BUSINESS INTELLIGENCE – ENABLING SELF-SERVICE

A case study in a global manufacturing company

Master´s thesis
in information systems science

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1   INTRODUCTION

In this global market, businesses are competing in global scale to meet changing customer demands and to provide the best value for potential customers. Effective and timely information for today's business decision making is not only considered advantageous but essential to survive in the competitive and rapidly changing markets (Lönnqvist & Pirttimäki, 2006, 32). Today's enterprises are collecting more detailed data which in turn has increased the amount of business data drastically. Businesses also look to leverage their data assets by introducing modern data analysis and reporting systems to make better, data-based, decisions and to improve performance and to meet customer demands. Most of the businesses today, in fact, have leveraged business intelligence technologies. (Chaudhuri, Dayal & Narasaya 2011, 88.)

Business intelligence can be understood as information processes that include activities driven by the organization's information needs in the purpose of gaining competitive advantage (Pirttimäki 2007, 92). Business intelligence includes a broad set of applications and technology to gather and store data so business users can access and analyze the data to make better business decisions (Raisinghani 2004, 25).

Traditionally, business intelligence has been designed to support managerial needs. High-level management needed to have an overview of the business and its performance in regards of reaching its strategic goals. Initially business intelligence was considered only as a managerial tool, it was developed from managerial information systems, executive information systems and decision support systems with the goal of supporting strategic level decisions (Arnott & Pervan 2005; Bara et al. 2009.) Nowadays businesses management often measures business performance through a set of performance indicators (Bose 2006, 50) with the goal of understanding where it needs to improve to meet its strategic goals. Business performance management (BPM) has been the focus of many BI researches. BPM is way of management controlling and leading the company with the right initiatives to meet its strategic goals by monitoring, analyzing and acting on the results. (Gaiss 1998; Ballard et al. 2005; Quinn 2010.)

On the other hand, the decision making field has moved to ever quicker pace. Increased competition and rapidly changing environments have caused business users not to be satisfied with scheduled analytical reports, pre-defined key performance indicators and pre-defined report dashboards. Business users demand ad hoc type queries to be answered quickly with actionable information. The information has to be accessible by the right people and at the right time. (Azvine et al. 2006, 26.)

The recent shift in the business intelligence market has been from highly governed and centralized, IT-authored reporting towards a decentralized BI model empowering business users with self-serviced analytical and data discovery capabilities (Sallam et al., 2015). According to a TDWI (The Data Warehousing Institute) research by Imhoff &

White (2011) 78% of the questionnaires responded that in their businesses there is a need for faster time value from BI solutions. Software companies and major industry research companies such as Gartner and TDWI have focused much of their recent research in BI are on self-serviced BI and data discovery capabilities. According to Gartner's prediction (Parenteau et al. 2014) by 2017 most business users and analysts in organizations will have access to self-serviced BI tools to prepare data for self-analysis. Already businesses are focusing their BI investments into decentralized, self-serviced analytical tools with the intention to expand the scope of BI within organizations to broader range of consumers and non-traditional BI users (Sallam et al. 2015).

Young workers who have grown up with computers and the use of internet are used to finding answers quickly and easily using search tools such as Google. Their expectation of being able to gather needed information differs drastically compared to more old-fashioned workers. They are also used to communicating and collaborating together through different technologies, such as social media. Businesses need to provide the capabilities to easily access information without delays and sharing and enhancing together that information within the company. BI tools and governance models focused on self-service try to provide such capabilities. It is also important to understand that, even though software companies offer products for self-service or discovery capabilities, it is more of an organizational change in regards of business intelligence. (Imhoff & White 2011, 31.) Academic research, however, on self-serviced business intelligence is almost totally absent. During literature review the researcher was unable to find relevant studies on self-service BI model through the most common search tools and databases. As the shift in the BI market has recently been towards BI self-serviced industry (Sallam et al., 2015) it is important to gain understanding on how self-serviced BI could help businesses in terms of decision making and what possibilities and challenges may self-serviced BI bring. There is a clear research gap for self-serviced BI in the academic literature; hence it has been taken as a focus research problem for this thesis. The subject is approached with a case company study where the company has a business intelligence tools in use but works in mostly centralized manner. The goal of the case study is to gain understanding how the business users find information, how they use business intelligence and what the challenges in those are. Business users are also inquired on their opinion on de-centralized self-service BI model.

Self-serviced business intelligence aims to empower a bigger user base to use business intelligence tools to analyze and generate insights from business data. The basic factors enabling it are for example very easy to use BI tools, ability to access and choose source data more freely, such as including user's own spreadsheets, and making data warehouse solution easy to deploy and manage. The fundamental goal is to make information production and consuming as easy as possible for the end-users so businesses can use BI more for their daily information needs without the need of a centralized IT or BI team

expertise. Usually businesses are driven to self-service BI because centralized team is causing a bottleneck in producing information. Business needs change constantly and so do the information needs. The self-serviced BI initiatives are challenged by users' lack of skills related to BI or difficulty in understanding the data. (Imhoff & White 2011.)

This study shows that business users often require information to support their decisions but getting information may be laborious and difficult. Business intelligence is a set of tools trying to get information out of vast amounts of data (Sharthi & Hightower 2007). Business intelligence, however, has often been taken into use for higher level management to measure its business performance (Bara et al. 2009, 100). This study suggests that business intelligence could be also used to help all business users to address their information needs by having information in one place and enabling easy and understandable access to businesses data to all decision makers. Enabling self-service BI may enable fast and easy access to information and therefore enable faster decision making, however, businesses intelligence has to present the data in an understandable format so it can be easily understood by average business users. Benefits of self-service should not be taken for granted. Misunderstanding data can cause false conclusions which may become costly. Businesses must design their BI systems to be easy-to-use and have easily understandable data, which will require a lot of groundwork for BI system before self-service can be enabled.

This study's research goal is to understand how enabling self-service could help businesses meet their information needs.

- ***Research objective: Can self-serviced BI help businesses to meet their information needs?***

To answer the research question we try to understand what businesses use BI for and what the challenges in acquiring business information are. This brings us to how self-service BI model tries to resolve those challenges and what drives businesses to enable self-service. Our research questions are the following:

- ***RQ1: Why do companies use business intelligence?***
- ***RQ2: What are self-serviced BI objectives and drivers?***
- ***RQ3: What are the business information challenges at the case company?***

Research questions one and two are answered in both the literature review as well as the empirical study. Research question three is answered in the empirical study to try understanding what challenges the case company faces and how self-service BI could help resolve those challenges.

2   BUSINESS INTELLIGENCE

The literature review is focused on Business Intelligence (BI) research area which is a follow up term to decision support systems, executive information systems and management information systems (Thomsen 2003, 21). The purpose of this chapter is to review how academic research views the BI concept. How traditional BI has been understood and where business intelligence is going. One of the goals is to understand what the traditional BI offers to companies and how it has been utilized to enhance business performance. Secondly new concepts to BI are being discussed and how those further help businesses to generate information at the right time and place. In order to make decision making even faster and at the point of decision, while keeping up with the quality of information and decisions.

2.1   Overview of Business Intelligence

2.1.1   The concept of BI then and now

Today's enterprises collect more detailed data, which therefore comes in even bigger data volumes. Businesses look to leverage their data assets by introducing modern data analysis and reporting systems to make better, data-based, decisions and to improve their offering to their customers. Most of the businesses today have leveraged business intelligence technologies. (Chaudhuri et al. 2011, 88.)

   The Business Intelligence concept has its roots in the history of DSS (Decision Support Systems) and has been evolving throughout time. More and more concepts are introduced under the business intelligence area. Here we briefly go through the history of DSS area to better understand how the BI concept has evolved. One of the goals of this study is to analyze and discuss how the BI concept is evolving currently.

   In the 1960s database management systems (DBMS) became used by businesses to run operations and record transactions. Later in the 1970s DSS was introduced with the goal of providing data-based decision making support. The 1980s introduced Executive Information Systems (EIS) with goal of providing executives with information within their organization. Also tools like OnLine Analytical Processing (OLAP) and Data Warehouses (DW) were introduced in 1980s. The purpose of OLAP was to query and summarize information. Data Warehouses on the other hand were meant to combine data from different sources. These technology concepts and goals are the foundation of current BI structure. (Shariat & Hightower 2007, 40-41.)

Business intelligence has been built originally to serve as an executive-level managerial tool (Arnott & Pervan 2005, 71). The main characteristics of BI have been traditionally understood as (Bara et al. 2009, 100):

- representing information to high-level management
- setting strategic goals
- strategic planning
- setting KPIs (Key Performance Indicators) for measurement of business performance.

Executives have had the need to have an overview of business performance. BI has been developed to meet that need so that companies have the capability to react and make decisions accordingly so they can meet the strategic goals they have set.

The traditional business intelligence model is lacking in terms of providing information available to all levels of business decision makers at the right time and place. In the modern era of globalization companies around the world compete with each other, hence businesses must be even quicker to react to changing environment and new customer needs. Scheduled analytic reports, pre-configured key performance indicators (KPI) or fixed dashboards no longer satisfy the business decision maker's needs. Businesses require quick access to ad-hoc type queries and information they can act on from analytical applications with real-time business data and they need the information to be available to the right people and at the right time. Business intelligence as a concept tries to address this problem. However, the traditional BI solutions with pre-defined data warehouses or pre-defined reporting often fall short of this goal. These solutions often do not have real-time data and also do not allow user to choose data sources that they need to analyze and generate the information needed for the business decision at hand. Also these solutions often require experts to analyze and generate reports for business users. This causes a time gap between the business user's initial information need and having the report available. (Azvine, Nauck & Majeed 2006, 26.)

The importance of having information and analytic capabilities available at all times and at the point of decision is also emphasized by Karbhari (2006, 1). He points out that today's enterprise needs require business decision makers to make decisions in real-time by sorting through increasing volumes of information quickly while not losing operational efficiency. A few years ago users would be satisfied in waiting periods of time to have their information needs fulfilled, but today they require the ability to have their own intelligence dashboards, control their embedded analytics and generate their own reports through a standard web browser interface. To overcome the fast-paced changes in information needs some companies are moving towards self-serviced BI capabilities. Self-serviced BI is reviewed in chapter 3 of this study.

2.1.2   Definitions of BI

According to Arnott & Pervan (2005, 71) Business Intelligence is poorly defined throughout the industry. Software companies and consultancies try to define BI so that it supports their own products and needs. Database vendors define BI as extraction of data from different systems to integrate the data and to transform it. Analytical vendors, on the other hand, focus on statistical analysis and data mining or discovery (Azvine et al. 2006, 26) Popovič, Tomaž & Jaklič (2010, 7) point out that on the scientific research field the business intelligence terms are broadly defined as well. The definition of BI in a given study determines the scope and approach to the given subject. Hence it is important to review different BI definitions and decide the scope and approach that is taken in this study.

The term "Business Intelligence" was first introduced by Gartner Group, a major consultancy company within the IT industry. According to Sharthi & Hightower (2007) Gartner Group in 1996 first stated that BI is a set of tools which includes Data analysis, reporting and query tools that help businesses to synthesize valuable information from a sea of data. The technology approach to BI is also taken by Raisinghani (2004, 25): "Business intelligence (BI) is a broad category of applications and technologies for gathering, storing, analyzing and proving access to data to help enterprise users make better business decisions". Negash (2004) defines BI as systems that combine data gathering, storage and knowledge management with analytical tools so planners and decision makers can retrieve and present internal and competitive information from the data.

Negash & Gray (2008, 175) further argue that competitive intelligence (CI), the analysis and monitoring of competitors and competitive environment, is part of the BI concept as a subset. However, according to Hovi, Hervonen & Koistinen (2009, 79) international market analyzing companies such as Gartner and IDC have usually considered BI only in relation with internal information management. Using internal data organizations try to understand what and how they are doing in order to develop their business. This excludes externally available information and CI.

The general approach seems to understand BI as a technology which combines data from different sources and includes the tools to analyze it and generate information to support decision making. However, some researchers take this concept further from the technology aspect.

English (2005) wants to point out that the focus should not be on the tools and technology. BI is about understanding what is happening inside and outside of the organization. English states that there is no intelligence without the human factor of BI. A human will interpret the meaning and significance of the data to generate information and intelligence for the business.

Pirttimäki (2007, 92) concludes BI as an information process including systematic activities that are driven by the organization's information needs and the goal of gaining

competitive advantage. She also highlights BI as a managerial philosophy or tool and that the technology aspect of BI is only the enabler of generating information that can be used for the company to gain competitive advantage. Also Azvine et al. (2006, 27) see that BI is a process where one of the most valuable assets of a company, data, is captured, accessed, understood, analyzed and turned into information in order to improve business performance.

Sharma & Dijaw (2011, 114) define BI as a set of processes, both dynamic and continuous, where individuals, groups or even organizational structures continuously try to view their businesses' health status. According to this, organizations try to understand how they are performing in each area so they can make information-based decisions to improve in each area or business function to keep up with the competition or even gain competitive advantages. In fact, EPM (Enterprise Performance Management) system for BI is seen as a must have for an organization who wants to monitor its business activities' performance. Such systems would generally include setting up metrics such as KPIs in order to measure the performance of each process or activity (Bose 2006, 51). Also Arnott & Pervan (2005, 71) highlight the managerial approach of BI and define BI as a model and data oriented decision support system that focuses on management reporting. In other words BI is an Executive Information System (EIS) which purpose is to serve and support high-level management's decision making.

Some of the later academic research makes a small distinction between business intelligence and business analytics (BA). Generally BA can be treated as a subset of BI. Williams (2014) summarizes BI as an umbrella term that includes provision of relevant reports, scorecards, dashboards, e-mail alerts, pre-structured user-specified queries, ad hoc query capabilities, statistical analyzes, forecasts, models and simulations. He further specifies business analytics (BA) as BI subset which includes statistical analyzes forecasts models and simulations. Also Davenport & Harris (2007, 7-8) define analytics as a subset of BI which includes statistical and quantitative data analysis, explanatory and predictive models and fact-based management to drive decisions and actions. They see analytics as either input to human decisions or even as driver to automated decisions. Analytics try to understand why is something happening, what happens if it continues and what will happen next. Business analytics seems to be understood as a subset of business intelligence concept, where historical data is analyzed to predict the future.

To conclude business intelligence definitions, it can be seen as a process where business data from internal or external sources is transformed with the help of BI technology into relevant information to support business decisions.

2.1.3   Technical BI architecture

In this section the technical architecture of business intelligence is reviewed. Firstly the traditional data warehouse structure is introduced and secondly new technological components as part of the technical BI process are reviewed. New technological advantages have been introduced to technical BI architecture for it to better meet the demands of today's businesses. As information and analytical capabilities are needed at all times with real-time data and at the point of decision making, there should not be any delays in data and analytics availability (Karbhari 2006, 1).

The basic architecture is defined by Hovi et al. (2009, 86) as a technical process consisting of four different parts (Figure 1). This approach to BI is a more of the traditional model, which has later on expanded with more capabilities.
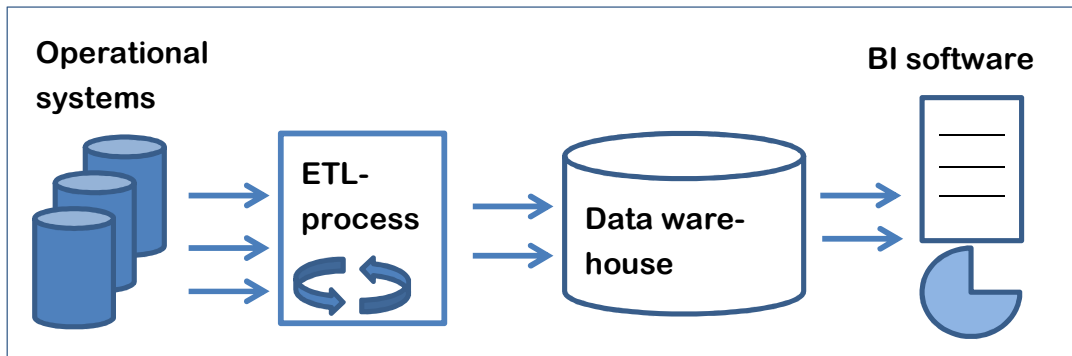
Figure 1 BI technical process (Hovi et al. 2009, 86)

The first part consists of operative systems and databases. These usually include ERP (Enterprise Resource Planning), CRM (Customer Relationship Management) and other operational systems. The operative systems have traditionally been the main data sources of a business intelligence solution, however as a concept is not limited to operative databases. (Hovi et al. 2009, 86.) The data in the operative systems is highly structured and repetitive (Shariat & Hightower 2007, 44). In terms of BI this would mean that businesses can monitor and measure the repetitive and structured data to be able to identify changes in business processes and performance in different functions usually though a set of KPIs (Bose 2006, 50–51).

Second part of the process is typically called the ETL-process (Extract-Transform-Load). The purpose of this process is to retrieve data from multiple operative systems and transform it into one, unified format (Hovi et al. 2009, 86). Companies may have multiple versions of the same information, like a customer record, in multiple databases. Hence the ETL process is needed to format, combine and aggregate the data. ETL often also includes data cleanse, so only relevant data is transformed forward so it can be better

understood and analyzed. Data warehouse vendors often offer ETL middleware customized for specific environments or industries. (Shariat & Hightower, 2007, 44.) Jordan & Ellen (2006, 17–18) also emphasize the importance of common understanding of data. A common format of data helps businesses to understand the same things in the same manner and make decisions according information generated from the same data. If business users come to different conclusions because they are looking at different view of the same data they might not trust the data quality anymore, in which case the business intelligence program loses value in the eyes of decision makers.

Third part of the structure is called data warehouse (DW). Data warehouse is the place where the information is gathered and stored by the ETL-process. Data warehouse can include data which has been unified and cleansed by the ETL-process as well as data which has been calculated or consolidated during the ETL-process. Pre-calculated and summarized data is often structured so that it is easier for the users to understand and analyze the data. (Hovi et al. 2009, 68.)

The last layer of the process includes the actual BI-tools that the business users use. In this layer the methods and interfaces, which the user is able to use to analyze the data, are defined. Typically this part includes pre-defined reports and dashboards, ability to do new queries, making use of multidimensional analyzes and having a look at pre-calculated metrics through scorecards. (Hovi et al. 2009, 68.)

According to Hovi et al. (2009, 6–7) the benefits of data warehousing are many. Firstly business could rely on operative system reporting. Operative systems often include standardized reporting, but those are often generalized and might not meet the need of the business. Generating new reports directly for operative systems is seen difficult as it requires in-depth knowledge of the usually very complex database structure. The design of such reports often needs to be outsourced to an external partner, which can be costly and time consuming. Combining data from multiple source systems also is not possible in such a case. Some companies, usually smaller, rely on spreadsheet reporting where data is manually added or data files from multiple systems are combined. Such work includes a lot of human work and is prone to human errors. Excel-based reporting systems often also include custom-coded and complex macros which often are only understood by the designer, hence it proposes a risk for the business if the expert is not available or leaves the company. The benefits of data warehouse as part of BI program are listed below (Hovi et al. 2009, 15–16):

- Integration of data from multiple sources into one, unified and understandable format. Function level view of same data, such a customer, is unified into one whole business level view
- Data warehouse is independent of business processes and less dependent on operative systems, which allows more flexibility to meeting new reporting needs

- Data can be pre-calculated and structured so that business users can understand the data more easily. More easily understandable data allows faster interpreting of data into information as well as allows business users to analyze it themselves without the need of experts in database structures.

Chaudhuri et al. (2011, 90) view the BI technical architecture as five different parts (Figure 2), and introduces how new technological advantages are being implemented into the existing parts to better serve the today's businesses information needs. There is an increasing need for even faster data access and ability to analyze information faster and efficiently at all organization levels. The ability of having the needed information available faster will allow the business to react quicker into potential problems or opportunities. The five layers of technical BI architecture are (Chaudhuri et al. 2011, 90):

- Data sources
- data movement, streaming engines
- data warehouse servers
- mid-tier servers
- front-end applications.
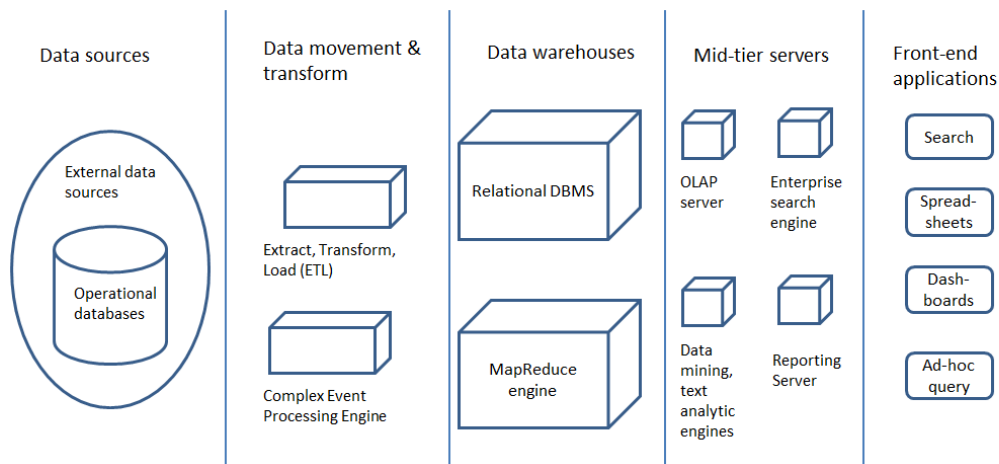
Figure 2 The five layers of technical BI architecture (Chaudhuri et al. 2011, 90)

Chaudhuri et al (2011, 90) state that there is an increasing need for supporting real-time business intelligence capabilities. New complex event processing (CEP) engines have been introduced to support those needs. Real-time decision support capabilities provide suggestions on how to speed up the information flow from data into decisions seamlessly (Azvine et al. 2006, 30 ; Sahay & Ranjan, 2008, 34).

Traditional data warehouses are often RDBMS (Relational Database Management Systems) which work by executing complex SQL queries. During the last decades there have been different developments and optimizations to allow analyzing of increased data volumes. More data is being produced and gathered by businesses today and there is a need to analyze that data in a cost-effective and efficient manner; this is often described as the *Big Data* challenge. New technologies such as *MapReduce* have been introduced to support those needs in BI environment. These technologies were originally developed for web search environments but nowadays part of some modern BI solutions. (Chaudhuri et al. 2009, 90.) RDBMS can still be seen as effective manner to gather and analyze structured and repetitive data, which often comes from internal data sources. Paraller RDBMS queries help the system to produce the data in a prompt manner. However if data becomes more complex and the variety changes (for example if analyzing text documents such as e-mails or external sources such as social media) MapReduce technologies become more effective (Ebner, Bühnen & Urbach 2014, 3750).

Mid-tier servers provide the technological tools that the BI applications use to retrieve and analyze the needed data from the data warehouse. These tools include traditional OLAP (On-Line Analytical Processing), which serves as analyzing data in a multidimensional view of data to enable user to filter, aggregate, drill-down and pivoting of data. Increasingly businesses deal with unstructured data such as text for example e-mails to and from customers, customer product reviews and complaints. New tools such as enterprise search engines or text analytics have emerged to easily provide the user with relevant information, including data in text format. As an example, a customer service representative could be having a meeting with a customer and he or she would like to have all related information of that customer available fastly. (Chaudhuri et al. 2011, 90.)

In short the basic technological structure consists of data sources, transformation of data, warehousing and front-end user tools. The basic structure overall has remained the same but new technological tools have been introduced to meet the challenges of increased volume of data, increased complexity of data and increased variety of data.

2.1.4   *Business analytics – new methods*

Even though the business intelligence research is quite well established, emerging research areas under BI are being introduced. Recently some of focus has been on new business analytics methods that analyze non-structured data and especially data sources outside of the enterprise borders, this is often referred to as Big Data (Baars et al. 2014, 13-14). Chen et al. (2012, 1172-1175) categorize new emerging topics for business intelligence & analytics (BI&A) under five critical technical areas. He also points out that these five different analytic areas may utilize similar underlying techniques:

- (Big) data analytics
- text analytics
- web analytics
- network analytics
- mobile analytics.

Data analytics or big data analytics refers to BI technologies that are related to data mining and statistical analysis. This includes data mining algorithms, quantitative analyzes, heuristics and optimization techniques. More recently data analytics area has developed from traditional structured content analysis into big-data-based semi-structured content analysis. While RDBMS-based data can be analyzed repeatedly, semi-structured data may require ad-hoc, one-time data extraction, parsing, processing, indexing and analytics using MapReduce or Hadoop environments. (Chen et al. 2012, 1174-1175).

Text analytics refers to methods of analyzing data in textual format such as documents, e-mails, social media content and communications between organizations and customers. A lot of data collected by today's businesses is in text format. Text analytics can be used for example as a basis of enterprise search systems (a Google like search of enterprise internal data). Text analytics is also used as a question & answer system such as IBM's Watson or Apple's Siri. *Web or Network analytics* focuses on analyzing external data such as social media and websites, often this kind of data is also in text format. Businesses may use such methods to identify business opportunities from social media chatter, the possibilities can be quite limitless. Lastly *mobile analytics* is similar to the previous ones but focuses on mobile platform analysis such as apps. (Chen et al. 2012, 1174-1178.)

Traditional BI was designed to measure structured data to monitor performance and identify problems (see chapter 2.2). These new tools, however, are analytical methods designed to provide new business supporting insights and analyzing markets, current and potential customers or other business stakeholders. New methodologies may allow businesses become even more analytical in business decision making and even in defining business opportunities and strategies. These methods speak of expanding usage of BI as part of everyday business decision making.

2.2 Business intelligence in use at different organizational levels

2.2.1 The business goals for BI

In chapter 2.2 the academic research on businesses utilizing BI at different organizational levels is reviewed. High-level management might require an overview of what the company is doing, insights on its business performance and insights on changing customer needs. Strategic management tries to look for a longer term viewpoint so they can make strategic business decisions. Then again, the business users at lower management levels or even the individual workers of the company might require different kind of information for their decision making. Certainly, the lower levels of the company hierarchy would need to look at more detailed process levels and analyze the design of those in order to meet the goals of the strategic leadership. At lower managerial levels the scope of intelligence is more focused and more has an operational time-frame.

Measuring the effects of business intelligence is important for the businesses. If expensive business intelligence programs do not meet the information needs of the company the whole BI investment becomes very costly for the company. Businesses should, in fact, regularly review of business intelligence meeting the needs of business users. (Hočevar & Jaklič 2010, 97.) Hence, it is important to understand what the information needs at different organizational levels are and analyze if the BI program itself meets those needs or not. Firstly the general goals for BI are reviewed after which literature on business intelligence at different organizational levels is reviewed to gain an understanding on what is the purpose of BI for strategic management as well as how the whole organization and BI is linked to that. Business intelligence is about having the information available to make decisions and to understand what is happening around you within and outside the organization. In section 2.2.2 an example framework, on explaining how BI is used in organizations, is reviewed.

Business intelligence aims to create efficiency and effectiveness to the business organization. Generally basic idea is providing easier and faster access to information of the company. Businesses can identify key success factors that help management to understand situations, in fact the one of the main goals of BI is to provide an overview of what is happening and why. (Hočevar & Jaklič 2010, 95.). A general business intelligence case is presented in Figure 3.

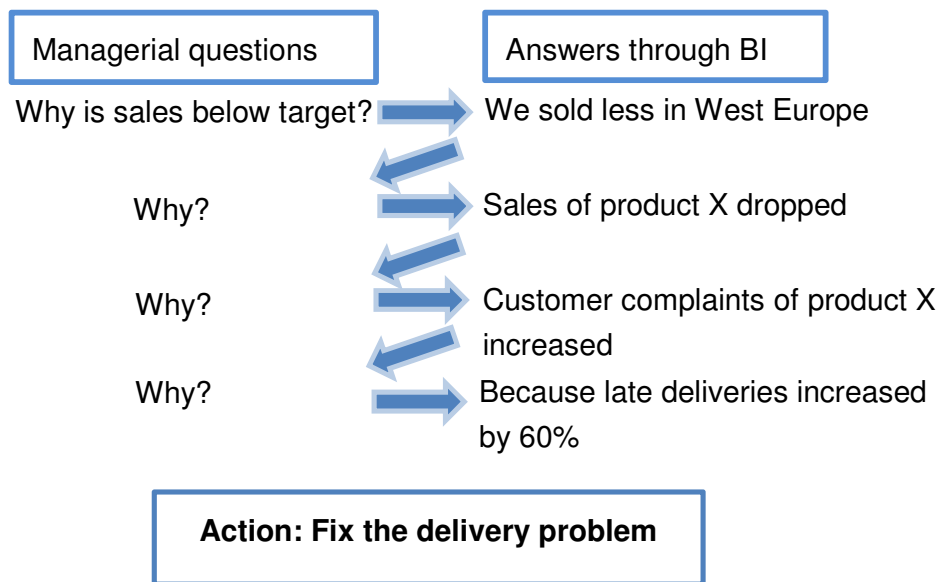| Managerial questions	Answers through BI
Why is sales below target?	We sold less in West Europe
Why?	Sales of product X dropped
Why?	Customer complaints of product X increased
Why?	Because late deliveries increased by 60%

Action: Fix the delivery problem

Figure 3 Typical research problem (Carver & Ritacco 2006, 10)

At first the strategic management asks the question why sales are below target. Secondly they could go into business intelligence to analyze where the sales have dropped. After noticing sales of a given products dropped in a certain area they ask the middle management to analyze why this was the case. The next organizational level of the company tries to find out what were the reasons behind this by doing analytics in business intelligence tool, they notice that customer complaints increased because the deliveries were late. Lastly the sales management will ask the operations team why the deliveries were late. Operations tries to find out the root causes of late deliveries of a given product to a given market area, after thrilling down and running analytics they might find the underlying cause and take operational actions to fix the cause and avoiding the problem in future. The given example suggests that different levels of the organization need different information and need to ask different questions and take different actions to meet the goals of the businesses. Also it emphasizes how business intelligence is required at all levels of the business organization so that the real root causes of the problems can be analyzed and fixed. The ability of drilling down through the initial problem into the final root cause and solution through the whole business organization is one of the key beneficial factors of BI (Hočevar & Jaklič 2010, 95-96). Being aware of what happens in the business processes and being able to analyze the problem areas for root causes of problems can benefit the company greatly in different aspects. Example benefits of business intelligence are (Thompson 2006; Carver & Ritacco 2006; Atre & Moss 2003)

- Increasing revenue

- Improving customer satisfaction
- Improving internal communication
- Improving decision making

Elbashir, Collier & Davern (2008) emphasize the link between organizational performance and business process performance. The organizational performance comes from process performance and BI helps the management to understand why organizational performance is / is not improving. Management needs to understand which part of the value chain is improving or hindering the organizational performance. Businesses can generate different organizational benefits that thrive from different process-level performance improvements which can be categorized as following (Elbashir et al. 2008):

- *Supplier or partner relations* are improved by having more efficient inventory management with reduced transaction costs and better coordination with suppliers and partners
- *Internal process efficiency* is improved from increased staff productivity, reduced decision making costs and reduced operational costs
- *Customer intelligence benefits* are improved by reduced marketing costs, reduced time-to-market from better understanding of customer needs and reduction of cost from unhappy customers. Customer aspect in fact is usually the most relevant improvement aspect from BI. More understanding of customer needs, reacting quicker to raising problems such as delivery problems, the ability to identify common complaint causes or faulty products from customer complaint forms etc. These can help businesses to create more value to their customers in longer term.

To concise, BI can help businesses to serve their customers more effectively by understanding the internal performance and having the ability to identify and fix problems faster. While at the same time it is not enough for the strategic leadership to notice that deliveries were late and it caused customer dissatisfaction, the operational and middle-management must be able to gather information and gain intelligence so they can react to the operational problems and improve their processes and fix problems.

2.2.2 *Ways of using BI*

The business justification for a business intelligence investment should be that business intelligence program supports strategic goals of the business. Without a good business justification the management is not as likely to support the program. Business should identify the business drivers, strategic goals and define what the business analysis issues

are. Also business should identify the information needed at strategic level to meet strategic goals and to do strategic level business decisions. (Atre & Moss 2003, 31.)

Traditionally business intelligence has been seen as a managerial tool, the BI concept has been developed from managerial information systems (MIS), executive information systems (EIS) and to support strategic decisions (Arnott & Pervan 2005; Bara et al. 2009). The information levels are often visualized as a pyramid. Shartiat & Hightower (2007, 43) proposed a conceptual information architecture on how information and reporting is used at different levels (Figure 4).
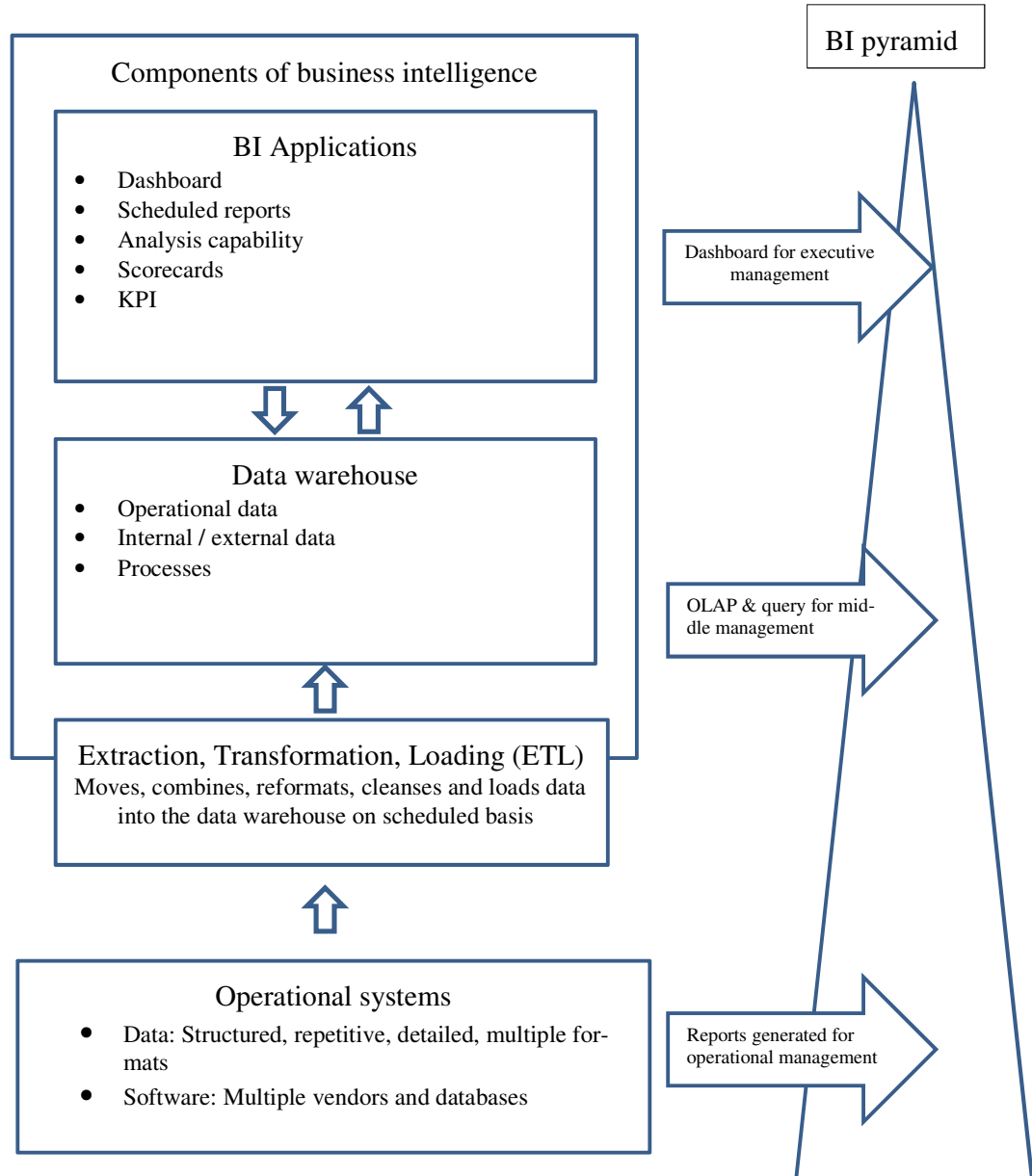
Figure 4 Standardized business intelligence architecture (Shartiat & Hightower 2007, 43)

At the top of the pyramid executive management has the ability of using pre-made dashboards. Where the manager can see an overview of a given business defined measurement, such as sales of last month in Europe. And the ability to drill-down into more detailed levels within the dashboard. For middle-management the model proposes OLAP-based analytical capability as well as ad-hoc-based query capabilities. Operational management uses pre-defined and standardized reports to do daily tasks. (Shartiat & High-

tower 2007, 43-44.) It could be argued that the model is based on the high-level managerial approach to BI. According to the model, the operational management has to rely on pre-defined reports to run daily operations without the ability of ad-hoc-based analysis and investigations. The problem of relying on pre-defined reports raises a problem when information is needed that is not yet provided by pre-made reports. Generally, operative reports are run straight from operational systems or databases. Azvine et al. (2006, 26) argues that they also require an expert to develop such reports and the process of generating a new report is often time consuming. Such an approach from operational user perspective is time consuming and non-adaptive, hence it is important to understand how those needs can be taken care of as part of the business intelligence solution in a given environment.

Further research also speaks of the problem of relying on pre-defined reporting. Karlöf (2002, 225) mentions that as business environments are ever more dynamic so are the information needs for the decision making. In a case where a person is not able to gather all the needed information there will be an information gap between the available information and information needed. Vitt, Luckevich, Misner (2002, 15, 29) call this gap the analysis-gap, the idea is that decisions makers have loads of different information available but struggle having the needed information available. The business problem is how it can provide the right information available for each employee. In case when pre-defined reporting will not fulfill that need, should the user be able to do data-based analyses on its own to fulfill the information need? This point is further discussed in the chapter 3 of the literature review.

A business works from day to day executing the strategy set by the top management. The alignment of the whole business and the way of working with desired ways and strategy is important for a business to succeed. Top management will seek to execute its strategy with different desirable behaviors using business performance management together with analytical task and capabilities (Acito & Khatri 2014, 566).

The concept of business performance management (BPM), corporate performance management (CPM) or enterprise performance management (EPM) has been studied by many researchers and many business intelligence vendors offer frameworks and software to support them. Those concepts are important part of understanding how businesses use BI for business management. According to Ballard et al. (2005, 13) BPM is a process that enables alignment of business goal business measurements. In general BPM is viewed as a continuous process where a business (Gaiss 1998; Ballard et al. 2005; Quinn 2010)

1. monitors its performance
2. analyze problems and solutions
3. acts accordingly.

To measure performance a company can identify a set of Key Performance Indicators (KPI) with the goal of measuring financial or non-financial key measurement that best

can monitor on how business is executing the strategy in a given area, hence the measurement must be derived and aligned with the business strategy (Bose 2006, 50). KPIs should be quantifiable measures, often agreed beforehand, and should reflect the critical factors of the organization. KPIs must be based on organizational goals derived from the business strategy, hence also KPIs often differ between organizations. KPIs are usually set for a long term and generally change as the strategy is changed. The KPIs are usually measured using a business intelligence technology and are often included in an executive BI dashboard with the capability of drilling down further into the metrics to find cause and effect links. (Bose 2006, 50.)

Gaiss (1998, 45-46) emphasizes how a business will continuously have to do operational analysis to optimize its operations and to identify causes and solutions to underlying issues identified by the KPI measuring. This also further speaks for enabling and sharing the measurement view to the whole organization. As well as enabling the analytical capabilities through the organization so all the organization parts can optimize work, identify issues and develop better and new ways of doing things.

Quinn (2010, 9) underline that in order to realize performance management benefits a business has to use BI to communicate and monitor strategic business performance at all organizational levels in a cycle of continuous improvement linking strategic, analytical and operational initiatives. The goal is to keep each individual informed on how the business is progressing on meeting specific strategic goals. If business performance is lacking, it can be identified by using the analytical capabilities of BI to detect problems and to find cause and effect. Then business can set operational initiatives to design solutions to those problems.

Acito & Khatri (2014, 566-567) have developed a framework of deriving value from business analytics in conjunction with business performance management (Figure 5).
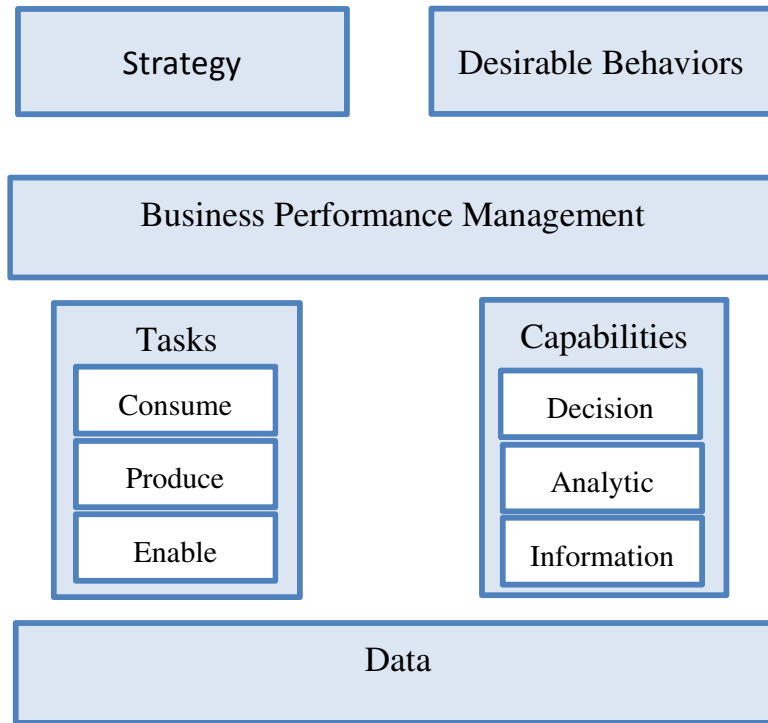
```
┌─────────────────────┐        ┌─────────────────────┐
│      Strategy       │        │ Desirable Behaviors │
└─────────────────────┘        └─────────────────────┘

┌──────────────────────────────────────────────────┐
│         Business Performance Management            │
└──────────────────────────────────────────────────┘

┌──────────────────────┐        ┌──────────────────────┐
│        Tasks         │        │     Capabilities      │
│  ┌────────────────┐  │        │  ┌────────────────┐   │
│  │    Consume     │  │        │  │    Decision     │   │
│  └────────────────┘  │        │  └────────────────┘   │
│  ┌────────────────┐  │        │  ┌────────────────┐   │
│  │    Produce     │  │        │  │    Analytic     │   │
│  └────────────────┘  │        │  └────────────────┘   │
│  ┌────────────────┐  │        │  ┌────────────────┐   │
│  │    Enable      │  │        │  │   Information   │   │
│  └────────────────┘  │        │  └────────────────┘   │
└──────────────────────┘        └──────────────────────┘

┌──────────────────────────────────────────────────┐
│                      Data                          │
└──────────────────────────────────────────────────┘
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Figure 5 Structural framework for business analytics (Acito & Khatri 2014, 566)

Strategy refers to the business strategy, working as a basis context and justification for the analytics program of the business. Analytical capabilities should be designed based on the business strategy. *Desirable behaviors* refers to the beliefs and organization culture that is included in the mission statement, values, rituals and organization structure. Davenport et al. (2001, 125) point out that according to their study cultural factors are the biggest barrier in getting returns out of the BI investments. Enabling data-based analytical capabilities and data-based decision making culture in the organization is important for the analytical capability investments to succeed (Davenport et al. 2001, 127).

Business performance management tries to understand how business can be measured and what factors can include those measurements. Analytical capabilities can be seen as a close tie to BPM as businesses often invest in BI to be able to measure their performance and have a better overview of the business processes and functions' performance. In this given framework it could be seen as a link between the technical analytical capabilities as well as the human analytical tasks and the business strategy and desired behaviors. Businesses have strategies and desired missions and values that they try to follow. BPM helps the business to measure how well it is executing those goals. Then again users can use analytical capabilities to further understand which factors affect the capability of executing the strategy as best as possible.

According to Chandler et al. (2011) analytically engaged employees can perform three potential tasks

1. consume insights generated by others
2. produce insights from data
3. enable creation of insights.

These tasks orient from Gartner's business analytics framework (Chandler et al. 2011) which have been implemented to this framework by Acito & Khratri. Consuming intelligence means utilizing analytics for decision making purposes and producing intelligence refers to defining and doing analysis. Enable refers to all technologies and cultural factors that enable users to go and produce information out of the data using different BI related tools. The focus of the framework is on tasks that users can take instead of specific organizational roles. (Chandler et al. 2011; Acito & Khatri 2014.)

Chandler et al. (2011, 7) also introduce the multi-task role called *prosumer* which means an analytically enabled person can have all the three roles. A person could consume information from others, produce information out of that. The business intelligence trend and new capabilities are more and more enabling the self-serviced way of doing analytics. The more a business enables users to do self-serviced analytics and act as prosumers the more insights a company can produce and even further develop the BPM metrics of the business. This will also further enable a business culture of data-based decision making and utilization of BI technologies. Enabling data-based insights within decision making processes will benefit the company with making fact-based choices which would result in better decisions in a long run. (Chandler et al. 2011, 7-10.)

The three capabilities are supported by different BI technologies. *Decision capabilities* are tools, for example pre-defined dashboards and reports. These tools support delivering of information for decision making purposes by enabling sharing of information and making data easier to understand through visualization. *Analytical capabilities* refer to tools as well as methods that business uses to do predicative analyzes, statistics, ad-hoc queries, simulations and optimizations. *Information capabilities* are technologies that organize, aggregate, describe, and most importantly, share data to the organization at the right time and at the right place for business users to make information-based decisions. (Acito & Khatri 2014, 567.)

The framework helps to understand how business data acts as part of enterprise management where the business tries to execute its strategy with the desired values and methods. Business users and factors enabling business users to produce and consume information as part of their decision making process helps business to make better, fact-based decisions. Business performance management is a link between the data and the human work of getting information out of that data and strategic management. Business users analyze their processes trying to gain understanding of process performance, based on the data. This can enable new insights on what factors influence a given performance in a

given functional area. Therefore enabling of business users to analyze data and doing data discovery can enable the business to find out new measures and critical factors that affect the current measurement. This in turn will enable strategic management to consume that information to gain better understanding of its business performance and potential challenges. On the other hand, looking from top to bottom, when a business is executing a strategy and measures how it is doing so it (with BPM) may notice problems and lack of performance within its processes. In such a case it is important for the business to identify in more detail what is causing the problem or lack of performance to fix the problem and to improve its operations. Business users can dwell deeply into the problematic situation using the analytical capabilities of the company to find out the cause of the problem. The challenge businesses face is how they can enable users to analyze data, discover new links and insights and gain better understanding of the data to produce information for themselves as well as others. (Acito & Khatri 2014 ; Chandler et al. 2011.)

Smith & Goddard (2002, 248) also speak of the continuous development of performance management. A business will continuously aim to monitor its activities and measure how they are doing in executing the strategy, analyzing the results and responding accordingly. Performance management can be seen as a continuous and looping process. The process is illustrated in figure 6. The process also illustrates the importance of being able to analyze the results and figure out the root causes and figure out ways to improve and respond. A business must also continuously review its performance management context. A business, through analysis, can recognize if the environment or customer needs are changing. A business can also find ways of doing things more efficiently or identify new ways of providing value to the customers. This again can give input to change the whole strategy of the company. (Smith & Goddard 2002, 248.)
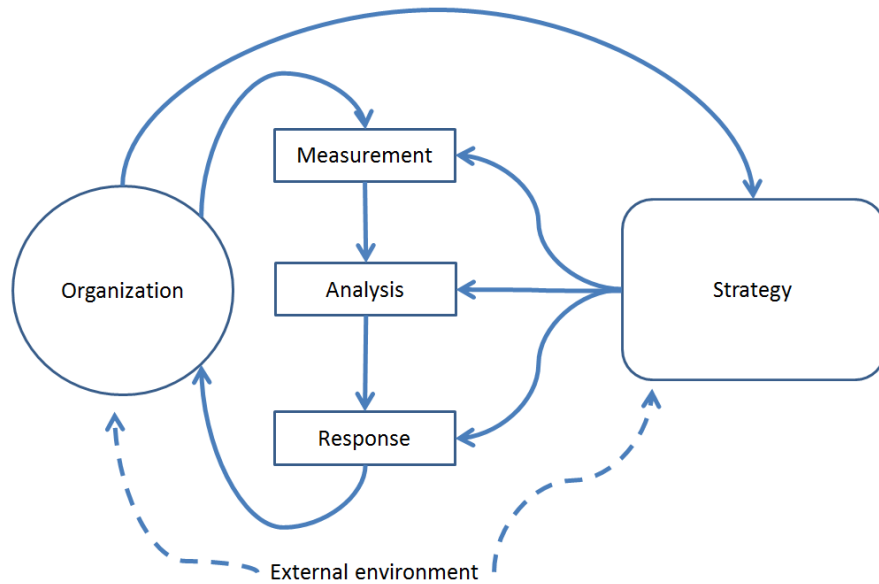
Figure 6 Performance management process (Smith & Goddard 2002, 248)

Literature review on managing business and its performance highlights the importance of having abilities to conduct processes analysis. In order to identify sudden problematic situations, changing customer needs or changing environment. Hence it can be said that the information and analytical needs of the company can't be fulfilled truly with pre-defined reporting and operational systems only. Business, throughout, has to be able to do produce and consume the information it has available to provide new insights and to be able to adapt to changing environments and needs. The ability to understand potential problems and reacting quickly to fix potential problems speaks for the importance of en-abling business intelligence capabilities throughout the organization.

While the role of business intelligence as part of the organizational business perfor-mance management has been researched a lot it's still something that requires further research and is still developed currently. BI tries to offer more and more end-user analyt-ical methods to analyze processes, to further enhance the link between process analytics and performance management. (Baars et al. 2014, 13.)

3 SELF-SERVICE BI

3.1 Shift in usage of BI

The recent shift in the business intelligence market has been from highly governed and centralized, IT-authored reporting towards a decentralized BI model empowering business users with self-serviced analytical and data discovery capabilities (Sallam et al., 2015). According to a TDWI research (Imhoff & White 2011, 5) 78% of the questionnaires responded that in their businesses there is a need for getting value out of BI solutions faster. Azvine et al. (2006, 26) also emphasize how business users struggle getting the right information available for their daily decision making purposes, they are dependent on IT or other analysts to provide the information they need. Imhoff & White (2011, 5) say that nowadays businesses are trying to find alternative solutions to improve information easy and fast information availability. One suggested approach has been to enable users with access to BI reports, queries and analytical capabilities themselves without the need of IT specialist intervention. The approach's goal is to wider the use of business intelligence to meet more business information needs and problems. Enabling better BI usability and consumability are critical factors of self-serviced BI culture. Kosambia (2008, 20) argues that for a business to gain competitive advantages organizations must find new ways of quick and easy information access. In the information age anyone has the ability with a single Google search to find vast amount of information very easily. However, getting information out of internal business data is far more complex. Businesses should try to enable self-serviced BI environment where minimum intervention from specialists is needed. (Kosambia 2008, 20.)

Academic research has not much addressed the concept of self-serviced business intelligence, even though it has been a hot, emerging concept within the BI industry and amongst the software companies. During the literature review the researcher was unable to find academic research papers on self-service BI model through the most common and biggest databases and search tools. Much of the self-service review has been taken on by major commercial research businesses. In this section the following subject areas will be covered:

- objectives and drivers for self-serviced BI
- challenges with self-serviced BI
- governing of self-serviced BI.

3.2   Objectives of self-serviced BI

So that business can enable self-serviced BI it has to design the BI so that business users can themselves consume and produce information and enable others to further enhance that information to discover further insights Acito & Khatri (2014, 566). Imhoff & White (2011, 6) describe the self-service BI initiatives critical objectives in figure 7.
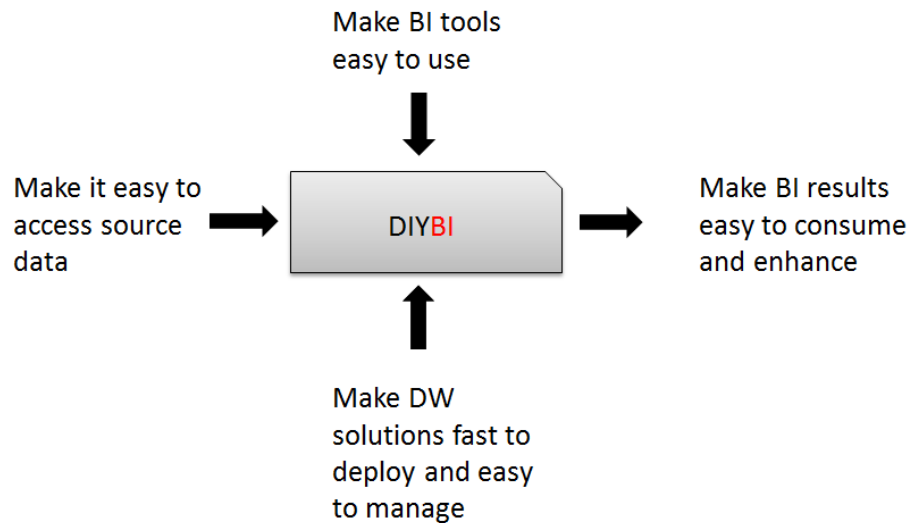

Figure 7 Objectives of a self-service BI model (Imhoff & White 2011)

The most critical factor is the ease of use of the BI tool. The tool has to be as user-friendly as possible so even persons not familiar with complex IT systems can produce simple reports and queries and more advanced users can discover and solve more complex problems. Secondly the results have to be easily consumed and enhanced. Information has to be easily understood; generally visualization and presentation are key factors in BI to help understand data and context. Another key element of information management in a business is enhancing the information results further. A self-service BI solution could enable more efficient knowledge management by providing interaction within the tool so people can give more context, comments and feedback on the analysis or reports and hence further enable others to generate further insights. Imhoff & White (2011, 6.)

Recently the variety and volume of business related data has increased (Williams 2014, 10-11) and new emerging analytical tools have emerged to meet those needs (Chen et al. 2012, 1167). Imhoff & White (2011 ,7) point out that self-service BI data warehouses must support agile data warehousing methods to meet all those needs. Software-as-a-service (SaaS), cloud warehousing and analytic DBMSs may offer solution for business to easily implement new technical DW solutions to meet new and changing analytical needs. Kosambia (2008, 21) argues that with self-serviced BI business users should be able to

make text-based search, like in Google, to get the needed results. Analytical tools using the warehouse should be designed so that it hides the complexity of the data warehouse.

Lastly the fourth objective of self-serviced BI is to enable source data access for users. One of the key elements of BI is the ability to combine data from different sources. However, as different users might need different kinds of data to meet their personal data needs this rises a problem of what should and what should not be available in the data warehouse. While data warehouses often include data from company internal sources such as ERP or CRM systems data there are needs to combine small external data sources with systems' data. Imhoff & White (2011, 7) during their interviews found out that if the data was not accessible then nothing else mattered. While it might be impossible for IT to arrange all the data needs in the ready-made data warehouse. The self-serviced BI solution should allow of combining new data sources with the existing data warehouse, for example customer product reviews, customer satisfaction results, e-mails and others. Typically new BI tools aimed at self-serviced BI usage allow users to import such data on the go. For BI to be effective, agile and quick a user will not be satisfied with waiting for IT to import the data to the warehouse, also including all the user specific data needs in a common data warehouse could get out of hand quickly.

In the framework by Acito & Khatri, reviewed in chapter 2.2.2, the three business analytical tasks are to produce, consume and enable insights. Self-serviced BI could support those tasks more efficiently versus traditional centralized and IT-led analytics. To conclude this chapter the concept of self-service is linked to the business analytics framework to better understand how self-service BI can enhance business analytical capability.

Producing analytics and information is one of the business tasks within the framework. Self-serviced business intelligence supports more production of information by making producing information as easy as possible to allow more users to produce information. Information production process also becomes faster and more agile as the bottleneck of centralized BI team is removed from ad-hoc type information needs and doing analytics.

A business analytical task of consuming information is enhanced as more information is produced. One of the goals is also to be able to present information in a format that is most easily understood. Only by understanding the data and results can information and knowledge be obtained. In terms of information consumption, however, self-service BI can bring a problem in report quality and trustworthiness. The user might not have the necessary understanding of the subject and the data model to produce.

A self-service BI solution in itself is an *enabler* of information production within an organization. It includes both a technological tool that is designed to be as easy to use as possible and a culture of enabling business users to produce analytical insights on their own. In a self-service BI solution businesses have to design methods of enabling BI to be used without IT intervention. Such methods can be training the usage of the tool, helping

understanding of data, process of validating results and methods of sharing insights within the organization.

3.3   Drivers for self-serviced BI

An important aspect is to understand what drives businesses into adapting self-serviced BI i.e. what are the business reasons of investing into self-service BI. According to the survey results by TDWI study (Imhoff & White 2011, 9) the most substantial drivers were:

- constantly changing business needs (65%)
- IT's inability of providing reports in timely manner (57%)
- goal of more analytical-driven business (54%)
- slow information access (47%).

Imhoff & White (2011, 9) argue that self-service BI helps businesses to meet these challenges. Constantly changing business needs becomes a problem when reports are pre-defined and users to not have the ability of modifying them to suit new needs. As such, they must request a specific person to modify it or provide a new version of it. Additionally different users might be willing to see different versions of the same. Self-service BI business needs to build up an infrastructure for self-analysis capability, including data models and pre-made models or templates to build up reports. As business users must wait for others to produce the reports for them, they might be forced to go around the problem by start building up their own analytic solution to get the information. A single unified system available for such is often more cost-efficient than multiple self-built solutions in different business units. The need to be an analytic-driven organization drives from the tough global business competition. Decisions made per factual information instead of intuition can ensure better results in long term. Enabling users to produce information on their own for their decisions is the basis of truly analytical-driven organization. (Imhoff & White 2011, 9)

One important driver for self-service BI is to reduce the load on the centralized IT or BI team. According to the survey results by Logi ananalytics (2014, 9) respondents on average reported 37% less requests on IT for BI. It shows that self-service BI model will not be fully self-dependent but instead easier and quick results can be acquired by end-users directly and so the centralized expert team can focus on the more difficult challenges and BI development. Major drivers for self-service initiative identified by Logi Analytics (2014, 7) were:

- business users want to acquire information on their own and on their own time
- more analytical organization
- limited IT resources.

Both questionnaires highlight the need that businesses want to be more analytical and want to be more independent in acquiring information. Nowadays business environment is more dynamic and hence the information needs for businesses change more rapidly. Business users are not satisfied with pre-defined reporting and demand more and more frequently new reports, enabling of self-service is a way businesses try to solve that problem.

3.4   Inhibitors of self-serviced BI

According to survey by Imhoff & White (2011, 32) businesses felt the following factors being the biggest inhibitors of successful self-serviced BI culture:

- business user skills (59%)
- lack of data quality and control (55%)
- lack of training (39%).

This shows the importance of proper training as well as setting up a culture of sharing knowledge and best analytics practices within the organization. Making BI as easy as possible and enabling it for the user in the end is the only way for business users to develop such skills. Centralized BI team should also focus on data governance within the data warehouse, even though less governance is possible in a de-centralized BI environment (see chapter 3.3) some level of control should be kept. Other factors included lack of budget, management support, and confidence in the possibility of self-serviced BI or suitable BI tool.

A survey study on self-service BI adoption has also been conducted by Logi Analytics. According to their report (Logi analytics 2014, 11) business IT teams saw the following factors being the biggest inhibitors:

- limited budget (48%)
- business user skills (48%)
- data security and access control (38%).

Other factors were lack of support from IT or management, however, only 23% felt the tools were hard to use.

Both studies show that lack of business user skills and training are perhaps the biggest inhibitors of self-serviced BI. Hence, for a self-serviced business intelligence initiative to work, businesses need to focus on training of both the actual tool and especially on the business data. While the tool itself can be made as simple and friendly as possible, it is the business data that can often be so complex and difficult to understand that users can't build analysis on their own from it. It is also important to realize that any organization going into self-serviced BI cannot expect an adoption overnight but should see it as a learning process moving towards more and more self-serviced capability.

3.5 Organizing self-serviced business intelligence

One aspect of business intelligence is the governance of the BI solution. BI focus shift to more agile methods and user-centric self-service BI puts pressure on more responsive BI governance frameworks. Baars et al. (2014, 14) point out that research should be made to answer a relevant and current research problem: "How can BI Governance be designed and enforced despite highly decentralized BI responsibilities?"

While academic research has yet to address the governance model supporting more user-centric approaches, the possibilities for such are reviewed here in short. Commercial business research house Gartner has designed certain models to help businesses design new BI governance models, which will be reviewed in this document together with governance suggestions from TDWI research. The goal is to understand how business intelligence governance needs or should change to better support this new way of BI.

According to Schlegel et al. (2014) key challenge with BI governance is that traditionally heavily centralized BI teams can't deliver domain expertise and time-to-value responsiveness at a level that is required. Centralized BI team tends to work as a bottleneck if more and more users are demanding analytical capabilities and results to their information needs. A centralized team helps business to be consistent and have governance on critical reporting areas such as financial figures and business performance measurement. Another problem of centralized BI is that if the demands of the business users are not met they might have to rely on their own analytical tools to fulfill their more in-depth needs. When businesses start to use their own tools and methods, such as Excel-based data analysis not supported by the BI experts, it brings a problem where the possibility to govern reporting and analytics is lost. Schlegel et al. (2014) call this "shadow IT", an unofficial IT process designed just to meet the individual needs, not supported by the official process (business BI solution). Decentralized approach, however, might be agile but struggles with consistency in reporting structures, methods, information sources as well as sharing good practices. (Schlegel et al. 2014.)

Imhoff & White (2011, 29-31) suggests a few governance points to support the self-service model described in chapter 3.1. In terms of feasibility of accessing results and enhancing results, ability of commenting and rating published analysis done by others in the company could work as a self-governing model. The more people interested and giving high rating to a given analysis would mean more people agree and believe it includes relevant findings. Secondly information consumer should know if the results are based on governed data (ie. governed data model at data warehouse) or include other sources (such as personal spreadsheets or external data).

Centralized BI team should also enable users with reporting templates and models, to keep a level of consistency. This way the results are more easily understood and consumed by others. Pre-made templates and models also could help users to design their

reports and analysis. BI and data warehouse designers can build re-usable components as well as encourage the usage of components built by users that have been recognized well and useful. The usage of standard ETL process can still work to govern what data (including format & naming) is pre-staged for users to use for their analysis. This can help users still have a unified view of data, which could otherwise become a problem of self-serviced BI model. On the other hand, as users produce other data sources (external data or others) those can be implemented into the data warehouse if deemed useful for others as well. (Imhoff & White 2011, 30.)

In any case, centralized BI management can, and perhaps should, play an important role in BI governance of self-serviced BI by enhancing user competence of data as well as the BI tool and also by building data warehouse and infrastructure to support current needs as well as upcoming needs. Even though self-service BI shares more of that responsibility to user base, centralized team should still monitor and oversight the capabilities. Centralized team should have a crucial role in data governance. Relevant things such as what data should be part of the governed data warehouse, in what format structure and common naming definitions. The role of evaluating if certain information components, analysis and reports become more popular and even critical in business management should also be considered amongst the responsibilities of the centralized BI team. Once such is identified it could be standardized, secured and shared throughout the company as validated report. Information consumers can then utilize that given report in a more secured manner as it would be more trustworthy source. (Imhoff & White 2011, 30.)

From the technological tool perspective a business can benefit from having a single BI tool to standardize and rationalize reporting. Also a competency framework can then be built around the single tool. A single tool might not satisfy all the different users of the organization and most likely will not be the best in each analytical area, however, it might be easier to train people on a single tool as well as easier to govern the usage of the single BI tool. (Kosambia 2008, 21-22.)

Gartner recommends a two-tiered governance model to support both centralized and decentralized approaches. Business intelligence unit should be promoting and collaborating with decentralized BI users and teams to support both top-down approaches (such as BPM) as well as bottom-up approaches (individual needs). (Schlegel et al. 2014.) It is up to the business to evaluate its analytical needs as well as organizational culture to design the best suited governance model. However, it is clear that the rise of self-serviced BI tools and capabilities requires business to think a new way to of BI governance. Parenteau (2013) says that few BI programs have been able to find a balance between self-serviced BI governance and end-user empowerment. The writer of this thesis suggests that more research should be done on BI governance supporting self-serviced BI.

Gartner has introduced around 2001 a BICC (Business Intelligence Competency Center) model where the goal is to promote BI technologies, standards and BI competence in

an organization. The idea is to have a one centralized team working together with decentralized teams and to identify reporting needs and prioritize. (Strange & Hostmann, 2003; Schlegel et al. 2014.) Gartner (Parenteau, 2013) suggests that the BICC idea should be evolved to enable self-service BI. Originally BICC was developed to support top-down needs and businesses have had troubles on finding balance between self-service and BI governance. Gartner recommends that businesses should (Parenteau, 2013):

- establish training programs with certification tiers
- allow some data integration and model skills at decentralized business units
- transition centralized BICC to oversight and coordinator role
- invest in relevant tools.

The tiered training program works so that as user becomes more skilled he or she would be able to move onto the next tier and gain more access / abilities in the BI tool. At first levels user would be mostly an information consumer without the ability to design reports. The following level could be a limited self-service level where user can design reports with a limited and simplified data set. As user gains more understanding he or she could be allowed to have wider access in order to be able to generate more advanced reports and validate them for the use of others. (Parenteau, 2013.) The idea behind this model is that less experienced users are given limited access in order to avoid misunderstandings. Additionally, reports that are given to public use can only be published and validated by more advanced users who have better understanding on data models and business system processes. Validation can also be tiered so that self-validated is only available for the creator, then a more advanced user can start a validation process on it if it is the users feel the same information could be used by others. Finally after thorough validation the report could be marked as trusted and final version published. An example certification tier model can be found in figure 8.

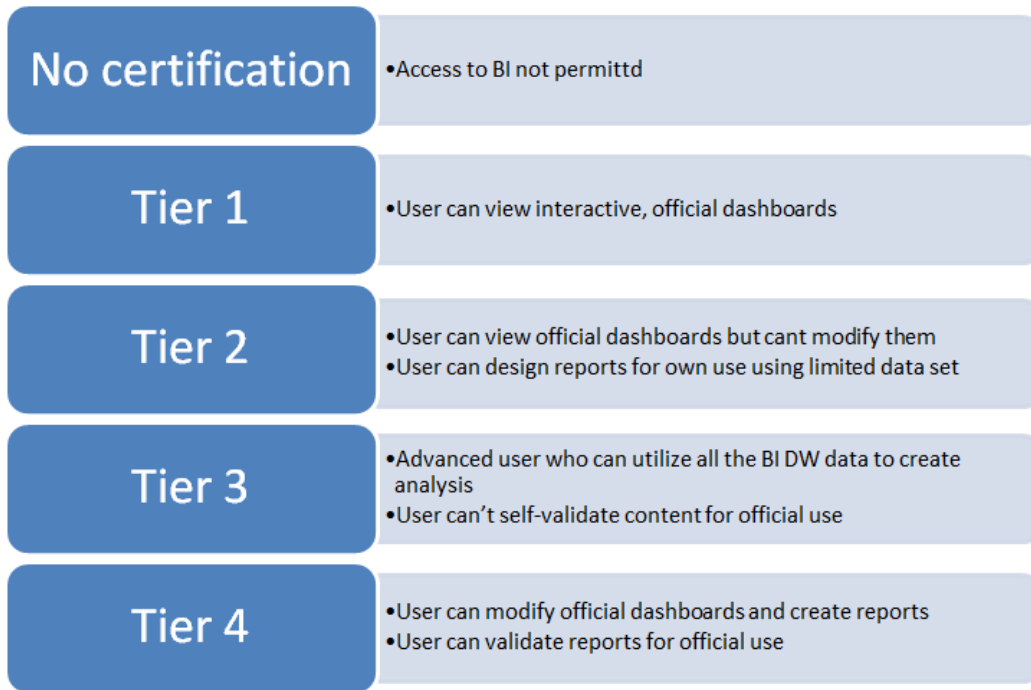| No certification | •Access to BI not permittd |
Tier 1	•User can view interactive, official dashboards
Tier 2	•User can view official dashboards but cant modify them •User can design reports for own use using limited data set
Tier 3	•Advanced user who can utilize all the BI DW data to create analysis •User can't self-validate content for official use
Tier 4	•User can modify official dashboards and create reports •User can validate reports for official use

Figure 8 Self-service certification tier example (Based on Parenteau 2013, 5)

4   EMPIRICAL RESEARCH

4.1   Methodology

The concept of self-serviced business intelligence is approached with a qualitative single case study. A single case study is an empirical study that tries to capture and understand a phenomenon in a real-life context using a single case, for example one business organization (Dul & Hak 2007, 4).

As part of gathering empirical material for the study a set of interviews in the case company were held. Interviews are popular way of studying a case where the researcher tries to gain deeper understanding of a given subject or context. Interview is also a suitable approach where the researcher does not have a clear understanding of the possible answers in beforehand. Using the interview the researcher can gain understanding on how the subjects experience a given situation and how they feel about it. It also allows the researcher to identify motives behind the answers. (Hirsijärvi & Hurme 2008, 34-35.)

Interview method chosen in this study is a theme-focused interview which is a semi-structured interview method. A characteristic for semi-structured interview method is that some aspect of the research subject has been decided in beforehand but not all of them. In theme-focused interview the interview follows certain themes but not necessarily in a pre-defined order. It is a method that can be used to gain understand on someone's believes, thoughts and experiences of a given subject. (Hirsijärvi & Hurme 2008, 47.)

In the context of this thesis the theme-focused interview method is well suited as the goal is to understand what business users feel are the information challenges. To be able to evaluate how self-serviced BI could help businesses it has to be first understood what the challenges are. Secondly this study tries to understand if the subjects feel self-service organized business intelligence could help resolve those issues. The approach can be seen as practice-oriented where the researcher tries to evaluate the usefulness of a certain approach (self-service BI) to a business situation (Dul & Hak 2007, 8).

In practice, the writer interviewed the interviewees personally and did voice recording on the interviews. All the interviews were held in Finnish based on a Finnish theme template, which was translated and can be found on the appendix. Two separate interview templates were made in order to interview both the business users as well as the team responsible of developing the business intelligence solution. The interview recordings were transcribed to a text file and then analyzed. More details of the interview can be found in chapter 4.2 and findings of the interviews are reviewed in chapter 4.3

4.2   Overview of the case

4.2.1   The case company

The case company reviewed for this thesis is a Nordic high technology manufacturing company working globally. Core business is mostly based in Northern Europe, other significant locations are in US, other locations in Europe and Asia Pacific region. The case business has around 1500-2000 employees and with annual revenue of around 200-400 million euros. Business includes both product sales as well as service sales. Business is structured into two major market areas which both include products and services. Case company works on a high mix and low volume market mostly including customizable products as well as projects sales for customers. Both business areas are supported by typical support units such as finance, marketing and IT (Figure 9).
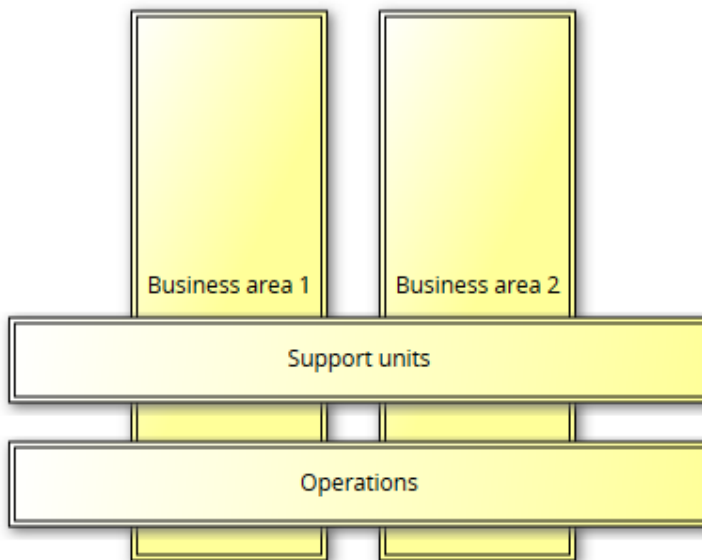

Figure 9 Simplified business structure of the case company

The researcher has worked as part of the group IT unit over three years at the time of conducting this study. The group IT team is planning on developing and defining the enterprise architecture and as part of that evaluating and developing its reporting and business intelligence program. This thesis aims to provide the case company information and guidance on how business intelligence can better help the information needs at the company. The thesis was done as an assignment by the case company's IT department.

4.2.2 Analysis of the BI solution at the case company

The business intelligence solution is provided to the organization by its IT department which has a separate "BI team" dedicated to developing and providing the BI tools. The current BI team consists of a BI development manager, a BI expert as well as external consultants helping on more technical matters. Both the manager and the expert were interviewed for this study in order to understand how BI is organized and managed at the case company.

The case company has adapted the use of Oracle's business intelligence technology in 2008 at the same time as the company adopted Oracle E-Business Suite ERP system in use. The ERP has been taken in use globally at the case company and covers most of the business ERP needs, including different sales-related areas, SCM, manufacturing, finance, service and so on. As the single, global ERP covers most of the internal management of the case company it is the single most used source system for the business intelligence tool as well. In fact, currently the business intelligence is heavily focused on the ERP system but also includes a few other source systems, a CRM tool and a financial consolidation system.

Initially in 2008 the case company took in use a pre-made BI data integration and data model designed to be used in together with the ERP system designed to be heavily customized by the customer to meet its needs. However, according to the BI team of the company, it was later found out that it did not meet the information needs of the company. The initial BI tool was not transparent and even for a BI developer it was hard to see the connection of BI data and the source system data.

Hence, in the beginning of 2015 the case company did a re-implementation of the BI tool and built a new data model. The new data model works so that all of the ERP system data, as well as certain data from other systems, is loaded into the BI stating area from which some of that data is aggregated, transformed and moved forward in the BI structure. The BI team feels the new model allows a lot better transparency, compared to the old out-of-the-box solution, of the data extract, transform and load process all the way to the presentation layer where data is available for use in reports. For development purposes good transparency of the data at BI system allows easier addition of new data into the BI tool as well as helps to validate data and reports and to identify possible problem causes. The basic BI structure works similarly as to what was found as a common BI structure in literature review in chapter 2.1.2, the basic solution of case company's BI structure can be found in figure 10.
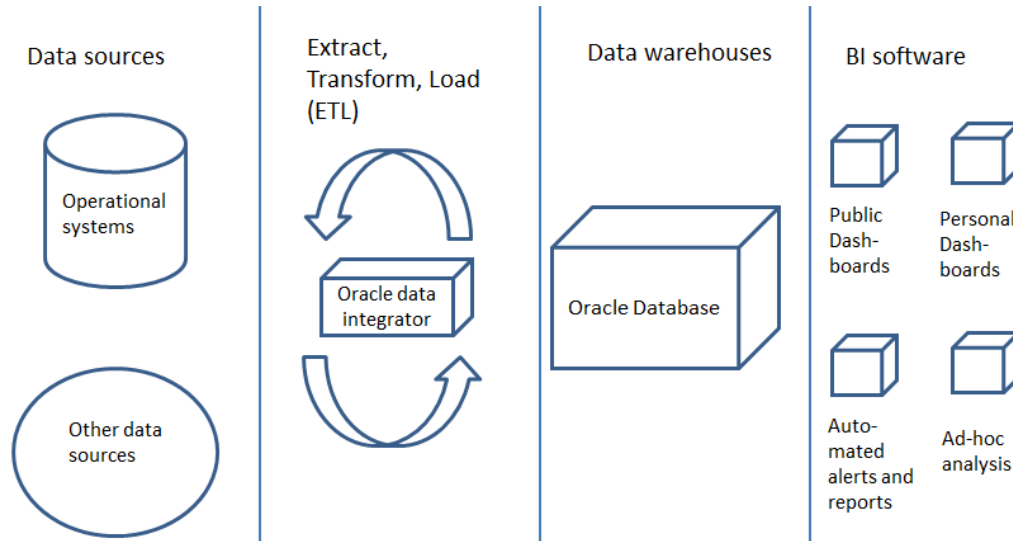
Figure 10 BI structure at the case company

On the data sources side the case company heavily relies on the Oracle EBS ERP system which is globally used by the business. Amongst the objectives for self-service BI, by TDWI, was the ability to access source data as well as easy to implement DW solutions. In other words, it means that the data availability must be in good shape for a self-service BI to work. If the data is not available in the BI it can hinder the success of a self-service BI solution. In terms of the case company, if the data is available in the global ERP system it is already available in the BI software itself or easily deployable. However, in a case where the data would not be available in the ERP system or is not yet amongst the chosen sources for the BI DW then the users may face problems of accessing needed data sources. According to the BI team the system does not allow user to choose new data sources themselves or upload their own data within the BI tool, but can export a given data set or report from BI tool to, for example, Excel and then join that with other sources. The BI tool itself will not support a single time or single user flexible choice of available data sources; instead the DW solution is centrally managed and built for standardized needs.

However, according to the BI manager the newly implemented BI solution technically allows much more easily to add new data sources to BI tool than the old system. Hence, in this regard the organization is prepared for self-service business intelligence if we consider the objectives of self-service solution set by TDWI. In a simple case adding new information to existing solution is mostly about linking the new data with existing data. Altogether, it was said that technically it is not hard to add new DW deployments, if the data in some context can be connected with existing data. It is more of a question of business case, should the resources be allocated to a specific DW deployment or not.

The ETL part transforms aggregates and moves forward the data from the staging area into the data model found in the data warehouse. ETL is handled with Oracle's data integration tool which was mentioned to be, in together with the new data model, flexible in developing the data warehouse solution. Data is extracted and updated once a day into the business intelligence tool, therefore real time data analysis is not possible at the moment.

The company uses data "star models" which in practice means that a given data or object is linked to multiple other data. These models can help an analyst or user who is making a report to identify what data he or she can use together with the data he or she is in need of analyzing. As mentioned by Kosambia (2008, 21) the BI tool for self-service should hide the complexity of databases. Star models or other data models could help users, who are interested in analyzing a given data or fact, to understand what kind of data he or she can link to this data. Such models could then be utilized within the BI tool itself in order to allow a user to construct simple reports with ease. Another point to consider for data warehouse would be business terminology, for example what term is used for each different thing. The case company already uses a global ERP system, and according to the BI team, is in this sense already in a good shape in terms of terminology as they do not need to make common terms to BI of same things from different systems. They comment, however, that terminology still has to be developed in the BI DW so people understand what data actually means in practice. As an example a business user needs to understand that which sales order revenue is actual revenue by customers and which of it is internal "revenue" between subsidiaries. Such ready-made "facts", filters and terms are developed into the BI DW. From self-service BI perspective developing such ready-made will make it easier for users to understand the data in the business context.

BI software itself has mainly two kinds of usage types or access types. The tool has been constructed so that different functions or different processes have their own dashboards. These dashboards have the metrics and reports that have been defined for that area; they may even share similar reports in different dashboards. Designing dashboards and their reports is limited to dashboards owners. End-users may access certain dashboards to view ready-made reports. Reports may be setup so that user is able to filter them in order to have different views of the same subject, dashboards can also be setup to have drilling down functions, for example if sales on-time-delivery metric would show bad values for a certain day the user could be able to drill down into those orders to find out the reason. Typical end-user will not be able to create new reports and analysis, only view ready-made dashboards. However, users have their own dashboards available where they can include a set of ready-made reports that they have been given access to. BI also allows ad-hoc analysis through its analysis module which is only accessible by the business analyst user type, hence its use is mainly limited to report development. In terms of sharing information the BI allows sending of automated reports at a given time or automated

reports triggered when some metric, for example, reaches a certain level. Reports can also be shared to company internal network in a non-interactive mode if needed. BI user structure is described in figure 11.
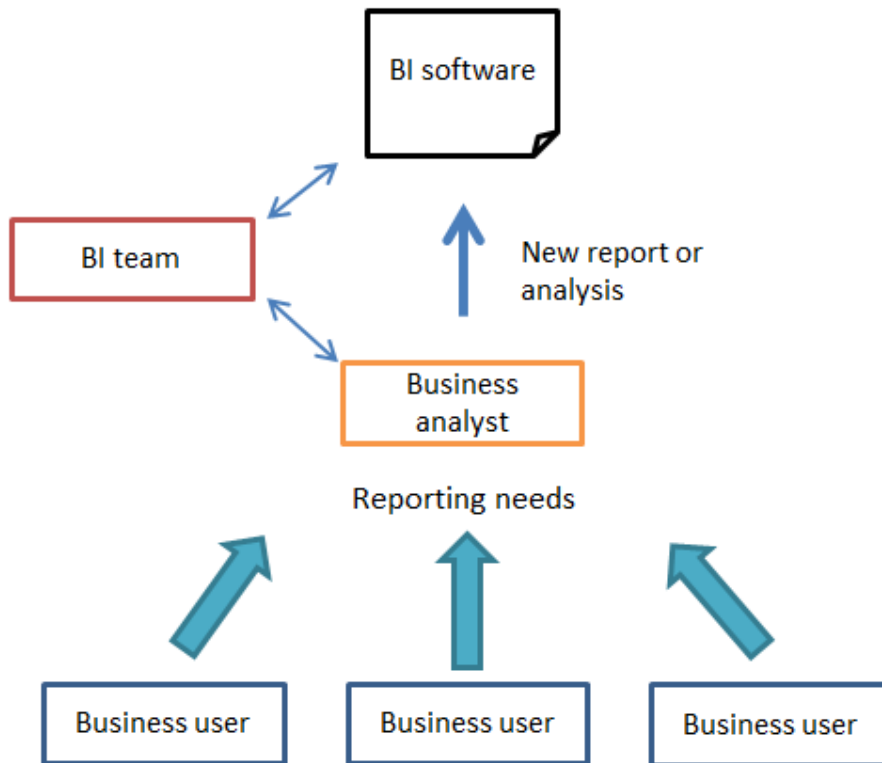

Figure 11 BI user base structure

Over 500 users are able to access the BI software directly. And a little short of 500 of the users are normal end-users without the ability to edit dashboards or make self-serviced analysis. Around 50 users are able to access "self-service" capability within the BI. These persons are either persons responsible to developing reporting for certain area or have been given special access to do analyze for themselves. The basic foundation is that business has special BI users called "business analysts" who are persons chosen to be responsible of developing reporting within BI in a given function or business process. These persons are responsible to the reporting for that function or process and gather and develop the reports. The idea is that the business users will contact the business analyst with new reporting needs or development ideas, instead of connecting the small BI team directly. BI team itself is not actually developing the reports themselves but offer close support and training to the business analysts. According to the BI team other tasks of the team include responsibility of:

- DW solution
- providing BI end-user software
- data model development
- promotion of the BI capabilities
- gathering new needs for better utilization of BI
- linking strategy and performance management in BI
- training business analysts.

BI team comments that previous to the new model most of the report development was done by the BI team itself, this was said to cause a bottleneck for BI reporting as well as having difficulties in prioritizing different reporting needs throughout the company. The old data model was so complex that even BI experts would have trouble understanding how a certain data in a source system is linked to the BI tool.

The current BI organization model at the case company is not a global self-service deployment but perhaps it can be said to be a partial self-service deployment where certain users on the business side have been trained into a role where they are responsible of developing the reports. The model was said to be based on the idea of a BICC model. The business analyst generally has better understanding of the business context in his/her area than and has better understanding of the reporting priorities in that area by working closely with that organization than the expert at IT department. The model allows the company to free up IT or BI team resources into developing the data models and reduces the reporting bottleneck of small expert team, which usually is considered as a driver by businesses to move into self-service model (Imhoff & White 2011, 9). Technically the BI tool itself would support self-service capability with the system's "analysis" tool which allows a user to do analysis with the data available and users already have their own dashboards available.

4.3   Interview findings

In this chapter the results of the business user interviews are analyzed in order to understand how business acquires information and what the challenges are. This is done to evaluate if and how self-service BI model could help businesses as well as where it might cause challenges.

4.3.1   Interview details

The interviews were conducted as semi-structured and theme-focused interviews. The main themes for the interviews were derived from the research questions:

- • RQ1: Why do companies use business intelligence?
- • RQ2: What are self-serviced BI objectives and drivers?
- • RQ3: What are the business information challenges at the case company?

A total of 8 business users were interviewed and also two BI experts were interviewed based on same themes but different interview templates. All the interviewees had a bachelor or master level education background and had worked with the company between 3months up to 20 years. The business users were all working on the operations business area or close to operations business area. The interviewees were part of the mid to top level management in the Operations business unit. The goal of the interviews was to find out how different stakeholders in the operations area acquire, develop, use information and what are the challenges related to it. Also they were inquired on how the perceive the self-service BI model.

Operations business function was chosen as the focus business function as it had been recognized to have some challenges in relation to acquiring information. The operations function is responsible for order fulfillment of products to the customer; this includes managing the whole supply chain, manufacturing and logistics. Operations business area can also been seen as quite standardized and hence is very data heavy in nature, in order to companies perform they need to measure and analyze data, especially common in standardized operations area.

The detailed interview template can be found in the appendix. Under first theme, producing information, users were inquired on gathering, analyzing and sharing information. They were also asked how they use the actual BI tool, what kind of automated reporting they use and what the main points of performance measurement are. Users were also asked on how they respond to ad-hoc needs, especially ad-hoc type of needs are usually done in a self-service way whether the user could/would use a BI for it or not. As in any case, usually ad-hoc would mean it is not something that is already been measured or reported in that business unit. On the same points the users were asked what the main challenges in those same areas are. On how business users perceive self-service they were asked on how they see it could benefit the company, what challenges may the business face with self-service and what would be the critical factors for the self-service model to function.

The goal of the interview results is then to try get understanding in relation to the research questions, how is BI used, what are the challenges in getting information and then how self-service tries to resolve those challenges, in other words what are the objectives and drivers to go for self-service BI model.

4.3.2   Acquiring information

In general the most popular ways of acquiring information were either through personal contact networks or finding data from different systems. In the context of BI we will only focus on acquiring data from systems in order to support a relevant business decision.

Typically business users would try to find data in order to see how a given process is performing, for example if orders are fulfilled on time or not. Often users also would look at cost and measure certain things that are causing cost, in order to keep it under control or to identify problems that need addressing. Business users also would try to gain information for trying to lead the business (area) into a certain direction, and by measuring it they can understand if a given change is happening or not. Typical business case also is to control something, for example costs or profitability. Some said that gaining an overview on business performance is important to manage their business. From Operations perspective knowing how much orders they are going to get is important to so they are able to plan for the future in terms of process capacity. As an example some interviewees would need an easy overview on how much of each product is sold, but said that such a report was not available in BI tool yet.

Most of the interviewees would use either the operational ERP system, business intelligence system or Excel spreadsheets as their main sources of data-based information. Some of the main measurements were available in the business intelligence tool. However the Operations unit also used many other tools which had separate databases. Hence, much of the data needed for business decisions was not within ERP system. As the BI DW was much based on the ERP system, the needed data from other tools was not available in the BI tool. Therefore, most of the business users would use Excel-based tools to gather the needed data from other databases that were not available in BI system.

Business users were also asked why they use BI or why they do not use BI. Most commonly people found BI a good way to gain information as

- if data was available it was thought to be validated and trustworthy
- in BI it is more easy to track the data sources
- BI is a place where data can be centralized to one place
- the work of finding and presenting a given data was already done.

Some people said that using Excel to combine data from different sources is time consuming and very old-fashioned. Many hoped that BI could be used more instead but data had to be available there at first. Business also said that developing BI is a continuous process and there were plans to get more and more of reports into the new BI system.

In some cases, even though ERP data was available in the BI tool, business also used custom made Excel macro-based tools to query ERP data for use. Some interviewees found Excel to be so flexible in order to do new reports and fulfill new information needs. Excel-based "BI" methods is something that the business has themselves full control on,

they only need a way to export data from a given system and can then freely do whatever they want with it. In fact, the main reasons to use Excel based solutions were

- ability to use almost any data sources
- flexibility of doing changes to the reports
- being familiar with the Excel tool
- it allows data input and comments
- knowing how to make reports in Excel

Business also used monthly based reporting using the Excel tool, it was said to be flexible but it also included a lot of manual work. If users were able to build the same solution themselves into a BI tool, assuming that data is available in the BI DW, they could save time by automating the reports. All in all, business seems to use a lot of time in finding and aggregating data manually from different databases. One user commented that in order for him to start measuring internal quality data he has to be able to get data from up to 10 different sources. Almost all the respondents said that data is very scattered in some areas, even though the company was using the ERP for most of its tasks.

4.3.3   *Processing and sharing information*

When users were asked how they refine and analyze the given data further they all were using Excel tool. Some users use also statistical analytics software but it was said to be too complex for a non-tech savvy person. Even if the data was available as a report in BI and user would like to analyze it they would often export the data into Excel and refine the data. Often users would also take ERP data through BI into-Excel and join that data with other system's data using Excel. Often users also had to go to the ERP system directly to find the needed data to analyze it further. One respondent said that currently on one given report area there is in development ways of giving the ability to further analyze within the BI tool directly, this also included adding new system as a source to BI DW.

The BI software itself supports drill-down functions and it is possible to build further deep-down analyzing options into reports with that. This would allow users to quickly analyze the actual root causes of possible problems, if for example a given metric is showing problems, without the need to use multiple tools. Analyzing data directly within the BI can enable users to consume information easily, which are amongst the main tasks of a BI solution (Acito & Khatri 2014, 566).

The most common way of sharing information was through meetings, Excel files, automated e-mails and manually adding measurements to information tables in the factory. Some of the automated mailing used was done with Excel-based tool but also BI software's automated e-mail system (periodic) was in use. Some users said they would like to use BI directly to share information but limited amount of licenses would not allow

them all to have BI access. This was said being one of the reasons of building Excel-based automated data extract and reporting. Some respondents said that BI could be better utilized to share information; ability to do self-serviced analysis further in BI could help in that sense. Not necessarily to make new analysis from scratch but at least having the ability to do small modification, filtering and drill-downs. From the perspective of enabling a full-on self-service BI model, it could help to have such abilities at first for users so more and more business users are involved in BI and therefore are able to develop further understanding of data and BI capabilities.

Interviewees were also asked on they use some kind of automated reporting methods. Some respondents said that they receive regularly automated reports via e-mail. Such reports usually are a status of a given metric in a weekly or daily level. Some said they found it useful as they could then receive information at ease without the need to log into a system and save time in that sense. Some also commented that they then go into the BI (if the report source was BI) to look into more detail if needed. In general respondents also commented that the reports make it possible for them to react into potential problems. However, it was also said that in order to go into problem root causes they would have to manually access source systems (such as ERP) or even go around asking people what could be the cause for a specific problem.

In some areas business also used event-based automated reports or if a specific metric goes above or below certain limits. Such reports are used in order to react quickly to a specific problem, for example if a delivery from a provider is late then business will get a report and be able to do necessary actions. Utilizing such methods, however, was not quite common yet but many commented that such would be very useful. Some said that in some units the goal is that a set of persons, who are mostly responsible of reacting to specific problems, will/should operate fully according to such report methods.

4.3.4   *Monitoring performance*

Business performance measurement is one of the common reasons of starting BI programs (see chapter 2.2). The interviewees were asked how such performance is measured in their responsibility area(s). Operations management commented that owner of a process is responsible for the measurement of the process. They said that reporting has developed to cover detailed levels in different areas, so that it is now possible to gain more detailed process understanding than before. As smaller "sub-processes" influence the performance of higher level processes it is important to measure at enough detailed level as well. For example, the speed of receiving components can affect the speed at which operations is able to manufacture the goods and ship out in time to customers. Measurement is done in a longer timeframe period as well as short time periods, especially in operations

where one has to be able to have, for example, X amount of component inventory at any given time in order to operate efficiently. Some areas was said to be lacking in performance measurement and that it's sometimes difficult to see the bigger picture. Business also commented, when asked, that they are using "traffic light" based measurements as well. These were used also in more long-term measurements as well as at daily levels. Business was using a daily management program in which they were adding manually measurements and traffic lights to whiteboards. For Operations to see the current performance and to know if they need to catch up in order to meet daily goals in a given process. Same methods were used also in other areas to easily see, for example, how well forecasting in a given product family has been going. Business user can then easily identify problem areas and do necessary actions and corrections. Some commented that traffic light-based measuring is not proper fact-based management but instead businesses should look at trends in order to see how things are going in a longer run.

Some of the performance measurement was done in the BI tool itself. But in the operations area, a lot of the daily, weekly or monthly measurement was done with spreadsheets. Again, the reasons to work with Excel were the flexibility to modify it, the ability to join any sources freely and familiarity of using Excel tools. It was said that the goal is to have more of the measurement in the BI tool directly but it is a question of resourcing. Some respondents also said that it is not usually possible to drill down into the data behind the measurements. Especially in Excel-based scorecard reports where the data is input manually one would have to go through many different persons to find out the data behind the measurements. In BI it would be possible to build the background for a given measurement so users can directly go and drill down all the way to transaction levels, if needed.

Having the measurements and scorecards in BI would save manual work in a longer run. Having self-serviced capabilities could help in this regard as business would have the ability to do the measurement directly into BI and not having the need to do it manually in Excel. Some business users said that as they have to wait for someone else to do the report, it will take longer time to have it. As business users in a given process themselves have the best understanding of a given process they would be able to quite easily build the measurement themselves. They said that they know the best what they need and also if they feel they really need that measurement as soon as possible they would have the motivation to allocate resources to do so. The BI team also commented that developing when developing new measurements it is at first easy on a thought level to define what should be measured but only after starting actual development at data level it is possible to understand what can or cannot be measured. As business users would in a self-service model define reports themselves they would gain better understanding on what can be measured, as well. Most of the respondents commented that it would be likely that self-service model would enable better understanding of data and processes as long as users would be able to learn to create the reports themselves.

4.3.5   Ad-hoc needs

According to Imhoff & White study (2011, 9) constantly changing business needs were the main driver for self-service initiatives. The interviewees were asked if they get many ad-hoc type needs and how those are handled and if those needs stabilize as constant needs. The respondents said they receive quite many ad-hoc type information needs. There was some variety on how ad-hoc needs could be handled. Frist of all, the business users had to think where can they get the information from, and where can they get it reliably. Some said that the new BI works quite well for ad-hoc type of needs as well, if the business analyst is available and if the data needed is already in BI. Most common way of responding to ad-hoc needs in operations business area was using spreadsheets. Some said that they manually go through different Excel files where they have stored information. Sometimes business would extract data from operative systems and analyze it using Excel. It was also mentioned that too often ad-hoc needs arise where the information is needed in a very quick pace. It was felt that it is a leadership problem that suddenly a given approach to a given subject is needed at a short timeframe. Often someone had to manually start finding data from systems using Excel-exports, which is found time consuming. It was also said that if the user would need to find information he or she did not yet have he or she would have to ask others by mail for further help, but in such a case the actual need would often be lost in translation. The more far from the requestor the information is generated the less it would fulfill the original need.

Business has to, in self-service manner, answer into ad-hoc needs. If BI was used as a single source system trying to cover most of the different systems, it could be easier to answer into ad-hoc needs by having the data easily available and enabling users to access it and do self-analysis. Business is already doing self-service analysis, but just not utilizing BI itself.

Interviewees were also asked if the ad-hoc needs often become constant reporting needs. Some respondents said ad-hoc needs become constant needs quite often. In such a case, it would mean a new BI report or adding a new Excel report or modifying current Excel reports. It was said, that if data is available in BI, with the new BI version users were more willing to have the report made into BI tool. Respondents also commented that nowadays more thought is put on if the need will actually be constant or not, so reports that are useless in future are not generated. In fact, some said that actually having to do the report themselves makes the user think if that is actually needed or not or if it can be utilized by business or not. A business analyst commented that often the ad-hoc needs are somewhat different approaches to same subject areas. The goal was to build such subject areas to the BI tool so that user can utilize those with small modifications to answer new ad-hoc needs. In this way there is no need for generating report from scratch and business will save valuable time.

4.3.6   *Challenges in acquiring and processing information*

In this section, the main challenges in each subject area are reviewed. Understanding how business acquires and processes information as well as what are the major challenges may identify drivers for utilizing self-service BI model.

The majority of the respondents said that the biggest problem is that data is scattered in different databases and not aggregated into one single source. Some said that data is technically able to be aggregated with ERP data into BI DW. It was also said that, as often data is manually saved into spreadsheets in different areas within operations, there is no common format or way to store data. Some part of the data availability issue seems to be on how operative business is handled and how operative systems are used or not used at all, in which case data was not available easily for analysis. From the perspective of BI it would be difficult to aggregate many different Excel-based tools in a BI DW, as they may not work in a standardized manner and format. Also as data is scattered around, it also caused a problem where different business users would use different sources to do analysis and conclusions. Manual aggregation of data may compromise data validity and cause false conclusions.

In regards of getting information, it was also said available resources have become a problem. Getting information involves a lot of manual and time consuming work; hence it is difficult to find resources to do it. Even if the data was available, limited amounts of persons were available to generate new BI reports. Business did not always know who they could ask to make the reports available and did not have a view on prioritization of different reporting needs. The BI team of the case company noted that one of their biggest challenges has been prioritizing reporting needs. In the old central model they would try to prioritize themselves, but recently had taken into use a prioritization team including stakeholders around the company who would prioritize at company-wide level. They also planned on releasing a reporting framework in goal of communicating and prioritizing reporting development plans.

According to the literature review one of the fundamentals of the BI is to aggregate data into one data warehouse from where it can be analyzed. Hence, the BI team should focus more on making the data available in the BI DW. When BI team was asked what they find out to be the biggest challenges for business they did not mention data availability. They had acknowledged that there is a need to include more source systems into BI DW and doing such projects were planned already. The business, analyst with financial responsibilities in the company, commented that there are no problems with data availability. It could be that financial figures and other important data in terms of ERP are easily available. But operations business area also needs other supportive tools to run their business, hence from their view much of the data is scattered around. Respondents

commented that if data was available in a single tool and understandable format, it would save time and resources in a longer run.

Interviewees were asked what the key challenges in refining, analyzing and sharing information are. It was said that as data is scattered, analyzing data is then again time consuming as well as sharing data becomes time consuming as one has to manually aggregate in order to make visualizations or PowerPoint shows. It seems that data availability is hindering the process of consuming and sharing information at the case company. When asked, if business was doing enough analytical and fact-based decisions, some said that more data-based decisions should be made but also in some cases too much time have to be spent to get necessary data available to make the decision. If the data was available easily it would enable more analytically-driven organization.

Another challenge faced by the business was understanding the data behind a given report. If the business manager was not involved in defining a given report, he or she would not fully know the logic of the report and therefore could not confidently share the results of such report. To prevent this problem BI team said that it is important to explain what data is used in the report and explain the report logic in the BI software directly. To consume information, one has to understand the information in order to avoid false conclusions. In fact, one manager mentioned that they often have to put effort into handling others' false conclusions. For example if one does not know how a specific business process is handled and then makes conclusions based on the data he or she might misunderstand it. In terms of self-service this will put a challenge as users are able to access more data and will be doing more self-analysis and without the relevant context understanding might come to wrong conclusions. To prevent such, businesses have to consider ways of avoiding data misunderstandings, for example utilizing data models and descriptions as much as possible.

4.3.7   Challenges in data quality

Biggest challenges in terms of data quality and reliability were also discussed. In general the respondents did not feel data reliability to be a major issue. Many said that with the previous BI installation they had many data quality and reliability issues. Also data validation with the old BI data model was difficult. Overall respondents said that BI data is mostly quite trustworthy. However, as the BI had just recently been re-implemented some report data validations were still in process. Within the BI tool, business had actually marked some newer reports as "validation in progress" so users would consider reliability of those reports before making important conclusions. Throughout the interviews many of the respondents highlighted that report validation is very important. Involvement of actual report users was also recommended as they would have the best business context

knowledge, the "floor-level view" into a given subject area. The BI team also commented that involvement of experts on the ERP processes is often needed to choose correct data and to help validate the reports. One of the managers also mentioned that the ability to drill-down into a given report's data in the BI tool would not only enable analysis in the BI tool directly but also enable easier report validation. For example, if an inventory value report is showing a certain amount, by drilling down a business user can actually see what it includes and confirm if it is true or not.

The importance of following process in the operational systems was considered as the most important factor influencing data quality. It was said that if users are required to input too much data in daily operations, they may feel reluctant to do so constantly, hence causing data quality issues. On the other hand, it was said that if certain steps and reasons (for example of late order) were input directly in the source systems then business could utilize BI efficiently for root cause analysis of potential problems (such as bad on-time delivery results). When business would analyze the given case he or she would need to input that data manually, for this they would use spreadsheets and therefore would not be able to do that kind of analysis directly using BI tool.

Interviewees were also asked if they feel the freshness of data is posing challenges. The data for BI was refreshed once a day and hence did not support short-time operative reporting. In general the respondents said that BI data is fresh enough for decision making. The BI system was not used in fast-paced operative reporting system. Instead, for such needs they would build Excel-based tools that would extract data directly from source databases. The BI team said that it has been recognized that there would be some needs to utilize BI for even real-time operative reporting but no plans had been made to answer those needs. From some business unit's perspectives, a real-time BI DW solution might be needed for a self-service model to fully fulfill all the reporting needs.

4.3.8   *Having the needed resources to develop reporting*

The case company had worked in a very centralized BI model but had recently shifted into more de-centralized model where a few users in each area would have access to self-service capability. Even though, the BI model as a whole is no longer centralized, the report development in BI was still centralized within business unit or process level. The interviewees were asked what kind of challenges they have faced with a centralized BI model or what kind of challenges they felt it may bring.

In the old model where BI team themselves would take care of the new report development, it was said by respondents that it had caused a bottleneck to BI report generation. Now with the limited, shared responsibility where the small BI team would no longer be responsible of generating reports it was said to be less of a problem. It was mentioned

that centralized model will cause report development to be slower and that it would be harder to fulfill actual needs from the business users' perspectives. However, at some point during the old BI installation a more free access policy was taken into use where more users would be able to make reports. It was said that in this model several users would make reports on similar subjects and end up with different results. The old data model was too hard to understand and misunderstandings became a problem. Trustworthiness of the BI system was lost amongst many decision makers. In fact, many of the respondents said that major benefit of the current model, where limited users can edit public reports, is that reports in general are much more reliable and better validated. As a whole the interviewees did not feel they had any major challenges with the current model but were mostly satisfied. It was said, however, that the current model still would cause some level of bottleneck. As prioritization was done at whole business group level, individual function's or team's needs may not be fulfilled as other needs had taken priority over them. Another point made was that some managers did not have a clear contact where they can contact for specific needs. Operations management felt that if they had more expertise on BI in their department they would be able to have more content available at BI and at faster rate. They also said that as Operations unit only had a couple of persons available to generate reports they already received a lot of request and also on subject areas which are not really under their responsibility. Even though shared responsibility had reduced bottleneck it would still not have fully resolved it in the case company.

In any case, business would still rely mostly on their personal Excel-based tools to provide new "BI" solutions for their responsibility areas and answer to ad-hoc-based needs. BI analysts were mainly used for more official reporting so far. However, as BI was recently re-implemented the company would not yet have had the possibility of recognizing full benefits of the new system and BI organization model. On the other hand, individual users would still not be able to utilize the benefits of having a data warehouse solution, which integrates different data sources into one unified place and in understandable data format (Hovi et al. 2009, 15–16). As from Operations unit perspective, data was scattered around and much manual work was needed to aggregate it for analysis.

The challenges business faced in acquiring information could be seen as managerial challenges more than technical. Even though integrating information into the BI DW is also a technical challenge, it was said that it is usually technically possible but more of a resourcing question rather than technical problem. In the end, business needs to recognize its challenges and allocate necessary resources to resolve them if seen necessary. The utilization of BI for the operations business unit's need is a managerial question on what BI should or should not be used for. It was mostly seen as a measurement tool for managerial reports and many users were used to finding information for their needs elsewhere usually by familiar Excel tool. In any case, it could be said that BI could help to meet

many of the information needs at the case company, if the business wants to allocate resources to develop its BI system for those needs.

4.3.9   *Perception of self-serviced BI*

The interviewees were introduced in short to a self-service BI model where they would not request expert to make a given report for them but would access a BI tool to generate the needed report themselves (Appendix 3). They were asked what they felt were the main benefits and challenges of a self-service BI model and what they felt was critical for the success of such model.

In a self-service model where user would not have to ask others to get those results, in general it was felt that it would be faster to get new reports needed for business decisions. One thing mentioned was when decision maker ask others to provide them something almost every time the original request would not have been enough detailed and further questions and changes had to be raised. Developing new report was said to be an iterative process, which is why developing it him/herself would speed up the whole process. The business intelligence team also said that self-service model may improve faster decision making through being able to get a specific information need fulfilled quicker. This again would enable better overview of current business performance and state and the ability to react quicker to potential problems.

The ability to produce own reports was also said to help satisfy your personal or your organizations own needs. For example one mentioned that if they would be able to make their own reports they would be more easily to get their own things under control as they understand the subject area and the needs and know how important each report is for their own team. In a centralized model one must prioritize different needs if resources are limited, even if something is important for a given unit it might not be seen as important at group level. Also defining reports themselves business users would better fulfill their exact, original needs. Or while generating the report the user would be able to realize how they want to approach the subject and perhaps even learn new approaches and identify potential problems quicker. In fact, almost all respondents said that validation of reports would be easier and much quicker as users would be able to validate on the go. They would themselves best understand the business context and have personal knowledge of the actual data content, for example how much time it takes to manufacture a given product. And use that knowledge to validate a report, some users had already felt this benefit when they did reports themselves using Excel spreadsheets.

Interviewees were also asked if they felt self-service model could help in understanding business processes through data. Majority of the respondents said that while developing a report or doing validations users may be able to identify new problems in the given

business processes. This would then again help finding root causes to problems and therefore help to improve overall business process performance. Additionally it may improve general process understanding and improve the ability to understand how well processes are followed. On the other hand, it was brought up by a respondent that generating reports of a given process may already require some level of understanding of that process in order to generate valid reports.

When asked what challenges self-service model may bring mostly these challenges were related to business user skills to generate reports. Similarly research by Imhoff & White (2011) and Logi analytics (2014) found one of the major inhibitors of self-service model to be lack of business user skills. Respondents said that in order to make reports one has to have a good understanding of processes and the data behind the processes and how different data elements relate to each other. The danger that arises is that if wrong data is used business would make non-valid reports and make false conclusions. This same potential problem was also brought up by the business intelligence team. Without proper understanding of what data should be used users may have misunderstandings. Previously, when more users had the ability to make reports the company, they had several users make reports of the same subjects and end up with different numbers. Validity and reliability was at bad level in the BI tool. There was no official process of validating public reports. Respondents said that in some cases they may require business expertise, BI expertise and ERP process expertise to be able to validate reports. Understanding of complex ERP processes was and is still a major challenge in developing and validating reports.

In order for a self-service model to work in practice different elements have to be thought of and taken care of. Interviewees were asked what they would see as important and needed for a self-service model to work at the case company. The consensus of the respondents was that pre-made data models should be defined that would hide the complexity of database structures. Modeling the data in an understandable format would help in understanding data and how a given data element can be linked to other data elements. Together with having a business terminology in BI where each data would be properly explained in sense that what it means in practice, what can it be used for and what that given data represents in the source systems. This way, users would be less prone to do false analysis by trying linking wrong data together. This approach is similar to what was suggested by Kosambia (2008), where he said that analytical tools should be designed to hide the complexity of database. The business intelligence team also commented that formatting data in a user-friendly format would require a lot of at the data presentation layer. In the end, formatting data to a very simple format was said to be a tradeoff between data precision and usability.

Having certain report templates and/or instructions on how to present data was also suggested by a few respondents. Having many different reporting formats would potentially cause confusion amongst users utilizing the BI dashboards. Another thing, especially from Operations unit's perspective, was the importance of having the necessary data available. If the data needed to make analysis was not available, users would not likely be willing to utilize BI and would still resolve to old Excel-based solutions.

Lastly, the importance of training was highlighted. Some interviewees suggested a learning path, where at first user would learn how to do basic level report but also the learning path should be available to get into more advanced level as well. The training should also include actual on-hands doing together with other people, in the end, learning by doing could be the most efficient way of learning. In fact, some respondents said that the change to self-service could be done gradually. By first enabling more reports available with the current model and as more and more users would familiarize with the system the transition into doing actual analysis could be easier. The business intelligence manager said that before going into the more spread self-service solution they would like to first have the official KPI metrics and most important and needed reports available for each function and process area, in order to have a "one set of numbers" at group level. He said that this would help users by having available official and validated reports that they could use as a base of their own reports or be able to validate their own reports with validated reports. It was said that usually the need is to add more dimensions or details to existing themes so the more of that is available the easier it would be to answer to different needs. Another suggestion made by BI team and some business interviewees was to design limited sub-sets of data of all the available BI DW data. Small and simple data cubes and data subject areas could simplify designing a report by less advanced users in order to avoid misunderstandings. For this, it should first be decided to whom the self-service is aimed to and what the data needs for those persons are.

The BI team said that there was not yet in plans a model with more spread self-service solution. They said that this limited self-service model would be in use at first to get a "one set of numbers" available for business decision makers. They also thought that there would be actual will and need for a self-service BI at some point and that it could actually benefit the business but it requires the basics to be done at first so that the challenges of misunderstandings and lack of skills can be overcome. The company already had bad experience of allowing too many users to define public reports without any process of having publicly shared reports validated.

To summarize the perceived potential benefits of a self-service model:
- developing new reports is quicker
- validating reports is quicker and easier
- more flexibility for what needs BI does answer to
- save resources by having necessary data available in a single place at ease

- better ability to identify potential problems in business processes
- ability to react faster to potential business challenges.

However, a self-service model may also bring certain challenges that would hinder the usage and benefits of the model. Perceived challenges were lack of understanding of operational systems' processes and source systems data which may cause misunderstandings and incorrect reports. Businesses would have to overcome these challenges to be able to be able to gain benefits of the self-service model.

4.4   Findings: Possibilities of utilizing self-serviced BI

In order to have user base to adapt into the use of a self-service BI solution it has to be able to reach Excel-like usability and flexibility as well as be easy enough for users to understand what data they need to use for their information needs.

Some of the interviewees said that especially for ad-hoc needs the self-service BI model could be utilized best. Currently business uses a lot of time manually aggregating data from different systems which is was said to be time consuming and hence causing unnecessary costs in terms of resourcing. Even though, it will generate costs for the company to build up the BI DW and data models for self-service use, in long run benefits could be gained from the BI solution in its entirety. It could be said, that the business is already doing a "self-service BI" by utilizing custom Excel-based tools that they had designed themselves. Some teams would design custom SQL queries directly extracting data from ERP databases which already had very complex database structures. Hence, it could be argued that for some more advanced users the self-service model could already be utilized. The problem of having widely used Excel-based analysis is that the ability to govern reporting and analytics is mostly lost (Schlegel et al. 2014). However, in order to gain benefits from operations perspective, firstly the BI team would need to add the necessary source systems available in BI DW. In order to avoid misunderstandings, at first, the company could only allow limited number of advanced users to utilize the BI system for ad-hoc type of needs. In fact, a few limited persons, not considered as business analysts, already had been given access.

For now, the case company could use a model where only analysts are able to modify official dashboards. Where reports would only be published after they were fully validated. Advanced users using BI system could design their own reports, and if they see it could be utilized for wider use they should contact on their area's business analyst for review of their report. The writer of the thesis suggests that the company could design an official validation process to have reports published at dashboards. For now and in future as the business users would design their own reports at their own organization units and

some of those may be utilized by others as well. In this case as more users would be consuming the information from those reports it is critical that the report is trustworthy to avoid costly false conclusions and therefore decisions made on wrong basis. The case company had already experienced problems of not having an official validation process available when more users had the ability to generate new reports. This problem could be avoided by having a validation process. The process could be defined so that the users who had originally made the report would contact analysts and after which their validation could be supported by BI team and relevant operational system experts if needed. After initial validation the business had also released reports on public dashboards and marked them as "validation in progress" so that actual users of the reports could even further help on validating the data which would even more ensure the validity of the report. It was said, that even after having good expertise with validation, it still proposed challenges. In order for the BI program or self-service program to be successful it has to be able to provide trustworthy information so that it may produce benefits at all.

A few of the respondents had already worked for a company where a self-service model was in use or was in progress of being taken into use. They commented that in those businesses they had built ready-made templates and limited data cubes for less experienced users. The same approach was suggested by BI manager. The case company could build data subject areas where limited data was available, defined and explained as clearly as possible for the end-users. This could be utilized by the basic self-service users with less experience. This approach could help avoiding unnecessary false conclusions as the BI would be simplified from the end-user's perspective. Simplified self-service is also supported by Imhoff & White (2011) research where they suggested that self-service BI tools should be made easy-to-use. Imhoff & White also suggested on building pre-made templates and pre-made analytical components (such as filters) so that producing new content was made easier as well as understanding the reports would be easier by having standardized reporting methods and views. Anyway, it was suggested by some interviewees that self-service should not be limited only to limited and very simplified data views. Advanced users should be able to utilize the full capabilities of the BI system, so that the responsibility of designing new and more complex report is not limited to a few and hence causing a bottleneck. It was suggested that business user should have some kind of learning path available which would prepare them for the limited self-service use and also have the ability to become more advanced user.

The case company was using a BI organization model base on the BICC idea. Gartner research (Parenteau, 2013) suggests an evolved version of the BICC model to enable self-service BI. The researcher suggests that the case company could utilize the evolved BICC model for self-service. At first, users are given basic introduction and given access to consume information. After more training the user can be given access to the self-service tool with limited data sets and simplified data cubes to create simple queries for their

personal ad-hoc type needs. As suggested by the interviewees, user should also have the ability to be trained to advanced level and given wider access and ability to do more complex level. Similarly as business analysts were able to do at the case company. The business analyst role could be above the advanced user role where the analyst has the responsibility of the public dashboards and approving validations. Lastly the BI team works in the administrative role coordinating and enabling others with BI capabilities. In order to avoid false information to be published the company could utilize the validation processes. The business analyst would be the contact point of publishing new reports to existing public dashboards and be responsible of approving the validation of those. With this model the case company could try to:

- avoid false reports to be consumed by less advanced users
- enable governed self-service by utilizing the BI tool
- simplify the process of getting information by having data available in a governed BI DW
- enable more people to be involved in developing reports
- avoid bottleneck of centralized reporting team
- have a clear learning path to become more advanced user.

The researcher argues that the self-service capability would enhance the tasks of information workers within the analytical framework (Chandler et al. 2011; Acito & Khatri 2014.):

- consuming insights generated by others
- producing insights from data
- enabling creation of insights.

Information is easily consumed as it is reported in a common place, the BI tool. The empirical study has found out that in the case company much of information is scattered around and reported therefore with different tools (often Excel-based). This has caused that a lot of reporting is stored in different places and not available in a single source where it can be consumed. Secondly, as more information is produced the more information could be consumed. Businesses must, however, ensure that consumed information is valid and reliable.

Objective of self-service BI is to allow more users to produce information for their own and others' use by using a single tool (in most cases). Producing insights from data is possible if data is easily accessible in a single source (BI DW). The case company had the problem of having data scattered and producing new insights was time consuming and complex.

Self-service tries to enable creation of insights by trying to ensure producing new insights is made as easy as possible for the less advanced users and also that more advanced users have the tools required to develop new reports and information. Centralized BI team should focus on enabling others to produce information instead of relying on a centralized

team to fulfill the reporting needs of the whole organization. Literature review as well as the empirical study identified that centralized team will easily become a bottleneck in fulfilling the information needs of the whole organization. Case company planned on building official metrics-based reporting first before doing a more self-serviced roll-out. The benefit of such is that users can utilize those validated components in their own report development. The interviewees also spoke of having pre-made components and filters available so that users do not have to start defining reports from scratch. The same was also suggested in literature by Imhoff & White (2011). It could be said that it is a development process to move into a self-service model from a centralized approach. Mapping the information needs of each business function or process and defining the needed data for those needs in an understandable format. Investment in self-service can be considered as an investment into development of business terminology and modeling of data in an understandable format. Implementing new BI tools will not likely yield benefits itself.

4.5   Generalizations and limitations of the research

All organizations have individual needs and challenges regarding information. It can be said that a single case study will not be able to generalize the individual information needs and challenges each organization faces. However, the literature review also shows that many businesses require easier and faster access to information; hence in that sense it works as an example organization to study the research question. The literature review on self-service is mostly based on whitepapers and academic research was not yet available, which limits the validity of this study. The researcher aimed to conduct the study objectively but acknowledges that he might have subjective views on different matter and results of this study also rely on the academic skills of the researcher alone. This study aims to find out example usages and potential benefits of self-service BI in a single case company and if it could be beneficial for its use for Operations business area. Studying a single unit in an organization should also be considered as limitative factor for this study. Different businesses may also include differently operating personnel, such as Operations vs Sales, which may have different challenges and needs. Literature suggested that each organization must find its own balance of organizing BI between centralized and de-centralized models as each organization works differently. Hence, this study will not be able to provide an organization model for BI that would be usable in a generalized manner.

4.6   Further research

The writer of this study feels that the academic community should address the question on the ability of self-service model addressing information needs at all organization levels. More studies should be conducted on the challenges and benefits of self-service BI model. The writer suggests that organizations who have implemented self-service BI model should be studied to identify potential challenges and benefits of self-service BI model.

5 CONCLUSIONS

The main objective of this study was to find out how self-service BI model could help businesses fulfill their information needs. This was approached with a literature review and with a qualitative single case study. The research objective and related research questions are:

- *Research objective: Can self-serviced BI help businesses to meet their information needs?*
    - *RQ1: Why do companies use business intelligence?*
    - *RQ2: What are self-serviced BI objectives and drivers?*
    - *RQ3: What are the business information challenges at the case company?*

Regarding the first research question the literature review shows that businesses have used BI mostly as a managerial tool to support managers' decision making. Businesses have had the need to understand what is happening around them and how well they are performing in different areas. Enterprise performance management is one subject area which BI has been traditionally used for. Businesses try to measure, using data, their business performance in internal or external processes. This has been used for strategic and managerial work to make better decisions on how business can operate better in those measurable areas and processes. Lately, however, BI has also been taken in use for more ground-level decision making even at operational timespan. Today's businesses generate a lot more data than before and that data can be utilized even more by businesses. Business users demand more information than before and information needs change more quickly.

The empirical study found that case company mostly used BI for measuring performance and giving an overview on certain important business areas, such as sales figures. Ad-hoc needs and business user-driven information needs were still fulfilled mostly using self-made tools and manual work. In other words, many business users were already doing BI-like work but outside the actual BI system. Regarding research question three, the interviews done for this study found out that the biggest challenge in finding information was that data is scattered around and not aggregated into one place. This forced business users to manually find and aggregate data from different sources using laborious Excel-based tools. Information needed for the decision maker was not aggregated in one single place nor did they have enough expert resources available to answer all individual information needs. It could be argued that BI is a technology and a process which aims to allow easier access to information in a one unified data base and tool, therefore BI could be utilized to help business users to find information more easily in one unified place.

Businesses are facing the trouble of expanding amount of reporting needs with centralized BI teams. The literature review shows that a new way of doing BI has risen to

counteract this issue. Self-service BI aims to provide the ability of business decision makers to easily and quickly access information to answer their personal information needs. Traditionally BI has been meant for top-down managerial overview and EPM but lately also bottom-up and operational level decision making requires data-based information. Hence, more and more businesses also use BI at all organization levels. Regarding the 3rd research question on what are the objectives and drivers for BI, it was found in the literature review that main drivers for self-service are

- the need to access information faster
- need to be more analytical organization
- IT's inability to fulfill the risen amount of BI reporting needs.

The objectives of self-service BI are to enable as easy as possible tools for BI, easily accessible source data and easy to implement new BI DW solutions. Enabling access to complex databases will not yield benefits yet, but businesses need to present business information in a way that average business user will be able to understand it. The empirical study shows that enabling access to complex information structures can result in incorrect reports where users have mistakenly connected data in a way that it does not provide the needed results. It was felt that much ground work is needed to build up understandable data components and pre-made data subject areas for business users to use. However, after such work is done, enabling self-service could reduce the load on BI experts and enable faster decision making by giving faster access to needed information. Simplifying data for business to use can be seen as a trade-off between usability and availability of different information, hence businesses need to keep in mind that simplified data model might not fulfill the needs of more advanced users. The case company had already given self-service access to more advanced users and had shown benefits of having BI expertise available at business functions. However, a wider roll-out was said to require simplification of data for the average level users.

It should be kept in mind that self-service should be considered as an organization model of using BI and developing BI database, instead of as an investment into BI end-user tool. A centralized model may benefit organizations in different ways such as providing trustworthy information. This study does not suggest that de-centralized self-service model should replace centrally managed BI but instead could be utilized together with centrally managed BI to better fulfill individual needs. As each organizations works differently, they have to find the BI organization model that best suits their needs. Some may find it easiest to focus development centrally and some organizations may find benefits in having decentralized teams or somewhere between. The results of this study suggest that BI could be utilized in a self-service manner to make information access easier and therefore more efficient for the average business user. This would enable good fact-based decision-making and the ability to identify potential problems and opportunities by having a better understanding of what is happening around us.

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APPENDIX

Theme-based interview structure

Original format translated and simplified for appendix use. Note that in theme-based interview the questions are themed and not asked precisely as described below

Information and BI

- Miten hankit tietoa itsellesi eri tilanteisiin ja päätöksien tueksi? (Mitä tietoa? Millaisiin päätöksiin? Kuinka usein? Millä työkaluilla?)
- How do you find information?
- How is information enhanced / analyzed?
  - o Do you have your own "BI" solutions?
- How is information shared forward?
- What kind of automated reporting is used for normal and exception situations?
  - o What kind traffic light or other key figure based reporting is used?
- How are processed measured? What are the key challenges?
- What do you use BI for?
  - o Why BI?
  - o How would you like to use it more?
- How often do information needs change? Do you get a lot ad-hoc needs and how are ad-hoc needs answered?
  - o Does ad-hoc needs become standard needs and what is done in practice in that situation?

Challanges

- What are the biggest challanges in your daily work related to getting information?
  - o Challenges in acquiring information, availability of data
  - o Challenges in enhancing and analyzes
  - o Challenges in sharing information
- What kind of challenges do you experience with information quality and reliability?
- Challenges regarding data freshness?
- What kind of challenges does centralized report development cause?
  - o How slow?
  - o How well are needs fulfilled?
  - o Challenges in description of need?

Self-service

- Should decisions be made more per fact-based analysis? How ?
- What benefits can self-service model give?
  - o In what kind of situations?
- What challenges may self-service model cause?
- What do you see as critical factors for the model to work?
- What benefits would you see with the ability to choose own data sources and using those with current DW data?
- Benefits of refining existing dashboard reports for own use?
- Could self-service help understanding processes?

BI team interview

Information and BI

- Why the case company does BI? For whose use is BI aimed for?
  - What is BI used for? Is it for operative use as well?
- Organizing BI development
  - How are new reports made? By who?
  - What are the roles of the BI team?
  - How is data and report validation done? Who is responsible?
- How and per what basis are data warehouse data sources chosen?
- Can user include own data for BI analysis?
- How are users supposed to enhance / analyze information further?
- How can BI-made information be shared?
- How are development needs prioritized?

Challanges

- What are the biggest challenges in using and developing BI in BI team's view?
  - Old vs new version?
- What do you see as biggest challenges from user perspective?
- Challenges regarding linking BI and source data and Business terminology?
- Challenges regarding fulfilling user needs?
- Challenges regarding users' need description and understanding?
- Challenges regarding data quality and reliability?
- Is data scattered? Does something limit the ability of aggregating data into BI DW?

Self-service

- What benefits, challenges and opportunities do you see with self-service model?
- Has self-service BI investments been considered? If so, how?
- What would be the critical elements for the model to work?
- What needs more development with current BI for self-service BI model?