still, there can be seen some patterns that can be identified from BI architecture landscapes, which have been recognized among the researchers. The most common parts in the BI architecture are source systems, data storage (e.g. EDW, Data Marts), reporting tools which are used for decision-making (Dayal et al. 2009; Turban 2001). Usually in large companies the term data warehouse is replaced with the term enterprise data warehouse (EDW) which is seen as a large central repository for all the data at a corporate level. The idea is to gather and integrate all the relevant information into the one location where it is usable for various purposes (Hovi et al. 2009).

In addition, Ong et al. (2011) introduced the multi-layered business intelligence architecture which has been adopted from different scholars' views (e.g. Baars & Kemper 2008; Shariat & Hightower 2007). However, there can be seen some congruence between the researchers' views. This means that different researchers have acknowledged to same critical elements of business intelligence which are related to source systems, data warehouse and reporting tools. Ong et al. (2011) want to add scholars' existing BI architecture views that the data mining, predictive analytics and data visualization should be included into end-user layer. The business intelligence architecture is described in Figure 8, which illustrates the different layers of the business intelligence architecture, which are: data source layer, ETL layer, Data warehouse layer, end-user layer and metadata repository. Those layers are described in more detailed manners in the next section.

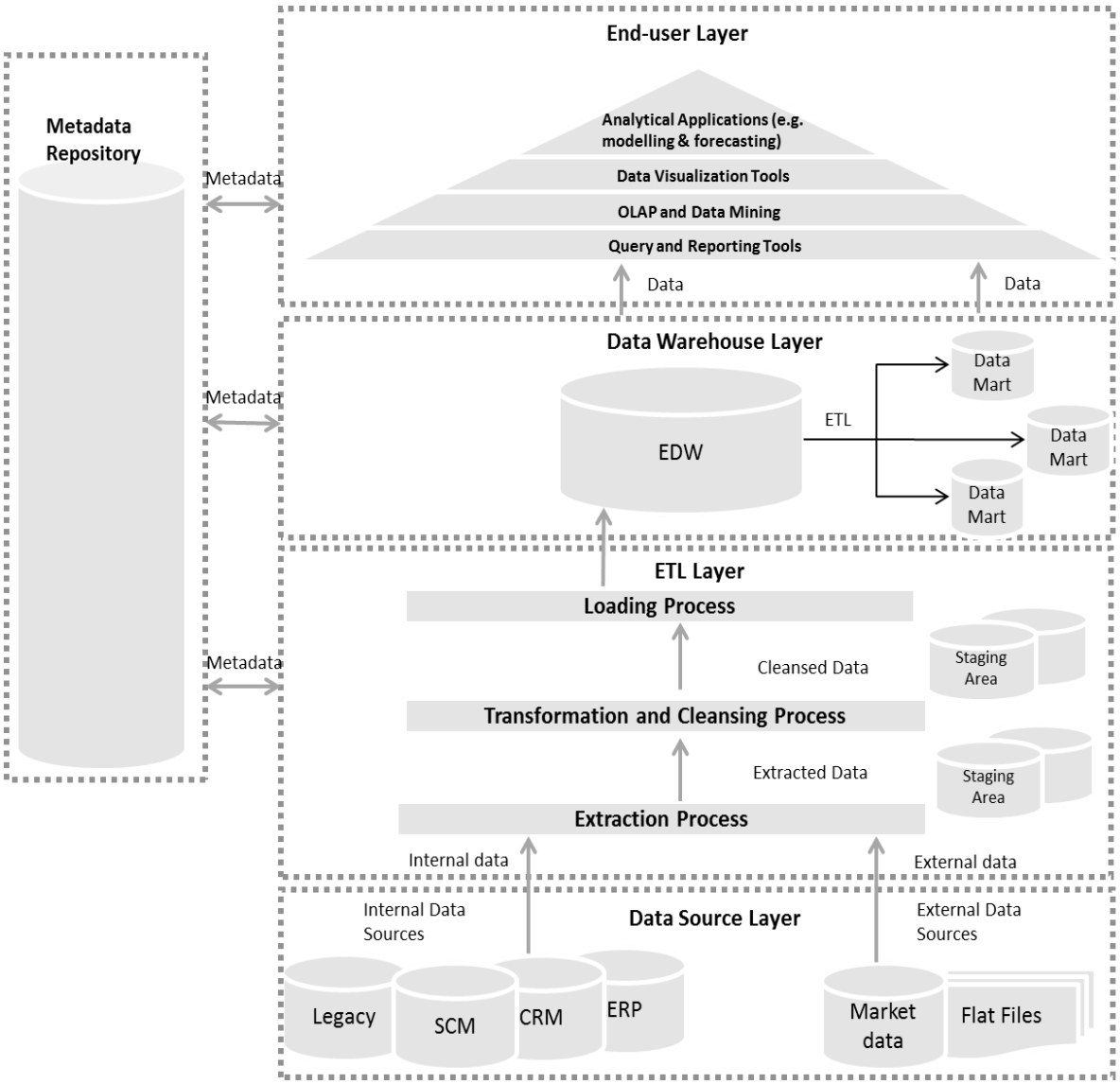

Figure 8. *Business Intelligence Architecture (Adopted from Ong et al. 2011; Shariat & Hightower 2007; Turban 2001)*

Data Source Layer

As discussed previously, a data warehouse is one of the core components for business intelligence and data warehouse is a collection of corporate information which is derived from operational systems and external data sources (Chen et al. 2012; Turban 2001, p. 143). According to Balaceanu (2007), the source systems are not really part of business intelligence landscape, but the information systems form a basis for the entire business intelligence architecture and for the usage of the gathered data on decision-making. Dayal et al. (2009) add, because of the systems usually are heterogeneous, data needs to be integrated and transformed into the same format in order to ensure coherency of data. In addition, the data which is in the operational systems is usually characterized as structured data (Shariat & Hightower 2007). These data source systems are often called Online Transaction Processing (OLTP) systems. From these systems the data is

periodically extracted, cleansed, integrated, transformed, and loaded into a data warehouse (Vitt et al. 2002). The main function of the operational systems is to support users' day-to-day working activities in the organization (Hovi et al. 2009; Shariat & Hightower 2007).

ETL Layer

The term ETL is getting more attention among business intelligence scholars than among traditional database scholars (Dayal et al. 2009). This justifiable due to ETL (Extract-Transform-Load) is one of the key elements for using cleansed and coherent data on decision-making. The ETL-process can be characterized as an own process which purpose is to extract, transform and load the data into a data warehouse from different source systems (Baars & Kemper 2008; Vitt et al. 2002). According to Ong et al. (2011) ETL can be described as an own layer, which is containing three main processes introduced above.

The extraction process contains both external and internal data sources but however, the extraction process needs to be carefully planned due to data volumes in the operational systems are high and all of the data might not be relevant to decision-making. This means that organization needs first to identify the relevant information needs as described in the previous chapter. In the traditional business intelligence architecture, the extracted data flows to temporary storage which is called a staging area (Hovi et al. 2009). According to Ong et al. (2011) this process occurs prior to the transformation process and this can be called as a phase one in the ETL-process. The first phase of the ETL-process is critical due to users must be able to decide which data is relevant from the source systems (Loshin et al. 2013, pp. 191-195). Usually, users do not want to extract all of the data from the source systems because it may not be relevant or not even cost-effective for the decision-making.

The second phase of the ETL-process is called transformation, where data is converted into a uniform format enabling better reporting and analysis. In addition in the transformation phase, the business logic and the rules are defined in order to guarantee the consistency of the extracted data in the organizations (Hovi et al 2009). According to Davenport & Harris (2007), the transformation process is not that streamlined process than the extraction or loading due to it needs more definitions about the usage of the data and more coordination between the business and IT departments. For example, there can be legal bindings which do not allow collect data from certain user groups (i.e. users which age is under 18) (Hovi et al. 2009). Also, the transformation phase could be time-consuming process due to different source systems contain different types of data and it can be challenging task to integrate and transform data in to the same format. The last part of the process is the loading which means that the transformed and cleansed

data is loaded into data warehouse and it is can be then used in the reporting (Ong et al. 2011).

Data Warehouse Layer & End-user Layer

In the traditional business intelligence architecture, there can be seen two different components in the data warehouse layer: an EDW and a data mart. As discussed previously, EDW stands for an Enterprise Data Warehouse containing the different types of data which is serving the whole organization (Hovi et al. 2009; Ong et al 2011). Shariat & Hightower (2007) include in this definition that data warehouse is a logical collection of integrated information designed and gathered from many different operational data sources to support management decision-making. Due to the complexity of EDW, some organizations want to divide the data into smaller subsets which are stored into data marts. Usually, these subsets contain information from the specific area. For example, a marketing data mart may include information about the customers, products, and sales but may not include delivery schedules (Chaudhuri et al. 2001).

The difference between the source systems databases and the EDW is in the form of data and the structure of these repositories. The source systems are storing the real-time or near real-time data which is usually stored in the operational database which uses normalization and entity-relationship model (Balaceanu 2007). These systems are called Online Transaction Processing (OLTP) systems. Chaudhuri et al. (2001) add that OLTP allows organizations to collect large data volumes from daily business (e.g. point-of-sales data). In contrast, the data in the enterprise data warehouse is denormalized, summarized, and stored in dimension-based. This type of data is optimized for reporting and analysis using historical and aggregated data on decision-making (Online Analytical Processing, or OLAP). Usually, when organizations are using the OLAP technology it is referred to as a cube in order to describe the multidimensionality of the data which can provide more depth into analysis of the data due to different functionalities of the cubes (e.g. drill-down function) (Hovi et al. 2009). In Table 4, the main differences between OLAP and OLTP are introduced.

Table 4. *Differences Between OLTP and OLAP (Adopted from Hovi et al. 2009; Plattner 2009; Chaudhuri et al. 2011)*

	OLTP	***OLAP***
Users	• IT Professionals	• Knowledge Workers
Function	• Support the Day-to-Day Operations	• Decision Support
Usage	• Repetitive	• Ad-hoc
Data	• Current • Up-to-Date • Detailed	• Summarized • Historical • Multidimensional • Consolidated
Data Representation	• Rows	• Columns (stored as Star Schema or Snowflake Schema)

The main users for OLTP systems are IT professionals whereas OLAP system primary users are knowledge workers. Moreover, the OLTP systems data is mainly current-up-to-date transactional data which is also called real-time data. In the OLAP systems, the data is historical (i.e. data from last month), multidimensional and aggregated containing drill-down functions. OLTP systems like ERP system prefer write-optimized structures and OLAP systems need read-optimized data to achieve better query performance (Knabke & Olbrich 2011). Hence, the row representation of the data is more common in operational systems (OLTP systems) and column-oriented storage suits better for OLAP systems such as BI systems.

In addition, the end-user-layer can be seen as a BI portal or some BI application which uses data from EDW or from the data mart (Shariat & Hightower 2007). These applications are representing the data in the form of reports, dashboards or data can be accessed with some different data mining tool (Hovi et al. 2009).

Metadata Repository

Metadata management is also acknowledged among business intelligence researchers. According to Turban (2001), metadata provides information about the content of the data warehouse and it includes a guide for moving data in the data warehouse. Shariat & Hightower (2007) define metadata to be a collection of rules and direction that guide ETL-process and data flow into EDW. Hence, the metadata is not only containing technical information about the data, but also business information as well as business rules (Davenport & Harris, 2007).

The fact that metadata is not only relating to the technical information can be seen in Chaudhuri et al. (2001) and Ong et al. (2011) classifications about metadata. Chaudhuri et al. (2001) divide metadata into three different categories which are administrative metadata, business metadata and operational metadata. Ong et al. (2011) include these classifications in their own publication, but they have included also OLAP metadata which is providing descriptions about the structure of the cubes, dimensions and hierarchies which are used in reporting. As discussed previously, OLAP stands for Online Analytical Processing which means a concept for multidimensional analysis of the aggregated quantitative data which is usually related to the business functions such as revenue and profits (Baars & Kemper 2008). Hence with help of OLAP tools, user can get more flexibility around data regarding dimensions of the facts. This means that users can group and classify the data with different dimension, for example to see how much revenue was in last December. Moreover, the reporting metadata is used to store reporting templates and also this metadata contains information about different queries (for example how to join data from different tables).

3.4 Summary

The concept of business intelligence has been defined from various perspectives and usually business intelligence has been seen as an umbrella term for the different subconcepts. The chapter gave first an introduction to the term for business intelligence contributing the terms competitive intelligence, competitor intelligence and business intelligence. According to the different researchers, the term business intelligence is usually seen as the broadest covering the different terms above (Pirttimäki 2007). However, in some demographic areas the term business intelligence is mainly covering the technical perspectives while the competitive intelligence related more to the processes and to the managerial approach.

In the managerial approach business intelligence is seen as a process, which main purpose is to identify information needs, gather data from internal and external sources and turn the data into information. Usually, the analyzed data will lead into new insights, which enhance the decision-making in organizations (Laihonen et al. 2013; Lönnqvist & Pirttimaki, 2006; Rouhani et al. 2012; Vitt et al 2002). Also from the technical point of view, business intelligence is seen a set of tools and technologies which are enabling the decision-making in the organizations. Technologies are related to the source systems (OLTP systems), data warehouse, data marts, OLAP cubes, dashboards. OLTP systems contain operational data which is supporting daily activities in the organizations. From the source systems data is extracted, transformed and loaded in the repositories called data warehouse or data marts (Dayal et al. 2009; Shariat & Hightower 2007). Usually, the data which is coming from the internal source systems such as ERP or CRM is structured by its nature (Baars & Kemper 2008). Data locating in the data warehouse is historical, aggregated which is used in reporting. In addition, a powerful tool for analyz-

ing the data is OLAP (online analytical processing) technology which aggregate and group data and construct multidimensional element for the data giving more flexibility for the queries.

However, the different approaches above can be seen to complement of each other. The technical approach is providing the tools for supporting the business intelligence process introduced in the managerial perspective (Sangari & Razmi 2015). In addition, the goal for both approaches is to provide actionable information to support decision-making in the organization. Hence, business intelligence is seen as *a wide range of applications, technologies and processes for gathering, storing, analyzing data to help members of organizations to gain insights in order to make better decisions* (Larson & Chang 2016; Lönnqvist & Pirttimäki 2006; Rouhani et al. 2012; Sangari & Razmi 2015; Watson 2009).

4. AGILITY & BUSINESS INTELLIGENCE

The chapter is giving more detailed information about agility in business intelligence. First section is describing the different levels of business intelligence giving insight how the usage of the data at different levels has been changed. The second section is discovering the link between the agility and business intelligence, answering the question "what agility means in the context of business intelligence." The last part of the chapter is focusing on the different technologies and methodologies that enable agile business intelligence. In addition, in this part the benefits of the technologies and methods in the context of agile business intelligence are introduced.

4.1 Requirements for Business Intelligence at the Different Levels

Nowadays, there is less and less time to make reasonable decisions, which are based on data. According to Hughes (2013), the study has shown that 43 percent of enterprises are finding it harder to make timely and reasonable decisions based data after a business event or a business need occurs. This means that organizations need to be able to react more quickly to the changing business needs with the help of technology. Traditionally, business intelligence is seen as a combination of technologies and processes which are supporting the tactical and strategic decision-making and it has been reactive in nature and based on summarized and historical data (White 2005). However, operational business intelligence is providing more options to make faster decisions in real-time.

Usually, the traditional business intelligence has been characterized as a tool for the managers in order to make strategic decisions and steer the course of the organizations (Thierauf 2001). Pirttimäki (2007) has depicted the different levels of business intelligence and divided those levels into three different categories: Strategic intelligence, Tactical intelligence and Operative intelligence (Figure 9). The classifications have derived from Thierauf's (2001) classifications, where strategic business intelligence is the most extensive level and operational intelligence is the most specific level of business intelligence.

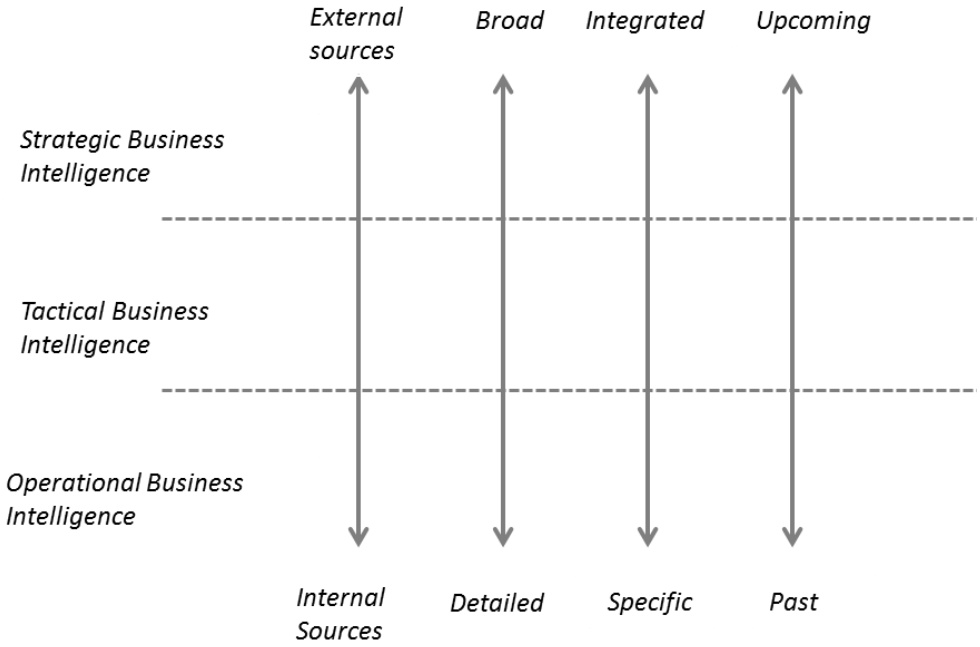

Figure 9. *Different Levels of Business Intelligence (Adopted from Pirttimäki 2007)*

In operational business intelligence, the timeframe for data is narrower than for example in strategic business intelligence (Thierauf 2001, p. 66). This means that the decisions which are based on operational data are more time-critical and the decisions are focused on the daily operations. Also data for operational business intelligence is coming from internal source and data itself is detailed and specific by its nature. Usually, the operative business intelligence systems are called OLTP systems which are utilizing transactional data from different source systems such as from ERP system (Vitt et al. 2002). In addition in the framework (Figure 9), operational business intelligence is based on the historical data which main goal is to fulfill the daily activities in the organizations (Pirttimäki 2007; Thierauf 2001). Furthermore, the traditional BI is aiming to fulfill the top management needs with relevant information, which is supporting tactical and strategic decision-making (Bucher et al. 2009). Moreover, traditional business intelligence has previously answered the question "What have happened", but now with more sophisticated systems and methods business intelligence can answer the questions "What is happening now" and "What is the most likely to happen" which rely on the fresh and more real-time data gathered from the operational systems (Tank 2015).

However according to the different researchers, operational business intelligence is relating to the current situations in the organizations and hence operational business intelligence uses a fresh real-time data on the decision-making (Chaudhuri et al. 2011; Watson 2009; White 2005). Hence, this means that operational business intelligence is not that tightly related to the historical data as described in the Pirttimäki's (2007) & Thierauf's (2001) illustration. Operational business intelligence has been introduced in order

to organizations can make more agile decisions in the faster pace (Tank 2015). This means that the paradigm has shifted from the managements' supporting systems to the operational activities which are using the OLTP systems on decision-making (Bucher et al. 2009). For example, local store managers can focus on operational decision-making that supports daily activities while the top management requires a view of overall business at a glance. In the example, both needs are however derived from the operational systems which are relating to transactional data (Gossmann 2013). Thus, the main purpose is to reduce the time which has spent during the decision-making process.

As discussed above, nowadays operational business intelligence represents a new era in the decision-making. In the past, the strategic and tactical decision-making activities were in the center of the decision-making in the organizations (Pirttimäki 2007). However, those are still important components for business intelligence, but operational business intelligence has gained more attention due to the emergence of the technologies which are enabling the better usage of the OLTP systems in the decision-making (Deloitte Tech Trend Report 2014; Stodder 2013). Hence, this so called real-time business intelligence would be beneficial for organizations at the tactical and operational levels (Tank 2015). However, as stated the strategic BI is still needed in the organizations: it can be utilized in the introduction of a new product line, while tactical business intelligence enables the decisions which timeframe is from a couple of months to a year and these decisions can be related to the new resource allocation for the new project (Eckerson 2007). Hence, operational BI provides low level decision-making information for the relevant person in order to enhance day-to-day business operations (Sharma & Prasad 2014). The user who needs the information may not be in the management level, it is more relevant that the analyzed information helps the user in the daily activities. Thus, this means that business intelligence is not nowadays only a managerial tool: it helps broader user group to enhance decision-making. In the research, this direction is called pervasive business intelligence, which is including all of the user groups in the organization to the decision-making process, which operational business intelligence enables (Cognini et al. 2014; Watson 2009).

Figure 10 characterizes the different situations between strategic, tactical and operational business intelligence. The number of decisions increases when organizations are making more operative decision but the value of the single decision is not high as at the strategic or the tactical level.

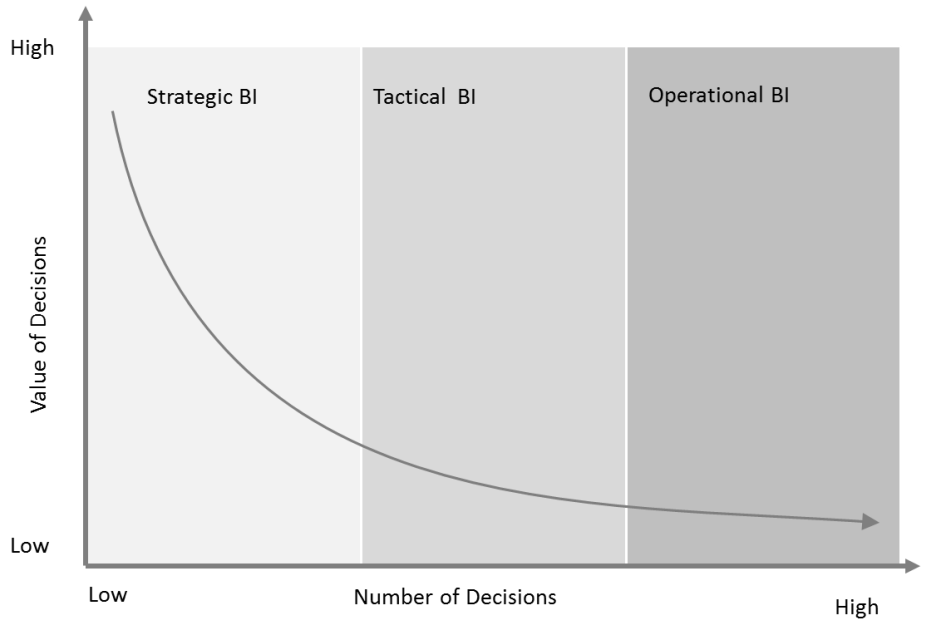

Figure 10. *Operational BI Supports Lower-value Decisions Than Tactical or Strategic BI (Adopted from Eckerson 2007)*

The operational decisions must be made rapidly before the problems escalate into bigger events or the opportunities are missed (Eckerson 2007). Hence, these operative business intelligence systems must provide insight to the decision-makers while the event is occurring due to immediate actions can be taken. Usually these systems are also called real-time decision support systems, which can facilitate operational and tactical decisions and might even enhance strategic decision-making (Power 2011). However, in the TDWI research, the organizations main goal is to shorten the decision cycles, which has seen as crucial matter in order to achieve the competitive advantage (Stodder 2013). This means that organizations need to meet the customer expectations and preferences more timely manners. In the Stodder's (2013) research this means that the most of the decisions are based on the operational decisions in order to be more proactive in the decision-making.

Furthermore, the real-time business intelligence will benefit the most the operative levels in the organizations due to it supports organizations day-to-day operations (Power 2011). In addition, the usage of the real-time data can help eliminate gaps within the business and being able to show the information in faster pace (Tank 2015). Hence, organizations that can analyze data and turn data into information sooner and more frequently, will realize advantages over the organizations that are locked into slower decision cycles. A good example is related to the campaign management: with the help of real-time business intelligence, users can discover more rapidly if the launch of the campaign has a positive influence in the revenue in a wanted segment. Furthermore, delays in decision-making can yield to the missed opportunities, higher costs, and reduced productivity (Stodder 2013; Tank 2015). However, the faster decision-cycle can

be achieved with the emergent technologies and new methodological choices introduced in the next chapter.

Overall, it can be said that the real-time decision-making is more critical and hence operational business intelligence is gained more attention among the researchers, but among the business intelligence vendors as well. The one of the related trends that enables faster and more accurate decision-making is so called self-service business intelligence. According to Weber (2013), self-service business intelligence is giving methods to all the workers – regardless their position in organization – to access data required to support decision-making in the organizations. Imhoff & White (2011) define the self-service BI as a BI environment that enables users who need information to become more independent without the need to rely heavily on IT organization. The definition does not characterize who the user is: it might be a person who needs operational data or it might some user from executive level. In addition, business intelligence systems are increasingly being used by end-users and users who need to leverage the operational information in the decision-making (Ng et al. 2013). Hence, the future business intelligence systems need to be designed in a way that people who have not deep experience in the technical and analytical terms can still use these systems in order to support their daily activities.

Thus, the goal is to make BI applications accessible to the wider crowd in order to enhance their decision-making. Business intelligence vendors and industry experts have recognized that the goal of business intelligence is to eliminate problems, which are related to the usage of the real-time data on decision-making but as well as lowering the cost of reporting and analysis by providing the data for the right people (Obeidat et al. 2015). This means that nowadays the goal of BI is not only to support managers' and executives' information needs, which are more strategic and tactical by its nature but also support the operational decision-making as well.

4.2 The Different Aspects of Agility in Business Intelligence

According to Knabke & Olbrich (2013), the term "agility" has been observed before it was related to the business intelligence concept. For example, agility has been related to the different functions in organizations. Bi et al. (2013) discuss organizational agility from the perspective of IT and supply chain. Also agility has seen to have a centralize role in the manufacturing for a decade (Pankaj et al. 2009). This means that agility is not only related to information systems and it can be associated with different areas in business.

The agility concept was introduced by Fowler and Highsmith (2001) to the software development practice. Their publication "The Agile Manifesto" contains 12 different principles. However, the method is describing an overall agile concept in the software

development and according to the Manifesto's 12 principles, it can be described as methodology for giving best practice or a framework towards more agile software development. Those 12 principles are introduced below (Management Institution of Finland 2015):

1. Satisfy the customer through early and frequent delivery
2. Keep development cycles short
3. Working software is the primary measure of progress
4. Welcome changing requirements, even late in the project
5. Business people and developers work together daily throughout the project
6. Build projects around motivated individuals
7. Place emphasis on face to face communication
8. The best results emerge from self-organizing teams
9. Continuous attention to technical excellence and good design
10. Promote sustainable development phase
11. Simplicity is essential
12. Team reflects regularly where and how to improve

The 12 principles seem to be universal and are not related to any specific system development concept which means that those principles can be applied to the different systems development practices. In addition, due to the principles do not give any specific context where principles can be applied and therefore, those can be utilized in the business intelligence systems. Furthermore the principles are best practices or a framework, which may have been one of the success factors for implementing them into BI context as well (Muntean Surcel 2013).

According to the studies, the concept of agility is also quite vague and there is not only one right answer to its definition (Conboy & Fitzgerald 2004; Salmela et al. 2015). In the Oxford dictionary, the term "agility" means "the ability to move quickly and easily" (Oxford dictionary 2016) which is only one form of many different definitions for agility (Knabke & Olbrich 2013; Pankaj et al. 2009). Although the different scholars are discussing information system agility (Conboy & Fitzgerald 2004; Pankaj et al. 2009; Salmela et al. 2015), but the principles of agility in information systems can be applied to the business intelligence systems as well due to business intelligence systems can be considered as information systems. The justification for this is that the information system is a conceptualized combination of human and IT components which are operating in context of organization (Byrd & Turner 2000). In addition, information systems and business processes are tightly linked together and therefore, the organizational agility is synchronized with information systems agility (Pankaj et al. 2009). Knabke & Olbrich (2013) add that the strategic value of agility in information systems for the organization can be extended to describe agility of business intelligence domains as well. Hence, if organizations information systems cannot be adaptive and respond to the changing envi-

ronment, the effectiveness of organizations business processes may be compromised. In addition, agility of information systems can be a hard task to overcome, especially if organizations have grown through mergers, which usually means that organization has multiple old legacy information systems, which are not seen as a basis for agility (Reddy & Reddy 2002).

Agility of the information systems means that information systems need to have ability to respond to the changes including reactive and proactive characteristics of the response (Knabke & Olbrich 2013). In addition, Pankaj et al. (2009) highlight real-time element for the information system agility and time is specified as an attribute of analyzing and responding to the change. In addition Obeidat et al. (2015) have acknowledged real-time to be one of the critical factors of agile business intelligence. Table 5 encompasses the different definitions for agility in business intelligence and information system context.

Table 5. *The Definitions of Agility in Business Intelligence and Information System Context (Adopted from Knabke & Olbrich 2013)*

Year	***Author(s)***	***Definitions***
2004	Conboy & Fitzgerald	Agility means "proactively or reactively" to respond to changes "through high quality, simplistic economical components," which are in tight relationship with the environment.
2005	Dove	The definition for agile information systems is linked with "responseability," or the ability to both proactively and reactively respond to the changes in the environment.
2007	Oosterhout, Waarts, van Heck & van Hillegersberg	"Agility entails an innovative response to an unpredictable change."
2009	Pankaj, Hyde, Ramaprasad & Tadisina	"An agile information systems defined as one that can sense a change in real-time, diagnose the change in real-time, select a response in real-time, and execute the response in real-time."
2010	Yellowfin	"Agile Business Intelligence (BI) is about an organization's ability to adapt its BI program to meet the changing needs of the business and its operating environment. Agile BI incorporates both a technical and process-oriented approach to managing the delivery of BI projects and Agile BI is about responding to the immediate needs of the BI user, rather than working to establish and deliver ALL potential reporting needs upfront."

2011	Evelson	"Agile business intelligence is an approach that combines processes, methodologies, organizational structure, tools, and technologies that enable strategic, tactical, and operational decision-makers to be more flexible and more responsive to the fast pace of changes to business and regulatory requirements."
2012	Zimmer, Baars & Kemper	"Agile business intelligence the ability to react to unforeseen or volatile requirements regarding the functionality or the content of a BI solution in a given time frame."
2012	Poonacha & Bhattacharya	"Becoming 'agile' was considered to be the response of an enterprise to the increasingly competitive and uncertain business environment." These uncertainties are classified to the three different group for manufacturing but they can be reflect to the information system context as well: 1. Supplier uncertainty is related to uncertainty of human resources with the necessary competency of the subject. 2. Demand uncertainty can be linked with uncertainty of change requests in the user context. 3. Operational uncertainty is related to different processes and practices which need to be followed when developing different systems and software.
2013	Baars & Zimmer	"BI agility is the ability to efficiently and quickly react to changes in foreseen or unforeseen requirements based on structural and behavioral characteristics of the BI system as well as anticipating changes proactively."
2013	Muntean & Surcel	"Agile means ability to be adaptable and agile business intelligence solution should provide access to accurate information in the right format to the right person at right time."
2015	Baars & Hütter	"Agility means the ability to react to both foreseen and unforeseen events, the speed and timeliness of theses reaction, and their efficiency. " In the survey, conducted by the Baars & Hütter, the response time among the respondents was valued really high.
2015	Salmela, Tapanainen, Baiyere, Hallanoro, Galliers	Information system agility has divided into four different streams: streams (IT infrastructure, IS development, IS personnel and IS organization). The most suitable definitions for agile IS appears in the first two: • Infrastructure flexibility: "the ability of the IS department to respond quickly and cost-efficiently to systems demands."

		• IS development: "The continual readiness of an ISD method to rapidly or inherently create change, proactively or reactively embrace change, and learn from change while contributing to perceived customer value."
2016	TDWI (The Data Warehousing Institute)	"Agile business intelligence addresses a broad need to enable flexibility by accelerating the time it takes to deliver value with BI projects. It can include technology deployment options such as self-service BI, cloud-based BI, and data discovery dashboards that allow users to begin working with data more rapidly and adjust to changing needs."

There are quite many similarities between the definitions above. First, agility can be characterized to react and respond rapidly to the change (Baars & Hütter 2015; Dove 2005; Pankaj et al. 2009; Salmela et al. 2015). It can be some changing information needs or a new development requirement related to the business intelligence systems (Muntean & Surcel 2013; Salmela et al. 2015; Zimmer et al. 2012). Pankaj et al. (2009) add to the definition the real-time element which usually means turning data into information in a smaller timeframe. The goal for real-time business intelligence solution is to reduce the latency between acquiring the data from the operational systems and performing the analysis over the acquired data (Chaudhuri et al 2011). However, according to Evelson's (2011) and TDWI's (2016) definitions, agile business intelligence is more than a new name for the concept where data is transformed into information in real-time or respond to the changing information need more quickly. It represents the new concept in business intelligence enabling new opportunities with the rising technology trends to process and use the data more agile manners. In addition, those definitions also giving insight to the methodological and project management side regarding agility (i.e. how business intelligence projects can be managed more agile manners).

In Figure 11, the different aspects of agile business intelligence are described. Figure 11 is describing two different streams for agile business intelligence, which have found in the literature. Those streams are agile methodologies (e.g. Scrum) and agile technologies. Agile technologies have been divided into different sub-classes, which are focusing on more specific technologies. Furthermore, most technology components are linked each other constituting agile architecture for business intelligence. In addition, these different streams can be seen as enablers for the faster decision-making and also giving tools to respond to the changing requirements in business intelligence environment.

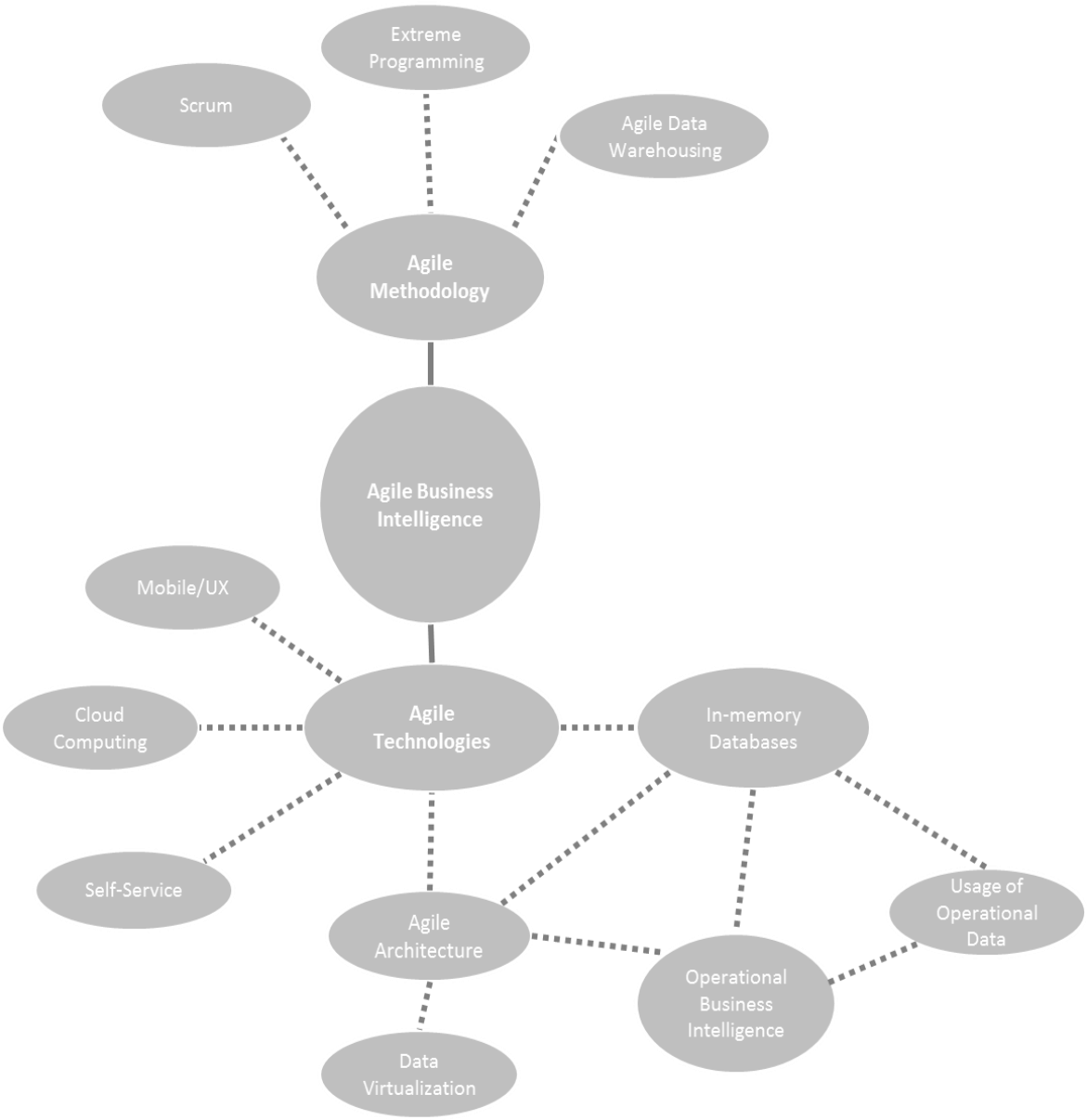

Figure 11. *Different Aspects of Agility in Business Intelligence (Adopted from Munteanu & Surcel 2013; Sangupamba Mwilu et al. 2015; White 2005; Watson 2009; Zimmer et al. 2012)*

Agile architecture can be also included in the technology side, but here the agile architecture is wanted to illustrate as a separate box due to it is quite significant enabler for business intelligence agility. Agile architecture is covering also the infrastructure side which means the different type of servers and appliances which are one part of the architecture (Muntean Surcel 2013). In the following sub-chapters the different aspects of agile business intelligence are highlighted and also these sections are describing the agility enablers for business intelligence.

Operational Business Intelligence as an Enabler for Agile Business Intelligence

As stated previously, the main focus of the traditional business intelligence has been on the historical and aggregated data which is located in the data warehouse systems. However, the concept of business intelligence has been changed with the emergence of technologies (such as in-memory databases) which have helped for capturing, storing, processing and using real-time and transactional data on decision-making. The usage of the real-time transactional data is called also operational business intelligence (Chaudhuri et al. 2011). Furthermore, the business users in organizations have been acknowledged that there is a demand for more accurate and timely data. In order to get more time-critical data, nowadays the technologies are making it possible to deliver data that is only minutes old for the decision-making (Watson & Wixom 2007). Moreover, real-time data can enhance solutions that directly affect the organizations' ability to compete in the changing business environments (Watson 2005).

This has opened more doors for business intelligence and now the focus has been shifted from historical data to the real-time operational data which not only influence to the monitoring the operations, but also current operation can be influenced in real-time with the transactional data (Watson 2009). This means that operational business intelligence becoming more important factor to the side of traditional business intelligence, which has served more strategic and tactical decision-making. Moreover, the user group for operational business intelligence is not limited to the manager, it delivers value and insights on demand for all workers in order to the critical business objectives can be achieved faster (Eckerson 2007). Hence, operational business intelligence provides an alternative solution for operational decision-making.

In addition, the one of the key factors which have led to the usage of the real-time data on decision-making is the competitive pressure of business: organizations need to be able make decision more rapidly at a fast pace with the "hot" data or need to able to re-engineer their operations based on the changing requirements (Chaudhuri et al. 2011; Tank 2015). Hence, there is a need for real-time business intelligence due to employees do not have the most recent information in order to make the operational decisions in agile and rapid manners.

The goal of operational business intelligence is to reduce the latency between the operational data is acquired and when it is analyzed. Furthermore, the biggest goal is to react to the change more rapidly by making faster and more agile decisions which can lead to the better customer value and increased revenue streams (Chaudhuri et al. 2011; Tank 2015). According to White (2005), operational business intelligence have proactive and reactive elements: the main objective of operational business intelligence is to react faster to the business needs but also anticipate upcoming problems and make decisions in advance before the problems will escalate into major risks. Thus, the underlying as-

sumption for the goal of the operational BI is the same in both cases: to reduce latency in turning data into information.

According to the Watson (2009), the usage of the operational data in business intelligence will create a new chapter for business intelligence due to the paradigm and underlying assumptions in business intelligence have been changing towards more agile decision-making. As stated previously, the organizations need more timely and more real-time data in order to make more agile and faster decisions (Tank 2015). To understand the value of the real-time business intelligence, Hackathorn (2004) has provided a model which is described in Figure 12.

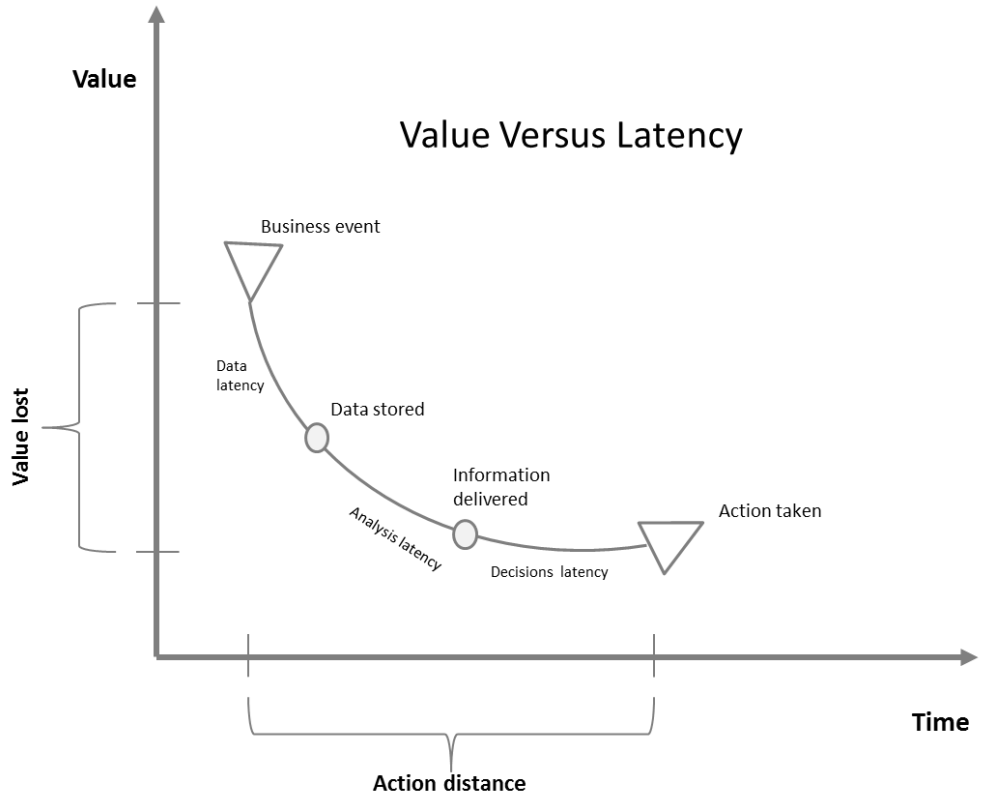

Figure 12. *Action Time and Business Value (Adopted from Hackathorn 2004; Watson 2009)*

Turning data into valuable information for organization causes latency on decision-making. Low latency (e.g. fresh) data has more value than high latency data (Tank 2015). X-axis in Figure 12 describes the business value of a certain business event. The business value increases from operational to the strategic decision while the amount of decisions decreases (Eckerson 2007).

The starting point in Figure 12 is called a business event. A business event is an event which occurs in a business process and it requires some response. Action then will reply to the event and the reply occurs after the business event (Hackathorn 2004). Action

distance or action time is the amount of the time that passes between the business event and actions taken. If the distance increases, more value is lost (Watson 2009). For example, if the customers are requesting some information or asking change request to the system, action distance describes the time which is needed to fulfill the request for the customer. This means that the longer the action distance is, the longer the latency will be and the less business value accrues to the organization. According to Hackathorn (2004) the action distance can be divided into three different components: data latency, analysis latency and decision latency. The first one is the time it takes for the business intelligence system to gather data and store it in the data warehouse. The analysis latency means the time between retrieving the data from the data warehouse and delivering the analyzed data for the business users. The final component is the decision latency which means the time that it takes to make a decision based on the analyzed information which has retrieved from the data warehouse. (Hackathorn 2004; Tank 2015 White 2005.) In addition, the first two of the components can be minimized with the usage of the new operational or real-time business intelligence technologies (Watson 2009). The reduction of the decision latency is more challenging and typically it is related to the cognitive capabilities of the employees and organizational structures and bureaucracy manners.

Hence, operational business intelligence can be assimilated with the concept of agile business intelligence due to the goal of operational business intelligence is fulfilling the definition of agile business intelligence. For example, Evelson's (2011) definition for agile business intelligence was: "*Agile business intelligence is an approach that combines processes, methodologies, organizational structure, tools, and technologies that enable strategic, tactical, and operational decision-makers to be more flexible and more responsive to the fast pace of changes to business and regulatory requirements."* This means that we can consider operational business intelligence to be one of the enablers for agility in the context of business intelligence.

4.3 Agile Methodologies in Business Intelligence

According to Knabke & Olbrich (2013), many researchers have raised the question how the business intelligence systems can respond to the changing requirements caused by business environment. In addition as per the previous section, agile business intelligence definitions include agile methodologies as part of agile business intelligence concept in order to gain more responsive actions towards changing requirements in the business environment (Evelson 2011; TDWI 2016). Moreover, according to 45 percent of respondents in the survey - conducted by TDWI (The Data Warehouse Institute) - the reporting requirements are changing at least monthly (Stodder 2013) which means that organization needs to be able to adapt to these changes.

These agile methodologies are referring to the software development methodologies based on the Fowler and Highsmith (2001 publication “The Agile Manifesto”. The different characteristic of these methods are: collaboration between different teams, iterative development and adapting for the changes (Muntean & Surcel 2013). Stodder (2013) highlights the collaboration between business (often called users) and IT professionals. The main point is that the different groups jointly refine the requirements for the business intelligence system development in order to understand better the usage of the data in the business contexts.

There are different methods such Scrum or Agile Data Warehousing, which can be utilized in information system development in order to enhance agility of the system implementation and development (Rehani 2011). The use of Scrum is the best know agile methodology for the software development (Krawatzeck & Dinter 2015). The main components of Scrum are so called user-stories and sprints. User-stories are the requirements, which are needed to add into the business intelligence system. For example, a user story can be a requirement for the changing reporting requirement, which is needed to take into account in the future. Sprints are a given timeframe of the development cycle which shortens the cycle dividing the bigger change requests into the smaller ones. (Hughes 2013). Agile Data Warehousing can be seen as a hybrid of two agile development methodologies: Scum and Extreme Programming which are addressing the challenges in DW and BI context (Muntean & Surcel 2013).

In addition according to Muntean & Surcel (2013), the most of the business intelligence projects fulfill the same principles then traditional information system projects and therefore agile software development characteristics of the information systems can be applied to the business intelligence projects as well. However, the agile methodologies for business intelligence system development are less mature than in software development. Still, many organizations want to utilize these methodologies due to those have proven to remove the wait and waste, which occurs in the traditional data integration process (Stodder 2013).

The implication of agile principles to the business intelligence system has gained significance among the researchers as well. According to Krawatzeck & Dinter (2015), the research is focused on the utilizing of the agile methodologies in the development of the business intelligence systems. These methodologies are more related to the project management side such as Scrum and Agile Data Warehousing. Agile methodologies are well suited in the business intelligence context due to traditional development methods have several shortcomings. The one of the best known traditional methodologies is called the waterfall approach. According to Muntean & Surcel (2013), the waterfall method does not give any agility in the development of business intelligence systems. For example, the method is showing inflexibility towards the analytical changes and also the development cycles are long. In addition, the projects which are utilizing the

waterfall methods are characterized to be too time-consuming and not delivering the expected value or the benefits (Stodder 2013). Hence, the waterfall method does not show any agility for business intelligence due to according to Evelson (2010) the purpose of agile business intelligence is to:

1) Develop new capabilities for business intelligence systems in faster pace.
2) React more quickly to changing requirements in business environment.

From these goals can be seen that agile business intelligence methodologies are not different than any other agile development methodologies, which are based on the Agile Manifesto's 12 principles. For example, Golfarelli et al. (2012) and Hughes (2013) have discussed about using users-stories and Scrum for developing the business intelligence solution. In addition, researchers have compared the usage of agile development methodologies and waterfall development methods. Rehani (2011) has found out that using the agile methodologies instead of the traditional waterfall method in business intelligence systems development will reduce the risk of failing in the delivering the project. This is related to user engagement which is done in the earlier stage than in the traditional waterfall method. Also flexibility will increase because of the development is done in a smaller bathes and there are more iterations than in waterfall methodology (Rehani 2011). Hence, agile methodologies for business intelligence are an important concept for developing systems in terms of time and flexibility.

Thus, according to the different researchers and practitioners, the usage of the agile software development methods will increase agility in the business intelligence system development as well. Dasgupta and Vankayala (2007) were using Scrum as a development method and a process model to maintain a real-time business intelligence system. The conclusion of the project proves that the Scrum enhances agility in the context of business intelligence. The same result was found in the Rehani's (2011) results which indicate that the usage agile development methodologies have potential to increase agility in business intelligence.

4.4 Enabling Technologies for Agile Business Intelligence

The landscape of business intelligence is growing with the new emerging technologies such as cloud computing, mobile business intelligence, self-service business intelligence and real-time business intelligence using in-memory databases (Chaudhuri et al 2011). These new technologies are focusing on the better ways of delivering data and getting the business intelligence applications to the hands of users more rapidly than the traditional business intelligence solutions. In addition, according to Deloitte's Tech Trend Report (2014) these technologies are seen as a next wave for enabling better agility in business intelligence solutions. The most common factor for all of these technologies is that those are seen as enablers for agile business intelligence which are enhancing the

real-time business intelligence. These emerging technologies have dived into subcategories which are giving more insight about the technology itself in the business intelligence context.

Cloud Computing in Business Intelligence

Many different researchers see the cloud computing on the technical terms by emphasizing virtualization (Chaudhuri et al. 2011) while the others separate the cloud computing from the technology point of view and highlight the internet service provision, which is close to the concept called Software-as-a-Service (Baars & Kemper 2010). In the SaaS concept, the applications are provisioned which is helping the deployment of the applications and gives more agility to business intelligence. (Heino 2010, p. 53) Hence, the most common concept to business intelligence from the cloud computing perspective is seen from the infrastructure side (called Infrastructure-as-a-Service) or from the software point of view (SaaS). However, Sangupamba Mwilu et al. (2015) add that Platform-as-a-Service (PaaS) is possible for business intelligence. Usually when BI tools are moved to IaaS or PaaS platforms, the main purpose is to leverage the scalability of these platforms. When organization is utilizing the SaaS solution, then we are discussing about utilizing the BI tools from the cloud which is affecting the accessibility of the different BI tools from the cloud.

Business intelligence from the cloud is one of the new ways to build business intelligence solutions. According to Deloitte's Tech Trend Report (2014), the adoption of the cloud technology is growing rapidly, but the cloud technologies are not seen as a total replacement for the on-premise solutions. However, more and more of the solutions can be utilized from the cloud and different vendors are providing business intelligence as a service, which is so-called Software-as-a-Service (SaaS) model (Ouf & Nasr 2011).

Cloud technologies can provide more agility and flexibility for business intelligence systems. One of the factors for enabling agility with cloud technologies is the flexible access to the system due to these technologies are always online, which is crucial for users (Ng et al. 2013) in order to guarantee the continuity of the service. This means that cloud computing has a lot of potential for its on-demand network access and its function as an enabler for agility has been noticed among the organizations (Sangupamba Mwilu et al. 2015). In addition regarding the SaaS model of the cloud BI, these solutions are easy to access via any web browsers, which user wants to choose (Ouf & Nasr 2011). Hence, this concept is referring to the term "BI Anywhere" which means that the user could access to the information via web browser while data is located on the multiple remote servers.

The second concept regarding business intelligence from the cloud is relating to the virtualization which allows the virtual servers to be hosted in the cloud, providing the better allocation of resources and accurate results more rapidly than on-premise solu-

tions (Obeidat et al 2015; Sangupamba Mwilu et al 2015). The one of the biggest benefits of the virtualization technology from the cloud is the more focused usage of the hardware resource which has led to the lower cost of the system management (Chaudhuri et al 2011; Obeidat et al. 2015).

Cloud BI can produce many different benefits for organizations. Obeidat et al. (2015) mentioned that the biggest benefits are scalability and flexibility. The scalability means that the cloud computing has seen as a way to quickly scale up or down and adapt to the changing requirements, which is feasible in agile manner (Baars & Zimmer 2013). In addition, Ouf & Nasr (2011) have acknowledged the flexibility is one of the key factors for agility. For example, the cloud can be a good option for ad-hoc analysis which requires a specific data for supporting decision-making. In order to fulfill this need, sometimes organization have created a new data mart which may not be the most cost-efficient solution, especially if the need is a short term (weeks or months) by its nature. The other use case for the cloud business intelligence solution can be to demonstrate the proof of concepts (Ouf & Nasr 2011) which is hosted from the cloud in order to reduce the development time and enhance the user experience of the solutions for the customers. Hence, it can be said that the deployment cycles of cloud BI are faster than in on-premise solutions.

Despite the fact that the business intelligence solution or software is running in the cloud, the integration with back-end systems is still possible (Ouf & Nasr 2011). Also, organizations need to be aware of the risks of migrating data into the cloud. In some cases, the usage of the cloud might not be the best fit for organizations. For example, if organizations tend to have so called sensitive data that cannot be outsourced for the cloud environment (Obeidat et al. 2015) and for this reason a good solution for this issue may be in private clouds which hold more control over security than so called public clouds. In addition, different techniques for processing queries on encrypted data in public cloud are really important matter in order to achieve greater security (Chaudhuri 2011). However, organizations need to be sure that investments in the private cloud will benefit the organizations in the future due to the investment cost can be high in comparison with the public cloud option (Heino 2010, pp. 208-215).

As discussed previously, there are many benefits for using the cloud technologies in the context of business intelligence in order to enhance agility. However, the recent studies show that, the half of the respondents does not have any plans for implementing the cloud BI technologies. Hence, this might be due to the organizations are still in the early stage of business intelligence (Stodder 2013). However according to Demirkan & Delen (2013), some progress can be seen towards cloud business intelligence and many of the organizations are in the process of building BI systems that are utilizing data and information as a service. Utilizing Data-as-a-Service has gained significance among the researcher as well (Sangupamba Mwilu et al. 2015). This means that complete EDW can

be designed to use cloud solutions using the pay-per-use concept which provide scalability to the solution due to on-demand usage of the EDW (Demirkan & Delen 2013; Sangupamba Mwilu et al. 2015).

In-Memory Business Intelligence

In-memory business intelligence is related to the software or an application that utilize the in-memory database (Ivan 2014). According to the Deloitte's Tech Trend Report (2014), the revolution of in-memory databases has been seen as one of the biggest enablers for agile business intelligence. In addition, the same possibilities have been acknowledged among the researcher and according to Knabke & Olbrich (2015a) research, the in-memory technology can be a technology enabler for agile business intelligence. With the help of the emergent technology, the paradigm has shifted from analytical systems to the transactional systems. Unlike traditional OLAP servers, in-memory databases rely on different set of techniques for achieving good performance. The technology is providing an opportunity for OLAP engines focusing on exploiting main memory of the database to make response times for ad-hoc queries shorter (Chaudhuri et al. 2011). Muntean & Surcel (2013) add that the main function of in-memory business intelligence is to replace and eliminate traditional disk-based technologies which have been related to the relational databases and OLAP systems. Furthermore, decision support by the business intelligence systems will move away from the historic reflections to steer the future direction of organization using real-time data (Knabke & Olbrich 2015a).

With the help of the in-memory technology, organizations can analyze the bigger amount of data on real-time and for example, to generate add-on sales and create on-demand customer value (Deloitte Tech Trend Report 2014). The in-memory technology is different from the traditional business intelligence from the architectural point of view: the data is not pre-processed, extracted nor aggregated to the data warehouse or into OLAP cubes. Instead, the data is loaded into database memory where it can be provided for the users more rapidly (Hovi et al. 2009, p. 105). Moreover, if we compare the in-memory database with the conventional data warehouse, the relational data warehouses use physical hard drives to store the data. Instead keeping the data on the physical hard drive, the in-memory database systems store data permanently in the main memory, which makes the access faster than with the data warehouse systems (Knabke & Olbrich 2011).

In-memory technologies are changing the basic architecture of the database by replacing the disk storage with Random Access Memory (RAM), which is nowadays possible due to the prices of RAM has been falling. The second factor is relating to the operating systems where the 64-bit operating system is becoming more common, which enables the bigger memory sizes that accelerate the processing (Chaudhuri et al. 2011). The

biggest benefit is related to the speed of query processing using in-memory databases, which according to the vendors is over 3000 times faster to the previous technologies processing speed of the transactions (Deloitte's Tech Trend Report 2014). In addition, according to Knabke & Olbrich (2015a), the researchers have identified significant reductions in time required for information retrieval when using the in-memory database.

However, the in-memory database solutions may not be total replacement for the data integrations and data warehouses: it will provide one solution for agile business intelligence, especially if data is coming only one source such as ERP due to it does not require then any integration or data consolidation (Hovi et al. 2009, p. 105). However, with the single or just a few data sources, the in-memory database also enables the real-time data usage without conventional data warehouses. In addition, traditionally data warehouses have focused on storing the quantitative data but now the different aspect regarding the external data sources and unstructured data such as social media have seen to create new potential value for organization (Chen et al. 2012; Knabke & Olbrich 2015a). According to Muntean & Surcel (2013), the in-memory databases can create new possibilities for organizations by allowing them to integrate data from transactional systems, external data sources or third party data warehouses. If in-memory business intelligence is compared with traditional business intelligence, the time to make data available for BI tools associated with source systems (e.g. ERP), could be reduced substantially using in-memory solution (Ivan 2014). Furthermore, one approach to this matter could be for utilizing semi-virtual data warehouse concept which is based on in-memory database. This means that instead of storing the data in the DW, user can access data directly from the source system which provides more agility due to a reduced complexity of the business intelligence architecture (Knabke & Olbrich 2011).

In the research conducted by Knabke & Olbrich (2015b), was investigated the benefits of the business intelligence system running on the in-memory database and compared IM database system with the DW based business intelligence system. The focus was on the end-to-end process of sales and margin reporting. The end-to-end process means that the process is covering the whole process from the data extraction from the source system until data is available for the analytical purposes. The overall result is showing that the time spent in the process decreased significantly: the process to provide data for reporting and analysis decreased over 92 percent from the previous. In addition, the data mart construction is not necessary in the in-memory solution which reduces the overall time. (Knabke & Olbrich 2015b.)

Hence, by using business intelligence systems that run on the in-memory database using column-oriented data storage, the performance of the analysis increases significantly. According to Knabke & Olbrich (2011), the advance is that the data is located in the main memory and it does no need to be loaded on the slower hard disks, which are used as a basis for the conventional data warehouses. In addition, column-oriented database

allows the access only relevant tuples during querying which will increase the performance of the in-memory database. Moreover, Muntean & Surcel (2013) have acknowledged that the in-memory technology has a lot of potential to help BI system to become more agile. Thus, these improvements allow for a quick reaction to change and ensure better agility for BI systems. This means that agile business intelligence is reducing the time (called action distance in the previous chapter) that is needed to turn data into valuable information on decision-making. In-memory technologies are enabling OLTP and OLAP applications to run from the same platform, which reduces or nearly eliminates the need to extract or load data (Knabke & Olbrich 2011). Hence, the in-memory business intelligence is affecting ETL-layer reducing its complexity.

Mobile Business Intelligence

Mobile business intelligence (Mobile BI) is providing access to the business intelligence applications (such as dashboards) and front-end software for the employees via tablets and smartphones (Watson 2009). For example, retailers need an instant access to the details about sales events when they are visiting different stores of the retail chain. In addition, this means that in the retail store, the shopkeeper can do assortment planning via the smartphones or the tablets on the shop floor and modify the orders based on today's demand. Also they can monitor the key sales figure with the Key Performance Indicators (KPIs) – comparing the actual sales to the planned ones and adjust the orders based on the current status of the inventories and hence, improve agility on decision-making and enabling agile business intelligence.

Thus, the trend of mobile business intelligence may be a real advantage for decision-making or at least a real support for analyzing the data. However according to TDWI research, mobile business intelligence is still a relatively new concept and only 14% of the respondents is currently using some kind on mobile BI application (Stodder 2013). Still, this is not removing the fact that mobile BI is a growing trend in business intelligence area and mobile business intelligence has potential for achieving the one of the biggest trends in business intelligence (Chaudhuri et al. 2011; Chen et al. 2012; Lim et al. 2013).

The potential of the mobile BI is showing in the future plans of the organizations for implementing the mobile BI solutions. According to the TDWI research, almost half of the respondents has future plans to implement the mobile BI solutions due to the usage of the mobile business intelligence solution could facilitate agility in business intelligence (Stodder 2013). The main reason for the potential of mobile business intelligence is for enabling the better interaction – which is not dependent on location – between the users and applications for knowledge workers (Chaudhuri et al. 2011). Cognini et al. (2014) state that mobile business intelligence is related to the concept of "business intelligence to anywhere", which is relating to the previous example about the retail store:

user can access to the business intelligence application via the smartphones and tablets regardless of the location of the users. Moreover, Hoos et al. (2014) acknowledge the same but also add that the usage of mobile business intelligence can create new possibilities for business process improvements and enhance productivity in the organizations. Mobile BI can provide also ability to access real-time information to enhance the timeliness of the decision support. This means that mobile BI enables the real-time decision-making on the move when the access to the computer is not available (Burstein et al. 2011 pp. xxxiii-xxxiv).

In addition, the same benefits have been a noticed in the TDWI's research: mobile business intelligence can accelerate agile business intelligence due to easier access to the data and to the analytical application (Stodder, 2013). The concrete benefits for the organizations are related to the reduction of the used time and increased flexibility. These benefits are related to the "anywhere" and "anytime" characteristics of mobile business intelligence (Cognini et al. 2014; Hoos et al. 2014). This means that users can analyze the data anytime and independent of the location. Hence, users can get the required information wherever they are, using tools that enhance agility.

4.5 Summary

Agility in business intelligence has not yet been studied in comprehensive manners in the academic research. This has affected fact that, there is no overall consensus what agility means in business intelligence and what are the components for agile business intelligence. However, some research directions can be seen from the literature, which can be classified as enablers for agile business intelligence. The agility concept has long roots in manufacturing and in the supply chain management research. In addition, in 2001 the term "agility" was introduced in the software development on behalf of Fowler and Highsmith (2001) whose publication "Agile Manifesto" can be seen as a cornerstone for agile system development. The publication constitutes of 12 principles, which have applied in different software development methods such as Scrum and Extreme Programming. However, using different methods such as Scrum in the business intelligence system development does not be enough to fulfill the definition of agile business intelligence due to methods does not provide any concreate tools for enhancing agility in business intelligence. Thus, the enablers for agile business intelligence have dived into two main streams or categories: technologies and methods. This means that according to different definitions of agile business intelligence, it is more than a new name for the concept where data is transformed into information in real-time or to respond to the changing information needs more quickly. Agile business intelligence represents the new concept in business intelligence enabling new opportunities with agile project management methods and also with the rising technology trends to process and use the data more agile manners.

The need for agile business intelligence has been gaining more attention in the srecent years due to there is less time to make reasonable decisions, which are based on data. In addition, enterprises are finding it harder to make timely and reasonable decisions based data after the certain business event or the business need occurs. This means that organizations need to be able to react more quickly to the changing business needs with the help of technology. Traditionally, it has seen that business intelligence is supporting the tactical and strategic decision-making and it has been reactive in nature and based on summarized and historical data (White 2005). However, operational business intelligence is providing more options to make faster decisions in real-time and more agile way. The paradigm has shifted to operational business intelligence due to technologies such as in-memory databases are enabling faster query processing and usage real-time data on decision-making.

Another element of agile business intelligence definition is flexibility, which means that the organizations needs to have tools and methods for adapting to the changes of environments. The flexibility can be enhanced not only with the agile methodologies but also with the technologies such as mobile business intelligence and cloud business intelligence. Mobile business intelligence and cloud business intelligence are relating to the concept "BI anywhere", which means that data and BI application are not dependent on location and decisions can be made for example from the shop floors via smartphones and tables. The concrete benefits are for the organizations are related to the reduction of the used time and increased flexibility. Furthermore, one big benefit of cloud BI solutions is the scalability, which means that cloud computing has seen as a way to quickly scale up or down and adapt to the changing requirements, which is feasible in agile manners.

Table 6 summarizes the enablers the key benefits of each enabler for organization. The enablers and benefits are founded from the used literature.

Table 6. *The Key Benefits of the Enablers*

Enablers	***Benefits***	***Author(s)***
Agile methodologies	• Faster development cycles of BI systems • Flexibility to adapt to the changing requirements in business environment.	Dasgupta & Vankayala (2007); Evelson (2011); Golfarelli et al. (2012); Hughes (2013); Krawatzeck & Dinter (2015); Muntean & Surcel (2013); Rehani (2011); Stodder (2013)

Cloud Business Intelligence	• Flexible access to the BI systems • Access to the information via web browser while data is located on the multiple remote servers. • A quick way to scale up or down and adapt to the changing requirements, which reduces the risks associated with traffic overflow causing server failures. • Better allocation of resources and accurate results can be achieved more rapidly by utilizing virtualization. • Proof of Concept can be demonstrated to customer more rapidly by using the cloud solution. • Decreased management cost of the IT systems.	Baars & Zimmer (2013); Chaudhuri et al. (2011); Demirkan & Delen (2013); Heino (2010); Ng et al. (2013); Obeidat et al. (2015); Ouf & Nasr (2011); Sangupamba Mwilu et al. (2015); Stodder (2013)
In-memory Business Intelligence	• Real-time decision-making • Faster data processing • Simplified BI architecture • Reducing the needed time to turn data into valuable information on decision-making. • Enabling OLTP and OLAP application to run from the same platform, which reduce or nearly eliminates the need to extract or load data.	Baars & Hütter (2015); Chaudhuri et al. (2011); Hovi et al. (2009); Ivan (2014); Knabke & Olbrich (2015a); Muntean & Surcel (2013)
Mobile Business Intelligence	• Providing access to data wherever and whenever user wants. • Enabling ad-hoc analysis • Better interaction between the users and applications. • Enabling the real-time decision-making on the move when the access to the computer is not available. • Creates new possibilities for business process improvements and enhance productivity in the organizations.	Burstein et al. (2011); Chaudhuri et al. (2011); Chen et al. (2016); Cognini et al. (2014); Hoos et al. (2014); Watson (2009)

Operational Business Intelligence	• Using real-time data on decision-making • Giving more information about organizations day-to-day operations. • Reduces the action time • Able to react changing environment more rapidly.	Chaudhuri et al. (2011); Hackathorn (2004); Eckerson (2007); Tank (2015); Watson (2009); Watson & Wixom (2007); White (2005)
Self-Service Business Intelligence	• Faster and more accurate decision-making • Giving methods to all the workers – regardless their position in organization – to access data required to support decision-making in the organizations. • Enables users who need information to become more independent without the need to rely heavily on IT organization.	Imhoff & White (2011); Ng et al. (2013); Weber (2013)

As per the Table 6, the different benefits can be seen for different enablers. According to Table 6, some of the benefits can be linked to different enablers. For example, “BI Anywhere” can be related to the mobile business intelligence and cloud business intelligence. In addition, many different enablers have benefits that are related to the element of time which can be reduced time in the development cycle or the faster query time.

5. CASE: SAP

In this chapter, the system landscape of the case is introduced. The case landscape is related to the SAP environment and SAP's different components and applications. This means that the most critical applications of SAP are introduced and the applications are reflected on the business intelligence context. Hence, the chapter gives an overall understanding about SAP as a company, but also shares a glance of SAP's most critical applications and components in the context of business intelligence. However, the first section of the chapter gives a brief introduction SAP's the best known system: ERP, which needs a short introduction in order to get better understanding about the evolution of SAP and its penetration and transition to the business intelligence markets as well. In the latter section, the business intelligence concept is introduced more broadly in the SAP landscape. In addition, the latter part is a cross-section of the different components and applications of SAP in business intelligence.

5.1 An Overview of SAP

SAP stands for Systems, Applications & Products in Data Processing and it is a German multinational software company that makes enterprise-level software for organizations to manage their business operations and customer relations (SAP Website 2016). SAP has grown to be the one of the market leaders in business applications and analytics through different mergers and acquisitions in the past 40 years (SAP Annual Report 2015). The power of SAP in the software markets is showing in the fact that over 87 percent of Forbes Global 2000 are SAP customers (SAP Website 2016).

SAP was founded over forty years ago in 1972. SAP is best known for its Enterprise Resource Planning system and the first large scale product was launched in 1979, called R/2, which was running on mainframe computers (SAP Website 2016). In addition at that point, SAP was focusing on the German markets. However, during 80's SAP operations gained more attention and SAP started expanded to the European markets (SAP Website 2016).

The one of the biggest impacts in 1992 was the growing popularity of client-server architecture, which played a central role in the next-generation product release. Client-server architecture can be described as network architecture in which computer or process on the network work as a client or a server (Njoku et al. 2013). A client can be defined as a computer or a process that requests services from the servers and in addition a client can be described as a front-end application (Nieh et al. 2000). The new product

name was called R/3, where the letter R indicated the real-time element and the number three means the utilization of a three-tier architecture approach (SAP Internal Training Materials 2016), which layers are: database, application servers and presentation layer, which called SAP GUI (Graphical User Interface). In the 90's, SAP R/3 was seen as a dominant leader for the ERP systems and it was the most used system to optimize and re-engineer organization business processes (Cooke & Petterson 1998). The one of the benefits of the SAP ERP system is the compatibility with multiple platforms and operating systems such as Windows NT and Unix (SAP Website 2016). The compatibility was one the factors that increased the interest among the different customers. In addition, SAP R/3 goal was to bring together several core business functions into one integrated data model providing seamless access to the information.

The baseline for SAP R/3 relies on its tables, which are controlling the way that the different business processes in SAP R/3 are executed (Al-Mashari & Zairi 2000). In addition, the SAP users can configure these processes, for example creating new tables that suit better for the users' needs. Besides the technical configuration, there are different functionalities that make SAP a comprehensive system. These functionalities are related to:

- Financial Accounting (SAP FI module)
- Controlling (SAP CO Module)
- Sales and Distribution (SAP SD module)
- Production Planning (SAP PP module)
- Quality Management (SAP QM module)
- Plant Maintenance (SAP PM module)
- Materials Management (SAP MM module)
- Human Resources (SAP HR module)

For example, SAP FI module which contains e.g. general ledgers, account receivables and SAP CO module contains for example cost centers and profitability analysis. In addition to these modules SAP R/3 has modules which are related to Asset Management, Projects and Industry Solutions (SAP Internal Training Materials 2016). SAP's core system is called an ERP system, which can be considered as an IT infrastructure that enables the flow of the information between business processes in the organization (Al-Mashari & Zairi 2000). Figure 13 illustrates the different layers of SAP.

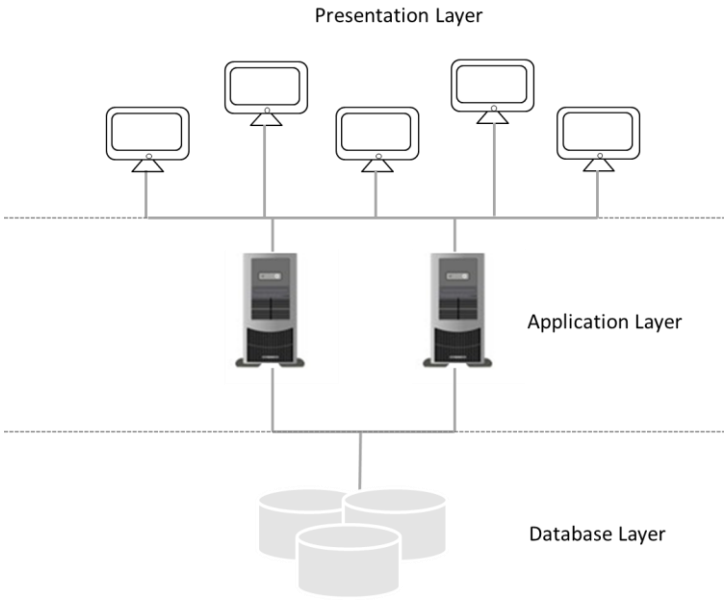

Figure 13. *Three-Tier Architecture (Adopted from Bancroft et al., 1991; Al-Mashari & Zairi 2000)*

On the database layer reside those components which are related to retrieve the data from the database layer. This means that the layer stores data, for example regarding business functions, SAP tables, programs. On the application layer exists all the software components, which are specialized in processing business applications such as SAP SD, SAP FI, SAP CO. In addition, the function of SAP application layer is to work as communicator between the two different layers (SAP Internal Training Material 2016). The last layer is called presentation layer and the main goal for the layer is to interact with the users.

After R/3 has been one of the dominant systems in the ERP markets, in the late 90's and early 2000's, SAP introduced a new tool set, called Business Information Warehouse (later called Business Warehouse - BW), which has embedded pre-developed ETL programs and a model-driven approach to the Enterprise Data Warehouse (Berg & Wood 2014). The main purpose was the same than traditional business intelligence tools have had – to answer the question: "What is the current status of the business and how the decision-making process can be enhanced." The one of the SAP's goals was to make the data warehousing more efficient and easier, particularly for SAP R/3 data.

The next big improvement to the SAP landscape was called SAP NetWeaver, which was acquired from the other company and it was launched under SAP in 2004 (SAP Website 2016). The breakthrough of SAP NetWeaver changed the underlying technology perspective for the SAP applications due to NetWeaver was used as a primary technology platform of SAP, laying a technical foundation for different SAP applications.

At the same year, SAP released a new version of R/3. The core component of the new system was SAP ECC (ERP Central Component) and it was the evolutionary successor of SAP R/3 with revised technical architecture (SAP Internal Training Materials 2016). In addition, SAP started to provide a bundle of the different applications under a single solution called SAP Business Suite, containing ERP, CRM, HCM (Human Capital Management) applications. Due to the complexity of the Business Suite, SAP has started to focus more heavily on simplifying the system landscape introducing S/4 HANA applications, which has built upon an in-memory database stack called HANA. In addition, the other key area of SAP has been the development of the cloud solutions, which nowadays SAP provides as well as on-premise solutions (SAP Website 2016).

5.2 SAP & Business Intelligence

SAP is mainly associated with ERP functions, but business intelligence in the SAP landscape has gained a significant attention among different customers (SAP Website 2016). Nowadays SAP has a wide spectrum of different BI tools, which varies from data warehouse solutions to the reporting & visualization and advanced & mobile analytics called SAP Fiori. Hence, SAP is able to deliver a broad range of business intelligence capabilities for enhancing the organizations decision-making with SAP's product portfolio. According to Gartners' research organizations often choose SAP as their enterprise BI standards, especially if they are using SAP as a vendor for the data warehouse and ERP applications (Parenteau et al. 2016). In addition, in 2016 SAP has acknowledged being one of the visionaries in the field of business intelligence and analytics, providing important and modern BI capabilities to organizations, such as self-service BI platforms and BI from cloud (Parenteau et al. 2016).

The oldest BI tool in the SAP landscape is called Business Warehouse (BW), which is defined as an enterprise data warehouse (SAP Internal Training Materials 2016). The BW was a packaged-based business intelligence solution, which secondary purpose was to complement SAP ERP applications. SAP Business Warehouse integrates and processes transactional data and transfers it to different business intelligence front-end applications which have the better analysis capabilities (Bange & Seidler 2013). Generally, SAP BW follows the same principles as the other EDW solutions as well. However, the difference in SAP BW compared with the other EDWs is that the BW contains the embedded ETL-process. Hence, this means that organizations do not need to purchase any other license for the ETL-tools, such as Informatica. Organizations data is collected centrally in SAP BW from different data sources, which can be SAP or non-SAP related. Furthermore, organizations can leverage SAP BW data with the bundle of applications called SAP Business Objects (SAP BO). The purpose of these front-end applications and technologies is to replace the old SAP Business Explorer, which has been used on the top of SAP BW (SAP Internal Training Materials 2016). In Figure 14, the comprehensive list of the SAP business intelligence products is described.

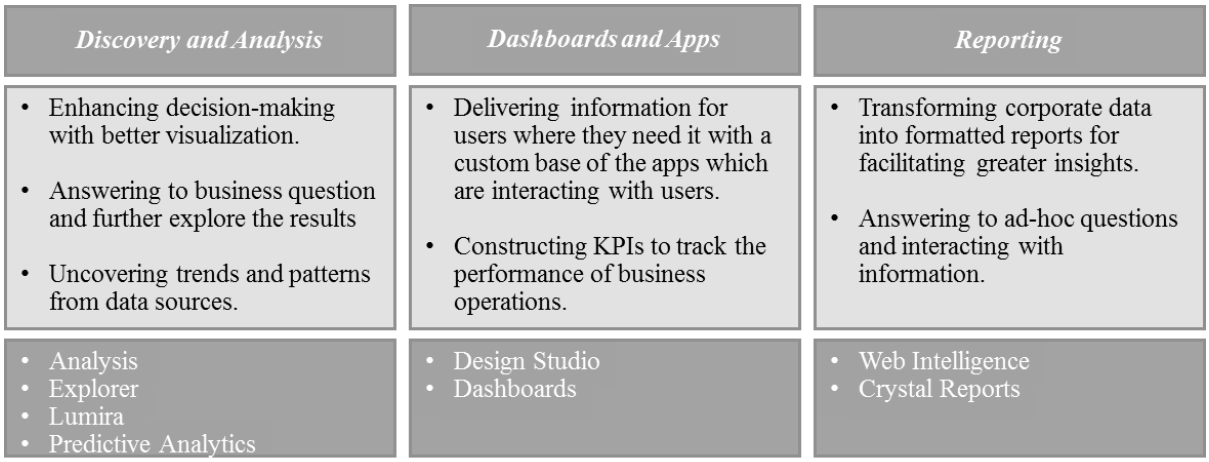

Figure 14. *The Key Products of SAP BI Front-end Tools and Products' Functionalities (Adopted from SAP Internal Training Materials 2016; Bange & Seidler 2013)*

Figure 14 is showing the main purpose of the front-end tools and also the benefits of the tools for the organizations. The tools have been divided into three different groups: Discovery & Analysis, Dashboards & Apps and Reporting. At the bottom section of Figure 14 is describing SAP's different products, which are fulfilling the purpose of the box at the top. According to Gartner research SAP's BusinessObjects Suite is mostly used for large organizations, which uses the traditional business intelligence solution and organization is seen as reporting-centric enterprise (Sallam et al. 2016). The Design studio is one of the key components to develop applications and dashboards. In the recent years SAP has focused more on self-service and now SAP has launched a product that enables self-service capabilities called Lumira which is including smart data discovery capabilities with built-in predictive algorithms and data preparation capabilities (SAP Internal Training Materials 2016). In addition, SAP has developed the different product for data discovery called Predictive Analytics. As per Figure 14, SAP is providing a wide spectrum of the business intelligence tools, which are serving different purposes. However, to all of the tools the underlying goal is the same than any other BI-tools as well: to generate insight which will enhance decision-making in the organizations.

In 2010, SAP introduced a platform called SAP HANA, and SAP applications like SAP ERP and SAP BW have been able to run on SAP HANA (SAP Website 2016). SAP HANA has two main functions: it can be used as a platform or as a database. SAP HANA utilizing in-memory technology, which can process larger volumes of data compared with the previous solutions. HANA has been as a platform for SAP Business Suite, but also for the new ERP system called S/4 HANA, which is completely built on the in-memory HANA platform. According to SAP, S/4 HANA has the next-generation ERP solution and a replacement for SAP Business Suite (SAP Internal Training Materials 2016). Although the tight relationship with the ERP system, SAP HANA can be utilized in the context of business intelligence as well (SAP Training Material 2016). From the technological point of view, HANA is combining the row with column-

oriented database structure, giving the possibilities to use HANA in transactional and analytical purposes (Bange & Seidler 2013).

Depending on the use case of HANA, it is able to integrate data in real-time between the different applications or it can use the traditional ETL-process, which is called a batch oriented extraction (Bange & Seidler 2013). These two approaches are possible with the different tools such as SAP Landscape Transformation Replication Server (SLT), which main purpose is for replicating data on real-time (SAP Internal Training Materials 2016). SAP Data Integrator extracts and transforms the data from the source systems and loads it into HANA (Bange & Seidler 2013). Hence, this means that HANA has two different components for extracting data from the source system and load it into HANA. In addition, HANA has a modelling tool called SAP HANA Studio, which can be seen as a collection of applications for HANA. HANA Studio allows users to create and manage user authorizations, and to create or modify existing models of data in the SAP HANA database. The overall picture of HANA is given in Figure 15, which is showing how HANA is providing the source system data for the business intelligence applications.

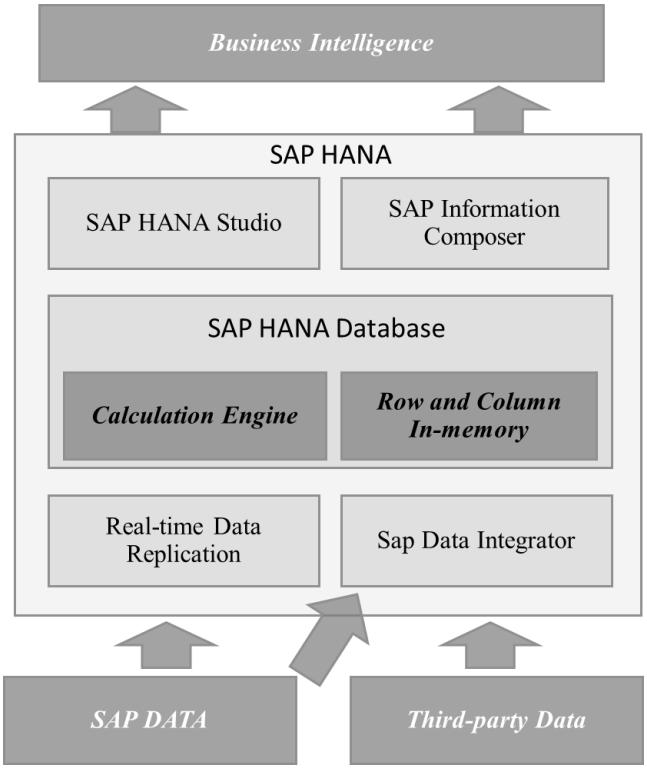

Figure 15. *Overall Picture of HANA in Business Intelligence Context (Adopted from SAP Internal Training Materials 2016; Bange & Seidler 2013; Sikka et al. 2012)*

Despite the fact that HANA is gotten a lot of attention among different customers, SAP has announced to focus more on the cloud applications in the context of business intelligence. In addition, SAP has developed a wide range of products that will run on HANA platform or on HANA database such as mobile solution called SAP Fiori. Furthermore as per previous sector, SAP S/4 HANA has its own embedded analytics capabilities (SAP Internal Training Materials 2016). According to Gartner's research SAP has announced to focus on the cloud-based platform that intended to deliver a full range of analytical capabilities running on HANA Cloud Platform (Called HCP) (Parenteau et al. 2016). Hence, this means that SAP is now offering two different implementation scenarios for business intelligence:

1. SAP BusinessObjects BI suite, primarily for on-premises deployments
2. SAP Cloud for Analytics for cloud deployments

The chapter gave a brief overview of SAP and its main functions. Although SAP is seen as an ERP-driven vendor, SAP is noticed in the field of business intelligence as well. This can be justified with the development of the new business intelligence software and applications to enhance the decision-making process. In addition, SAP has launched a new Platform called HANA which will provide more value for the business intelligence context.

SAP HANA as an Enabler for Agile BI

The biggest enabler for agile business intelligence in SAP BI landscape is the in-memory platform called SAP HANA. SAP BI covers all analytical applications from SAP, mostly made up of the SAP Business Objects portfolio, such as Analysis, Design Studio, Crystal Report etc. In almost all cases, the BI applications send requests to SAP HANA for data. They usually do not generate new data for SAP HANA. Depending on the analytic tool, there are different ways to connect to SAP HANA. The different BI applications can run on HANA platform which enhances and enables the usage of real-time data on decision-making. Due to HANA's columnar-oriented structure, it can store data in the main memory which means processing the large amounts of data in the short period of a time (Bange & Seidler 2013). In addition to a classical row-based data store, SAP HANA is able to store tables in its column-based data store. Apart from performance reasons, the column-oriented store offers much more potential for data compression (Gossmann 2013). Hence due to above, the response times for query and analysis decreases. In addition, HANA can be used as a database or a platform for the different BI applications such as self-service tool Lumira or mobile application called SAP Fiori. (SAP Internal Training Materials 2016). SAP Fiori provides an access to BI content and tools wherever and whenever user wants. The main objective for Fiori is to provide the data and the tools for analysis to the users. This enables users to react independently and promptly for the changing requirements of the environment.

The decision-making process can be supported with operational, tactical and strategic business intelligence. As stated previously, operational business intelligence supports daily activities with list reports and dashboards which are focusing more on specific business process and usually related to a single OLTP system. Tactical and strategic business intelligence relate to decision-making which includes a data warehousing concept where data is extracted from multiple source systems. With the HANA implementation, these different elements of business intelligence can be covered in three different scenarios (Bange & Seidler 2013):

1. Working as a database for SAP Business Suite, HANA can run directly on the operational data and use the operational data in the decision-making.
2. Acting as an additional database to existing systems that provide data for BI tools and applications. This means that different BI systems, for example Qlikview can read the data directly from HANA.
3. Acting as a database for SAP Business Warehouse (SAP BW Powered by SAP HANA).

The in-memory technology combined with the row- and column-oriented database structure speeds up the operational applications such ERP and CRM but also it provides analytical capabilities including dashboarding, reporting and analysis with data on real-time derived from the OLTP systems (Bange & Seidler 2013). This means that the data derived from the operational systems does not need to be transferred into data warehouse which reduces the action distance. If data transformation is necessary, the calculations can be performed in HANA due to optimized performance of the database (Bange & Seidler 2013).

SAP has different versions of HANA platform for different use cases in order to meet organizations' needs more precisely. For example, organizations can choose SAP S/4 HANA with embedded analytics which is using content for the new simplified data models compared with the previous solutions. If organizations are interested historical and strategic reporting, then SAP BW powered by SAP HANA could be a suitable solution for them. Table 7 is introducing different characteristics of HANA solutions. However, the underlying baseline is the same in the different solutions: all of those are running on HANA platform.

Table 7. *Characteristics of Different HANA Solutions (Adopted from Meleegy & Butsmann 2015)*

	SAP S/4 HANA Embedded Analytics	***SAP HANA Live***	***SAP BW Powered by SAP HANA***
Application	SAP S/4 HANA	SAP S/4 HANA, SAP Business Suite powered by SAP HANA, SAP Business Suite	SAP S/4 HANA, SAP Business Suite powered by SAP HANA, SAP Business Suite, non-SAP applications
Deployment	Co-deployed	Side car and co-deployed	Side car and co-deployed
Reporting	Embedded operational and real-time decision-making	Embedded operational and real-time decision-making	Enterprise data warehousing, historical, compliance and operational reporting
Data source	SAP data	SAP data	SAP and non-SAP data
Data cleansing and harmonization	No	No	Yes

SAP Business Warehouse (BW) is the flagship data warehouse solution of SAP and it was the first SAP application that was enabled to run on SAP HANA (SAP Internal Training Materials 2016). SAP BW has had to re-invent itself since the arrival of SAP HANA which is able to take over many of the duties of SAP BW. SAP BW acts as the loading mechanism for data to SAP HANA, but its key role is to provide data for reporting and for other SAP BW powered applications. SAP BW on HANA increases the performance of SAP BW solutions, particularly in the key areas of reporting and data loadings (SAP internal Training Materials 2016). Other major benefits include a significantly reduced data footprint which means that data is compressed to use smaller amount space in the data warehouse and also with HANA organizations does need to store redundant data into EDW. A classic SAP BW design involved building many layers of aggregation in order to improve the speed of reporting. With the raw power of SAP HANA data can be aggregated "on the fly" and hence there is no longer a need for building aggregates and storing the related redundant data. By removing the aggregates, data modelling can be simplified. However with SAP S/4 HANA, operational reporting can move back into the transactional application, which means that SAP BW system

can be used for its core use cases to support historical and strategic reporting (Meleegy & Butsmann 2015).

SAP S/4 HANA Embedded Analytics and SAP HANA Live are both standard applications which enable the real-time reporting but the underlying technology differs: HANA Live uses native SQL views where SAP S/4 HANA Embedded Analytics is based on ABAP (high-level programming language of SAP). However, both of the solutions can utilize mobile BI application called SAP Fiori and other BI tools (Meleegy & Butsmann 2015). SAP S/4 HANA combines OLTP and OLAP functionalities with on a single in-memory platform. This means that organizations can use a single platform for OLAP and OLTP. Figure 16 compares the traditional data warehousing to SAP S/4 HANA.

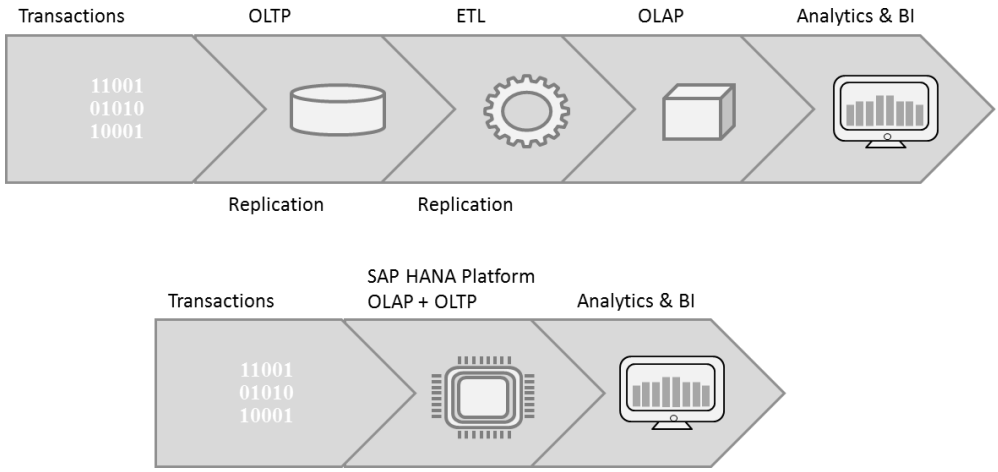

Figure 16. *The Difference Between Traditional BI and SAP S/4 Embedded Analytics (Adopted from SAP Internal Training material)*

Hence SAP S/4 HANA is enabling the analysis from the OLTP systems and thus data is not needed to move from the system to another. This is enabling better operational reporting by utilizing the in-memory database. SAP S/4 HANA Embedded Analytics has its own embedded BW in the core which provides the OLAP capabilities for the different BI tools (SAP Internal Training Materials 2016). However, SAP S/4 HANA Embedded Analytics is not seen as a replacement for the other analytical tools and its main role from BI point of view is to complement and enhance the other BI tools (Meleegy & Butsmann 2015). The main reason is that the organizations' needs vary from operational reporting to the strategic business intelligence. For example, in the comprehensive EDW cases an external BW solution is needed which helps to analyze the historical data and ensure data consolidation from multiple sources (SAP Internal Training Materials 2016). To summarize the main points, SAP provides different solutions to run on HANA platform bringing traditional business intelligence and operational business intelligence together enabling the real-time decision-making. In addition, SAP HANA is providing flexibility to analyze new types of data in different ways, without creating conventional data warehouses and data marts (SAP Internal Training Materials 2016).

Furthermore, a major advantage comes from the revised 2-tier architecture that SAP HANA is using to enhance to efficiency. This has led to the fact that SAP HANA applications have reduced costs of ownership, as no additional application server needs to be installed and administrated (SAP Internal Training Materials 2016). As stated before, HANA-based applications often have no need for a traditional application server, because the presentation logic has been moved to the client and the data-intensive processing is pushed to the database layer.

SAP Cloud BI Platform as an Enabler for Agile Business intelligence

SAP can integrate SAP public cloud solutions including Ariba and SuccessFactors to SAP HANA solutions. This includes Suite on HANA (SoH) and BusinessWarehouse (BW) running either on SAP HANA Enterprise Cloud (HEC) or on-premise. For recent years SAP has focused more on the cloud-based solutions (SAP Website 2016) and it is designed to unlock all of the new possibilities of cloud computing, as well as help to speed the adoption of SAP HANA innovations. For example, this means the rapid development of the proof of concepts in the SAP landscape using the cloud platform (Ghattamneni 2016). At its center is a set of public cloud applications and cloud suites. These provide the cloud line of business applications that provide the ability to manage core business with increased agility (SAP Internal Training Material 2016).

To bring the benefits of cloud economics and SAP HANA for existing SAP landscapes, the SAP cloud product portfolio includes managed cloud services. SAP's managed cloud offering has full integration with SAP apps including Ariba and SuccessFactors, Business Suite, and other SAP Applications. Cloud can take advantage of an SAP HANA optimized infrastructure as well as tailored professional services delivered by SAP or certified partners (SAP Internal Training Materials 2016). The key advantage of SAP HANA Enterprise Cloud is that it is the fastest and easiest way to access SAP HANA-based innovations for mission critical applications. This is referring to the concept of "BI to Anywhere" as described in the previous sections (Cognini et al. 2014). In addition, the cloud solutions simplify the IT landscape by reducing the complexity of the different solutions. Also, with the help of SAP cloud solutions organizations can minimizes the expense of infrastructure management (SAP Internal Training Materials 2016). The entire portfolio is built on a common platform: SAP HANA platform. Through this approach, SAP makes the entire portfolio available: the application, development, and integration services, as well as the SAP HANA database and analytics and foundational capabilities of SAP HANA Cloud Platform to speed the development and delivery of innovations for the different organizations (SAP Internal Training Materials 2016).

Overall it can be said that SAP has a strong focus on business intelligence with multiple different tools and solutions. The main enabler for agile business intelligence in the

SAP landscape is the HANA platform due to the most of the SAP applications can be run on the top of the platform which enablers real-time decision-making process with multiple different application which are serving different needs of users. In addition, SAP has a strong focus on the cloud BI where the applications are also run on the top of the HANA Cloud Platform.

5.3 Summary

SAP is a German company that is providing the enterprise-wide information systems in order to enhance organizations business processes. SAP is best known of its Enterprise Resource Planning system that constitutes of different components such as Financial and Controlling, Sales and Distribution etc. SAP introduced it graphical user interface in 1992 with the R/3 product which has built on three-tier architecture. This means that R/3 has three different layers: database, application servers and presentation layer.

The next big improvement to the SAP landscape was called SAP NetWeaver. The breakthrough of SAP NetWeaver was changing the underlying technology perspective for the SAP applications due to NetWeaver was used as a primary technology platform of SAP, laying a technical foundation for different SAP applications. Along with this revolution, the core component of the system was revised and it was called SAP ECC (ERP Central Component) and it was the evolutionary successor of SAP R/3 with revised technical architecture. In addition, SAP started to provide a bundle of different applications under a single solution called SAP Business Suite, containing ERP, CRM, HCM (Human Capital Management) applications. Due to the complexity of the Business Suite, SAP has started to focus heavily on simplifying the system landscape introducing S/4 HANA applications, which has built upon an in-memory database stack called HANA. In addition, the other key area for SAP has been the development of the cloud solutions.

Despite the fact that SAP has seen an ERP-oriented vendor, for recent decade it has given more focus on business intelligence and analytics applications as well. Nowadays SAP has a wide spectrum of different BI tools, which varies from data warehouse solutions to the reporting & visualization and advanced & mobile analytics called SAP Fiori. To enhance the usage of different applications, SAP has launched a new platform called SAP HANA, which has two main functions: it can be used as a platform or as a database. SAP HANA utilizing in-memory technology, which can process larger volumes of data compared with the previous solutions. Although the tight relationship to the ERP system, SAP HANA can be utilized in the context of business intelligence as well. From the technological point of view, HANA is combining the row with column-oriented database structure, giving the possibilities to use HANA in transactional and analytical purposes (Bange & Seidler 2013).

Depending on the use case of HANA, it is able to integrate data in real-time between the different applications or it can use the traditional ETL-process, which is called a batch oriented extraction (Bange & Seidler 2013). These two approaches are possible with the different tools such as SAP Landscape Transformation Replication Server (SLT), which main purpose is for replicating data on real-time (SAP Internal Training Materials 2016). SAP Data Integrator extracts and transforms the data from the systems and loads it into HANA (Bange & Seidler 2013). Hence, this means that HANA has two different components for extracting data from the source system and load it into HANA. Despite the fact that HANA is gotten a lot of attention among different customers, SAP has announced to focus more on the cloud applications in the context of business intelligence. In addition, SAP has developed a wide range of products that will run on HANA platform or utilize HANA database such as mobile solution called SAP Fiori. Furthermore as per the previous section, SAP S/4 HANA has its own embedded analytics capabilities (SAP Internal Training Materials 2016). In Table 8 the key benefits of the enabler are complement and compared with the SAP landscape and SAP products capabilities.

Table 8. *The Key Benefits of the Enablers Compared with SAP Landscape*

Enablers	***Benefits***	***Author(s)***	***SAP Landscape***
Agile methodologies	• Faster development cycles of BI systems. • Flexibility to adapt to the changing requirements in business environment.	Dasgupta & Vankayala (2007); Evelson (2011); Golfarelli et al. (2012); Hughes (2013); Krawatzeck & Dinter (2015); Muntean & Surcel (2013); Rehani (2011); Stodder (2013);	Not applicable
Cloud Business Intelligence	• Flexible access to the BI systems • Access to the information via web browser while data is located on the multiple remote servers. • A quick way to scale up or down and adapt to the changing requirements, which reduces the risks associated with traffic overflow causing server failures.	Baars & Zimmer (2013); Chaudhuri et al. (2011); Demirkan & Delen (2013); Heino (2010); Ng et al. (2013); Obeidat et al. (2015); Ouf & Nasr (2011); Sangupamba Mwilu et al. (2015);	SAP BO applications run on SAP HCP • Flexible access to the BI systems • Easier access via web browser • Real-time data processing

	• Better allocation of resources and accurate results can be achieved more rapidly by utilizing virtualization. • Proof of Concept can be demonstrated to customer more rapidly by using the cloud solution. • Decreased management cost of the IT systems.	Stodder (2013)	SAP HEC • Decreased management cost of the IT systems.
In-memory Business Intelligence	• Real-time decision-making • Faster data processing • Simplified BI architecture • Reducing the needed time to turn data into valuable information on decision-making. • Enabling OLTP and OLAP application to run from the same platform, which reduce or nearly eliminates the need to extract or load data.	Baars & Hütter (2015); Chaudhuri et al. (2011); Hovi et al. (2009); Ivan (2014); Knabke & Olbrich (2015a); Muntean & Surcel (2013)	SAP HANA, SAP HANA Live, SAP BW Powered by HANA • All of the benefits that mentioned in literature can be found from SAP landscape. • In addition SAP mention the usage of unstructured data and big data which usage is enabled with SAP and Hadoop integration.
Mobile Business Intelligence	• Providing access to data wherever and whenever user wants. • Enabling ad-hoc analysis • Better interaction between the users and applications • Enabling the real-time decision-making on the move when the access to the computer is not available. • Creates new possibilities for business process improvements and enhance productivity in the organizations.	Burstein et al. (2011); Chaudhuri et al. (2011); Chen et al. (2016); Cognini et al. (2014); Hoos et al. (2014); Watson (2009)	SAP Fiori • Providing access to data wherever and whenever user wants. • Enabling ad-hoc analysis • Better interaction between the users and applications. • Enabling the real-time decision-making on the move when the access to the computer is not available.

Operational Business Intelligence	• Using real-time data on decision-making • Giving more information about organizations day-to-day operations. • Reduces the action time • Able to react changing environment more rapidly.	Chaudhuri et al. (2011); Hackathorn (2004); Eckerson (2007); Tank (2015); Watson (2009); Watson & Wixom (2007); White (2005)	SAP HANA Live, SAP S/4 HANA Embedded Analytics • All of the benefits can be found from the SAP landscape. • In addition, SAP mentions simplification as one the biggest benefits.
Self-Service Business Intelligence	• Faster and more accurate decision-making • Giving methods to all the workers – regardless their position in organization – to access data required to support decision-making in the organizations. • Enables users who need information to become more independent without the need to rely heavily on IT organization.	Imhoff & White (2011); Ng et al. (2013); Weber (2013)	SAP Lumira • All of the benefits can be found from the SAP landscape. • In addition real-time query processing is mentioned.

The methodological enablers are not considered in the SAP landscape due to SAP is seen as technology. The methodological enablers are more related to the project management and those need to be considered in the organization. Hence, the enablers in the SAP landscape are only related to the technological enablers.

Mostly all of the enablers which have founded in the literature can be found from the SAP landscape. In addition, SAP has strong focus of using HANA as a platform for the various use cases which enhances the real-time business intelligence and faster decision-making. Hence, the real-time element can be a universal benefit for all the enablers due to these technological enablers are running on HANA platform. However, SAP's cloud portfolio is still under development and SAP has announced to focus more heavily on that. Hence, this means that all the benefits for the cloud utilization of SAP might have not yet been discovered or recognized. Still, the benefits founded in the literature have been recognized in the SAP BI landscape but additional benefits have not yet been discovered in order to get more comprehensive and detailed information of benefits for utilizing cloud solutions.

6. DISCUSSION OF THE FINDIGNS

This chapter summarizes the key finding of the study. In the first section, the characteristics of the traditional business intelligence are compared with agile business intelligence. In addition, the main enablers and benefits are summarized. The second part is the conclusion which is contributing the research questions and objectives of the study. The last parts are related to reviewing the thesis in comprehensive manners and giving suggestions to the further research.

6.1 The Key Enablers for Agility in Business Intelligence

This chapter is giving more insights about agility in business intelligence. First, the chapter was introducing the variation of definitions in the context of business intelligence and information systems. The observation of the agility concept wanted to expand to information system research as well, due to business intelligence systems are a subgroup for information systems and also business intelligence systems usually use the data from different systems and the extracted data is stored into data warehouses. In addition according to Knabke & Olbrich (2013), the strategic value of agility in information systems for the organization can be extended to describe agility of business intelligence domains as well.

Agility is a quite familiar concept in the information system literature, but however in the business intelligence context, it has not yet achieved such significance. This can be deducted from the number of the researches, which are only covering of business intelligence and agility. However, some research directions can be seen regarding agility in the business intelligence context. According to Evelson's (2011) and TDWI's (2016) definitions, agile business intelligence is more than a new name for the concept where data is transformed into information in real-time or respond to the changing information need more quickly. Agile business intelligence represents a new concept in business intelligence enabling new opportunities with the rising technology trends to process and use the data more agile manners. Many of the researchers contribute the real-time responsiveness to be one of the key requirements for agile business intelligence. Table 9 is indicating the changes between the traditional business intelligence and agile business intelligence. Table 9 summarizes the technological, but also the methodological elements.

Table 9. *Characteristics of Traditional and Agile Business Intelligence (Adopted from Baars & Hütter 2015; Muntean & Surcel 2013; Kanbke & Olbrich 2013; Larson & Chang 2016; Obeidat et al. 2015)*

Criteria	***Traditional business intelligence***	***Agile business intelligence***
Business requirements	• Well defined • Well documented	• Can be changed during the development process • Iterative
Integration approaches	• ETL tools • Data from the source systems to staging area • Data marts	• Data remain in-memory database • Data virtualization • Cloud computing
Data timeline	• Historical data	• Real-time data
Data refresh	• Daily loadings into DW	• Real-time (might be couple of minutes old)
Action distance	• Long, causing latency on decision-making (Decision-making based on the data could take long time, especially if the data is not yet gathered to the Data warehouse).	• Short, causing in the optimal situation zero latency (Using operational data and fast in-memory databases this can be achieved).
Data source format	• Mainly structured • Limited unstructured data • Flat files (such as .csv files)	• Structured • Unstructured data • Big data
Development methodology	• Waterfall	• Agile development methods (such as Scrum, Agile Data Warehousing)
Levels of decision-making	• Mainly strategic • The focus is more in the longer-term decision-making with the aggregated and historical data.	• Mainly operational. • Supports day-to-day operations with transactional data.

Hence, the emergence of the new technology trends, methodologies and applications has been in a central focus for enabling agile business intelligence. In addition, the paradigm has shifted from strategic, long-term decision-making into operational (or real-time) business intelligence, which is needed to support day-to-day activities within organizations. This transformation has occurred due to changed requirements for the data usage (i.e. real-time, faster decision-making). Furthermore, the new emergent technologies have made it possible to process the larger amounts of data – whether it is structured or unstructured, internal or external – in real-time and more flexible manners. Thus, it is then easier for organizations to respond reactively or proactively to the changing requirements in the environment.

The most scholars are discussing the real-time business intelligence, which can be referred to as operational BI (Chaudhuri et al. 2011). The real-time aspect is critical if business intelligence systems are not only used for strategic decision-making but also for operational-decision making. The reason for this is related to fact that the traditional data warehousing concept is time-consuming because it is related to the ETL-process from the different source system through different layers (Knabke & Olbrich 2011). Hence, the common data warehousing concept is not suitable for real-time business intelligence due to its latency. However, this is only one approach to agile business intelligence and most researchers include the flexibility in the definition of agile business intelligence in order organizations are more adaptable to the changing requirements (Baars & Hütter 2015; Zimmer et al. 2012). The flexibility elements can be covered with agile methodologies such as Scrum and Agile Data Wsarehousing, which have gained attention also in the context of business intelligence development. In addition, from the technological perspective, mobile business intelligence and cloud-based business intelligence solutions enable the usage of the different BI tools with better accessibility to the information. This concept can be seen as “BI to anywhere”, which is literally stating that the usage of business intelligence tools and insight generation is not dependent on its location (Cognini et al. 2014). This means that organizations can make decision in more agile manners and faster pace, for example retailers can make decisions regarding the assortment planning on the shop floor via tablets based on today’s demands. Hence, the new methods and the new technologies are expediting the decision-making process and giving more agility for business intelligence.

The biggest benefits of agile business intelligence are relating to the time, flexibility, simplicity and accessibility with the help of different technological and methodological choices described in the previous sections. The reduced time and the increasing simplicity can be achieved by utilizing in-memory databases in business intelligence. Using the in-memory databases can simplify the business intelligence architecture by reducing the unnecessary layers from the architecture (Knabke & Olbrich 2015a). Furthermore by using the in-memory database technology, data can be stored in more efficient manners. The efficiency is related to the usage of the column-oriented approach for storing data

and hence the performance of analysis increases. Because of utilizing the column-oriented approach, most queries use a smaller amount of attributes than traditional data warehouse (relational database), which enables a better performance of the database. The most valuable benefits for utilizing the in-memory database are related to process high data volumes due to the in-memory database can process the larger data volumes in more efficient manners than the traditional data warehousing process. The utilization of IM technology is causing less delays in response times (Knabke & Olbrich 2011). These characteristics of the in-memory database accelerate the query processing and enable the usage of real-time data on decision-making, which facilitates more accurate and faster decision-making. Hence, using the in-memory database allows for a quick reaction to the changes in the business environment.

The benefits from the agile methods are related also to flexibility and time. Using the agile methodologies organizations can improve the speed of the BI system development and introducing new functionalities and reports more quickly in order to fulfill the changing requirements. The agile methods in business intelligence context can be used for example in the development of ETL and data integration processes (Krawatzeck et al. 2015; Muntean & Surcel 2013; Stodder 2013), which facilitate agility in business intelligence. The underlying concept of agile development methods is to shorten the development cycles of business intelligence systems and adapt to the changing requirements by incrementally adding different features to the systems (Rehani 2011). In contrast in the waterfall approach, the changed requirements are not handled until the maintenance cycle which occurs after the development cycles is ended (Muntean & Surcel 2013). This is one of the main reasons why projects executed with waterfall methods take a longer time for stakeholders to realize the business benefits and the value of the developed system (Stodder 2013).

The cloud business intelligence is providing many virtual applications which enable better scalability and higher cost savings due to pricing models are usually related to the pay-per-use concept, especially in the SaaS model (Demirkan & Delen 2013; Sangupamba Mwilu et al. 2015). The scalability means that the cloud BI has seen as a way to quickly scale up or down in order to adapt to the changing requirements. In addition, scalability can improve agility in business intelligence (Baars & Zimmer 2013). Moreover, one of the factors for enabling agility with cloud technologies is the flexible access to the system due to these technologies are always online, which is crucial for users (Ng et al. 2013) in order to guarantee the continuity of the service. This means that cloud computing has a lot of potential for its on-demand network access and its function as an enabler for agility has been noticed among the organizations (Sangupamba Mwilu et al. 2015). Hence, any business process or user can access data wherever it resides. This concept is referring to the term “BI Anywhere” which means that the user could access to the information via web browser while data is located on the multiple remote servers.

Mobile business intelligence provides a means for organizations to adapt to the changes with the build applications which are related to the enterprise apps industry-specific apps or e-commerce apps (Chen et al. 2016). The potential of mobile business intelligence is for enabling the better interaction – which is not dependent on location – between the users and applications for knowledge workers (Chaudhuri et al. 2011). Mobile BI can also be related to the concept of "business intelligence to anywhere" (Cognini et al. 2014), which is relating to the previous example about the retail store: user can access to the business intelligence applications via the smartphones and tablets regardless of the location of the users. In addition, the usage of mobile business intelligence can create new possibilities for business process improvements and enhance productivity in the organizations (Hoos et al 2014). Mobile BI can provide also ability to access real-time information to enhance the timeliness of the decision support. This means that mobile BI enables the real-time decision-making on the move when the access to the computer is not available (Burstein et al. 2011 pp. xxxiii-xxxiv). If mobile BI is reflected on the benefits, it can reduce the execution time of the processes due to "business intelligence to anywhere" concept. The second benefit is also regarding the flexibility due to mobile users can execute the different task and access to the dashboards and report wherever and whenever user wants (Hoos et al. 2014). Hence, these benefits are enhancing agility in business intelligence.

The enablers of SAP were found in the internal training materials such as handbooks and training videos. In addition, to get more comprehensive understanding about the enablers academic papers are included which have acknowledged the different enablers. The enablers of SAP BI were focusing only on the technological enablers and due to that matter, the methodological enablers which were founded in literature can be seen as universal enablers which are not affected technological solutions. This means that methodological enablers can be applied to the different system landscapes and hence those are not related only to the SAP BI landscape. The different products from SAP BI landscape have acknowledged for being a one of the leaders in agile business intelligence (Evelson 2015). For example, Lumira and BusinessObjects Explorer enhance agility in the organizations because of the self-service capabilities of the products. This means that business users can do the report and analysis more independently without relying heavily to the IT department of the organizations. The self-service BI is increasing the flexibility and independence among the business users (Bange & Seidler 2013). This contains the visualization of the information in order to increase the usability and insight through the dashboards and apps. SAP Lumira increases the flexibility and independence for the business users and enables real-time decision-making with HANA optimization (Bange & Seidler 2013). In addition, SAP can nowadays be seen as a dominant force in the areas of in-memory and cloud BI & analytics (Evelson 2015).

SAP HANA is one of the biggest game changers in the SAP landscape due to it can be used as a database or as a platform. This means that SAP is enabling the usage of the

real-time data with the faster query processing and combining OLTP and OLAP functionalities which reduced the need for the traditional ETL-process. In addition, SAP has multiple cloud solutions that enhance the flexibility and agility in the organization enabling them to respond to the changing requirements of the environment in the faster pace. The benefits from operational business intelligence are related to SAP S/4 HANA and HANA Live applications which underlying technologies rely on OLTP but those applications have enhanced with analytical OLAP functionalities to provide analysis and reporting into a single system in order to reduce the complexity of the IT landscape. Furthermore, SAP HANA provides integration with other systems such as Hadoop which enables storing and using of the high volume and unstructured data.

6.2 Conclusion

The master's thesis started to conceptualize the key elements of the traditional business intelligence. The thesis contains different definitions of business intelligence and the key components that are needed to transform data into information in order to generate insights which enable a better decision-making process. In addition, the definition for business intelligence was formalized based on different researchers' points of view of business intelligence. Hence in this thesis, business intelligence is seen as *a wide range of applications, technologies and processes for gathering, storing, analyzing data to help members of organizations to gain insights in order to make better decisions* (Larson & Chang 2016; Lönnqvist & Pirttimäki 2006; Rouhani et al. 2012; Sangari & Razmi 2015; Watson 2009).

Agile BI solutions enable organization to adapt the changing market conditions in the faster pace. According to Evelson (2011) definition for agile business intelligence is: "*Agile business intelligence is an approach that combines processes, methodologies, organizational structure, tools, and technologies that enable strategic, tactical, and operational decision-makers to be more flexible and more responsive to the fast pace of changes to business and regulatory requirements."* The definition is formalizing a good baseline for agile business intelligence and the definition is reflected on the enablers of agile business intelligence. The key enablers for agile promote a faster decision-making process in the organizations but also provide tools and methods to respond the changing business environment. The identified enablers have divided into two main classes: agile methodologies and agile technologies. The methodologies are related to Scrum or Agile Data Warehousing in the context of business intelligence. Technology solutions divided into different sub-classes such as: in-memory technologies, cloud business intelligence, mobile business intelligence, operational business intelligence and self-service business intelligence. These enablers are forming a baseline for agility in business intelligence and fulfill the definition for agile business intelligence.

The different enablers of agile business intelligence contribute different benefits to the organizations. One of the biggest benefits is related to the usage of real-time data on decision-making which facilitates faster and more accurate decision in the organizations. In addition the concepts “BI anywhere” and “BI everywhere” are related to the usage of mobile business intelligence and cloud business intelligence. Moreover, the flexibility of systems is focusing on to the cloud solutions of business intelligence.

These different enablers were reflected on the SAP landscape which contributes the most of the enablers with the different products in the SAP landscape. The biggest benefit is related to the SAP HANA in-memory database which enables most of the SAP application to run on the SAP HANA. This enables the real-time decision-making with column- and row-oriented database structure. The one of the key benefits which SAP provides is the simplified data models and simplified business intelligence architecture. This means that with SAP HANA, the ETL-process does not need to be relied that heavily than before due to SAP product SAP S/4 HANA is combining the OLTP and OLAP functionalities. Furthermore, SAP HANA can be run on SAP BW which enables traditional data warehousing and analyzing the historical data more deeply but with the enhanced query performance. However according to Stodder (2013), the in-memory technology might not always be an optimal choice for organizations and organizations need to investigate how frequently in-memory databases can refresh the data and organizations need to evaluate if the IM technology is suitable for fulfilling their needs.

The flexibility and scalability are related to the SAP HANA cloud offerings and SAP Fiori mobile business intelligence applications. These systems enable the real-time decision-making powered by SAP HANA but also enable ad-hoc analysis. SAP system landscape is constantly under development providing more features and enhancements to the context of agile business intelligence which will generate more possibilities for organizations to use real-time data on the decision-making (SAP Internal Training Materials 2016). The thesis answers four different research questions:

- *What agility in business intelligence means?*
- *What are the enablers of agile business intelligence?*
- *What are the benefits of agile business intelligence for organizations?*
- *How does agile business intelligence differ from traditional business intelligence?*

The first research question is answered in chapters 3 and 4, where the term business intelligence is defined from the various different perspectives and then it is put in the context of agility, formalizing the definition for agile business intelligence. After the definitions, the different agile business intelligence enablers are recognized based on the academic literature. In addition, the different benefits are related to the different ena-

blers. However as can be seen from the results, the same benefits may be related to the different enablers. The differences between business intelligence and agile business intelligence are summarized in chapter 6 in form of a table. All in all, the thesis managed to answer the different research questions in a holistic manner and finding similarities between the academic publications and SAP BI landscape. In addition, the thesis was able to draw a synthesis between the different benefits from SAP BI landscape and from the literature. The different enablers have classified into technological enablers and methodological enablers for agile business intelligence. Furthermore, the benefits of these enablers are acknowledged and those benefits have reflected on the definition of agile business intelligence. This means that the enablers founded in the literature are fulfilling the definition of agile business intelligence. As per previous sections, agile business intelligence is a relatively new term and the spectrum of these enablers will increase over the time when the technologies are becoming more mature in the different organizations. In addition, the need for agile business intelligence will be increasing in the future due to the amount of the data increases and the traditional ways of storing data in the data warehouse will not be efficient anymore. Furthermore, the flexibility is also in a central role due to the different task will transform more mobile form and the decision-making process will not be done behind the manager's desk: it can be done for example on the shop via tablets and smartphones. Finally, the operational and real-time decision-making will be increasing, which can facilitate more accurate and punctual daily decisions in the organizations.

6.3 Evaluation of the Research

The critical evaluation of the study is needed to take into account due to it enhances the objectivism in the study. The main point of the evaluation is related to the objectivity of the research. This means that the researcher's own opinions and points of view cannot jeopardize the results (Kitchenham & Charters 2007). The evaluation of the objectivism is based on the founded literature of the phenomenon. The objectivism of the results can be justified with the existing literature but also with the critical evaluation of the study is needed. This is easier to conduct in the quantitative research but in the qualitative research full objectivism might be problematic (Saunders et al. 2009). The qualitative research is usually based on interpretivism where the researcher needs to interpret the qualitative materials (Butler 1998; Cole & Avison 2007; Minger & Wilcocks 2004; Myers 1997). However, in these situations the researcher needs to justify all the research choices with the objectives of the study and reflect the material on the research questions.

The thesis focused on investigating qualitative materials which were in written or in visual format. The first part of the study, which was conceptualizing the enablers of agile business intelligence, was based on the literature founded in the academic and commercial (such as Deloitte's report) publications. The reliability of the first part is

easier to achieve due to academic contribution. In addition, the different steps for conducting the literature review have been documented in chapter 2 in order to enhance the transparency of the study (Wohlin 2014). Nonetheless the search procedure is well-documented, but the researcher's choices to include or to exclude different articles may affect the outcome of the results. This aspect has contributed by evaluating the suitability of the different articles based on the research objectives and research questions. In addition, the research has been done by a single person and it might decrease the reliability and give more biased outcome of the research (Kitchenham & Charters 2007; Wohlin 2014).

The second part of the study is giving a comprehensive understanding about the enablers of SAP BI landscape which have been reflected on the enablers founded in literature. However, the full objectivity is harder to achieve in the second phase of the study due to materials were SAP's own internal training materials which might give a biased and too optimistic picture of the SAP's enablers for agile business intelligence. In addition, the benefits that SAP BI provides to the organization have to be critically evaluated. However as stated before, the benefits of the enablers have reflected on the academic literature which give more credibility to the results. Furthermore, the second phase included the different articles which contributed enablers in SAP BI landscape in order to get the more reliable results of the enablers in SAP BI landscape. Finally, the materials that were used in the study are not commonly available and those are accessed via company's own portal which can affect the repeatability of the study.

6.4 Suggestions for Future Research

Agility in the BI context is a relatively new concept which has shown in the number of publications regarding agile business intelligence. For example, the search term "Business Intelligence" from IEEE Xplore produces over 2400 publications while search term "Agile Business Intelligence" produced only five results from the same database. This means that agility in business intelligence context needs to be investigated more comprehensive manners.

The second element is related to the benefit realizations of the different enablers founded in this thesis. This topic is highly interesting due to emergent technologies are enabling the usage of the real-time data on the decision-making. Due to work nowadays is not dependent of the location, the different technologies enable the ad-hoc analysis and faster decision-making which will be more critical in the future. However, the actual numbers (i.e. monetary benefits) relating to the improvements has not been studied in comprehensive manners. In addition, the thesis was conducted as a case study which was related to the specific system landscape. Now the benefits of the enablers from SAP BI landscape are investigated, it would be interesting to found out how these benefits are realized in the organizations.

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