Business Intelligence within Large Companies– Challenges and Maturity

LUNDS UNIVERSITET
Lunds Tekniska Högskola

Authors

Emma Sikander, Lund University, Faculty of Engineering
Sofia Öberg, Lund University, Faculty of Engineering

Supervisors

Dag Näslund, Department of Industrial Management and Logistics, Lund University, Faculty of Engineering
Søren Plaugmann, Head of Nordic FS BI, EY

Acknowledgements

_____   _____

Emma Sikander   Sofia Öberg

Abstract

Title	Business Intelligence within Large Companies- Challenges and Maturity
Authors	Emma Sikander and Sofia Öberg
Supervisors	Dag Näslund, Division of Engineering Logistics, Lund University, Faculty of Engineering
	Søren Plaugmann, Head of Nordic FS BI, EY Copenhagen
Purpose	The purpose of the thesis is to create a Business Intelligence maturity model based on eight examined operational BI propositions. Furthermore it is to explore the recognition level and business impact of these propositions.
Methodology	The work process consisted of an initial explorative phase where a theoretical framework was created based on literature research. Founding on that the maturity model was developed, and then further tested in a survey. The survey also examined the recognition level of the propositions. To explore the business impact of the propositions three in depth interviews were held.
Conclusion	The main conclusions in the project are that the eight examined propositions are common challenges among large Scandinavian companies. The developed maturity model covers these challenges and can be used by organizations to see where they are at in their maturity curve and what the next step in the maturity process is. The higher the BI maturity is, the less recognized the propositions are. The recognition level of propositions and the BI maturity impact the business success, and the BI maturity among large Scandinavian companies is somewhat moderate. Other conclusions are that a well functioning BI environment is essential for any large organization since it enables the achieving of strategic goals such as efficient and effective processes. However, efficient BI-processes and a functioning IT landscape can be difficult to establish, especially for large companies. There are extensive amounts of data to process, the implementation costs are high, and the needed change management resources are often overlooked.
Keywords	Business Intelligence, Maturity Model, Operational Challenges, Business Impact, Value Creation,

Table of content

1. Introduction

The first chapter aims to provide the reader with an overall understanding of the thesis, its background, the issues it strives to answer, its delimitations, and the outline of the report.

1.1 Business Intelligence Definition

BI combines data collection and data storage with analytical tools in order to synthesize information that helps support decision making. It facilitates managerial work and increases the decisions based on relevant information as opposed to decisions based on personal experience and judgment. BI helps decision makers understand the capabilities of the firm, and the trends and future directions in the market environment. Among the first to define BI was Howard Dresner in 1989 as *"concepts and methodologies for improvement of business decisions using facts and information from supporting systems"* (Power, 2007)*.* Since then BI has been referred to with various definitions. Williams and Williams (2007) think of BI as *"business information and business analysis within the context of key business processes that lead to decisions and actions"*. A more technical aspect is adopted by Watson and Wixom (2010) defining BI as an *"umbrella term that is commonly used to describe the technologies, applications and processes for gathering, storing, accessing and analyzing data to help users make better decisions"*. The Data Warehouse Institute (TDWI) has a similar definition *"Business intelligence (BI) unites data, technology, analytics, and human knowledge to optimize business decisions and ultimately drive an enterprise's success"*. However, they also add *"BI programs usually combine an enterprise data warehouse and a BI platform or tool set to transform data into usable, actionable business information".* (TDWI, 2013)

When combining the definitions it can be concluded that BI is an analytical process that converts disintegrated data into knowledge and action-oriented information. This information is then used in the decision making processes and in the achieving of business goals.

1.2 Problem Background

The business environment today is rapidly changing and is more competitive than ever before. Complex, analytic technologies provide information about almost anything. Not only is there more information than previously, but the information is also more precise, detailed, and comes with higher speed. Scanning and processing information in a correct and effective manner has become highly crucial in order to stay competitive (Negash, 2004). The increased volume, speed and diversity in data access create a crucial need for managing information, and there is an obvious must of timely, precise and up-to-date business information and knowledge (IBM Institute for Business Value; LaValle, 2009). As a result of this companies today are spending vast amounts of money on information technology (IT). The deployment of IT systems and services has increased tremendously the last couple of decades and companies such as IBM, Microsoft, Dell, SAP and Oracle have experienced an immense growth. However, many experts are questioning whether these investments really do lead to productivity gains for the companies applying their solutions, or if it does not. Some analysts talk about how companies today may be data-rich but at the same time the might just as well be information-poor. All the same, it is clear that BI gains are difficult to measure. Improvements such as better decisions leading to potential efficiency advances and cost savings are not easily quantified. (Stiroh, 2001)

Managers all over the world are well aware of the complex, analytic technologies that are available today for providing insight and support for business decisions. Still, in a survey conducted in 2008 with more than 250 executives, 40% says that their major business decisions are grounded on experience and personal judgment rather than business analytics (Williams, 2011). In an IBM study conducted in 2009 similar conclusions are drawn. Out of 225 business leaders all over the world all agree that there are some or many gaps or lack of trust in information when it comes to extracting and prioritizing relevant information and applying information to optimize operations, to have more predictable outcomes and to understand risk. (IBM Institute for Business Value: LaValle, 2009)

There is clearly a gap between investing in the right technology and using it the right way, or a difficulty in the combination of the both. The challenges when it comes to achieving the full business value of BI investments consist both in technical aspects such as managing data and processes in an efficient way, and business aspects such as adapting the BI investments to strategic goals and using the BI applications right (Williams, 2011). Commonly perceived BI challenges have been comprised in the eight propositions stated below (EY, 2013a):

1. Retrieving data: Substantial amount of man hours are wasted on retrieving data
2. One version of the truth: Multiple definitions on the same object; there is a large need for "One version of the Truth"
3. Technologies: Duplicated technologies solve the same tasks
4. Competencies: Required BI competencies to satisfy needs are already present in the organization, but an overview is missing
5. Transparency: Low reliability and transparency in data leading to redundant work
6. High cost: Few BI consumers per report and low reuse of data give a high cost per report
7. Reactive rather than proactive: Reporting focused on looking backwards and less on identifying business opportunities
8. BI Processes: The organization has a large amount of parallel BI processes, many of those lacking standards, documentation and alignment (EY, 2013a)

Various maturity models have been developed aiming to better understand why and when companies experience BI challenges. The BI maturity models try to describe what the common difficulties are when it comes to establishing BI applications and reaching its full business value, and where in the maturity process of BI that they are usually encountered. The maturity models cover different dimensions, depending on the applied definition of BI and what its creator has considered to be important aspects (Rajteric, 2010). This project aims to create a BI maturity model covering the eight propositions above, as well as defining the proposition's level of recognition among large, Scandinavian

companies. It also links the propositions to strategic challenges, and discusses the business impact of the propositions.

1.3 EY Ordering the Project

EY is one of the global leaders in assurance, tax, transactions and advisory services. Within advisory services the firm offers, among other things, expert knowledge on the linkage between enhanced business performance and a more efficient IT organization (EY, 2013b). This thesis is conducted in collaboration with the Financial Services Risk Advisory department at the Copenhagen office, Denmark. EY has observed certain commonly recurring difficulties that companies in Scandinavia seem to face in terms of achieving the full business value of BI investments. These perceived difficulties have been summarized into the eight propositions stated in the problem discussion above, and will serve as the starting point of this thesis.

1.4 Purpose of the Thesis

The purpose of the thesis is to explore the recognition level of eight operational business intelligence (BI) propositions among large Scandinavian companies, and to create a maturity model that covers the found propositions. Furthermore, it is to explore the business impact of the propositions.

1.5 Delimitations

This project is limited to verifying the eight propositions stated above which means other aspects of BI are not included. The developed maturity model covers a chosen set of sub dimension, which means there are groups of criteria more or less important to focus on for some organizations. Also, there are groups of criteria that are left out in the model that might be important to focus on for some organizations. The research is restricted to large Scandinavian companies, and the study should thus be considered covering this geographical area with focus on large companies.

1.6 Target Groups

This master thesis is mainly aimed at employees within the BI sector, to be used as a scientific study proving the strategic effects of common BI challenges. The

second target group is other professionals and students in the academic world with an interest in BI. The reader is expected to have a basic knowledge of business theory and IT.

1.7 Objectives and Deliverables

The main objective of the project is to provide a compilation of common operational BI challenges (referred to as propositions) among top Scandinavian companies, describing to what extent the propositions are recognized. Also, it is to provide a BI maturity model that covers aspects related to the propositions. The maturity model will function as a tool for companies, which through placing themselves in the maturity framework can understand how to improve their BI environment and use of BI. Furthermore the project aims to examine the business impact of the eight propositions. The academic report is intended to describe the current BI context, to document the project work, and to provide a full background of the propositions and the maturity framework.

1.8 Disposition of the Thesis

The composition of the thesis is structured as following:

1. **Introduction**
    The first chapter aims to provide the reader with an overall understanding of the thesis, its background, the issues it strives to answer, its delimitations, and the outline of the report.

2. **Methodology**
    This chapter aims to provide an understanding for how the study has been conducted. The credibility of the thesis is discussed as well as the different methods used.

3. **Business Intelligence According to Research**
    This chapter provides an understanding of the theory behind the research. First the BI process is illustrated. Then the technical and business aspects related to the propositions are described. Next, the eight examined propositions are presented and the business value of BI is discussed. Then different types of maturity models are described, as well

as a summary of their included components. Finally the new, developed maturity model is presented.

4.   Business Intelligence Challenges Related to Maturity Phases

This chapter includes a compilation of the results from the survey and in depth interviews. It gives an overview of the BI maturity among large Scandinavian companies and to what extent the eight propositions are recognized. Also, the propositions' business impact is illustrated.

5.   Analysis- BI Maturity, Recognition and Business Impact of Propositions

This chapter contains an analysis based on the survey results and in depth interviews. It describes how the eight propositions are linked to BI maturity based on the maturity model, where in the maturity model companies are and why they are not increasing their maturity. It also discusses the business impact of the propositions.

6.   Conclusions

This chapter presents the conclusions of the thesis and shows how the project adheres with its purpose. Finally, recommendations on future research are given.

2. Methodology

This chapter aims to provide an understanding for how the study has been conducted. The credibility of the thesis is discussed as well as the different methods used.

2.1 Work process

The project consists of five main phases described in figure 2.1. The work process has followed this scheme, a part from a few iterations between the phases.
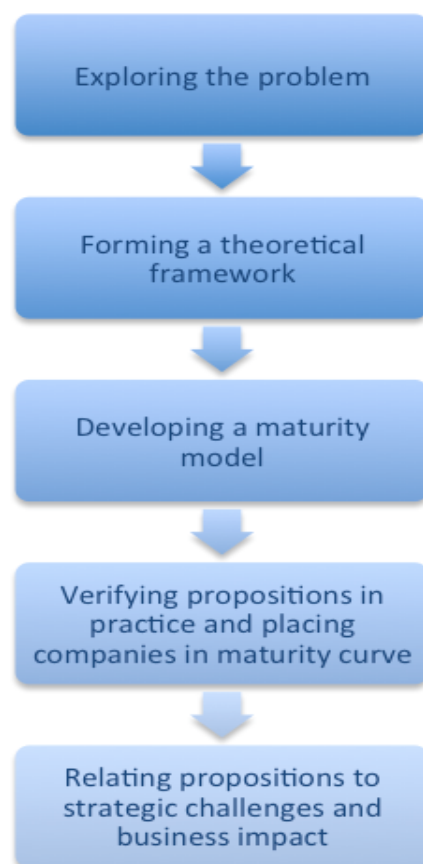
Figure 2.1: Work process of project

2.1.1 Exploring the Problem

The initial problem definition was presented by EY. In order to completely understand the problem and what was supposed to be the final output of the project, meetings with EY as well as the project's supervisor at LTH were held. Also, research on material from EY was done.

2.1.2 Forming a Theoretical Framework

At first an explorative approach of the BI context was taken, so that the project team could create their own understanding and view of the field. This was essential in order to conduct an examination of existing challenges. A desktop study (Höst et al., 2006) conducted as a literature study was done. This allowed the project team to collect data from earlier published research. Lund University's web based literature base (LUB Search) was mainly used. Sometimes also the search engine Google Scholar was used to find relevant articles. Books within the subject Business Intelligence and methodology has also been used. Consequently, the theoretical framework is mostly based on secondary data. Apart from this, discussions with BI knowable personnel at EY were conducted, providing the project team with first-hand knowledge. Summarizing contemporary views on BI, the authors could create an extensive knowledge base within the field (Höst et al., 2006). Besides serving as a knowledge base, the research also allowed the authors to explore existing maturity frameworks, so to realize that there was a need for a specially updated and adapted maturity model describing the processes and aspects of the eight propositions.

2.1.3 Developing a Maturity Model

Once the background study was considered satisfactorily thorough, a continued desktop study was performed (Höst et al., 2006) narrowing down on BI maturity frameworks. Seven models that showed to be of common use were further examined and the different approaches and dimensions of the models were compared. Founding on already existing frameworks, a new maturity model was constructed. It was inspired by the seven already existing models but this new model focused on the propositions that the thesis aimed to verify.

The already existing models together cover all aspects needed for the propositions. The new maturity model is therefore built up by taking relevant parts from the existing models and combining them into a new maturity model covering all aspects needed.

2.1.4 Verifying Propositions in Practice and Placing Companies in Maturity Curve

Based on theory and frameworks found in the previous steps, the normative phase of the project started. Deductive reasoning was used, i.e. a proposition was examined based on theory from empirical studies (Lekwall and Wahlbin, 2001).

According to Lekwall and Wahlbin (2001) there are three different questioning methods that are used to gather primary information: a written survey, a phone interview or a personal interview. Table 2.1.4 shows a summary of some important characteristics for the methods.

Characteristics	Written survey	Phone interview	Personal interview
Cost per interview	Low (may increase through reminders et.c.)	Quite low	Often high
Speed	Often low	High	Quite high
Risk of falling-off	Often high	Moderate	Moderate
Control of respondants	Often bad	Good	Good
Possibility to a "dynamic" questionning	None	Quite good	Good
Limitations in the questionning technique	Big (only simple, self-explaining questions)	Some (illustrative picture can be sent in advance)	None
Maximum realistic size of the interview	Up tp 40-50 questions	5-30 minutes	Up to 2-3 hours (longer when the subject is interesting for the interviewee)
Possibility for the respondants to be anonymous	Good	Limited	Limited

Table 2.1.4: Summary of questioning methods (Lekwall and Wahlbin, 2001, p 263)

2.1.4.1 The Survey

To examine the recognition level of propositions and the companies' maturity model the written survey method was used since the project team wanted to reach a large number of respondents, which is possible with this method. This bottom-up approach (Lekwall and Wahlbin, 2001) aimed to illustrate the current situation of Scandinavian companies. Summarizing the results of the survey, an overview of the companies' recognition level of the first seven propositions was determined. Also, the companies were placed into a maturity curve supported by the developed maturity model. This illustrated at what maturity stages most companies are.

Between five and nine response alternatives are often used in a survey. Few alternatives increase the risk that only some of the alternatives are used, and the alternatives may not be precise enough causing the responses to not enough detailed. Many alternatives increase the workload for the respondent, and too many steps might be meaningless (Lekwall and Wahlbin, 2001). A response scale with five alternatives was used in the survey since this was considered precise enough by the project team and the survey experts, and it made the alternatives easy to understand for the respondents.

The sample population of a survey must correspond to the target population in order for the outcome to be representative and objective, and falling off of respondents must be taken into consideration (Höst et al., 2006). The survey was sent to 112 large Scandinavian companies, i.e. companies with more than 250 employees and annual revenue higher than 50 million euro (Europeiska Kommissionen, 2006; Tillväxtverket, 2011), from various industries. The rate of response of the survey was 20%. 69 of the companies were Swedish, 18 were Norwegian, 15 were Finnish, and 10 Danish. Out of the responding companies 15 were Swedish, 4 were Danish, and 3 were Norwegian. This means that most of the responding companies were Swedish. The interviewed companies are three of the survey respondents. The companies that received the survey were found using lagestcompanies.com where all a list with all largest companies in Scandinavia was retrieved. 112 of the largest companies in Scandinavia was considered a reasonable sample population, and to be a big enough number of

companies to provide an overview of the situation of large, Scandinavian companies. Contact details were found partly through EY's customer database, and partly through calling the receptions at the companies asking for the right persons contact details.

The survey recipients cover six different company sectors being industrial products, government and public sector and life science, financial services, retail and consumer products, oil, gas and energy, and technology media and telecommunication, as can be seen in figure 2.1.4.1a. However, 50 % of the respondents were from the industrial products sector, which means that the result mainly applies on this specific sector. See figure 2.1.4.1.b.
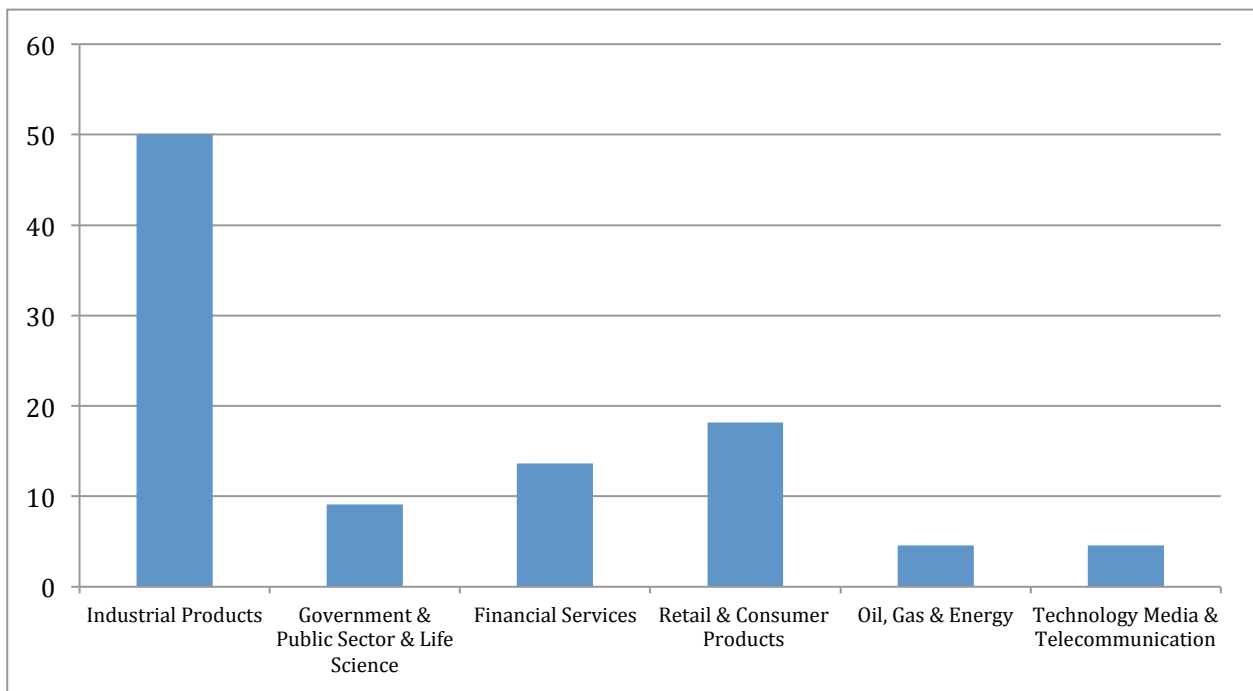
Figure 2.1.4.1a Survey recipients by industry
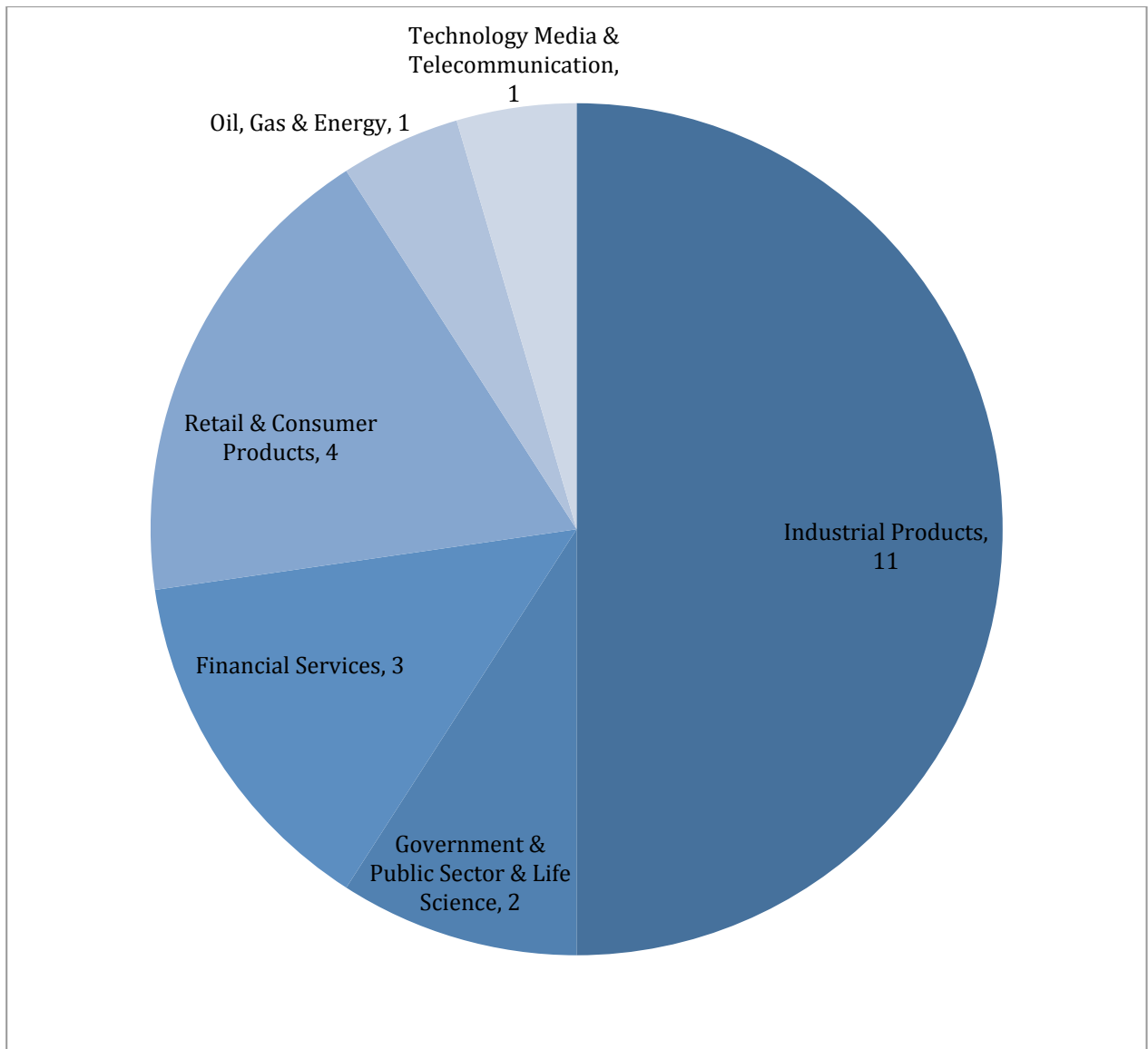
Figure 2.1.4.1b Survey respondents per industry

The survey was web based and created at surveymonkey.com, which is an online survey service. The project team had an account where they could create the questions and layout and gather the responses. A unique link was made for each company where they could reach the survey directly. Before sending out the survey, a preparation email was sent out to all companies explaining that they were going to receive a survey in a few days, see appendix 3 (A3.1). The purpose of the survey was also explained and that this would be interesting for them to participate in since they would be able to take part of the results. When sending out the survey almost the same email was used (again explaining what the

respondents would get out of participating and the purpose of the survey), but then the unique link was inserted too, see appendix 3 (A3.2). The companies had one week to answer the survey. Reminder emails were sent out three days before deadline to all non-respondents, see appendix 3 (A3.3). After deadline the project team tried to reach the non-respondents on phone to further increase the number of respondents. The emails, phone calls and promise of getting the results of the survey was all aiming to increase the response rate (Lekwall and Wahlbin, 2001). See appendix for the full survey and the results.

To analyze the recognition levels of the survey the mean and standard deviation was used. If a random sample from a population is used then the sample mean can be calculated with the following formula (Montgomery, 2013):

$$\bar{y} = \frac{\sum_{i=1}^{n} y_i}{n}$$

The standard deviation can be used as a measure of dispersion and can be calculated with the following formula (Montgomery, 2013):

$$S = \sqrt{\frac{\sum_{i=1}^{n}(y_i - \bar{y})^2}{n-1}}$$

The mean and standard deviation of the recognition level on a scale 1-5 of each of the propositions can be seen in table 2.1.4.1c.

	Mean recognition (1-5)	Standard Deviation
Proposition 1	3,4	1,00
Proposition 2	3,3	1,21
Proposition 3	3,5	0,96
Proposition 4	2,9	0,56
Proposition 5	2,9	0,99
Proposition 6	3,4	0,90
Proposition 7	3,6	0,67

Table 2.1.4.1c: Mean and standard deviation of the recognition level from the survey answers

A high standard deviation indicates a large dispersion from the mean data point. The calculated standard deviation shows that the different companies' recognition level scores are somewhat dispersed and that not all are right on the

mean recognition point. However, with only 22 respondents it is difficult to draw any big conclusions from this.

2.1.5 Relating Propositions to Strategic Challenges and Business Impact

In order to gain deeper knowledge, to be able to both verify the results from the survey and to link the operational challenges to a strategic level, a top-down approach was taken (Lekwall and Wahlbin, 2001). To examine the business impact and to be able to discuss the maturity model and the propositions more deeply, the personal interview method was chosen, see figure 2.1.4. This because there are no limitations in the questioning technique, and the project team could have longer time with the interviewee to gain deeper knowledge. Three in depth interviews were performed, held with BI knowledgeable employees at three different companies. Through the expert knowledge of the interviewees, the results from the previous step could be verified, and the business impact related to the propositions could be discussed. One more proposition was added to the BI propositions before the interviews where conducted but after the survey where sent out; *BI Processes: The organization has a large amount of parallel BI processes, many of those lacking standards, documentation and alignment.* It was considered to be an important challenge that had been overlooked in the first phase of the thesis where the survey where developed.

2.1.5.1 The In Depth Interviews

The interviews were performed in a semi-structured manner, i.e. the interview has prepared questions, but during the interview the interviewer can choose to change the order of the questions and the phrases to adapt to how the interview proceeds (Lekwall and Wahlbin, 2001). The interview was built up according to Höst et al., (2006); first describing the context, then some neutral questions, main questions, and finally wrap-up questions together with information on how the interviewers will get back to the interviewee. A description of the five areas of questions is described below and illustrated in figure 2.3.3. See Appendix 4 for the full interview guide with all the discussed questions.

Introduction

The first part of the interview aims to inform the interviewee about the thesis project as a whole, and the goals and agenda of the interview. It also asks some introductive, neutral questions to get the basic knowledge about the interviewee and the company´s BI strategy and environment.

Maturity Model

This part of the interview is part of the main questions, along with the following two parts about propositions and business impact. The maturity model is gone through sub category per sub category. The interviewee gets to explain where in the maturity process they are at and why.

Propositions

This part of the interview aims to confirm what their recognition level of the proposition is, and to provide an understanding of what might be causing them.

Business Impact

In the business impact part the goal is to map a pain chain describing how the operational BI propositions are linked to the strategic goals of the company. It also aims to understand and describe how the company sponsors BI projects, and where the resources are placed.

Other Challenges

This last part of the interview covers wrap-up questions and the interviewee has the possibility to add things that were not talked about earlier in the interview. Also, the interviewee is informed on how the project team will be in contact with them, and when they will receive the results of the interview.

2. *Discuss the propositions according to the survey result.*
Discuss possible reasons for propositions and connect the propositions to maturity.
Discuss how they got to their current maturity level, what challenges they faced, and if (and how) they are working towards the next level.

2 Propositions

3 Business Impact

3 *Explain their pain chain/how we mapped their strategic challenges. Do they agree?*
Fill out the pain chain together. Go through strategic challenges one by one, top down approach.

1 Maturity Model

BI Interview

Areas to cover

4 Other Challenges

1. Describe the maturity model thoroughly. Discuss their position in each of the subcategories.

0. *Intro:*
Present the overall agenda and goals of the interview.

4. *Are there other operational BI challenges that we have not discussed? If so, how is it connected to their BI maturity?*
Anything else they like to add or discuss?

Figure 3.1.5.1: Interview framework

Three companies were chosen that the project team considered representative for large Scandinavian companies. All three companies were part of the 22 survey respondents. Two of the companies were Danish and one was Swedish. The interviews were conducted at the companies' offices and had a duration of about two hours. The whole project team was present at the interview. One person was taking notes and the other one was leading the interview. Afterwards the notes were rewritten into a text that described what had been said at the interview. It was sent to the interviewed company that confirmed the contents. Like this, the project team had time to fully understand and discuss the companies' situations and answers and to verify the answers with the interviewees afterwards (Lekwall and Wahlbin, 2001).

2.1.5.2 The Business Impact Model
The project team used a previously developed model from EY when making the business impact model. It was modified to fit the purpose of this study and to cover the examined propositions. First the examined propositions were put into the model and according to the theoretical framework it could be concluded that

16

they affect the efficiency of the IT-processes. Then the strategic challenges were placed into the model. The tactical linkages were discussed one by one in the in depth interviews. The tactical linkages that were recognized at the interviewed companies were put into the model. This means that the tactical linkages are only examples of difficulties that may exist in a company, and they do not all apply for all companies.

2.2 Criticism of Sources

A critical approach has been maintained throughout the project to all sources, as to ensure a clear and objective interpretation of all information. The theoretical framework is based on secondary data, whereas primary data was gathered to examine the recognition level of propositions, the companies' maturity level, and the business impact of propositions (Höst et al., 2006). The models (the maturity model and the business impact model) were created based on both primary data form the theoretical framework and the results from the survey and interviews.

2.2.1 Theoretical Framework

It is important to use various, trustworthy sources when forming a theoretical framework based on secondary data. Referring to used sources in a clear way throughout the text and evaluating every source thoroughly are important steps in the literature study (Höst et al., 2006). BI has been, and is, continuously evolving as a scientific notion and therefore so is the literature in the field. The available literature mainly consists of books and research papers by researchers, analysts and consultants, which risk bias practical solutions rather than theoretically tested models. However, the project team chose well-known researchers, papers and publicists in the field as well as tried to have several sources on the same information. Many different sources are used in the paper to increase the trustworthiness of the information. There is not much statistical evidence of BI, since its effects are not easily quantified (Stiroh, 2001).

2.2.2 The Survey

A written questionnaire is advantageous as a large population can be reached and the cost per examined unit is relatively low. However, there are some critical points that must be considered before using a questionnaire. The falling-off can

be large and affect the result. To reduce the falling-off the conducted survey was adequately long, not containing too many questions (Lekwall and Wahlbin, 2001). Consequently, the survey does not provide a detailed picture of the companies' BI situation, but instead it gives an overview of their BI maturity and recognition level of the eight propositions. The survey is thus not used to verify or reject the propositions, but instead it serves as a basis to see the overall maturity trends and proposition recognition. Moreover, the questions in the survey were clearly phrased in order to avoid misinterpretations (Höst et al., 2006; Lekwall and Wahlbin, 2001). Also, all respondents were promised a summary of the outcome, which would function as a motivation to complete the survey. The survey was examined by two independent survey professionals (Katharina Norborg, GfK and Sten Mårup, Codan) that examined the survey questions and the process in order to get a good outcome and increase the response rate. Sören Plaugmann at EY that is experienced in the field also examined the survey, this in order to verify the relevance of the questions.

The survey was conducted in a quite early state in the study and was based on the current developed maturity models and propositions at the time. One more proposition was added and the maturity model was developed further, mostly on the business aspects of the maturity. The survey is therefore not fully aligned with the final analyze. Nevertheless, seven out of eight propositions where covered and modifications made on the maturity model were small and therefore the survey result is concluded to provide a quite accurate overview how well the companies recognize the propositions and their maturity level.

It is assumed that the answering companies can be seen as a random sample of large Scandinavian companies. This might be a weak assumption because the response rate where 20% of an already selected sample of the population (large Scandinavian companies).

2.2.3 The In Depth Interviews

It is always limiting when only a few interviews are conducted, and this affects the outcome (Lekwall and Wahlbin, 2001). Therefore, more interviews with more companies could have been conducted. Also, only one person per company was interviewed which may also affect the result. Although the interviewees

where well acquainted with the field of study they can still be bias. To further enforce the interview results more interviews at the same company could have been held, and with employees from different units and levels in the company.

2. 3 Credibility of the Thesis

In order to ensure the authenticity of a study the credibility should be verified. The credibility incorporates three aspects from which it can be evaluated; validity, reliability and objectivity. High credibility equals high trustworthiness (Lekwall and Wahlbin, 2001).

2.3.1 Objectivity of the Thesis

The objectivity in a study indicates to what extent the result is generalizable, i.e. if it is applicable in other contexts (Nilsson, 2013). The creation of the maturity framework implies a risk of subjectivity, since the project team chose the criteria. This affected the outcome of the analysis. To decrease the subjectivity, and to be sure to cover all important aspects, the criteria were based on and supported by literature research as well as the opinions of independent BI experts.

A survey always poses a risk of subjectivity. The respondent rate within the industrial products sector was significantly higher than the other sectors, and the overall survey result thus mainly picture this sector. This can be seen as subjective, but then it should also be considered that a big part of the large Scandinavian companies belongs to this sector. Also, most of the respondents were Swedish companies, which makes the result more applicable to Swedish companies than the whole Scandinavia. The size of the respondent companies based on annual turnover and number of employees vary between the companies but they all fit into the definition of large companies, a part from the two exceptions that almost reach the criteria for a large company. Thus the outcome of the survey applies to large Scandinavian companies, which it was intended to do. However, since the number of responding companies was no more than 22, the outcome cannot be generalized and should not be seen as representative for all large Scandinavian companies. Instead it should be seen as

a guideline of to what extent the propositions are recognized among many large Scandinavian companies.

The project team together with EY decided on the sample of the interviewed companies. Since there were a limited amount of interviews there is a risk for low objectivity. However, the companies were considered representative within their industries, and for large Scandinavian companies.

2.3.2 Reliability of the Thesis

The reliability designates if a result is consistent, i.e. if the same outcome would be achieved if the examination was done again (Nilsson, 2013). To increase the reliability in terms of literature sources various sources have been used. The sources have been evaluated before using them. Since some sources are articles produced by companies selling e.g. ERP-systems, the project team has tried to find additional sources supporting that information. As mentioned above, BI is a rather new field and a lot of the literature available comes form consultancy companies or IT companies. Critical or negative information on BI is therefor difficult to find, but these aspects of BI are instead further discussed in the in depth interviews.

To increase the reliability of the survey all respondents had positions such as CIO or head of BI, which ensured qualified respondents with expertise within the BI field. Also for the in depth interviews the interviewees had positions where they had overview and understanding of the BI environment, e.g. DW application manager or part of the BI management team. Thorough discussions were held, where both the project team and the interviewee had enough time to fully understand the questions and answers. This allowed the project team to ask additional questions if more understanding was needed, which improved the reliability (Lekwall and Wahlbin, 2001).

Only one person at each company where interviewed. The data collected from the interviews is based on a single persons perception. This might affect the result. (Lekwall and Wahlbin, 2001)

2.3.3. Validity of the Thesis

The validity reflects if the drawn conclusion is really answering the question it is supposed to answer. This means that the collected and measured data should be accurate and not contain errors. To increase the validity several viewpoints can be used for the same purpose and the collected data can be crosschecked with different methods to make sure it is consistent (Lekwall and Wahlbin, 2001). To ensure high validity of the project various BI experts were involved, confirming that the right conclusions were drawn. The outcome of the survey and the maturity model were examined again in the in depth interviews, which further increased the validity. The response rate of the survey was (as already mentioned) 20%. After comparing this rate with similar survey studies, and discussing it with two survey experts, it was concluded to be in the range of what could be expected. The result of the survey was thus considered to be valid enough to generate a description of the current situation. However, there were not enough respondents to draw any general conclusions

3. Business Intelligence According to Research

This chapter provides an understanding of the theory behind the research. First the BI process is illustrated. Then the technical and business aspects related to the eight propositions are described. Next, the eight examined propositions are presented and the business value of BI is discussed. Then different types of maturity models are described, as well as a summary of their included components. Finally the new, developed maturity model is presented.

3.1 Business Intelligence Process

The literature presents numerous models of the BI process. They differ in terms of number of phases, storage methods, type of information that is collected, and structure of the cycle (Hannula and Pirttimäki, 2003). However there are also many similarities, e.g. the typical phases included; identify information needs, identify information sources, extracting data from sources, process the data, store data in a structured way, analyze the data and finally distribute information and utilize it. (Muller et. al., 2010; Lönnqvist et. al., 2006) The different BI process models can be translated into the Information Value Chain (IVC) developed by EY, seen in figure 3.1. It contains the essential phases of the BI process models found in the literature. The IVC is a value chain similar to any other value chain known from business theory, but differs in the way that the output is fact-based decisions instead of profit. The IVC consists of five steps (EY, 2013a):

1. Collect: Identifying internal and external source systems and extract structured and unstructured data from them
2. Process: Validating, cleansing, and transforming the data into business standards and match it to the common granular level
3. Organize: Storage of the transformed data in the data warehouse
4. Analyze: Produce information from the data through putting the data into a context, and exploring and visualizing it to extract new insights

5. Decide: Communicate the information to the users at the right time and in the right format, i.e. using the right tools, to enable fact based decisions (EY, 2013a)

The five stages are maintained by the supporting foundation comprising the processes, architecture, technology, and organization (Ong et al., 2011; Watson, 2009). Also, important factors affecting the reliability and accuracy of the information is metadata, traceability, data quality, business rules, and security (Williams and Williams 2007). Simultaneously, the corporate strategy and objectives affect the IVC and there will be a continuous interaction and adaption between them (Cooper et al., 2000). Current business needs and available support are central when it comes to the information management strategy, which highly affects the IVC (Williams and Williams, 2007). This is presented in the following illustration by EY:
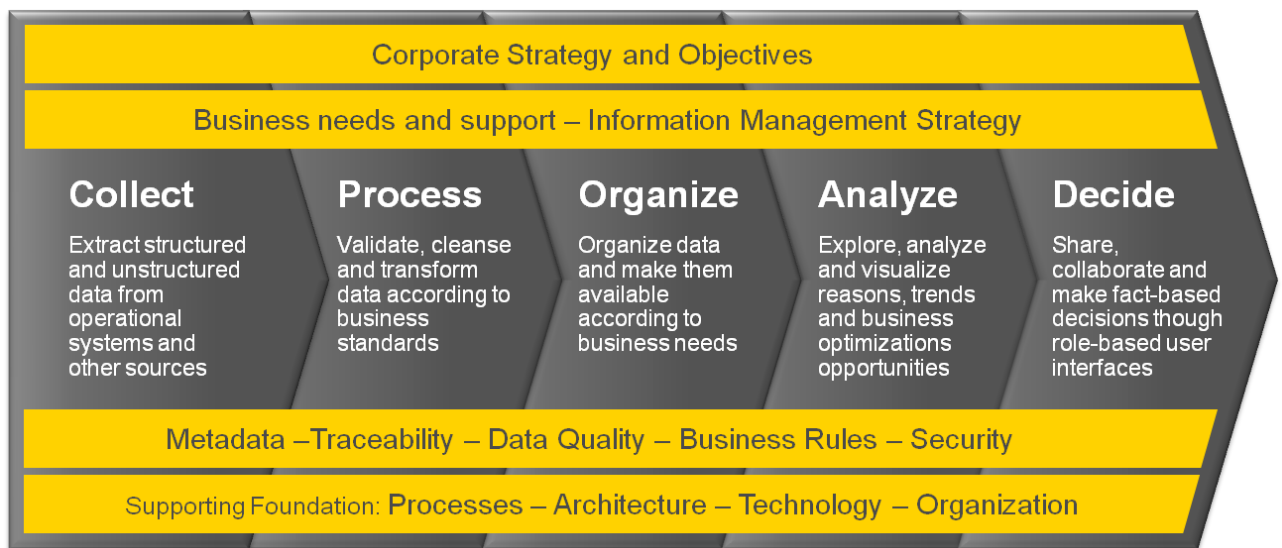
Figure 3.1: The Information Value Chain (EY, 2013a, p.2)

There is both a technical and a business side of the BI process, and thus also to achieving the full business value of BI investments (Cooper et al., 2000; Williams and Williams 2007). Subsequently, the dimensions of BI can be divided into two main categories, which are technical and business. In the following sections important dimensions of both categories are presented. Those dimensions are also covered in the proposed maturity model, which further explains the

different maturity levels of each dimension. Each dimension is also closely connected to one or more of the propositions, which is indicated as"P1-8".

3.2 The Technical Aspect of Business Intelligence

3.2.1 BI Architecture

The BI architecture describes how different BI components are put together to enable the BI system to work smoothly. A solid BI architecture is essential for a successful BI investment (Ong et. al., 2011). BI is not implemented and performed the same way in all companies, and that there are vast differences when it comes to BI architecture (Lönnquist et. al., 2006). Successful BI architecture is adapted to the goals and nature of the BI initiatives. There are various examples of BI architecture in the literature (Watson, 2009; Ong et. al., 2011). Although the structure of the different architectures varies, there are some major similarities. The component source system, data integration, data storage, as well as analyzing and reporting tools are always included. As shown in figure 3.2.1 the source systems provide data to the data storage. Before being put into storage the data is prepared using data integration technologies and processes. The architecture, technologies and data models of the data warehouse vary and by using different applications the user can extract and use the data from the data warehouse and marts (Watson, 2009).
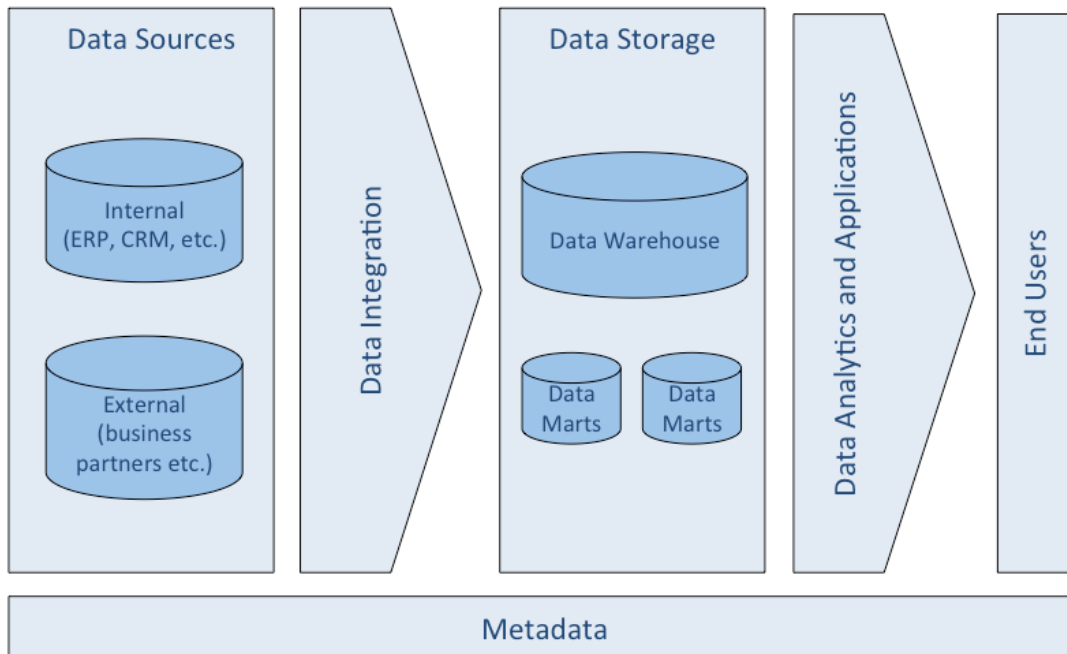
Figure 3.2.1 Business intelligence architecture

3.2.1.1 Data Sources

An organization normally uses several different data sources (Chaudhuri et. al., 2011; Watson, 2009). This can be challenging since the data from the different sources might differ in quality or do not have consistent representation, codes and formats (Chaudhuri et. al., 2011; Watson, 2009). Other challenges are that multiple source systems might comprehend the same data, which results in the same data existing at several locations and perhaps in different formats (Watson, 2009).

3.2.1.2 Data Integration

The number of different data integration processes and ways to handle a source system is increasing. A common method is called ETL (extract transform and load). Then the data is first extracted, i.e. the relevant data is identified and collected. Then it is transformed and afterwards finally loaded into a data repository (Chaudhuri et. al., 2011; Watson, 2009; Ong et. al., 2011). An example of another data integration process is ELT (extract load and transform) where the data is loaded into the data repository before it is transformed (Watson, 2009).

3.2.1.3 Data Storing

Once the data is collected it has to be stored, and this can be done using different architectures. Individuals that collect data that is supporting their own or their immediate workgroup's information needs often put it into spreadmarts, which usually are built using spreadsheets such as Excel. These spreadmarts can be seen as a shadow system that is outside the corporate data repository (e.g. data warehouse, data marts or ERP system) and might include conflicting data (Eckerson and Sherman, 2008). Another type of architecture is independent data marts. The independent data marts usually support a single department/business or process/application (e.g. finance, production) and do not act as an organization wide resource. This often results in multiple records of the same information and a lack of "a single version of the truth" for the organization. Due to the inconsistent definitions, dimensions, measures it is also difficult to run distributed queries across the marts (Watson, 2009; Eckerson, 2004). The need of a more organization wide data repository requires more developed architecture. Data warehouse (DW) is seen as the most significant BI technology and a central element in the BI architecture (Alhyasat et. al., 2013; Vasile and Mirela, 2008). The DW supports multidimensional analysis and contains consistent data from most or all operational systems of the organization. By extending your BI environment to other actors in the supply chain benefits such as better support of the supply chain by knowing the suppliers and customers' service levels, stock levels and deliveries are reached. This enables better decisions and an optimal planning. (Langdale, 2008)

The architecture affects the success of BI in many ways. When companies use repositories that is not aligned with each other such as spreadmarts, independent data marts or independent data warehouses there is a risk of conflicting data. This often leads to no single version of the truth (P2), and the company might experience issues concerning the trust off data (P5). Also, the time it takes to find the needed data increases (P1) (Watson, 2009; Eckerson and Sherman, 2008). Non-aligned and complex data architecture often implies that duplicated technologies solve the same task (P3) and that there are various parallel BI processes without standards, documentation and alignment (P8)

26

(Alhyasat et. al., 2013; Williams and Williams, 2007). The nature of the BI architecture can also affect the possibility to use BI reports in a proactive way (P7), since complex architecture often leads to little overview of information and the company (Langdale, 2008).

3.2.2. Standardization

The level of standardization in a company's BI environment shows the extent to which there are defined, documented and implemented definitions and rules for key terms and metrics as well as for the technologies and tools. Several, incongruent data warehousing and BI solutions are common within large companies, and often imply low standardization. A standardized BI environment can integrate information from different data sources and make it consistent, so that it can be used more efficiently for analysis (Williams and Williams, 2007). To achieve a standardized BI environment a holistic view of the company as well as the BI tools and applications must be taken, and what performance metrics, processes, and people that have higher impact on the business strategy must be evaluated and considered. All data sources must be taken into account so that information can be integrated from different operational systems. The goal is to achieve a cross-organizational BI infrastructure, with standardized BI software and tools. This ultimately leads to better business analysis and insights traversing the whole company (SAP Thought Leadership, 2009).

A low level of standardization is likely to cause difficulties such as inconsistency in information, little business insights across the company, and high deployment, maintenance and training costs (P2, P5) (SAP Thought Leadership, 2009). It is also likely to imply incompatible technologies and tools, causing duplicated technologies that solve the same task (P3). Little standardization causes incompatibility between departments and difficulties in process integration, i.e. parallel BI processes lacking standardization, documentation and alignment (P8). (Williams and Williams, 2007).

3.2.3 Data Quality

Their are several reasons for data quality issues (e.g. errors, omissions, old or invalid data), some examples are acquisitions of new data sources, bad applications, wrong data input and BI implementations but also complex

architectures and fragmented definitions and rules (Vasile and Mirela, 2008; Eppler, 2003; Graham, 2008). According to Stoller (2009) there are two main reasons for the difficulties in controlling data quality. The first is that the amount of data is increasing fast. The second reason is that organizations detect the need of combining information from different departments that often uses different systems and BI processes. The systems have to be linked together and the departments might have different ways of collecting and storing their data.

One of the information quality attributes is traceability meaning that the source and information about the data should be available. This is achieved using metadata, which can be explained as data about data. It contains information about where the data is stored, the changes that have been made to it, how it relates to other data, and the source of the data (Ong et. al., 2011). The metadata is stored and managed in a metadata repository, which both keeps all the information about data as well as sets standards for metrics and rules. The common metadata repository ensures data consistency as long as all analytical applications use it (Davenport and Harris, 2007). The metadata repository also reduces the time spent on maintenance (Davenport and Harris, 2007) as well as development time (Ong et. al., 2011).

Data quality issues cause reduces the acceptance of reports and trust in data (Graham, 2008). A way to make users trust the BI information is to provide metadata. Metadata is critical in order to ensure the traceability and transparency of information, which highly affects the reliability of data (P2) (P5) (Watson, 2009). If the users do not trust the data they will not use it and the cost per report will be high (P6) (Williams and Williams, 2007).

3.2.4 BI applications

Once the data is in the marts or data warehouse the BI value delivery begins. The user applies front-end applications that present the information they need to support their decision making. Through quick visualization the required data is shown to the user (Chaudhuri et. al., 2011). Other common tools and applications are SQL queries (structured query language), published reports, data mining, scorecards, OLAP (online analytical processing) reports and forecasts (Watson, 2009). Whether the user chooses an ad hoc solution or off-

the-shelf application, the organization must have a variety of tools since multiple types of data analysis need to be conducted. The far most used BI application is Excel, in spite of its many limitations (Davenport and Harris, 2007). Advanced BI applications such as closed-loop BI refers to data input and interaction capabilities, which means that the user can e.g. enter data, adjust forecasts, or add comments and these modifications are sent to transaction systems activating business activity (White, 2009).

The applied BI applications must be aligned and adapted to the organization and its goals so that the right data is presented in the right form, this to avoid redundant work and wasted resources. (P1, P6) (Williams and Williams, 2007). If different software/hardware systems and applications are used that are not compatible there will likely be limitations in the synchronization of the overall use of data, and there might be duplicated technologies solving the same task (P3) as well as parallel BI process lacking standardization and alignment (P8) (Davenport and Harris, 2007; Popovic et. al., 2010).

3.3 The Business Aspect of Business Intelligence

3.3.1 Use of BI

The use of BI includes where in the organization BI is used, the number of BI users and the way it is used. Traditionally, BI is thought of as tools for the top management, but it can provide information and analysis competence at all levels in the company (Negash, 2004). However, it is important to separate the BI producer from the BI consumer (from hereby referred to as the user). The BI environment should be constructed so that the user can assimilate the delivered information without needing to process, retrieve or change any data or report. Also, external actors in the organization's supply chain can be integrated in the use of BI. This is a significantly growing BI trend, and is called pervasive BI (Watson, 2009). Common types of users mentioned in the literature are management and executives, power users, and knowledge users. The power users are key players in a certain business area, e.g. processing financial transactions, and interact with the system on a regular basis. The power users also have a formal training in the system (Deng and Chi, 2012). Knowledge users

are both applying information from the BI environment in their work and contributing with their own knowledge to it (Gartner, 2013). The optimal width and type of BI users differs between organizations and situations (Wixom and Watson, 2001). BI analysis can be used in a reactive as opposed to proactive way. When it is used in a reactive manner the analysis and data is applied ad hoc as it appears, and on any operational application possible. A proactive use of BI implies that the analysis is used as to prevent and plan for future change and adaption, and allows the organization to respond to the business environment and changing opportunities and threats. (Williams and Williams, 2007)

Lack of communication between different levels in the organization, and especially the BI team and the end users, often implies a lack of understanding of the BI processes. End users may be competent and present, but still unaware of how to best make use and profit from the BI processes (P4). Unawareness and lack of coordination can also cause low reuse of BI reports and few users per report (P6) (Popovic et. al., 2010). Furthermore, BI analysis can be used in an ad hoc, reactive manner or in a more planning, proactive manner depending on at what level in the organization it is used (managers, power users etc.) (P7) (Williams and Williams, 2007).

3.3.2 Strategic Alignment

According to Williams and Williams, (2007), the ROI of a BI investment can only be ensured if the investment is aligned with a core business process i.e. aligned with the business strategy. This means that establishing new BI technologies and applications will be useless unless they are focused on business processes with large impact on profits, i.e. strategic organizational goals. The BI analysis must thus focus on and deliver KPIs and other information that support key processes of the organization that add value to the company. In order to ensure strategic alignment there are some main aspects that must be considered. Firstly, it is critical that there is a consistency and reinforcement between business strategies, key management, and business processes. This requires strategy mapping and planning (Hall, 2004). Secondly, BI applications should directly contribute to the improvement of business processes that drive profit. This means that key management requirements should be the starting point when

developing and motivating new BI initiatives. Managers must define what analyses they need and what data could be useful for them to make better business decisions. Thirdly, the right IT architecture and strategies must be deployed to support the BI initiatives in the right way. This technical aspect of the matter must ensure that the right choices of architecture, tools, methodology, and technologies are made. At the same time, the incorporated technical methods must be flexible enough to adapt to new BI requirements as the business environment changes. (Cooper et. al., 2000; Williams and Williams, 2007). Watson (2009) refers to this as strategic alignment on the strategic level. At the tactical level, it corresponds to ensuring that BI projects are right on schedule. At the operational level, it tackles data quality and metadata matters. All this is included in what Watson (2009) calls BI governance, and it should be performed at all levels and across all functions of the organization. To ensure strategic alignment it is also important that employees define, explain and communicate what information they require to the IT or BI team, so that they know how to best develop and adapt the BI process (Williams and Williams, 2007).

Lack of strategic alignment reduces the overview of the organization and cooperation between departments. It increases the risk of missing out on already existing competencies within the company (P4), and the risk of redundant work and low use of the delivered analysis since the required information is not included (P1) (P6) (Cooper et al. 2000). Furthermore, lack of strategic alignment is likely to hamper the proactive use of BI, since the analysis will not be corresponding to future, strategic goals (P7). Also, the number of parallel processes solving the same task will increase since there is no clear overview and optimization with regards to core processes (P8) (Williams and Williams, 2007).

3.3.3 Acceptance

The level of BI acceptance refers to the extent to which end users trust the data provided in the analysis and how willing they are to make decisions based on BI reports. The amount of errors, exceptions and omissions in the data and reports are factors that affect the trustworthiness of analysis, i.e. the BI acceptance. To

achieve high BI acceptance, the right data sources should be used and adapted applications should be in place, so that the right information is gathered and presented in a thoroughly manner. The level of acceptance further increases if relevant metadata is easily accessible to the user (Williams and Williams, 2007).

Low level of acceptance is likely to lead to redundant work since users will need to gather additional information to base their decisions, or even recalculate the data and redo the analysis (P1, P5). If the analyses are not trusted, there will be little use of reports, which leads to high cost per report (P6). (Williams and Williams, 2007)

3.3.4 Process Integration

In order to run an organization multiple types of processes are used. Each process uses analytical information frameworks and tools to support decisions making, and thus depend to high extent on the BI environment (Williams and Williams, 2007). The integration of organizations processes is increasing due to the advances in information technology (ERP, EDI, B2B procurement etc.). A company with functional silos, where the processes are on functional/departmental level, use internal integration in order to developed cross-functional processes. The integration can also be done across several firms in the supply chain (Barki and Pinsonneault, 2005). An important success factor when it comes to establishing cross-functional processes is the integration of independent, function/departmental focused information systems into a common process-focused database and network (Majchrzak and Qianwei, 1996). Information system integration can be divided into two aspects. The first is the technical aspect, that describes to what degree the systems are interconnected and the level of communication between them. The second aspect is to what degree independent organizations business processes are connected through computer and telecommunication technologies (Barki and Pinsonneault, 2005). To be able to develop cross-functional processes within the organization the overall value streams must be fully understood, i.e. organization's value-adding processes must be mapped, both internally and to external actors (Hines and Rich, 1997). A BI team with full comprehension and overview of the BI environment as a whole is often a success factor when it comes to establishing

cross-functional processes. (Williams and Williams, 2007).

Process engineering determines in what operational or management process the BI application is used, how it will be used by who. This will give the company a foundation for standard processes, standard analytical frameworks, and business rules. If the information is not used in a timely manner and in a specific management process, the business value of the BI application will not be reached (Williams and Williams, 2007). The return on a BI investment does not come from the BI application itself but rather from the improvement it generates in business processes (Popovic et. al., 2010). BI is often comprehended as a technological tool and the fact that BI must be implanted in specific business processes to be able to create business value is overlooked (Williams and Williams, 2007). It is important that someone from both the technical and the business side have stewardship of a BI project. They should own the project together, and be responsible for the critical data needed in the process. Together they close the gap between the technical and business side, and this ensures that the BI environment supports the core processes (Eckerson 2004; Drnevich, and Croson, 2013).

Little process engineering and integration imply little alignment, standardization and cooperation across departments in a company (P8) (Barki and Pinsonneault, 2005), leading to wasted resources, redundant work (P3), high costs and little use of the BI reports (P6) (Hines and Rich, 1997), and an inability to trust the delivered reports (P2, P5) (Eckerson 2004; Williams and Williams, 2007).

3.3.5 Change Management

Process engineering generates change in both individual and organizational behavior. It affects data ownership, use, and access as well as it changes the way work is executed within the business processes. The resistance to the change increases with the magnitude of the change (Wixom and Watson, 2001). Subsequently process management is closely linked to change management. Change management consists of principles of how to handle organizational change process, e.g. new enterprise applications like ERP or EDW implementation. Difficulties in successful change management are typically an

understatement of the adoption risk of new BI applications. A main issue is that users tend to use the analytical frameworks and information provided through the BI applications in an unstructured and ad hoc manner, since that is how they traditionally are used to work. This reduces the value of the BI reports substantially. Structured training must be applied to make the employees throughout the organization understand and accept the established BI processes, so that they can benefit from it to its fullest potential. If users do not accept and use the BI reports, the business value of BI initiatives is lost. (Williams and Williams, 2007)

All BI processes that make people change the way they work, i.e. affects the end users, are closely dependent on successful change management. This comprises BI applications, standardization, use of BI, strategic alignment, acceptance, and process integration. Since these categories affect all eight propositions, so does change management.

3.4 Business Intelligence Propositions

According to the literature, there are gaps between investing in a better BI environment and achieving the full business value of the BI environment. The project focuses on eight typical difficulties found by EY (EY, 2013a), connected to the subjects discussed in chapter 3.2-3.3:

1. *Retrieving data: Substantial amount of man hours are wasted on retrieving data.* BI end users spend too much time on preparing and producing reports. The final analysis delivered to the end user lack useful content or is not entirely corresponding to the end users needs. The user will waste time on tasks that are not really his or hers to do, time that could have been spent on analyzing the information. (Popovic et. al., 2010; Williams and Williams, 2007; EY, 2013a)

2. *One version of the truth: Multiple definitions on the same object; there is a large need for "One version of the Truth".* There is a lack of trust in the reports and analysis delivered to the users due to various definitions on the same object. Multiple data sources, different data formats or different software/hardware that is used lead to different data representing the

same thing. (Popovic et. al., 2010; Chaudhuri et. al., 2011; Williams and Williams, 2007; EY, 2013a)

3. *Technologies: Duplicated technologies solve the same tasks.* Various technologies are often used in an organization. One department can be used to one particular technology, whereas another department prefers another one. Consequently, there will be several technologies in use, often solving the same tasks. This is both a waste of time and money, and is likely to increase the risk of no single version of the truth. (Ong et al., 2011; Watson, 2009; EY, 2013a)

4. *Competencies: Required BI competencies to satisfy needs are already present in the organization, but an overview is missing.* The BI environment may be designed and implemented, but an overview may still be missing meaning that end user is not aware of the available resources and how the BI environment can be used. This implies that end users throughout the organization do not fully understand and profit from the BI system. It might also be a problem that the company have information and the competences to extract and analyze the information but is not aware of the possible value of it or that it even exists. (Popovic et al., 2010; Watson, 2009; Wixom and Watson, 2010; Williams and Williams, 2007; EY, 2013a)

5. *Transparency: Low reliability and transparency in data leading to redundant work.* If the metadata is not clear and accessible for all users, the traceability and transparency of the data decrease. Data quality issues affect the reliability in data (Graham, 2008). This leads to a lack of trustworthiness, and end users will need to go back and find out where the data comes from before using it. Inaccessible and inconsistent metadata thus decreases the reliability of the information and implies redundant work. (Davenport and Harris, 2007; Ong et. al., 2011; TDWI Research: Loshin, 2013; EY, 2013a)

6. *High cost: Few BI consumers per report and low reuse of data give a high cost per report.* If the BI investments are not aligned with the company's strategic goals, then the BI investment will not add value to the core business processes. This means the BI analysis will not be useful no

matter how correct and timely the delivered information is. (Cooper et al., 2000; Williams and Williams, 2007; EY, 2013a)

7. *Reactive rather than proactive: Reporting focused on looking backwards and less on identifying business opportunities.* Instead of using BI analysis in a proactive manner in order to prevent and adapt to the business environment and changing opportunities and threats, BI reports are often used in a more reactive manner. Managers use the information in an ad hoc manner as it appears, and apply it on any operational application that is available. (Hagerty and Hostmann, 2010; TDWI Research: Eckerson, 2007; EY, 2013a)

8. *BI Processes: The organization has a large amount of parallel BI processes, many of those lacking standards, documentation and alignment.* Parallel BI processes that lack standardization and alignment often implies wasted resources and more confusion within the organization since there are multiple analysis on the same thing. The cost for the overall BI environment is likely to increase, and there will be less compatibility, understanding and cooperation across the organization and its business processes. (Barki and Pinsonneault, 2005; Hines and Rich, 1997; Popovic et. al., 2010; EY, 2013a)

The eight propositions are all associated to each other, and therefore they will affect each other. E.g. *duplicated technologies* affect *one version of the truth,* which leads to *low reliability*, and so on.

3.5 Business Value of Business Intelligence

The effect of BI is mainly intangible gains such as knowledge and information. The BI contributes to the decision making process by adding valuable and accurate information. This leads to avoidance of unnecessary cost and enhanced revenue due to better decisions and improved resource allocations and maximized investments. Even if was possible to measure the benefits of BI there would be a time lag until the impact occurred, which would make it difficult to connect BI to its effect. (Lönnqvist et. al., 2006) However, it is clear that BI improvement does effect the organization on several levels in the company, as well as the whole supply chain. (Stiroh 2001; Williams and Williams, 2007)

3.6 Business Intelligence Maturity Models

A BI maturity model is a tool for understanding how a company can use BI investments related to its current state of BI maturity. It describes where an organization is in the maturity process and how to proceed in order to improve the use of BI and increase the BI maturity. The model shows how to better align IT with business efforts, and what value BI brings to the organization. It can also describe the drivers for BI, where in the company most of the BI is done, and what strategies for using and developing BI are currently deployed. The use of maturity models gives a better understanding for how to use and develop BI. It also helps to justify BI investments. (Chuau, 2010) Different maturity models cover different aspects of BI, and most of the models focus on a specific domain. However they all provide a framework for comparison and a way to highlight areas within an organization that needs specific attention (Rajateric, 2010). Below seven different types of maturity models are presented.

3.6.1 The Business Information Maturity Model by Williams and Thomann

The Business Information Maturity Model by Williams and Thomann (2003) focuses on the business and organizational culture aspect of BI maturity. It suggests that in order to capture the full value associated with established BI technologies, an organization must not only look at BI as a technical concern and a change in technological tools, but also see the importance of changing the way business is conducted. That is, the maturity when it comes to business use of technology need to match the technical maturity. The organizational changes comprise three main points: understanding of how information can be better incorporated in order to back up the business, more efficient manner to define business requirements, and increased use of delivered information. (Williams and Thomann, 2003) When mapping an organization with regards to the Business Information Maturity Model three main factors for BI success are defined: alignment and governance, leverage, and delivery (Williams and Williams, 2007). The model can be seen in figure 3.6.1. Three maturity stages are described in the model:

Stage 1: At stage one there has not yet been a redefinition of the information role in the BI environment. The information requirements often consist of lists of data elements that the users need and the observed BI benefits revolve around more timely and facilitated end-user access to data. The return on investment (ROI) potential is low. (Williams and Thomann, 2003)

Stage 2: The next stage has a higher ROI potential. Information requirements are now set on answers to why, when and where information is needed and links it to business processes, goals and drivers. I.e. the information needs are closely connected to the business processes that support business goals. (Williams and Thomann, 2003)

Stage 3: The third and final stage incorporates the overall organizational processes and needs. It strives to optimize the information use throughout the organization. The ultimate goal is to replace all decision processes that still rely on individual users with organizational, completely information-based, decisions. The return on investment potential is optimal. (Williams and Thomann, 2003)
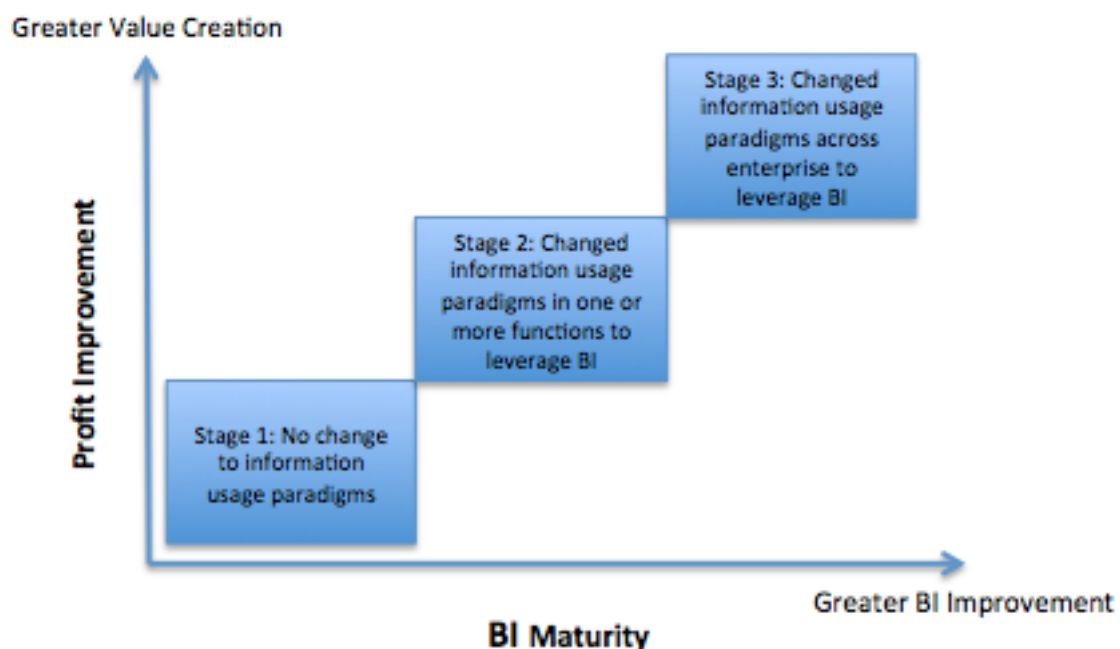
Figure 3.6.1 The Business Information Maturity Model by Williams and Thomann (Williams and Williams, 2007, p99.)

3.6.2 AMR Research's Business Intelligence/Performance Management Maturity Model, Version 2

The AMR Research's Business Intelligence/Performance Management Maturity Model, Version 2 describes a framework comprising technical aspects of BI in the lower levels of maturity, and then business and cultural aspects in the higher levels. The process goes from a technology-centered organization to an organization where culture, technology and philosophy are merged and business decisions are based rigidly on numbers. As the title suggests the model focuses both on BI and performance management and the key areas on which the companies are evaluated on are technology, BI tools, processes and performance culture (Hagerty, 2006). The model can be seen in figure 3.6.2. The four stages of this model are described as follows:

Step 1 Reacting: The first stage is a reactive stage characterized by tactical projects dealing with increasing efficiency and visibility of individual departments. There is a high reliance on manual desktop tools and ad-hoc processes performed by individuals with minimal consolidation between departments. (Hagerty, 2006)

Step 2 Anticipating: The second stage of the framework is more of an anticipating stage. Projects are more strategically oriented and departments are more integrated and share information between each other. Dashboards are used in the whole organization and data is increasingly important as it is delivered closer to real-time. (Hagerty, 2006)

Step 3 Collaborating: The third step is when the organization has become more collaborative and KPIs have a central role aligning the organizational strategies and identifying both current and future opportunities. Operational and financial metrics are clearly defined and standardized. Performance indicators and dashboards unite resources and business goals across the organization and future business actions are more easily and better planned. Groups within the organization work well with each other. (Hagerty, 2006)

39

Step 4 Orchestrating: The fourth stage is a more orchestrating, top-down approach. There is a rational and common vision and understanding of the organization and even small changes in the environment are detected and reacted upon. Business decisions are based completely on calculable success factors, and goals and expectations are defined and aligned with BI processes throughout the organization. Cultural and philosophical aspects are incorporated in the BI environment. (Hagerty, 2006)
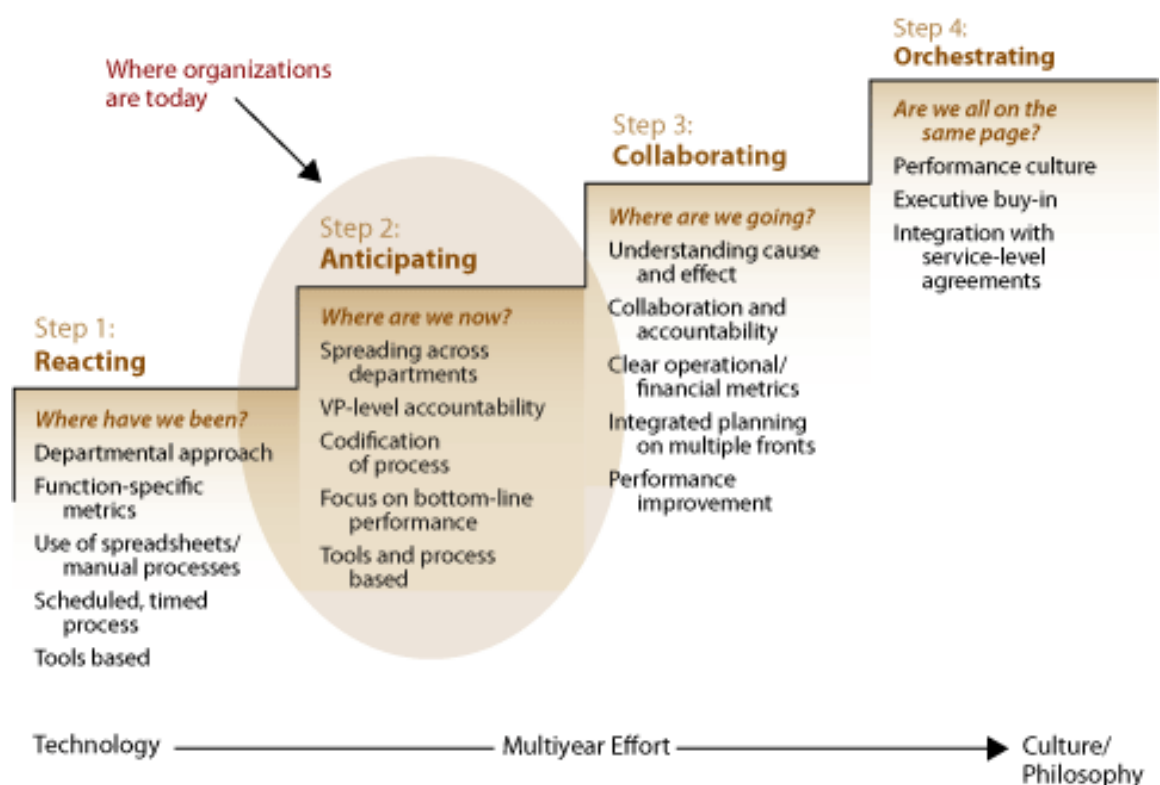
Figure 3.6.2 The AMR Research's Business Intelligence/Performance Management Maturity Model, Version 2 (Hagerty, 2006, p1)

3.6.3 Enterprise Business Intelligence Maturity Model

The Enterprise Business Intelligence Maturity Model draws from BI literature as well the Capability Maturity Model (CMM) concept. CMM describes a five-level framework of maturity through which organizations must pass in order to improve processes continuously. Each level cover process goals related to key process areas and key practices that must be mastered before the organization

can move forward to the next level. The levels are initial, repeatable, defined, managed and optimizing. The EBIMM combine these maturity levels with three key BI dimensions: data warehouse, information quality and knowledge process. These dimensions are seen as three major functions of which successful BI processes depend (Chuah, 2010). The model can be seen in figure 3.6.3. The five stages described in the model are:

Level 1 Initial: At the first level the same data exist in several files, multiple formats are used and redundant data marts are in use. No definite rules for data management are established. The information quality is dependent on the technical programmer analysts and coders. As for the knowledge process individuals have to collect and prepare their required information from existing reports and the focus is on day-to day operations instead of long-term and enterprise goals. (Chuah, 2010)

Level 2 Managed: The second level focuses on basic information management and system development where the data warehouse dimension is characterized by few independent data marts and an established policy defining how data structures are changed, created and managed. There are standardized quality control activities in terms of data quality. The knowledge process dimension describes well defined departmental data management, but no synchronization between departments. (Chuah, 2010)

Level 3 Defined: At the third level data is seen as an asset to the organization and the focus is on information quality. As for the data warehouse dimension there are appropriate, best practice data warehouse tools used and all application development is done according to the established data management policy. Data is viewed and used as a corporate asset. In terms of information quality the organization develops, documents and uses its own information quality processes. When it comes to the knowledge process information management concepts are departmentally well defined and established, but not across departments. (Chuah, 2010)

Level 4 Qualitative Managed: The future performance of the organization can now be well predicted. The data warehouse dimension is characterized by a

common metadata environment that enables corporate data structures and metadata throughout the organization. As for the information quality adequate resources are provided for quantitative processes supporting managerial activities. The knowledge process dimension describes how knowledge management principles are established and used.

Level 5 Optimizing: The final stage has a data warehouse dimension where data access and data warehouse performance is constantly progressed and the level of data redundancy is low. The information quality indicates continually improved and evaluated information quality management processes and as for the knowledge process dimension the knowledge processes are under continuous improvement. (Chuah, 2010)

Figure 3.6.3 The Enterprise Business Intelligence Maturity Model (Chuah, 2010, p3)

3.6.4 Business Intelligence Maturity Hierarchy by Deng

The BI Maturity Hierarchy model by Deng defines four stages within knowledge management from which BI maturity is evaluated. The model shows how well

the BI system is used, to what extent it adds value to core business process, and if it is used to indicate patterns and required KPIs. Aspects such as data architecture and applications are considered (Deng, 2007). The model can be seen in figure 3.6.4. The four stages in the model are described below:

Stage 1 Data: At the data level the goal for the company is high quality data that is integrated and clean. The work is focused mostly on collecting, cleaning and standardizing data and to deliver it in a usable and searchable format. This can be seen as a starting point for DW and BI. (Deng, 2007)

Stage 2 Information: At the information level the organization uses the high quality data to a greater extent and is capable of analyzing and identifying KPIs. Dashboards are used to present clear and meaningful information for business performance. (Deng, 2007)

Stage 3 Knowledge: An understanding of patterns and causes of trends characterize the knowledge level. The company also combines past experience and produced data to form new knowledge, a so-called expert system. (Deng, 2007)

Stage 4 Wisdom: At the wisdom stage the business productivity is high and the BI system is more efficient than before. Rigorous and timely business decisions are made which leads to high competitive advantage. (Deng, 2007)
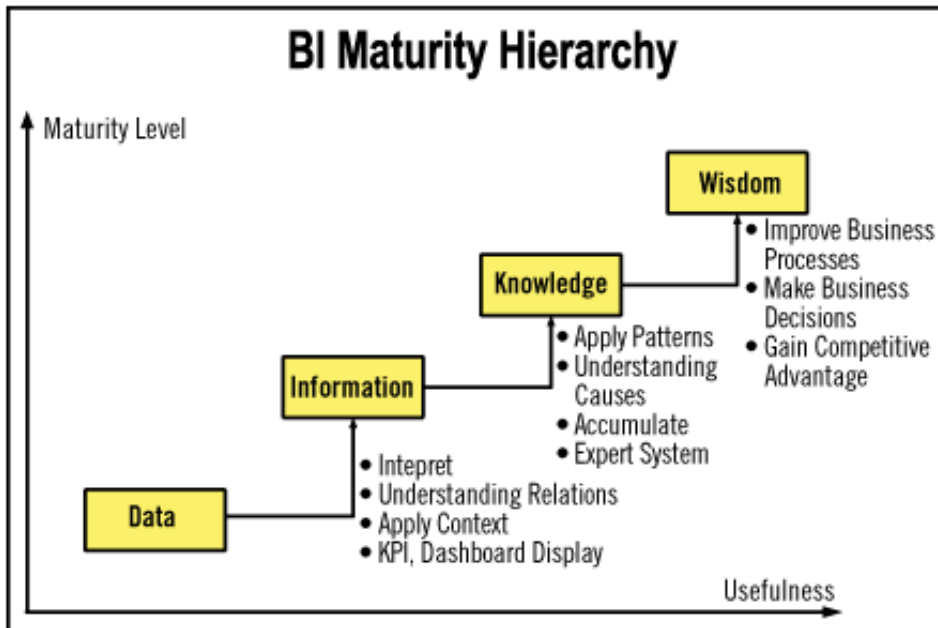
Figure 3.6.4 The BI Maturity Hierarchy (Deng, 2007, p1)

3.6.5 TDWI's Maturity Model

The TDWI Maturity Model is a widely known and commonly used framework (Williams and Williams, 2007). Initially, the major focus of this framework was on the technological aspects of BI. The areas of evaluation were scope, analytic structure, executive perception, type of analytics, stewardship, founding, technology platform, change management and administration (Eckerson, 2004). In 2009 however, an updated version of the framework was published. It is more complex than its predecessor and adds cultural and business aspects to the evaluation criteria. The new framework looks at four main aspects that affect the BI usability: architecture, analysis/design, support, and change management. Each domain comprises several components. Architecture contains flexibility, data, delivery, and performance. Analysis/design includes roles, requirements, and BI frameworks. Support incorporates feedback, training, services, and rapid development. Finally, change management comprises marketing, leadership and managing expectations (TDWI Research: Eckerson, 2009). The model can be seen in figure 3.6.5. The five maturity stages in the TDWI Maturity Model are (the first and second stages are counted for as one):

44

Stage 1 Prenatal: In the prenatal phase the organization usually have a standard set of statistical reports that are generated from established operational report system. The users get tired of the lack of agility and the slow access of data and are forced to take action themselves, by loading data from the source systems to spreadsheets and desktop databases. (Eckerson, 2004)

Stage 2 Infant Stage: There is a vast amount of spreadmarts i.e. spreadsheets or desktop databases used as a substitution of regional data bases or a data warehouse. The non-existing alignment among the spreadmarts makes it difficult to have a consistent and clear view of the enterprise. (Eckerson, 2004)

Stage 3 Child: In this stage the company realizes the importance of timely information and insight. Departmental-leveled data marts are created. Not only business analytics and executives benefits from BI but also knowledge users. There is still no interdepartmental consolidation of data since the individual data marts still has its own definitions and rules. (Eckerson, 2004)

Stage 4: Data warehouses are established that enables queries to run across the functional boundaries. Separated departments combine their knowledge to greater extent and new insight is gained that before where hindered by operational and analytical silos. The use of BI increases among the regular users due to the dashboards. Executives start to value BI as a tactical tool to spread information and more fact-based decisions are made. (Eckerson, 2004)

Stage 5 Adult: The Enterprise Data Warehouse: Either one of the warehouses is used and the other ones are eliminated or an enterprise data warehouse (EDW) is built from scratch. The EDW obliges as a strategic enterprise resource that provides a single version of the truth (Eckerson, 2004). Usually a special BI team is appointed that is independent from the organizational structure and reports directly to the executive management (Rajteric, 2010).

Stage 6 Sage: Now the company has a data warehouse that functions as a strategic enterprise resource. The next thing to do is to extend the EDW outward and downward. It is not uncommon that organizations today share information with there customer and suppliers to optimize their supply chain competitive advantage. (Eckerson, 2004)
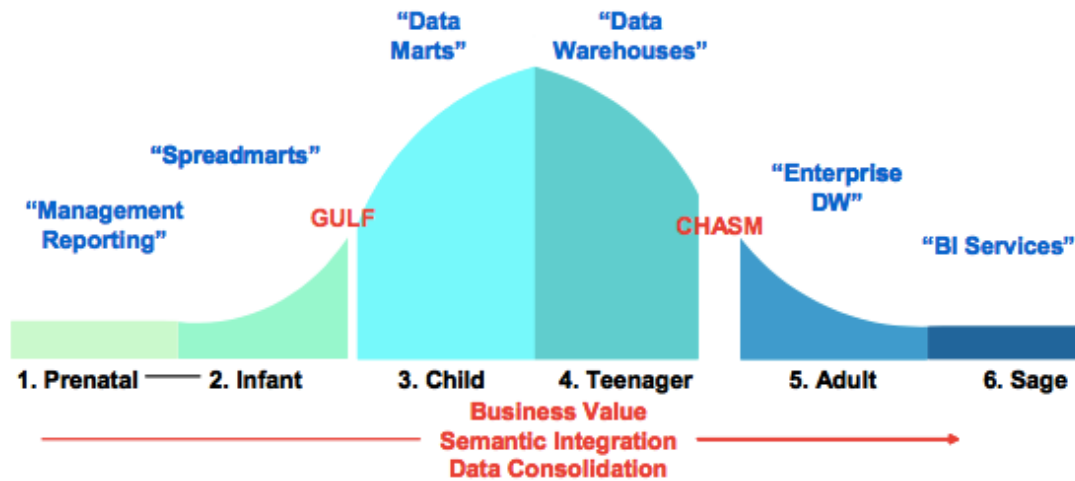
Figure 3.6.5 The TDWI Maturity Model (TDWI Research: Eckerson, 2007, p 4)

3.6.6. Gartner's Maturity Model for Business Intelligence and Performance Management

As suggested in the title, Gartner's Maturity Model for BI and Performance Management assesses both the BI maturity and performance management maturity. The main areas of evaluation are people, skills, processes, and technologies. Subareas include ad hoc, query, reporting, OLAP, data integration, data warehouse, analytical applications, and performance management applications. The model discusses trust of information, adaptability to a changing business environment, and integration of external users of BI such as suppliers, business partners, and customer (Hagerty and Hostmann, 2010). The model can be seen in figure 3.6.6. The maturity stages in the model are as follows:

Stage 1 Unaware: This level is recognized by inconsistent data, incorrect and inconsistent data interpretation. It is a constant struggle to satisfy the department's or the individual's information requests and needs. Spreadsheets

are widely used but not reporting tools. The IT department is responsible for the information management as well as the founding and reporting of BI. The organization does not understand the importance of BI and is not devoted to it. (Hagerty and Hostmann, 2010; Rajateric, 2010)

Stage 2 Opportunistic: The IT department takes action to invest in BI. The company uses software that is not modified to fit their needs. Metrics is not standardized across the firm but only on a departmental level. The data applications and tools are in silos. This leads to low transparency and little trust in data, and the reports are not utilized much. (Rajteric, 2010)

Stage 3 Standards: BI supports separate business units but there is no interaction between units. Dashboards are produced but the key metrics and tools are not aligned across individual business units. A BI competency center is created containing experts from IT and business departments. (Rajteric, 2010)

Stage 4 Enterprise: The business strategy for BI development is clear and BI is supported by the executive management. The BI environment supports critical business processes and the information is available to everyone in the company. The team of business areas and IT has enough resources to reach their goals. A strategic framework is established in the company, which combines the strategic goals of the company with measurements on the operational, departmental and functional levels of the company. Data quality metrics as well as management policy makes sure that the information is trustworthy and can be used in strategic decision making. (Rajteric, 2010)

Stage 5 Transformative: BI and PM becomes a part of the business processes across the whole organization and is part of the corporate culture. It is flexible and adaptable to the fast changing business environment and information needs. The information is trusted and used on all levels in the company. The users are well trained and can access the information they need easily. The users of BI also include suppliers, business partners and customers. (Rajteric, 2010)
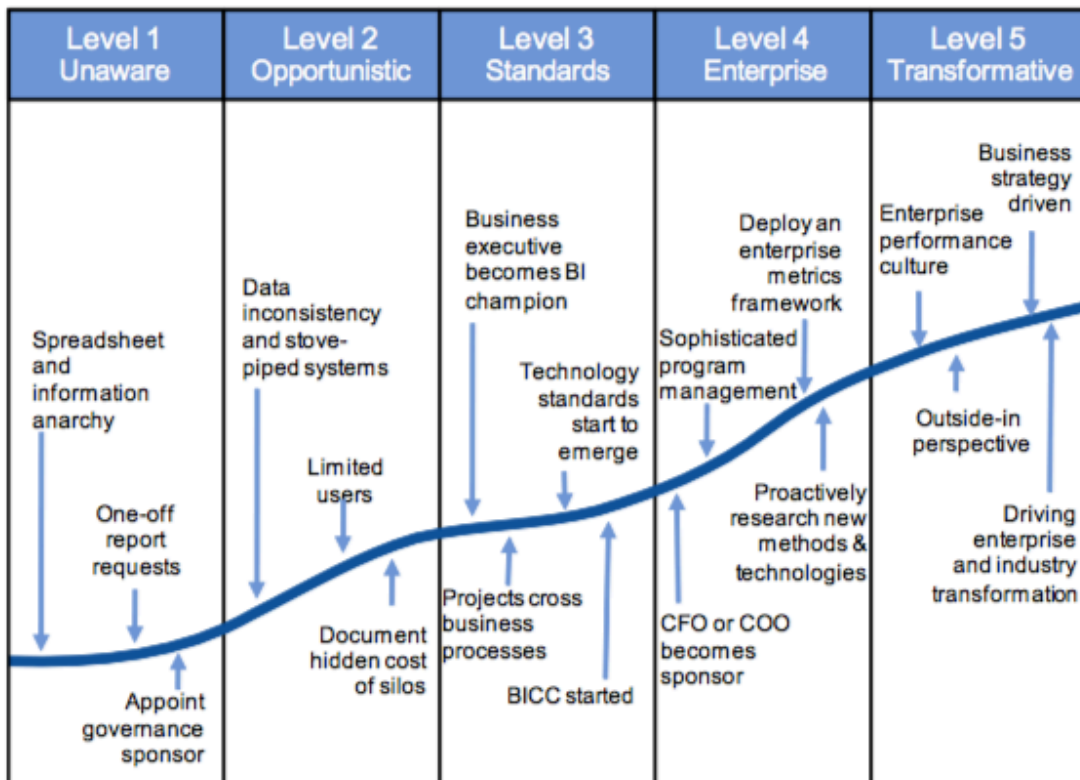
Figure 3.6.6 Gartner's Maturity Model for BI and Performance Management (Hagerty and Hostmann, 2010, p 2)

3.6.7 HP Business Intelligence Maturity Model

The HP Business Intelligence Maturity Model focuses on three BI dimensions: information technology, business enablement, and strategy and program management. Within each dimension there are five subcategories. Information technology comprises ad hoc solutions, localized solutions, shared resources, enterprise operationalized, and enterprise services. Business enablement incorporate facts and data for running the business, information for measuring and monitoring the business, insight for integrating performance management and intelligence, knowledge for fostering business innovation and people productivity, and foresight for creating strategic agility and differentiation. Strategy and program management includes operation, improvement, alignment, empowerment, and transformation (HP, 2009). The model can be seen in figure 3.6.7. The five maturity stages in the model are:

Stage 1 Operation: Frameworks are stating to be laid and concepts are being developed on a local or departmental level. The organization is trying to run the

business with focus on basic reporting and analysis capabilities provided on a monthly and quarterly basis. The most used BI tool in this stage is spread sheets and there is no cross-function or cross-departmental integration of data repositories. The handling of data is mostly done manually. The support from the top management is low and few employees know hos to use BI reports. (HP, 2009)

Stage 2 Improvement: BI is departmental and there is little interaction between business units. The ability to monitor the business increases since the visibility in the company is improved. Dashboards, scorecards, planning, and forecasting tools are introduced. BI reports are mainly used by the top management and knowledge users. The data repositories are focusing on single subject areas isolated from each other but several department or business units use them. The data quality improves and the BI teams responsibilities are cross-departmental. (HP, 2009)

Stage 3 Alignment: The degree of alignment and integration between business units and subject areas increases. Data warehouses/data marts are consolidated and an enterprise data warehouse might be developed. Balanced scorecards and streamlined KPIs are developed and BI is used at all levels of the company. The data is more consistent and of moderate quality, and it is delivered in a timely manner. Data stewardship is appointed and the organization moves from BI project management to BI program management with a BI vision and roadmap. (HP, 2009)

Stage 4 Empowerment: BI is a powerful asset and all information is centralized. BI affects the design of business processes and how employees work. Executives and managers use BI to support and reach the corporate strategy. There is one single version of the truth available across the organization, company has a robust data quality program, and standards and policies are organization wide. (HP, 2009)

Level 5 Transformation: A service-oriented BI architecture permits high information agility and business model flexibility. BI innovations are a significant part of the company's R&D investments because analytics is looked at as a

competitive advantage for the organization. Users at all levels use BI reports to optimize business outcome. Unstructured and structured data is entirely integrated and BI is embedded in systems, processes and workflows across the entire organization. The right information is available at the right time. (HP, 2009)
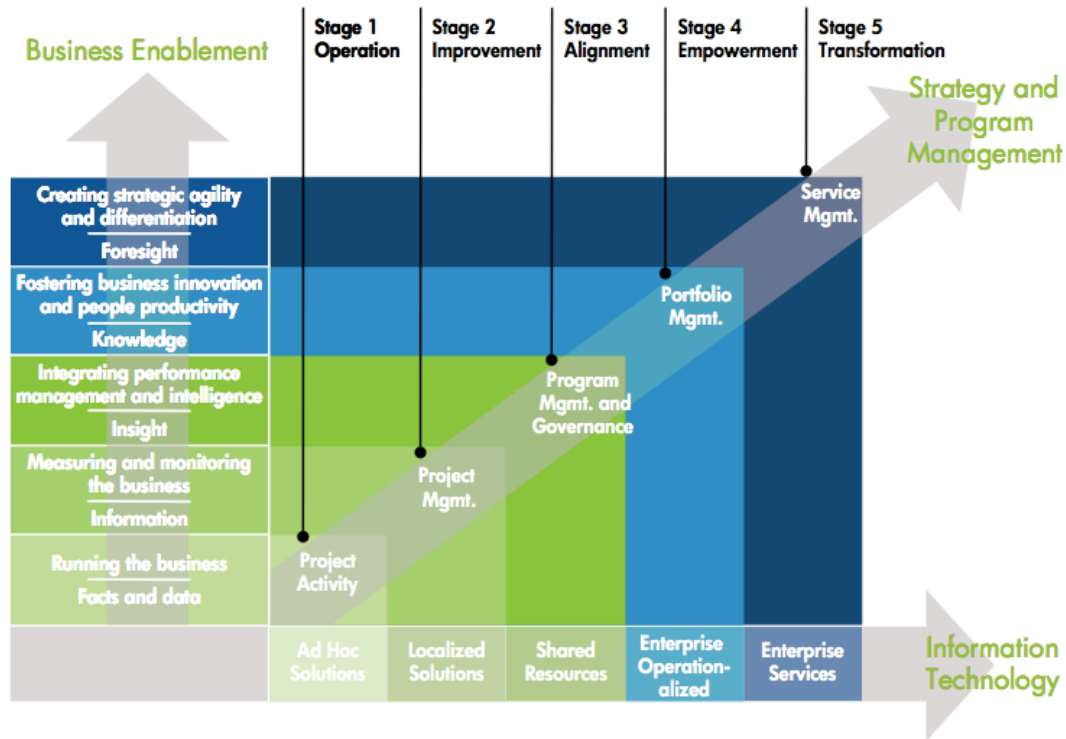
Figure 3.6.7 The HP Business Intelligence Maturity Model (HP, 2009, p3)

3.6.8. Compilation of Existing Maturity Models

A compilation of the examined maturity models above is presented in table 3.7.8. The compilation is based on the dimensions of BI that is connected to the eight examined propositions, see chapter 3.3 and 3.4. The dimensions that the existing maturity models are bringing up according to the compilation are not necessarily fully explained at every maturity phase, but it is mentioned and covered to some extent in the models. This indicate that even if an existing maturity model contains most or all of the requested areas they might still not fulfill the full explanation needed to cover the eight propositions.

	Dimensions	Description	BIMM by Williams & Thomann	AMR Research's BI/PM MMM, Version 2	EBIMM	BIMH by Deng	TDWI's Maturity Model	Gartner's MMBI/PM	HPBIMM
Technical	**Architecture**	Illustrates what architecture is deployed in the company		**X**	**X**	**X**	**X**	**X**	**X**
	Standardization	Degree of defined, documented and implemented standards and rules for key terms, metrics, technology and tools		**X**	**X**	**X**	**X**	**X**	**X**
	Data Quality	The amount of errors, exceptions, and omissions in data and its traceability (metadata)	**X**	**X**	**X**	**X**	**X**	**X**	**X**
	BI Applications	Describes the BI applications that are used e.g. dashboards, basic reporting, spreadsheets		**X**	**X**	**X**	**X**	**X**	**X**
Business	**Use of BI**	Who in the organization that uses BI, the number of BI users, and how BI is used	**X**	**X**	**X**		**X**		**X**
	Strategic alignment	To what extent BI reports correspond to the core business processes	**X**			**X**		**X**	**X**
	Acceptance	Do users trust the data and how much they are willing to base decisions on BI reports	**X**	**X**	**X**		**X**	**X**	**X**
	Process Integration	How BI is integrated in and supports business processes and how it is integrated across departments	**X**	**X**	**X**			**X**	**X**
Change Management		If employees accept, use and benefit form the BI environment, and if there is continuous training	**X**	**X**			**X**		

Table 3.7.8 Compilation of existing maturity models

3.8 Proposed Maturity Model

Different BI maturity models cover different aspects of BI, and can consequently be used for different purposes. The project team found that no maturity model covered all eight propositions that are examined in this thesis. Also, the models generally lack an explanation of the path to follow in order to improve the maturity within a specific dimension, i.e. a description that points out all steps of the improvement process. Thus, the maturity models are difficult to follow and interpret. Because of this, a new BI maturity was developed for this project that covers the relevant aspects for the propositions. Inspiration has been drawn from the above described maturity models, specifically the TDWI model. The project team found that TDWI model is thoroughly described and explains well the different maturity stages. It also covers many of the interesting aspects regarding the purpose of the new model. All the models together cover a wide range of dimensions, and they have all contributed to the different steps of the new model. The developed maturity model provides a clear and structured framework to follow and distinctly shows the maturity process for each aspect. The new maturity model aims to:

- Indicate a technical BI maturity level, and a business BI maturity level
- Indicate an overall BI maturity level
- Cover relevant dimensions for the eight propositions
- Cover both the technical and the business aspects of BI
- Provide a clear view of the maturity processes with regards to each dimension, which facilitates the understanding of what step in the maturity progress comes next

The developed BI maturity model focuses on two main categories of BI, technical and business. The technical maturity contains the subcategories architecture, standardization, data quality and BI applications. The business maturity contains the subcategories use of BI, strategic alignment, acceptance and process integration. One more subcategory is included in the model, which is comprised in both technical and business maturity; change management, see figure 3.8a. The subcategories are:

- **Architecture**: Illustrates what BI architecture is deployed in the company

- **Standardization**: Shows to what extent the company have defined, documented and implemented standards and rules for key terms and metrics, as well as technology and tools

- **Data Quality**: Shows the amount of errors, exceptions and omissions in data and its traceability (metadata).

- **BI applications**: Describes the BI applications that are used e.g. dashboards, basic reporting, spreadsheets

- **Use of BI:** Covers who in the organization that uses BI, the number of BI users, and how BI is used

- **Strategic alignment:** Describes to what extent BI reports correspond to the core business processes

- **Acceptance:** Illustrates to what extent users trust the data and how much they are willing to base decisions on BI reports

- **Process integration:** Describes how well BI is integrated in and supports business processes and to what extent it is integrated across departments

- **Change management:** Indicates to what extent the employees accept, use and benefit form the BI environment, and if there is continuous training
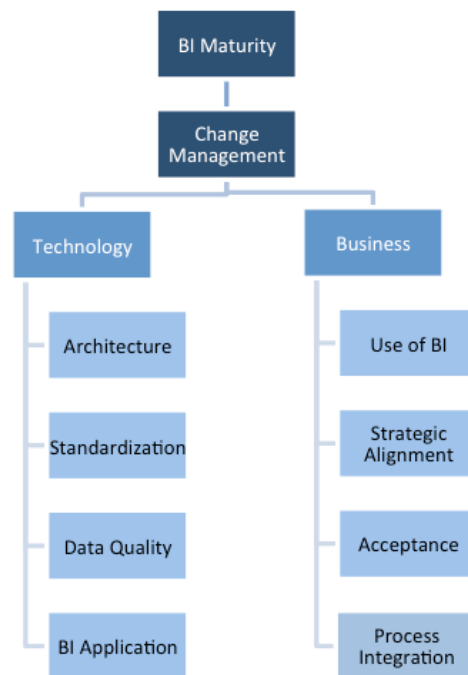
Figure 3.8a: Maturity model subcategories

Figure 3.8b shows how the propositions relate to the sub categories in the maturity model. This shows that the propositions and the BI maturity in a company are linked to each other.

	Dimensions	Description	Related propositions
Technical	**Architecture**	Illustrates what architecture is deployed in the company	1, 2, 3, 5, 7, 8
	Standardization	Degree of defined, documented and implemented standards and rules for key terms, metrics, technology and tools	2, 3, 5, 8
	Data Quality	The amount of errors, exceptions, and omissions in data and its traceability (metadata)	2, 5, 6
	BI Applications	Describes the BI applications that are used e.g. dashboards, basic reporting, spreadsheets	1, 3, 6, 8
Business	**Use of BI**	Who in the organization that uses BI, the number of BI users, and how BI is used	4, 6, 7
	Strategic alignment	To what extent BI reports correspond to the core business processes	1, 4, 6, 7, 8
	Acceptance	Do users trust the data and how much they are willing to base decisions on BI reports	1, 5, 6
	Process Integration	How BI is integrated in and supports business processes and how it is integrated across departments	2, 3, 5, 6, 8
Change Management		If employees accept, use and benefit form the BI environment, and if there is continuous training	1-8

Table 3.8.b: Maturity subcategories and related propositions

The developed BI matrix aims to provide companies with an overview of their current maturity level in the different sub categories. The matrix has two dimensions; the rows contain the benchmark categories and the columns comprise the BI maturity stages. There are five stages of maturity: Stage 1, Stage 2, Stage 3, Stage 4 and Stage 5. Stage 1 is the least mature stage and stage 5 is the highest level of maturity and gives five maturity points. The business value of BI increases along with the maturity growth. In the matrix each sub category is explained for each maturity phase. All of the previously presented maturity models contribute to the new developed maturity model, and the content of the

maturity phases draws from those. They have been adapted to fit into the new model's frame of sub categories.

The maturity matrix gives sub-category maturity scores, which correspond to an overview of their maturity level in each of the sub-categories. The company can see in what areas they need to improve and what are the next steps in order to advance in maturity. To go from one level to the next the organization must fulfill all requirements from previous steps. Throughout all the maturity phases change management is of high importance in order to increase the BI maturity.

		Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Technology	**Architecture**	Spreadmarts.	Independent data marts.	Independent data warehouses.	Enterprise Data Warehouse.	The BI environment is extended to suppliers and other external actors.
	Standardization	Defined, documented and implemented standards and rules for **no one** of key terms and metrics as well as for technology and tools	Defined, documented and implemented standards and rules for **some** key terms and metrics as well as for technology and tools.	Defined, documented and implemented standards and rules for **half** of the key terms and metrics as well as for technology and tools.	Defined, documented and implemented standards and rules for **most** key terms and metrics as well as for technology and tools.	Defined, documented and implemented standards and rules for **all** key terms and metrics as well as for technology and tools.
	Data Quality	The quality is dependent on the technical programmer analysts and coders. The users can not access any metadata.	There are ad hoc, firefighting, solutions to data quality issues. Metadata reports are produced and distributed periodically.	There are standardized data quality control activities and the owner of the data is responsible for the data quality. There are several metadata repositories accessible for the user.	There are few data quality issues and proactive data quality controls. There is a central repository accessible to the user with up-to-date metadata.	Continually improved and evaluated data quality management processes. The users can easily access up-to-date, relevant, and integrated metadata.
	BI Applications	Use a standard set of statistical reports. Users can access none of the data they need from a single user interface.	Ad-hoc reporting, OLAP. Users can access some of the data they need from a single user interface.	Dashboards and scorecards. Users can access most of the data they need from a single user interface.	Predictive analytics; data and text mining. BI for the masses. Users can access all the data they need from a single user interface.	Closed-loop and real-time BI applications.
Business	**Use of BI**	Ad hoc and random use of BI. Few users per BI report. Only power-users and executives benefit from BI.	BI is used reactively on operational level (fire fighting).	BI is used on tactical level. Knowledge users also benefit from BI.	BI is used proactively, supporting the business strategy. No decisions depend on tacit knowledge.	BI is the founding and driving force of the company strategy. BI optimizes the supply chain.
	Strategic alignment	Information requirements are not defined. End users see the data in an unstructured way.	End users define what information they need and the BI applications are adapted to the specified needs.	The information needs are linked to business processes that support business goals.	End users have a strong understanding of how the BI is supporting business functions and goals.	BI is a core competitive advantage, and is what differentiates the company.
	Acceptance	The users do not trust or use the delivered data due to errors, exceptions, or omissions.	Users trust their own departments/groups BI reports.	Users trust the data more than previous steps, but reconcile the reports with other sources.	The users trust and use the data.	BI is embedded in the company culture. All delivered BI reports are fully trusted and accepted.
	Process Integration	Functional silos.	Understand the business processes but they are not mapped. Business processes are not supported by BI information.	Mapped the processes and information assets. Incorporates BI information in the processes. A BI team governs the BI environment.	Cross-departmental process integration. BI affects the business processes design and how employees work.	Cross-organization process integration.
Change Management						

Table 3.8b: BI maturity model matrix

By taking the average of the sub category points, a main category score for technology and business is obtained. A company will probably not be on the same maturity level in all of the sub-categories and therefor the main category score will not imply that the company is on this maturity level in all categories. The technology score determines the y-value and the business score determines the x-value when the maturity is plotted into a BI maturity graph. In figure 3.8c there is an example of a fictitious company with business maturity 1.5 and technical maturity 2.0.
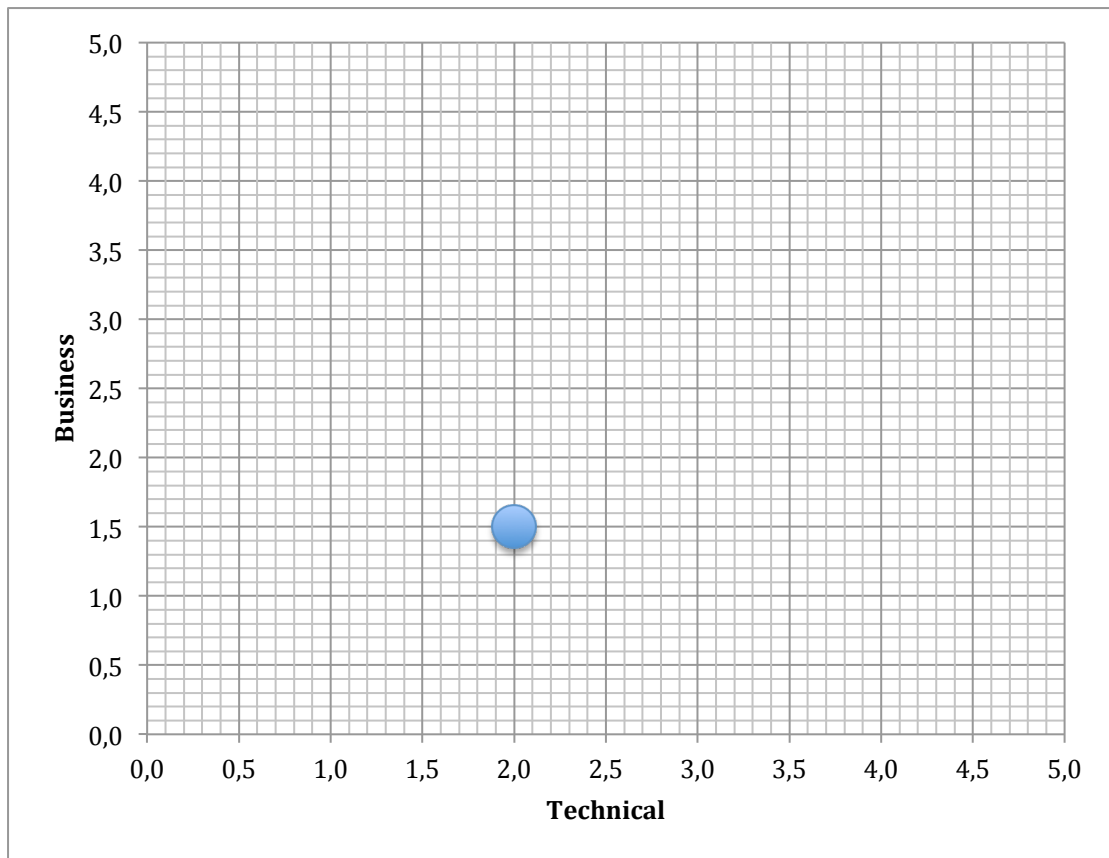
Figure 3.8c: Business intelligence maturity model – example of a company's BI maturity placement (1.5, 2.0)

4. BI Maturity and Proposition Recognition among Large Scandinavian Companies

This chapter includes a compilation of the results from the survey and in depth interviews. It gives an overview of the BI maturity among large Scandinavian companies and to what extent the eight propositions are recognized. Also, the propositions' business impact is illustrated.

4.1 Survey –BI Maturity and Recognition of Propositions

A survey was conducted in order to get an overview of the BI maturity among large Scandinavian companies, and to examine the level of recognition of the seven initially proposed BI propositions. Figure 4.1.1 shows the maturity level of the respondents in the survey. Note that dot (3.2, 2.9) and (2.1, 2.3) include two companies' placement since they had the same score. Most companies are close to the middle i.e. they have somewhat moderate maturity. The three companies that participated in the in-depth interviews are also inserted here.
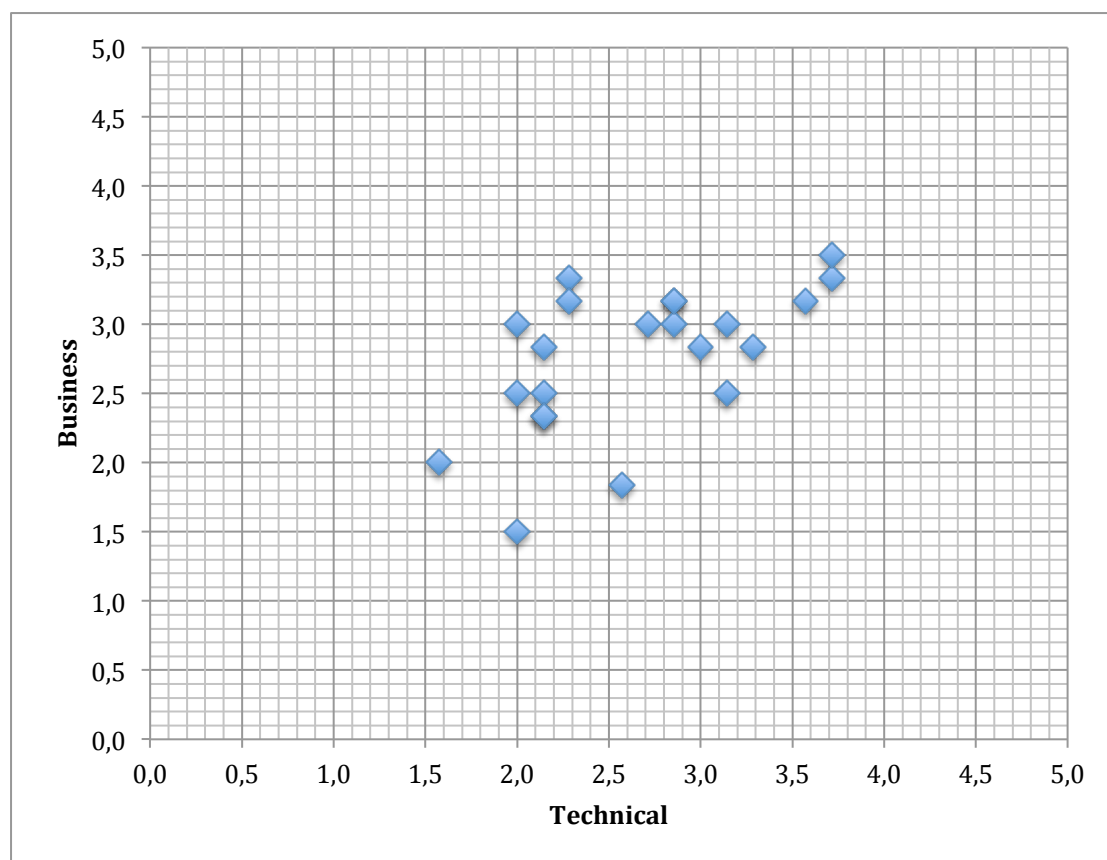
Figure 4.1a: Overall maturity for all respondents.

In figure 4.1.2 the responding companies rate of recognition of proposition 1-7 is displayed (since proposition 8 were added after the survey and was therefore only discussed in the in depth interviews). The mean recognition of the propositions varies between 2.6 to 3.5 on a scale of 1 -5 (see Appendix 1 for more details).

Table 4.1a: BI propositions

BI Propositions
1. *Retrieving data: Substantial amount of man hours are wasted on retrieving data* 2. *One version of the truth: Multiple definitions on the same object; there is a large need for "One version of the Truth"* 3. *Technologies: Duplicated technologies solve the same tasks* 4. *Competencies: Required BI competencies to satisfy needs are already present in the organization, but still the value is not captured* 5. *Transparency: Low reliability and transparency in data leading to redundant work* 6. *High cost: Few BI consumers per report and low reuse of data give a high cost pr. report* 7. *Reactive rather than proactive: Reporting focused on looking backwards and less on identifying business opportunities* 8. *BI Processes: The organization has a large amount of parallel BI processes, many of those lacking standards, documentation and alignment (EY, 2013a)*

Figure 4.1b: Recognition level of proposition 1-7

4.2 In Depth Interviews

4.2.1 Company A

4.2.1.1 Background

Company A is a large, Danish company in the retail and consumer products industry. It has about 41,000 employees and an annual revenue of more than 50,000 millions euro. Company A is present all over the world, though their main focus is in the Western Europe, Eastern Europe, and Asian markets. This is also where all production is located. This in depth interviews focuses on the West European division. Company A has experienced a steady growth, mainly through acquisitions, which has resulted in multiple IT systems within the organization. There is now an ongoing project where standardized processes will be introduced across Western Europe with the roll-out of BSP (Business Standardization Program). As a consequence of this SAP will be implemented as the common software. The goal is to establish a central supply chain to ensure on-shelf availability of Company A's products across Western Europe, to have a consolidated overview of this part of the industry and to use KPIs (key performance indicators) more efficiently. The common way to operate will

provide a more efficient BI solution for the organization as a whole, however each separate country will loose their specially adapted solution, which means the countries' specific performance may decrease.

4.2.1.2 Business Intelligence Maturity

In table 4.2.1.2 Company A's maturity level can be seen for each of the different sub categories. Company A currently has average maturity in most sub category but the with the ongoing BSP project the maturity in several subcategories will increase.

4.2.1.3 Operational Business Intelligence Propositions

Company A recognized all of the eight propositions examined in the study. In table 4.2.1.3 the characteristics of the propositions at Company A is explained.

Table 4.2.1.2: Company A's maturity level in each of the sub categories

		Maturity Level	Description
Technology	Architecture	3	Due to company growth through acquisitions of other companies there are today many different IT solutions within the company. As for Western Europe, each country has their local DW from where information is sent to the centralized DW. Only information that is valuable to stakeholders are sent and consolidated, which means there is no clear overview of other data e.g. production information. The ongoing BSP project will implement SAP as the common ERP system and BusinessWarehouse will be the common BI solution, with a few exceptions.
	Standardization	3	Previously the standards for key terms and metrics and technology and tools have differed between different countries, since the BI environment has not been the same. This has caused confusion and difficulties in consolidating different data. Currently Company A is at maturity level 3 but once the BSP project is rolled out and SAP is implemented there will be general standards for key terms and metrics as well as for technology and tools, i.e. this number will increase.
	Metadata	3	There are some standardized data control activities and some that is done manually when there have been data quality issues. All metadata comes from SAP and special access is needed to see the metadata. Once an employee has access he can also go into SAP and modify data. Therefore access is only given to super users who knows how to handle the data, and who needs to be able to see the metadata. Super users are familiar with SAP and for other users it is considered sufficient not to access any metadata.
	BI Applications	4	Such BI applications are in place so that users can access all the data they need from a single user interface. Standard sets of statistical reports are used to a large extent as well as scorecard and dashboards.
Business	Use of BI	3	The finance department use BI in a proactive manner to foresee the future and plan actions accordingly. Decisions are based on BI reports to a high extent. The finance departments are generally at maturity level 4, whereas the sales and supply chain departments do not depend on BI as much, since they started applying BI more recently. They use BI in an ad hoc and random way and is seen as "bonus information". Mainly power-users and executives benefit from BI. The sales and supply chain departments are generally at a lower level of maturity.
	Strategic alignment	3	The current project is closely aligned with the overall company strategy. Growing customer demand in Asia will be satisfied through investments and focus on that market. Currently some reports and KPIs are produced that are not really required, especially in the supply chain and sales department where BI is more new. The ongoing SAP project aims to identify needs and adapt applications accordingly.
	Acceptance	3	In the finance department's users generally trust and use the delivered data, and Company A is at maturity level 4. In the sales and supply chain departments users do not trust the data since it does not always contain all or the right information they require. They therefore are at a much lower maturity but this number is aimed to increase through the current SAP project since information requirement will be identified so that the BI tools can be adapted accordingly.
	Process	3	BI is mainly separated in different business processes. All processes and information assets are mapped and BI is incorporated in each of the processes. There is an understanding of the overall processes, however there is currently little interaction between them. There is also a BI team that governs the BI environment. The finance department use BI as an integrated part in their business process, whereas for the sales and supply chain departments it is generally not as integrated.
Change Management			Company A conducts training and courses with the employees, which have resulted in a good acceptance of the changes made. 15-30% of the BI/DW budget is spent on change management.

Table 4.2.1.3: Company A's recognition of propositions

		Recognition Level	Description
Proposition 1	*Substantial amount of man hours are wasted on retrieving data*	4	Many users, e.g. controllers mean that they spend much time making and preparing the reports before using it. However, they do also mean that when preparing the reports themselves they understand the information better and can therefore make better decisions. All the same, users spend time retrieving the data, when they could have used the time for other things.
Proposition 2	*Multiple definitions on the same object; there is a large need for "One version of the Truth"*	4	The different countries' varying and separated BI systems have caused multiple definitions of the same objects. This is a problem that Company A aims to minimize through the implementation of SAP, since standard definitions will then be implemented.
Proposition 3	*Duplicated technologies solve the same tasks*	4	The different countries' varying and separated BI systems have ben run parallel producing the same data. Then flat files have been sent to the head office to be consolidated. This has caused redundant work both when preparing the data and when consolidating all the countries' data. This is a problem that Company A aims to overcome through the implementation of SAP, when all countries will be working in the same BI environment.
Proposition 4	*Required BI competencies to satisfy needs are already present in the organization, but an overview is missing*	3	This is difficulty that Company A mean is hard to overcome. Users know that there are BI tools available and how to use them, but since they do not see the bigger picture they do not understand how they could benefit from them best and make most use of the available information.
Proposition 5	*Low reliability and transparency in data leading to redundant work*	3	This proposition varies across different departments. The finance department mostly trusts the data, but there have been occasions when trust has decreased because of data quality issues. Since most users prepare the reports themselves including they know the calculations and where the data comes from, and thus trust and use the information. At the sales and supply chain departments users tend to not use the data as much, and they often seek information from other sources as well or make decisions based on other factors such as experience.
Proposition 6	*Few BI consumers per report and low reuse of data give a high cost per report*	4	This is a main challenge for Company A. Since users modify and make their own reports only they are adapted to their own needs, and only themselves will use it. Consequently the number of BI users per report is low. The BSP project will decrease this problem since a number of standard reports will be implemented, making the reports useful to more users.
Proposition 7	*Reporting focused on looking backwards and less on identifying business opportunities*	3	The BI system is mainly used in a reactive manner for reporting on what has happened. However it is sometimes used more proactively, e.g. in terms of lowering production costs. The ongoing BSP project will make it possible to act more proactively since there will bee a better overview of the whole Western Europe organization, which means that the supply chain and production can be better optimized, and actions can be taken through managing resources across countries.
Proposition 8	*The organization has a large amount of parallel BI processes, many of those lacking standards, documentation and alignment*	4	The business units function separately and thus they do not profit from possible synergies in terms of BI. All countries also have their separate BI processes, which means many of them are run parallel. The BSP project aims to minimize the parallel BI process, and there will be cross-functional standards, documentation and alignment.

4.2.2 Company B

4.2.2.1 Background

Company B is a large, Swedish company in the industrial products industry. It has more than 46,000 employees and an annual revenue of more than 50,000 millions euro. It is a global company with growing markets in Asia, North America, and Western Europe. Company B started to develop their first DW solution in 1995 and has had the approach of addressing one process area at a time instead of building an enterprise DW, thus there are numerous BI systems and DW solutions throughout the company. Data has, up until 2011, primarily been presented in cubes and in 2009 there were more than 1900 cubes. Too much information has made the cubes slow to run, and it is a complex system where users spend a lot of time retrieving data from the cubes. Improvement projects and modernization work is ongoing to move the DW solutions to a more modern architecture and set-up, and a lot of work has been done with replacing cubes with data mart solutions on a high performing database engine.

There is a currently an ongoing project where SAP is being implemented as the common ERP system for the whole Western Europe organization and it will introduce SAP business warehouse (BW). This will lead to centralized enterprise DW with more consolidated information. It is a major project where each part of the company must be looked into specifically to see what information requirements they have and how the system must be adapted to fit those. The project will run during several years where departments gradually change to the new system.

4.2.2.2 Business Intelligence Maturity

In table 4.2.2.2 Company B's maturity level can be seen for each of the different sub categories. Company B is currently on an average maturity level but is leaning towards higher maturity. Placing Company B in some of the sub categories was difficult because Company B showed characteristics from several of the maturity levels in the same sub category.

64

Table 4.2.2.2: Company B's maturity level in each of the sub categories

		Maturity Level	Description
Technical	Architecture	3	One of the strategic goals established in 2010 was to implement an enterprise DW, but then it where decided to implement SAP. While waiting for SAP to be implemented it is not worth the investment to try to reach an enterprise DW. The departmental DW is therefore still the main architecture of Company B.
	Standardization	3 or 4	Technology and tools are mostly standardized, e.g. 95% use Cognos as the analytical application. There are some local solutions that differ. In terms of key terms and metrics the level of standardization is low. However, Company B mean that the users know what they are doing and that there is no real need or demand from management to increase standardization. Company B is currently at level 3 looking at the key terms and metrics while the technology standardization is reaching maturity level 4.
	Data Quality	2	There are some standardized data control activities (e.g. identifying entries that deviates beyond a specific tolerance level, checking that data is correctly loaded into repositories). Other control activities such as automatically measuring order values measurements are difficult to do due to too many product types with different correct values. Metadata is generally not available to users. In some cubes there have been incentives to add descriptions about the data, but it has not been prioritized since there have been other more urgent issues. Company B means that there is currently no need for making metadata available to users, since they trust that the data is correct anyway.
	BI Applications	3	Company B has started to use dashboards and scorecards in order to provide all users with the same information. Currently all users have access to the DW and they build and modify their reports themselves, which is something a standardization project aims to minimize. COMPANY B is currently at level 3 but might increase because they will develop more dashboards and scorecards that will satisfy the needs of most users.
Business	Use of BI	3 or 4	BI information is used in a both reactive and proactive manner at Company B. Users throughout the organization use and benefits form BI, also knowledge users. Company B is currently between level 3 and 4.
	Strategic alignment	3	The BI environment is supporting business processes and there is ownership of the BI initiatives both on the IT side and the business side.
	Acceptance	3 or 4	There have been a few issues in terms of data quality but generally there are little omissions and errors in the data and information. But when it occurs there might take some time to regain the trust from the users. Users generally trust and use the data. Company B is currently between level 3 and 4.
	Process Integration	3	Mainly the BI environment is integrated in each separate business process but there is some information exchange between individual processes. The information assets as well as the processes are mapped.
Change Management			Company B spend about 5-15% of the BI/DW budget on change management.

4.2.2.3 Operational Business Intelligence Propositions

Company B recognized some of the eight propositions as current challenges. In table 4.2.2.3 a closer description of each proposition applied to Company B can be seen.

Table 4.2.2.3: Company B's recognition of propositions

		Recognition Level	Description
Proposition 1	*Substantial amount of man hours are wasted on retrieving data*	4	The users generally modify and build their own reports, which leads to much time spent on retrieving data. The users are used to the flexibility of being able to create the exact report that they need. A current BI project aims to reduce this time. There will be more standardized reports that the users can use as they are.
Proposition 2	*Multiple definitions on the same object; there is a large need for "One version of the Truth"*	2	This is not a main challenge at SKF, but there are issues when different formats lead to confusion on specific objects.
Proposition 3	*Duplicated technologies solve the same tasks*	2	There are some duplicated technologies. The technologies are overlapping and often providing the same information. At some departments it might be necessary to have different technologies but overall Company B aims to have one technology throughout the organization. Duplicated technologies imply higher costs in terms of software license and more required knowledge and training since users and developers must be able to understand multiple systems.
Proposition 4	*Required BI competencies to satisfy needs are already present in the organization, but an overview is missing*	4	Many employees use old versions of tools in a way they have always done, and they do not know how they could best profit from the BI environment. The users must be educated so that they can use the new tools. An education plan for the more up to date tools is planned for next year and will improve this situation.
Proposition 5	*Low reliability and transparency in data leading to redundant work*	1	This is not seen as a challenge within Company B since users trust the data to large extent, even if e.g. the metadata is not accessible to large extent. Users still base their decisions on the provided information.
Proposition 6	*Few BI consumers per report and low reuse of data give a high cost per report*	5	Since the users make and adapt their reports themselves the reuse of the reports is low. There is continuous work being done in this area, and it will be even further improved when SAP BW is rolled out. The SAP project will establish a standard set of reports, which will reduce the numbers and costs of licenses and enable more users to use the same reports and higher reuse of data.
Proposition 7	*Reporting focused on looking backwards and less on identifying business opportunities*	2	This is not considered to be a big challenge for Company B. BI information is used proactively when it is possible and useful.
Proposition 8	*The organization has a large amount of parallel BI processes, many of those lacking standards, documentation and alignment*	2	The BI processes are sometimes parallel in separate business processes, but they are well aligned and there are implemented standards for how the users should build and load information and data.

4.2.3 Company C

4.2.3.1 Background

Company C is a Danish company providing drilling services to oil companies all over the world. They have approximately 3,300 employees of which about 80% work offshore on oilrigs. Company C is a part of a large concern with several units and has their head office in Denmark. Only specially approved electrical equipment is allowed on the drill floor where the operations take place. This means that employees cannot use standard office tools as PCs, laptops or tables to access performance data while working on the drill floor. Instead the information (mostly KPIs) is displayed on a board in meeting areas and on the computers in the office. Company C is currently changing ERP system from SAP to IFS, which is planned to go live in late 2014. Today they use Microsoft as a BI solution, which they will keep.

4.2.3.2 Business Intelligence Maturity

In table 4.2.3.2 below Company C 's maturity in the subcategories are explained.

4.2.3.3 Operational Business Intelligence Propositions

Company C recognizes the propositions, although to different degrees. In table 4.2.3.3 below a description of Company C's perception of the proposition are displayed.

Table 4.2.3.2: Company C's maturity level in each of the sub categories

		Maturity Level	Description
Technical	**Architecture**	3	The different business units in Company C do not share the same DW apart from a few exceptions e.g. HR. This is due to that the different business units have different needs and there are few benefits of having a common DW for all of the units in Company C. Company C has a main DW that is used by almost all departments. Company C is looking into sharing their data somewhat with their customers and suppliers. They are currently having a pilot project where they are sharing data with an equipment supplier to do proactive maintenance.
	Standardization	3 or 4	There are some key terms that still are used differently between the different departments in Company C. The metrics used in the ERP systems and the KPIs are defined, but overall there are some terms and metrics that are not defined. The standardizations of technology and tools are weaker then the key terms and metric standardization. The BI reporting has been running department-by-department and therefore there are several techniques and tools used and vast amount of systems in their IT landscape. They are now trying to make the list shorter although it is hard to make everyone agree and accept it. The maturity of the technology standardization might increase when the new ERP system is in place. The aim is not to have a too strict tools and technology standardizations because this might decrease the agility of the systems.
	Data Quality	2	There are standardized data control activities (e.g. customers check and sign data, "outlier reports" that identify entries that deviate beyond a specific tolerance level, and manual verifications where data quality is an issue) that proactively improve the data quality. Some data quality issues remain and they work on making metadata more visible and accessible (this drives a higher degree of ownership and quality input from users). Today some metadata is available in a PowerPoint attached to the reports, including sources and how it has been calculated. This has been used in operations for a couple of years and helps to build trust in the data and makes it easier for non-knowledge users to understand the data. They aim to make metadata more accessible (so that the user must not open a separate PowerPoint file).
	BI Applications	3	Company C is using dashboards, scorecards and reports. All users can access the scorecards through a portal. Other data and underlying cubes are not accessible to users although it would be preferable. Some information is not available due to restrictions and security e.g. financial information. Company C is not aiming for real time (in operations) due to safety reasons the employees should not risk distraction during the operations.
Business	**Use of BI**	3	The utilization rate of BI is high throughout the whole organization. Much of the reporting consists of delivering KPIs, which shows what happened and not what is going to happen. However the data is also somewhat used as a tool for maintenance, looking at what actions to take in the future. This is important since the maintenance planning is essential to maintain low downtime of the drilling. The aim is to use the data to do forward planning.
	Strategic alignment	4	The BI initiative in Company C is a top down project. It did not start as an IT project but as a performance management project. The performance drivers were identified, the processes were looked at and mapped, and then it was concluded what reports were needed. The BI solution was thus developed to support the performance and create better visibility of the organization. The employees understand how BI is supporting the organization on the high level. There is a high strategic alignment and they therefore reach maturity level 4.
	Acceptance	3	The workers trust the data to high extent, but sometimes reconcile the correctness of the data with other data sources before trusting it. The trust in the information has increased over time in as the data quality has increased. Decisions are rarely based on pure data, factors such as personal experience and knowledge, and how and by whom the information is presented also matters in the decision process.
	Process	3	Company C underlines that it is not about having fancy tools and applications, it's more important that the information is used in the processes. About 60% of the BI effort is put on the use of information and taking action. Each BI project has an owner on the IT side as well as on the business side. The company is currently at maturity level 3.
Change Management			Company C spend about 5-15% of the BI/DW budget on change management.

Table 4.2.3.3: Company C's recognition of propositions

		Recognition Level	Description
Proposition 1	*Substantial amount of man hours are wasted on retrieving data*	4	The data that has been inserted and mapped in the DW is easy to find and use. The data that has not yet been inserted and mapped in the DW is hard to find and thus time consuming for the user. This proposition is depending on the maturity of architecture and the applications available to the user.
Proposition 2	*Multiple definitions on the same object; there is a large need for "One version of the Truth"*	5	Since different departments define key terms and metrics differently Company C do have some confusion issues between departments. Sometimes different departments have different views of numbers of the same thing. However, "one version of the truth" is not seen as a major problem in the company and when working across departments the users are often aware about the different definitions.
Proposition 3	*Duplicated technologies solve the same tasks*	4	There are several technologies used in the organization, some of them solving the same task. The aim is to reduce the number of different systems. The problem is largely affected by the maturity in architecture, technology standardization and applications.
Proposition 4	*Required BI competencies to satisfy needs are already present in the organization, but an overview is missing*	2	This is not seen as a problem at Company C, they describe it to be the opposite. The company is lacking competences and technology to move further in maturity. They will need to invest in more advanced technology and hire people that have the knowledge to do the maintenance and analysis, such as statistical knowledgeable persons.
Proposition 5	*Low reliability and transparency in data leading to redundant work*	3	There is a high reliability in the data that is mapped in the DW and where they have metadata available. Thus this is not seen as a main challenge at Company C. They do however underline that there are still several reports that could be used but are not produced due to lack of data input. There are still functions that are not covered in the BI system. In those cases the reliability of data is much lower.
Proposition 6	*Few BI consumers per report and low reuse of data give a high cost per report*	2	This is not an issue because the reports/KPI that is produced is well integrated in the performance processes and the users trust and use the data. There are sometimes reports that are not used as much or even not at all, and in those cases the cost per report is higher. However, this is not considered a big problem at Company C.
Proposition 7	*Reporting focused on looking backwards and less on identifying business opportunities*	4	Company C is currently working on this issue. According to them, this should be seen as an opportunity rather than a challenge. They have recently achieved a high enough BI maturity to explore this opportunity, and starting to look into how to use BI reports to plan ahead (e.g. maintenance projects).
Proposition 8	*The organization has a large amount of parallel BI processes, many of those lacking standards, documentation and alignment*	2	There are parallel processes in the company due to different business problems needing to be solved. They will try to eliminate some of them, but there will always be a few parallel BI processes in the company since the information requirements differ. The alignment between the processes has room for improvement, and depends on standardization and architecture.

4.3 Business Impact

4.3.1 Tactical Linkages between Propositions and Strategic Business Intelligence Challenges

To examine the business impact of the propositions the tactical linkages between the propositions and the strategic challenges within a company were discussed in the in the depth interviews (see Appendix A5.1.3, A5.2.3 and A5.3.3). The strategic challenges were summarized as inefficient processes and ineffective processes since these are general challenges for most large companies. Figure 5.3.1 illustrates the linkages between these strategic challenges and challenges on the tactical level. It also shows how the tactical challenges are affected by the BI processes within the company, which are closely linked to the eight operational propositions. The model can be seen as a so called pain chain (EY, 2013a), describing what difficulties that lead to other difficulties at the operational, tactical and strategic level of the organization.
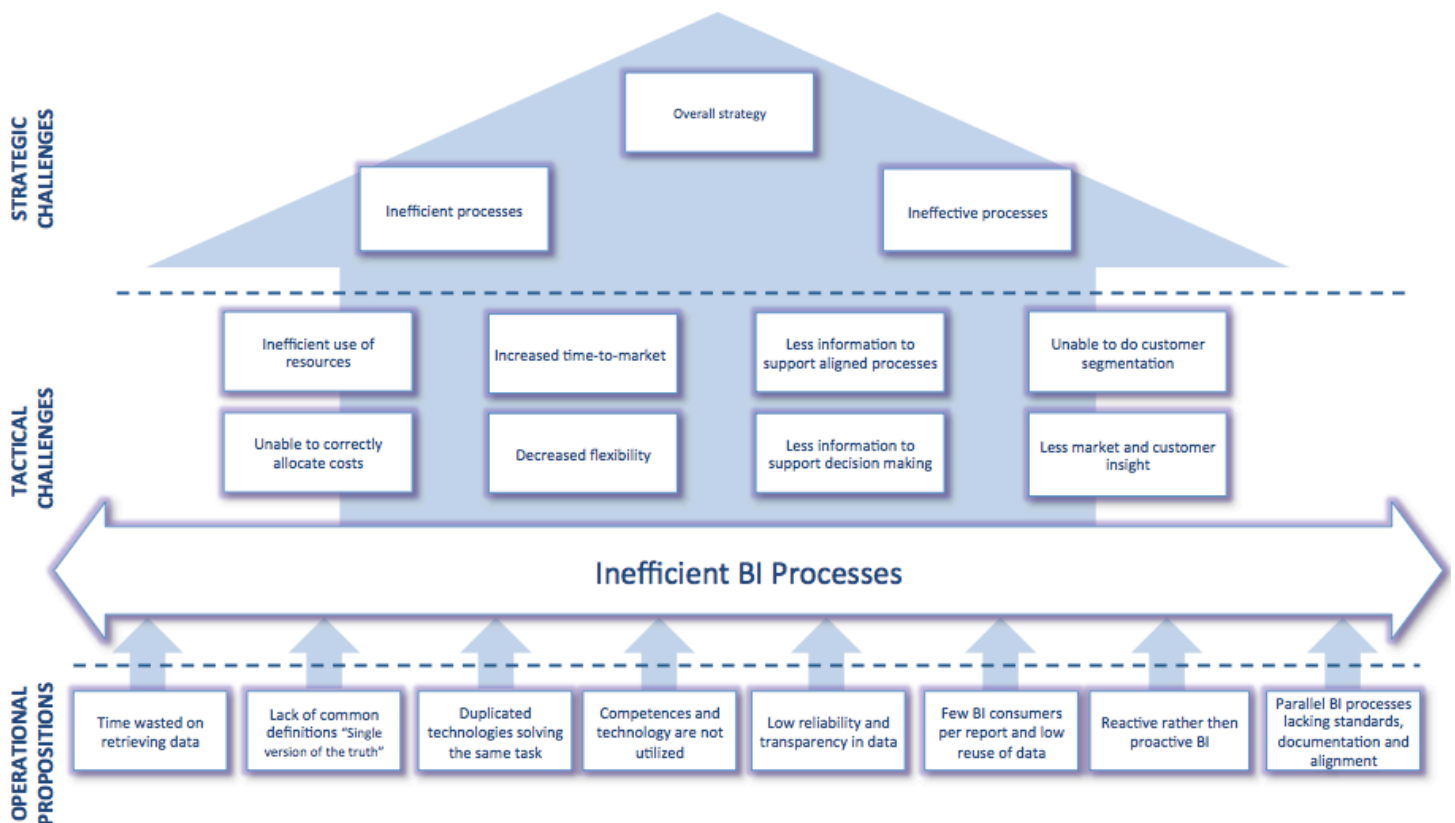
Figure 4.3.1 Business impact of propositions

Inefficient BI processes that lead to insufficient, untimely or wrong information is likely increase tactical challenges such as difficulties in the allocation of costs, decreased flexibility, less supported decision making, less market and customer insight. inefficient use of resources, increased time-to-market, less information to support aligned processes and an inability to do customer segmentation. These tactical challenges affect the efficiency and effectiveness of the processes, which impacts the overall strategy of the company. As been discussed previously, all eight propositions are linked to the BI processes within the company. Difficulties with the propositions correspond to inefficient BI processes, which links the operational propositions to the tactical challenges. The model illustrates an overview of the business impact of the eight propositions in a general manner, i.e. what impact they might have. The model should be adapted to each organization's specific challenges depending on the nature of the organization, i.e. it cannot be applied as it is without any modifications. The tactical linkages may be added or withdrawn depending on the individual company.

5. Analysis – BI Maturity, Recognition and Business Impact of Propositions

This chapter contains an analysis based on the survey results and in depth interviews. It describes how the eight propositions are linked to BI maturity based on the maturity model, where in the maturity model companies are and why they are not increasing their maturity. It also discusses the business impact of the propositions.

5.1 Recognition of Propositions and Linkages to BI Maturity

According to the survey and the in depth interviews the eight propositions are recognized by most of the companies but to varying extent. Below follows an analysis of how and to what extent the propositions are recognized, and how they relate to the subcategories in the developed maturity model. Change management relates to all propositions in terms of getting the users to accept, use, and benefit from the BI reports as opposed to continue working as they are used to.

Retrieving data: Substantial amount of man hours are wasted on retrieving data

This proposition had a mean recognition score of 3.4 out of 5 in the survey, and is one of the most recognized propositions out of the eight examined. All companies in the in depth interviews also recognized this issue. Company A and company B say that the users generally modify or build their own reports, which is very time consuming. If users cannot access the data they need directly from standard reports, dashboards, and scorecards they need to search for the data themselves and prepare their own reports. This is especially time consuming if the data architecture is complex and an overview of available data is missing. As company C describes, data that is not correctly mapped is hard to find and is very time consuming. However, user-unique reports has the advantage of being more adapted to each users, which might often implies better or more useful reports for the users. This opposed to standard reports, dashboards, and scorecards that may only include a certain amount of information.

This proposition might be argued to be a result of the low maturity level in the subcategories architecture, BI applications, strategic alignment and acceptance in the maturity model. Low architecture maturity often implies time-consuming processes for finding the required data or if the architecture is not adequate for the large amount of data that the company have the performance will be slow and it will be time consuming to retrieve the data. Without the right BI applications it is difficult for users to visualize and understand the information they need quickly. Little strategic alignment results in that the needed information might not be available to users (if the BI environment is not adapted to support the processes the needed information will not be provided), which forces the users to find and build their own reports. Low level of acceptance implies that users try to add more, supportive data to the provided information, which also results in wasted time.

One version of the truth: Multiple definitions on the same object; there is a large need for "One version of the Truth"

The mean recognition of this proposition was 3.1 in the survey, although one out of 22 selected the lowest level of recognition. But there is clearly a difficulty in establishing definition standards across a large, global organization according to the three interviewed companies. Often different IT systems have been used in different parts of the company, and if the company has grown through mergers or acquisitions there are often several ways of defining objects. Even between different business units in the same office or country the definitions often differ because they use and understand the objects differently within the specific units. Thus, multiple definitions of the same object often occur. The more independent divisions there are within a company, the bigger issue this seems to be. The three companies in the in depth interviews meant that this is normally not a big problem since the users often are aware of what other definitions there might be and can handle it appropriately. However, the more the companies grow the less familiar the users will be with how other departments may define objects etc. and the more important standardized terms will be. All companies agreed that one version of the truth increases the work efficiency and improves the cooperation and interaction between different departments. This proposition

relates to the subcategories architecture, standardization, data quality and process integration. Low architecture maturity such as independent data repositories often implies different definitions in different repositories resulting in contradictory data. Low level of standardization maturity implies no generally defined standards for definitions, which is likely to cause contradictory definitions. Low data quality maturity results in errors, exceptions, omissions and low traceability of data, which all increases the risk of multiple truths. Low level of process integration in terms of little interaction between different business unit and departments often implies little alignment in terms of definitions.

Technologies: Duplicated technologies solve the same tasks

This proposition had a mean recognition of 3.5 in the survey and is one of the highest recognized propositions. All the interviewed companies where having problem with duplicated technologies that often solves the same task. Within large organizations different department have often developed and used different BI systems resulting in duplicated technologies within the organization that are solving the same tasks. Users often want to keep their BI systems since they are familiar to the work processes and the technologies are adapted to their specific department and needs. Company B also mean that it sometimes even is necessary to have multiple technologies. However it was concluded that all companies in the in depth interviews aim to reduce the number of technologies used. The effect of fewer technologies will lower license, training and maintenance costs according to company B, it will also reduce the complexity of the BI environment. This proposition is a result of low maturity in the subcategories architecture, standardization, BI applications, and process integration. Low maturity in architecture in terms of complex IT landscapes often implies that parallel technologies partly solve the same tasks. Low standardization maturity in terms of no established standard technology and tools lead to that several similar technologies are used in a parallel manner. Low maturity in BI applications implies that several non-compatible BI applications may be in use that are likely to partly solve the same tasks. Little process

integration results in little overview and synchronization within and across business processes, causing duplicated technologies to solve the same tasks.

Competencies: Required BI competencies to satisfy needs are already present in the organization, but an overview is missing

The mean recognition of this proposition was 2.9, which together with proposition 5 had the lowest scores compared to the other propositions. Still the score shows that companies do recognize it. As for the in depth interviews two of the companies recognized this proposition, company A and B. BI tools are in place and users know how to use the information, but since they cannot see an overview of the BI environment and the organization itself, they do not fully profit from BI systems. Users tend to use only the applications and tools that they are used to and do not see the overall picture of how the available information can be used. Little overview can also be caused by lack of communication between the IT department and the business or management side, or simply bad IT understanding on the business side. The IT department may have good competences that remain unused because the business side of the company have not yet identified, understood, and communicated the business needs, and therefore the full potential of BI is not reached. Company C however found the opposite problem within their organization, i.e. they do not have enough advanced technical competencies in terms of employees and IT tools. It is possible that this problem also is due to a missing overview of the BI environment. High recognition of this proposition is linked to the maturity model's subcategories use of BI and strategic alignment. Low maturity level in use of BI implies that there are only a certain amount of BI users at certain levels in the organization, and that BI is used mainly in a reactive manner. This is typically related to an inability to use the present competencies due to the lack of a visible overview of the BI environment. Low level of maturity in strategic alignment lowers the cooperation between departments and the overview of the organization as a whole. Thus it is likely to miss out on available competencies within the company.

Transparency: Low reliability and transparency in data leading to redundant work

This proposition also had recognition level 2.9 in the survey. 3 out of 22 respondents in the survey put a recognition level 1 which is the lowest one. This might be an indication that the proposition might not be recognized at all by some companies. In the in depth interviews this was concluded not to be an overall big issue. However, Company A, B and C recognized this issue to momentarily occur at times when the data quality has been low and there have been errors and omissions in data. After a while the users tend to start trust the data again. The data reliability and transparency also differs between departments. The departments where the BI environment are well integrated and where they frequently use BI reports tend to trust the data more according to Company A. This opposed to departments where BI is rarely used and users prefer to back up the BI information with other information. Low transparency implies low reliability in data, leading to redundant work for users that need to find other information elsewhere to support their decisions. The users might also make their decision on other factors such as knowledge and experience, in which case the BI is not utilized at all. This proposition is a result of low maturity levels in the subcategories architecture, standardization, data quality, acceptance, and process integration. Low maturity in architecture and standardization causes low transparency in data as well as contradictory and inconsistent data, which cause redundant work for the users. Little data quality implies exceptions, omissions and errors in data as well as that the users will not be able to trace the provided information, i.e. low reliability and transparency. Low level of acceptance equals that users do not trust the data and that they are not willing to base decisions on provided data, which is often due to low reliability and transparency in data. Low maturity in terms of process integration implies little data integration and transparency across departments, which leads to redundant work for users.

High cost: Few BI consumers per report and low reuse of data give a high cost per report

This proposition had a recognition level of 3.4 in the survey. In the in depth interviews this was considered a problem at company A and B since users make

their own reports to a large extent. These specially adapted reports only match their own needs and requirements. Companies with more standardized reports subsequently have more users per report. However, this is not always suitable for companies since standardized reports may not provide all the information each specific user need. There is a tradeoff between standardization (many users per report) and adaptability (few users per report). Though, dashboards and scorecards can be made more flexible through use of filters etc. This proposition is linked to low maturity level in the subcategories data quality, BI applications, use of BI, strategic alignment, acceptance, and process integration. Low data quality maturity results in low reliability and transparency in data, causing less people to use the information. Higher maturity in BI applications implies dashboards and scorecards that are useful to many users, and often users can filter between different information depending on their requirements. Low use of BI implies that there are few BI users throughout the organization, i.e. few users per report. Low maturity in strategic alignment means that the BI environment is not enough matched to the core processes, which means the reports' information probably do not match what the users needs. Low maturity in acceptance means that users do not trust the BI information, which leads to low use of reports. Low process integration maturity implies that the BI environment is not integrated in the processes to support the core processes. This makes the provided information less useful and the reports are used less.

Reactive rather than proactive: Reporting focused on looking backwards and less on identifying business opportunities

This proposition was the most recognized proposition in the survey with a score of 3.6. The companies in the in depth interviews meant that this proposition depends on whether there is an overview of data available. More accessible overviews of larger parts of the company, and even of collaborators data, facilitate the proactive use of BI. At Company B however, this was not considered a big challenge as they meant that data was used proactively when needed. All companies thought of this more as an opportunity than a problem. This proposition is connected to low maturity in architecture, use of BI and strategic alignment. Low maturity in architecture means that there are many independent

data marts and no extension of the BI environment to collaborators. This results in that no clear overview of data is available, leading to less proactive use of BI information. Low maturity in use of BI implies that users do not use BI to its full extent, often because they do not see the larger overview of how they could best benefit form the information. Thus they do not use it in a proactive manner. Low strategic alignment maturity means that the data is not aligned with business requirements and that it is less suitable for proactive decisions.

BI Processes: The organization has a large amount of parallel BI processes, many of those lacking standards, documentation and alignment

This proposition was not part of the survey but only discussed in the in depth interviews because it was added after the survey where sent out. All interviewed companies agreed that this is a main issue when it comes to efficient BI processes. When business units function separately and the BI processes are not aligned across business units, there are many parallel BI processes that are often incompatible due to inconsistency in standards, documentation, and alignment, see chapter 3. This means that synergies in terms of the BI processes both within and across business units will be missed out on. For large, global companies this is often an issue since the BI environments traditionally have differed between countries and departments due to different needs and habits, which is explained by Company A, B and C. This proposition is caused by low maturity level in the subcategories architecture, standardization, BI applications, strategic alignment, and process integration. Low architecture maturity level implies independent and unaligned data repositories that increase the number of parallel BI processes needed. Low maturity level in standardization means that key terms, metrics, technologies, and tools are not aligned and standardized that is likely to cause incompatibility in BI processes. Little BI applications maturity implies that several incompatible technologies and tools are used, leading to parallel BI processes. Low strategic alignment maturity means that the BI processes are not aligned and used in the most efficient way supporting all core processes. This is likely to imply various parallel BI processes. Low maturity in process integration means that the BI processes are not fully supporting the core business processes,

and that they are not synchronized to support work across business units. This is likely to increase the number of parallel BI processes.

5.1.1 The Recognition of Propositions and Connection to Maturity Level

According to the survey result and in depth interviews the eight propositions are generally recognized among large Scandinavian companies. Although, some are more recognized and some are less recognized. Sometimes the survey and the interviews gave a very different view of the recognition of the propositions. This might be because the respondents to the survey did not understand the explanation to the propositions or that they did not realize the problem but they might still have it. In the interview the companies discussed the propositions and understood them properly.

All propositions are connected to the maturity subcategories described in the maturity model. Low maturity generally implies high recognition of the propositions. A way for companies to overcome the challenges and problems that the propositions imply is therefore to increase their maturity in the different subcategories.

5.2 BI Maturity among Large Scandinavian Companies

5.2.1 Maturity in Sub Categories

In the sections below each sub category in the maturity model is discussed. It analyses the maturity and difficulties that were discovered in the in depth interviews, and reasons for the companies not to increase their maturity level.

Architecture

In the interviewed companies the different business units, departments and countries have independent data warehouses to some extent and only selected data is consolidated. The different data warehouses usually exist because they have been developed to support a single department, country or business unit. Another factor influencing the architecture is that a company that has grown through acquisitions often has many different IT solutions, sometime independent from each other. All of the interviewed companies are aware that too many independent data warehouses is a disadvantage and they are all

currently actively working on improving the architecture by developing common data storage through the implementation of common ERP system etc. To change the BI architecture of a large company is a big project connected to large investments and long periods of time. It is also complex and there are many factors influencing the success, therefore it usually takes several attempts before the result is satisfying.

The BI architecture has to be adapted to the increasing amount of data. Solutions that worked well a few years ago have to be changed. For example, Company B had built their architecture with cubes. When the data amount increased the cubes got slower and now Company B is trying to replace the cubes with an architecture that is fitted to the vast amount of data that they possess.

Standardization

The standards for key terms and metrics differ between business units, departments, and countries to some extent. It is causing some confusion but the companies does not think that this is a major problem (often because the different business units do not collaborate too much) and is not actively trying to eliminate the lasting conflicting terms and metrics. However, more cross-company standards will automatically be established with the currently ongoing IT projects (implementation of ERP systems etc.) since these projects include standardization of key terms and metrics as well as technologies and tools. All interviewed companies agreed that a high level of standardization is beneficial for the company since different definitions on the same object might lead to different versions of the truth (which is seen as a problem in the companies). The more the departments see the need for a more cross departmental process based way of working, the more they will realize the importance of standardized definitions in the company.

When BI reporting has been run department-by-department, different IT solutions has been used and the employees therefore are familiar with different technologies. The interviewed companies have a varying degree of the standardization of technology and tools. Different units might be accustomed to different technologies and they have found a technology that fits their needs that

they are comfortable with. If the company is going to use a standard set of technologies they have to find technologies that fit all the needs of the already existing solutions. Another difficulty in standardizing the technology is that it will make employees change the way they work, which is not easy and takes time and resources. Due to reduced complexity, license costs, training costs, and administration costs the companies aim to reduce the amount of different technology by standardization.

Data Quality

There are data quality issues in all interviewed companies, at least from time to time. To prevent this standardized data control activities are used to various extent, e.g. customers checking and signing data, "outlier reports" that identify entries that deviate beyond a specific tolerance level, checking that data is correctly loaded into repositories. At some points, and at some departments where data quality is a bigger issue, data entries are checked manually. The data quality is of great importance in order to make the BI environment useful for the company. If there are quality problems in the data employees will stop using the data because they do not trust it, or they might base decisions on the incorrect data, which will impact the company negatively.

Another factor in making the data trustworthy is to make it traceable. This is why metadata is important, helping to determine the source of data and make it traceable. However, metadata is not always available to the users. Making the metadata accessible in a user friendly way is not highly prioritized because there is no big request for it and there are other more urgent issues. Although all of the interviewed companies agreed that metadata would positively affect the trust of data it seems that metadata is currently not seen as an important difficulty that must be overcome to increase their maturity. However, as the companies increase their overall maturity they will probably realize the value of available structured metadata in order for the users to trust the data even more.

BI Applications

All of the interviewed companies use dashboards and scorecards that is accessible to all users from a single user interface. Since all information that the

users need is not always available (standardized reports) users sometimes develop their own reports themselves. Overall the companies are satisfied with using scorecards and dashboards and are not interested in more advanced applications. However, focus might instead be on improving the dashboards, scorecards and reports to make them satisfy more of the users needs so that they do not need to build and modify the reports themselves. It is also of interest to make all the information available for the users from a single user interface.

The most important is not to have the newest or most advanced applications but instead to make the employees use the information. If the information is not used in the processes, advanced new applications are of no use. The companies need to evaluate if the users need more information than they already have. If the information they have now is not used then the users will probably not use the more advanced information either, but if the information is used and there is a need for more information it is probably worth investing in more advanced BI applications.

Use of BI

BI is used throughout the organization at the interviewed companies although the usage seems to differ between departments. Departments that have integrated BI in the business processes and depend on the BI information use it to a larger extent than departments that recently has introduced BI. BI is used both in a proactive and reactive manner. It is looked at to see what has happened, and when the information is usable for proactive decisions it is also used in that way.

There is a general acceptance for how executives make decisions and the issues they decide on are often considered too complex for data alone to be sufficient as decision base. Because of this it is extremely difficult to reach maturity level 5 where BI information drives the business and is the sole decision factor, and this is not something companies normally strive for. The optimal width and type of BI users differs between organizations and situations, meaning that high usage of BI by all employees is not always beneficial.

Strategic alignment

All companies agree on the importance of strategic alignment, but also on its difficulty to achieve because of a too complex existing BI environment (due to large, scattered organizations) and lack of information overview. All three companies are currently conducting projects aiming to make their BI architecture less complicated and more efficient, leading to better information overview. This is a step in the direction of aligning the BI environment with the company strategy.

The communication between the business and IT side is highly important. If the IT side is not told what must be done, they do not do it. At Company C BI started out as a performance management project where the business aspect of BI were always in center, which they mean is a success factor for their BI initiatives. They develop IT solutions depending on what the business processes need. The companies that has locally developed BI environments has more problem with the business alignment because they are only adapted to the local department's needs instead of the company as a whole. This often indicates problems with sub-optimizations. Increasing the strategic alignment is a slow process and is preferably done little by little.

Acceptance

Generally users trust and accept the information, but it differs from department to department. The more people have used the information before, the more they trust it. When there have been data quality issues due to architectural changes, wrong input of data etc. the trust has decreased. By time, the trust has been built again. The trust in data is therefore somewhat fluctuating, but over time it is increasing due to improvements in the BI environment and increased usage. When the users do not trust the data fully they might reconcile it with other sources before using it or not use it at all. The acceptance is something that will take time and is highly dependent on other subcategories in the maturity model, e.g. data quality. Although companies want to reach a high level of maturity in this area there are a lot of factors that needs to be handled and it is a slow, time-consuming processes.

Important decisions are usually not taken with data as the only decision base, since data often is not trusted enough to serve as decision base for complex problems. Usually some other decision factors are used such as personal experience and recommendations. Normally people don't trust data, people trust people.

Process Integration

Companies have several business processes. The companies seem to be aware of the business processes and have mapped them, and they are aware of the information need in each business process. There is no business value in BI if the information is not used in the business processes. To ensure that the information is used BI has to be aligned and incorporated into the business processes. It is important to have an owner of the BI processes and projects both from the business side and the IT side. They are responsible for the data and that all the information needs are fulfilled, and so they decrease the gap between IT and management. All of the interviewed companies do have an owner from the business side and the IT side, which they mean helps the BI environment to support the core business processes.

Change management

Change management is crucial for all BI projects to succeed. Employees are generally resistant to change, especially if new demands and instructions come from the top management that are perhaps not placed in their country, and as far as the employees believe they have not enough understanding of their working requirements and needs. All users need to accept the need for new tools, understand why it is beneficial, and learn how to use it in order to succeed with the BI investments.

5.2.2 Company Size's Impact on BI Maturity

The survey shows that the responding companies are close to the middle i.e. they have somewhat moderate maturity. This could be because large companies have been examined, and in order to build and run a large company there is a need for a working IT landscape and BI environment. Thus the companies are likely to have made some BI investments. However, to reach the higher levels of maturity

there are several large barriers to overcome which demands full support from executives, large investments and full acceptance throughout the company. This kind of BI maturity is difficult to achieve and there are few companies that have managed to do so. Concluding from the survey as well as the in depth interviews moderate BI maturity is common among large Scandinavian companies, and there is room for improvement in terms of BI.

Due to the size of the companies there are characteristics that contribute to their complex BI environments. The companies are often active in several countries maybe even in different continents. The departments are often big and somewhat independent from one another. The companies might have grown through acquisitions where new technology and data has been added that need to be integrated into the company. Or the companies have started their BI processes department-by-department and as the need for aligned BI processes and a common data warehouse arises there is vast amount of technology, data repositories and application to integrate and align. In a big company there are also vast amount of data that needs to be handled, and the amount of available data is increasing. There is also many people and department with different needs, habits and experience. Changing the business takes a lot of effort and time before everyone adheres to the new way of doing things and adapt to the changes. It is a complex environment where changes take time.

In order to stay competitive constant adaption to changes in the environment are necessary. Improvements in the BI environment can thus always be made. This means that BI projects should never be finished and closed down, but instead constantly improve and change the BI environment along with changing circumstances. BI can thus be seen as a iterative program without finish date.

5.2.3 Why Large Companies do not Improve their BI Maturity

From the in depth interviews three main reasons for not increasing the BI maturity concerning both technical and business aspects were concluded; complexity, high costs, or not useful. Complexity refers to that the taking the step to the next level of BI maturity is too complex. This is often because there is simply too much information to take into account, and all this data accumulated implies slow processes and highly complex BI architecture. It takes highly

advanced technical solutions to consolidate and sort all data. According to company B, there is a question about tradeoff between a compiled, standardized solution and the satisfaction of individual needs. Complexity also comprises large needs for change management. Large companies that have grown through acquisitions of other firms often have a highly complex and varying both technical and business environment, and the change management needs to make new BI solutions work throughout the organization are therefore large. Companies are not hindered by the complexity by default, but the complexity hampers and slows down the BI maturity. High costs refers to that the costs for implementing new BI solutions are often high, e.g. a new ERP-systems or new BI applications have high implementation costs, take long time to develop and make employees use. Also, more costs are often added along the development processes since new needs are discovered, and changes often have to be made once the new system is implemented. Not useful is when there is no strong need for higher BI maturity. E.g. more metadata or better standardization might not matter to the users, or a standard set of statistical reports might be just what is needed and preferred in the company. In other words, the company is not ready for higher BI maturity, and it will not be beneficial to them.

5.3 Business Impact

From the in depth interviews it could be concluded that there are linkages between the examined operational BI challenges and strategic challenges. Inefficient IT-processes affects tactical challenges such as inefficient use of resources, inability to correctly allocate costs, increased time-to-market, decreased flexibility, less information to support aligned processes, less information to support decision making, inability to do customer segmentation, and little market and customer insight, see chapter 4.3.1. For a large company well functioning BI-processes will support success in those areas. Large amounts of data have to be compiled and sorted, which is difficult to do without a well functioning BI environment. The mentioned tactical challenges affect strategic challenges such as inefficient and ineffective processes, which for most large companies are part of the overall strategy. The eight propositions examined in this project are all linked to inefficiency in BI processes, see chapter 4.3.1.

Subsequently, the eight propositions are somewhat affecting large companies even on the strategic level, as illustrated in figure 4.3.1. An efficient BI environment should therefor be considered as an important part of the company strategy, and as something that enables and improves the core processes and overall performance of the company.

Overall, better business decisions are something that cannot be neglected in the long run for any company, and obviously the BI environment plays a main role when it comes to core strategy. The more competitive the world becomes, and the more information access there is, the more important accessible and correct information becomes. For large companies it becomes increasingly difficult to stay competitive without a well functioning BI environment.

6. Conclusions

This chapter presents the conclusions of the thesis and shows how the project adheres with its purpose. Finally, recommendations on future research are given.

A well functional BI environment is essential for large companies due to large volumes of data to handle. The amount of available data increases and it is crucial for companies to take advantage of the information in order to stay competitive. Eight operational BI propositions were identified as common difficulties that hinder efficient BI processes. The propositions are presented in table 6a.

Table 6a: BI propositions

BI Propositions

1. *Retrieving data: Substantial amount of man hours are wasted on retrieving data*
2. *One version of the truth: Multiple definitions on the same object; there is a large need for "One version of the Truth"*
3. *Technologies: Duplicated technologies solve the same tasks*
4. *Competencies: Required BI competencies to satisfy needs are already present in the organization, but still the value is not captured*
5. *Transparency: Low reliability and transparency in data leading to redundant work*
6. *High cost: Few BI consumers per report and low reuse of data give a high cost pr. report*
7. *Reactive rather than proactive: Reporting focused on looking backwards and less on identifying business opportunities*
8. *BI Processes: The organization has a large amount of parallel BI processes, many of those lacking standards, documentation and alignment (EY, 2013a)*

The eight propositions were in general recognized among large Scandinavian companies. It is concluded that the level of recognition varies between the different propositions and the different companies, but only a few companies in

the study had the lowest level of recognition on only two of the propositions. Figure 6a shows the recognition level on proposition 1-7. Proposition 8 was not examined in the survey but it was recognized as a difficulty in all three in depth interviews, see chapter 4.2. Concluding from the survey and the in depth interviews all eight propositions are difficulties that large Scandinavian companies face.
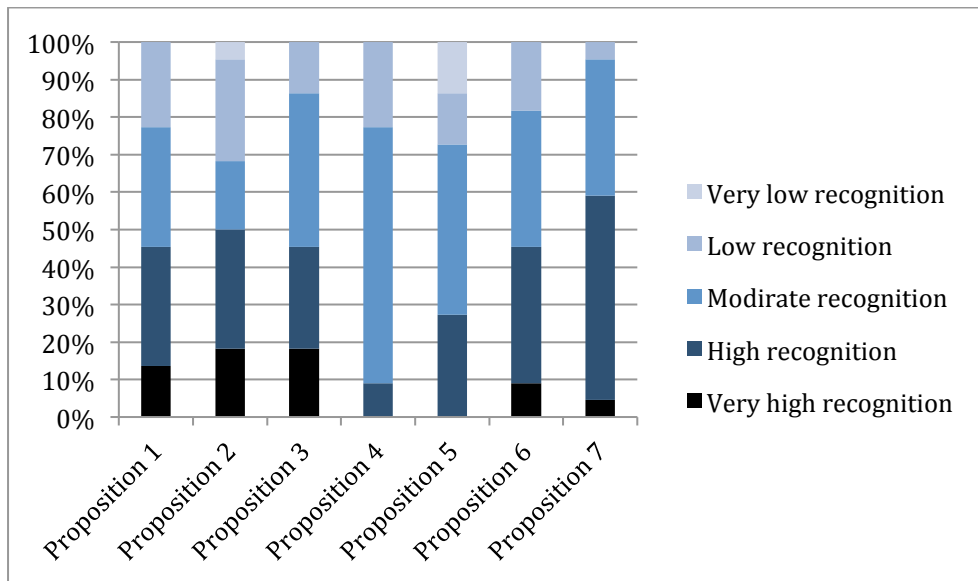
Figure 6a: Recognition level of proposition 1-7

A new BI maturity model is developed that covers all propositions through technical and business sub categories. The recognition level of the propositions are linked to the company's BI maturity level. The higher the BI maturity is within a company, the less the propositions are recognized. The maturity model is shown in table 6b, see chapter 3.8 for more information about the maturity model.

		Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Technology	**Architecture**	Spreadmarts.	Independent data marts.	Independent data warehouses.	Enterprise Data Warehouse.	The BI environment is extended to suppliers and other external actors.
	Standardization	Defined, documented and implemented standards and rules for **no one** of key terms and metrics as well as for technology and tools	Defined, documented and implemented standards and rules for **some** key terms and metrics as well as for technology and tools.	Defined, documented and implemented standards and rules for **half** of the key terms and metrics as well as for technology and tools.	Defined, documented and implemented standards and rules for **most** key terms and metrics as well as for technology and tools.	Defined, documented and implemented standards and rules for **all** key terms and metrics as well as for technology and tools.
	Data Quality	The quality is dependent on the technical programmer analysts and coders. The users can not access any metadata.	There are ad hoc, firefighting, solutions to data quality issues. Metadata reports are produced and distributed periodically.	There are standardized data quality control activities and the owner of the data is responsible for the data quality. There are several metadata repositories accessible for the user.	There are few data quality issues and proactive data quality controls. There is a central repository accessible to the user with up-to-date metadata.	Continually improved and evaluated data quality management processes. The users can easily access up-to-date, relevant, and integrated metadata.
	BI Applications	Use a standard set of statistical reports. Users can access none of the data they need from a single user interface.	Ad-hoc reporting, OLAP. Users can access some of the data they need from a single user interface.	Dashboards and scorecards. Users can access most of the data they need from a single user interface.	Predictive analytics; data and text mining. BI for the masses. Users can access all the data they need from a single user interface.	Closed-loop and real-time BI applications.
Business	**Use of BI**	Ad hoc and random use of BI. Few users per BI report. Only power-users and executives benefit from BI.	BI is used reactively on operational level (fire fighting).	BI is used on tactical level. Knowledge users also benefit from BI.	BI is used proactively, supporting the business strategy. No decisions depend on tacit knowledge.	BI is the founding and driving force of the company strategy. BI optimizes the supply chain.
	Strategic alignment	Information requirements are not defined. End users see the data in an unstructured way.	End users define what information they need and the BI applications are adapted to the specified needs.	The information needs are linked to business processes that support business goals.	End users have a strong understanding of how the BI is supporting business functions and goals.	BI is a core competitive advantage, and is what differentiates the company.
	Acceptance	The users do not trust or use the delivered data due to errors, exceptions, or omissions.	Users trust their own departments/groups BI reports.	Users trust the data more than previous steps, but reconcile the reports with other sources.	The users trust and use the data.	BI is embedded in the company culture. All delivered BI reports are fully trusted and accepted.
	Process Integration	Functional silos.	Understand the business processes but they are not mapped. Business processes are not supported by BI information.	Mapped the processes and information assets. Incorporates BI information in the processes. A BI team governs the BI environment.	Cross-departmental process integration. BI affects the business processes design and how employees work.	Cross-organization process integration.
Change Management						

Table 6b: BI maturity model matrix

The propositions affect the BI processes in the organization and impact the reach of strategic business goals. The business impact of the proposition have been summarized in a pain chain shown in figure 6c. The pain chain illustrates an overview of the business impact of the eight propositions in a general manner, i.e. what impact they might have. The model should be adapted to each organization's specific challenges depending on the nature of the organization.
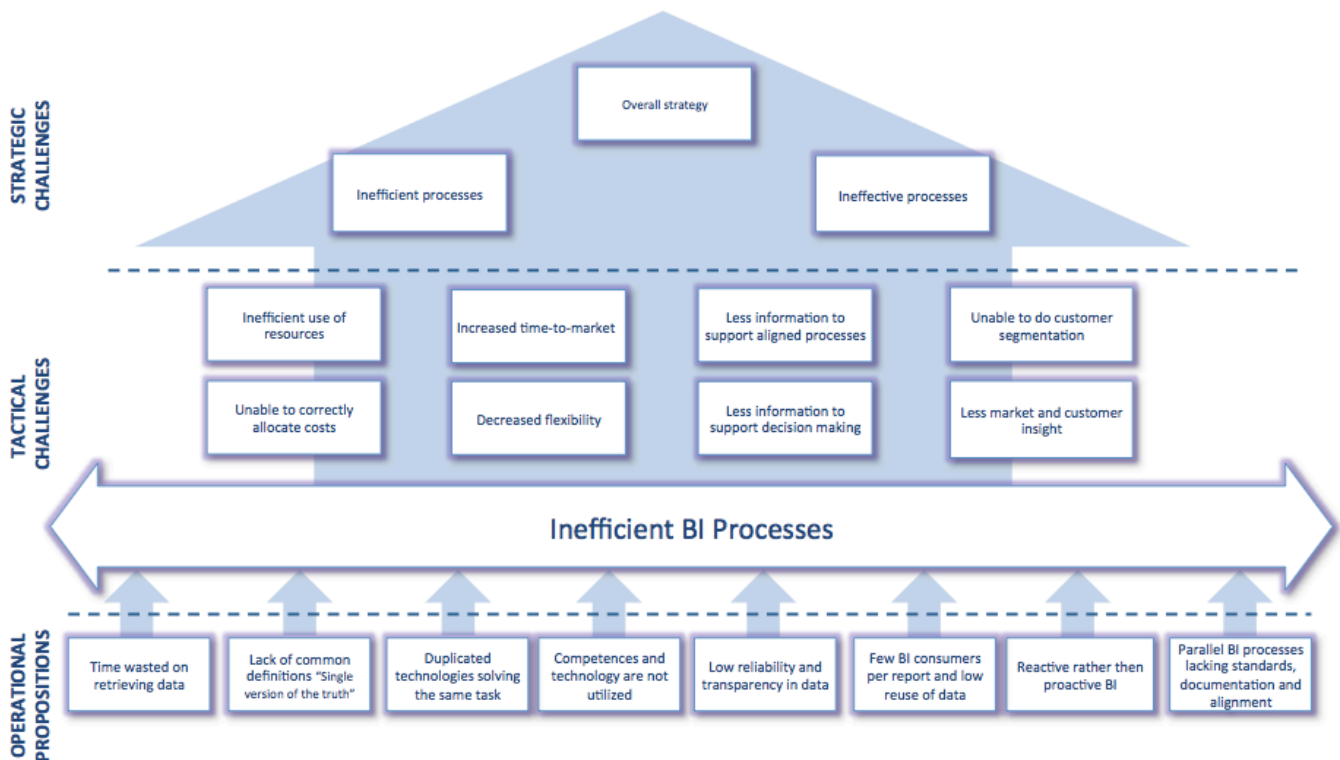
Figure 6c: Business impact of propositions.

In terms on future research a main gap in the BI literature consist in how to measure BI success. There is no commonly accepted definition of successful BI or how to measure BI benefits and costs. As discussed earlier it is difficult to estimate costs for BI investments, and it is even more difficult to discuss potential cost savings that will come with the improved performance. When BI in terms of costs and costs savings was discussed in the in-depth interviews it was concluded that there are tangible cost savings that can be calculated quite well such as savings in hardware, software, and wasted employee resources (e.g. time savings). However, those savings should not be the incentive or main reason for BI investments. The important benefits of BI are intangible cost savings due to

more efficient use of resources and better or more proactive business decisions. If those intangible cost savings were measured and valued it would be easier to argue for investing in BI development. The tangible and intangible BI cost savings were summarized in a table and linked to the eight examined BI propositions, see table 6d. The project team means that to able to better argue for BI investments, the cost savings of BI should be further researched; what are the financial gains that improved BI leads to?

		Proposition 1	Proposition 2	Proposition 3	Proposition 4	Proposition 5	Proposition 6	Proposition 7	Proposition 8
Tangible	Hardware			X					X
	Software			X					X
	Personel (time savings etc)	X	X			X			
Intangible	Efficient use of resources				X		X		
	Better business decitions		X						
	Proactive business decitions							X	

Table 6d: Cost savings related to BI propositions

A learning from the in depth interviews was that BI should not be seen as a project with a beginning and an end but rather as smaller, ongoing projects where the BI teams continuously learns and adapts along with the changing environment. BI should be an ongoing program rather than a time limited project. There are companies with largely scattered IT environments that may need to do large BI projects initially, but they should also be prepared to continue working with BI in an active manner. Successful BI demands continuous adaptions and changes since the business environment is constantly changing. More research on the benefits of continuous BI development is needed

to prove the effect of continuous BI work; what are the benefits of continuous development of BI?

More research is needed outside of Scandinavia in order to confirm the conclusions of this thesis in other countries and continents. Also more research is needed e.g. more surveys and in depth interviews, to better confirm the found results (companies' recognition level of the propositions, their maturity level and the business impact of the propositions). The surveys could contain more response answers and a more precise response scale in order to measure the level of proposition recognition and maturity more precisely. Also the impact of company size and industry should be further examined to strengthen and underpin the conclusions of this thesis. Interviews could be conducted with several employees at the same company and at different levels of the company to increase the objectivity and reliability of the study. The BI environment and challenges is perceived differently depending on whom you are asking, and how that person is using the BI environment. Executives might not have the same view as one lower down in the organization that is using the BI environment differently and maybe more frequently. The perception of BI might also differ between departments and counties.

7. References

Alhyasat, E. B. and Al-Dalahmeh, M., 2013. Data Warehouse Success and Strategic Oriented Business Intelligence: A Theoretical Framework. *Journal of Management Research*. 5(3), pp169-184.

AMR Research: Hagerty, J., 2006. *AMR Research's Business Intelligence/Performance Management Maturity Model, Version 2.* [pdf]Available at:
http://www.eurim.org.uk/activities/ig/voi/AMR_Researchs_Business_Intelligence.pdf [Accessed 21 September 2013].

Barki, H. and Pinsonneault, A., 2005. A Model of Organizational Integration, Implementation Effort, and Performance. *Organization Science*. 16(2), pp.165-179

Chaudhuri, S., Dayal, U. and Narasayya, V., 2011. An Overview of Business Intelligence Technology. *Communications of the ACM*, 54(8), pp.88-98.

Chuah, M-H., 2010. An enterprise Business Intelligence Maturity Model (EBIMM): Conceptual Framework. In: University Tunku Abdul Rahman, Department of Knowledge Science, Malaysia, *Fifth International Conference on Digital Information Management.* Thunder Bay, Canada. 5 May 2010. USA.

Cooper, B., Watson, H., Wixom, B., and Goodhue, D., 2000. Data Warehousing Supports Corporate Strategy at First American Corporation. *MIS Quarterly*, 24(4), pp. 547-567.

Davenport, T. H. and Harris, J. G., 2007. The Architecture of Business Intelligence [pdf] Avalable at:
http://www.accenture.com/SiteCollectionDocuments/PDF/ArchBIAIMS.pdf

Deng, R., 2007. Business Intelligence Maturity Hierarchy: A New Perspective from Knowledge Management. *MDM&Data Governance Summit,* [online] Available at: http://www.information-management.com/infodirect/20070323/1079089-1.html#Login [Accessed 21 September 2013].

Deng, X., and Chi, L., 2012. Understanding Postadoptive Behaviors in Information Systems Use: A Longitudinal Analysis of System Use Problems in the Business Intelligence Context. *Journal of Management Information Systems*. 29(3), pp.291-326.

Drnevich, P. and Croson, D., 2013. Information Technology and Business-Level Strategy: Toward an Integrated Theoretical Perspective. *MIS Quarterly.* 37(2), pp.483-509.

Eckerson, W., 2004. Gauge Your Data Warehouse Maturity. *Information Management,* [online] Available at: http://www.information-management.com/issues/20041101/1012391-1.html?zkPrintable=1&nopagination=1 [Accessed 2013-11-19]

Eckerson, W, & Sherman, R., (2008), Q&A: Strategies for Managing Spreadmarts, *Business Intelligence Journal*, 13(1), pp. 23-24, British Library Document Supply Centre Inside Serials & Conference Proceedings, [Accessed 2013-11-25]

Elbashir, M., Collier, P. and Davern, M., 2008. Measuring the effects of business intelligence systems: The relationship between business process and organizational performance. *International Journal of Accounting Information Systems.* 9(3), pp.135-153.

Eppler, M., 2003. *Managing Information Quality.* Germany: Springer Berlin

Europeiska Kommissionen. 2006. *Den nya definitionen av SMF-företag.* [pdf] Publikationsbyrån. Available at: http://ec.europa.eu/enterprise/policies/sme/files/sme_definition/sme_user_guide_sv.pdf [Accessed 2013-10-04]

EY, 2013a. Master Thesis contents 20120523. [pdf] *EY Advisory Services.* FS BI, EY Copenhagen.

EY, 2013b. Performance Technology, [online] Available at: http://www.ey.com/US/en/Services/Advisory/IT [Accessed 2013-09-12]

Gartner, 2013. Gartner IT glossary – knowledge users. [online] Available at: <http://www.gartner.com/it-glossary/knowledge-users/> [Accessed 2013-10-05]

Graham, P 2008, *'Data Quality: You Don't Just Need a Dashboard*!', DM Review, 18(8), pp. 36-37, Business Source Complete, EBSCOhost, [Accessed 2013-12-10].

Hall, C., 2004. *Business Process Intelligence.* Business process trends. Vol 2. No 6.

Hannula, M. and Pirttimäki, V. 2003. Business Intelligence Empirical Study on the top Finnish Companies. *Journal of American Academy of Business,* 2(2), pp.593-599.

Hagerty, J., 2006. AMR Research's Business Intelligence/Performance Management Maturity Model, Version 2. AMR Research, Inc

Hagerty, J. and Hostmann, B., 2010. *ITScore Overview for Business Intelligence and Performance Management.* [pdf] Gartner, Inc. Available at: http://www.gartner.com/id=1433813 [Accessed 21 September 2013]

Hines, P. and Rich, N., 1997. The Seven Value Stream Mapping Tools. *International Journal of Operations & Production Management.* 17(1), pp.46-64.

HP. 2009. *HP Business Intelligence Maturity Model: Describing the BI journey.* [pdf] Hewlett Packard Development Company, L.P. Available at: http://www.computerwoche.de/fileserver/idgwpcw/files/1935.pdf [Accessed 2013-09-22]

Höst, M., Regnell, B. and Runesson, P., 2006. Att genomföra examensarbete, Malmö: Studentlitteratur.

IBM Institute for Business Value: LaValle, S, 2009. *Business Analytics and Optimization for the Intelligent Enterprise.* [pdf] NY, United States of America. IBM Global Business Services. Available at: http://www-05.ibm.com/de/services/bao/pdf/gbe03211-usen-00.pdf [Accessed 2013-09-18]

Langdale, P 2008, 'Putting intelligence in your supply chain', *Manufacturers' Monthly*, pp. 26-27, Business Source Complete, EBSCOhost, [Accessed 25 November 2013].

Lekvall, P. and Wahlbin, Clas., 2001. Information för Marknadsföringsbeslut. Göteborg: IHM Publishing.

Lönnqvist, A. and Pirttimäki, V., 2006. The Measurement of Business Intelligence. *Information Systems Management.* Winter2006, 23(1), pp. 32-40.

Majchrzak, A. & Qianwei, W. 1996. Breaking the Functional Mind-Set in Process Organizations. *Harvard Business Review.* 74(5), pp.93-99.

Muller, R., Linders, S. and Pires, L. F., 2010. Business Intelligence and Service-oriented Architecture: A Delphi Study. *Information Systems Management.* 27(2), pp.168-187.

Montgomery, D. 2013. *Design and Analysis of Experiments, 8th edition.* Singapore: John Wiley & Sones.

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

Nilsson, B., 2013. Metodikkurs Kursdokumentation. *MIO920 Metodikkurs för blivande examensarbetare.* Produktionsekonomi, Lund University. Unpublished.

Ong, I. L., Siew, P. H. and Wong, S. F., 2011. A Five-Layered Business Intelligence Architecture. *Communications of the IBIMA.* 2011, pp.284-285.

Popovic, A., Turk, T. and Jaklic, J., 2010, Conceptual Model of Business Value of Business Intelligence Systems. *Management: Journal of Contemporary Management Issues.* 15(1), pp.5-29.

Power, D., 2007. *A Brief History of Decision Support Systems.* DSSResources.com, [online] Available at: file://localhost/Users/Sofia/Dropbox/Exjobb/Articles/Power,%202007.html [Accessed 2013-09-19]

Rajteric, H. 2010. Overview of Business Intelligence Maturity Models, *Management*, 15(1), pp.47-67.

Robson, C. 2002. Real World Research. Oxford: Blackwell Publishers.

SAP Thought Leadership., 2009. *Implementing Business Intelligence Standards.* [pdf] SAP AG. Available at: http://www.accelacommunications.com/microsite/biplatform/implement_BI_standards.pdf [Accessed 2013-10-04]

Sherman, R., 2004. Architecture Standards. *DM Review*. 14(5), pp.63-63.

Stiroh, K., 2001. Investing in Information Technology: Productivity Payoffs for U.S. Industries. *Current Issues in Economics and Finance*, 7(6), pp.1-6.

Stoller, J 2009, *Data quality: Familiar problem, new challenges*, CMA Management, 83(7), pp. 37-38, Business Source Complete, EBSCOhost, [Accessed 2013-12-10].

TDWI, 2013. *Business Intelligence*, [online] Available at: <http://tdwi.org/portals/business-intelligence.aspx> [Accessed 2013-10-03]

TDWI Research: Eckerson, W. 2007. *Beyond the Basics: Accelerating BI Maturity.* [pdf] The Data Warehouse Institute. Available at: <http://www.sdn.sap.com/irj/scn/go/portal/prtroot/docs/library/uuid/b070f eb8-ecd4-2910-e9b9-c495b4d30c67?QuickLink=index&overridelayout=true&12962211329836> [Accessed: 2013-09-21]

TDWI Research: Eckerson, W., 2009.*TDWI's Business Intelligence Maturity Model.* [pdf] The Data Warehouse Institute. Available at: http://tdwi.org/pages/posters/business-intelligence-usability/download.aspx [Accessed: 2013-09-21]

TDWI Research: Loshin, D, 2013. *Trusted Information for Analytics.* [pdf] The Data Warehouse Institute. Available at: http://tdwi.org/research/2013/03/tdwi-checklist-report-trusted-information-for-analytics/asset.aspx?tc=assetpg [Accessed 2013-09-18]

Tillväxtverket. 2011. EU:s definition av SMF/SME. *Insatser för tillväxt*, [online] Available at: http://www.tillvaxtverket.se/huvudmeny/insatserfortillvaxt/flerochvaxandefor etag/cipkonkurrenskraftochinnovation/eusdefinitionavsmfsme.4.21099e4211fd ba8c87b800017125.html [Accessed 2013-10-04]

Vasile, G. and Mirela, O., 2008. Data Quality in Business Intelligence Applications. *Annals of the University of Oradea, Economic Science Series*. 17(4), pp.1364-1368.

Watson, H. J., 2009. Tutorial: Business Intelligence - Past, Present, and Future. *Communications of the Association for Information Systems*. Vol. 25, pp.487-510.

Watson, H. J. and Wixom, B. H., 2010, The BI-based Organization, *International Journal of Business Intelligence Research*, 1(1), pp. 13-28.

White, C., 2009, Closed-Loop Business Intelligence: Reality or Simply Another Buzzword? *BeyeNETWORK*, [online] Available at: <http://www.b-eye-network.com/view/10275> [Accessed 2013-10-06]

Wieder, B., Ossimitz, M. and Chamoni, P., 2012. The Impact of Business Intelligence Tools on Performance: A User Satisfaction Paradox?, *International Journal of Economic Sciences and Applied Research.* 5(3), pp. 7-32.

Williams, S., 2011. 5 Barriers to BI Success and How to Overcome Them, *Strategic Finance,* 93(1), pp. 26-33.

Williams, N. and Thomann, J. 2003. *BI Maturity and ROI: How Does Your Organization Measure Up?* [pdf] Gaithersburg USA: DecisionPath Consulting. Available at:
http://www.decisionpath.com/docs_downloads/TDWI%20Flash%20-%20BI%20Maturity%20and%20ROI%20110703.pdf [Accessed 2013-09-15].

Williams, S. and Williams, N., 2007. The Profit Impact of Business Intelligence. San Francisco: Morgan Kaufmann Publishers.

Wixom, B. H. and Watson H. J., 2001. An Empirical Investigation of the Factors Affecting Data Warehousing Success. *MIS Quarterly*. 25(19) pp17-41. Published by: Management Information Systems Research Center, University of Minnesota. Available at: http://hinf551edwcase.wikispaces.com/file/view/3250957.pdf

Appendix 1 – Survey Questionnaire

A1.1 General Questions

1. Which answer best describes your company's industry?

- Industrial Products
- Oil, Gas & Energy
- Financial Services
- Government & Public Sector & Life Science
- Private Equity
- Real Estate
- Retail & Consumer Products
- Technology, Media & Telecommunications
- Other

2. What is your company's annual revenue (in Millions Euro)?

- <50
- 50-500
- 500-2,500
- 2,500-10,000
- 10,000-50,000
- >50,000
- No answer/Do not know

3. How many employees does your company have?

- <250
- 250-500
- 500-1,000
- 1,000-3,000
- 3,000-10,000
- >10,000
- No answer/Do not know

4. What is your position in the company?

- Manager/head of Business Intelligence

- CIO/ Head of IT
- Head of IT - Business Unit/Division
- Other IT Manager
- CFO
- CEO
- Other

A1.2 Technical Questions

5. What best describes your BI/DW architecture?

1. Desktop- or user-generated reports (e.g. Excel Sheets)
2. Multiple, non-integrated data marts or package solutions
3. Multiple, non-integrated data warehouses
4. A single, central data warehouse with multiple dependent data marts (Inmon), conformed data marts (Kimball), or no data marts
5. The single, central data warehouse is extended to suppliers and customers.

6. To what degree has your company implemented standards for the technology and tools that are used in the BI/DW environment?

1. Very low – None defined
2. Low – Defined some
3. Moderate – Defined about half
4. High – Defined most
5. Very high – Defined all

7. To what degree has your company defined, documented and implemented definitions and rules for key terms and metrics?

1. Very low - None defined
2. Low – Defined some
3. Moderate – Defined about half
4. High – Defined most
5. Very high – Defined all

8. To what degree do people and groups in your company adhere the defined standards and rules?

1. Very low – No one adhere or there are no standards
2. Low – Few people and groups adhere
3. Moderate – Some people and groups adhere
4. High – Most people and groups adhere
5. Very high – All people and groups adhere

9. What best describes the BI end users access of metadata?

1. The end users can not access any metadata
2. Some of the end users use metadata reports that are distributed periodically
3. There are several meta data repositories accessible for the end user
4. There is a central repository accessible to the end user with up-to-date metadata
5. The end users can easily access up-to-date, relevant, and integrated metadata

10. To what degree can the BI end users access the information they need?

1. End users can access <u>none of the data</u> they need from a single user interface
2. End users can access <u>some of the data</u> they need from a single user interface
3. End users can access <u>most of the data</u> they need from a single user interface
4. End users can access <u>all the data</u> they need from a single user interface
5. End users can access all the data they need, <u>including real-time data</u>, from a single user interface

11. What best describes the BI applications that are used in your company?

1. A standard set of statistical reports
2. Ad hoc reporting and/or OLAP
3. Dashboards and scorecards
4. Predictive analytics such as data mining and text mining
5. Real-time BI applications

A1.3 Business Questions

12. Who in the organization use the BI reports for decision support?

   1. Top management
   2. Top management and key players in certain business areas
   3. Users throughout the organization to moderate extent
   4. Users throughout the organization to high extent. Few decisions depend on tacit knowledge
   5. Users throughout the organization to full extent. No decisions depend on tacit knowledge. External actors such as suppliers and customers might use the reports

13. What best describes how your company perceives the purpose of your BI/DW environment?

   1. Random resource- An IT system needed to run the business
   2. Operational resource- A tool used for reactive actions, e.g. "fire fighting"
   3. Tactical resource- A tool for tactical decision making and planning
   4. Strategic resource- A tool used proactively for achieving business goals
   5. Competitive resource- A key tool used for gaining or keeping market share

14. To what extent is the BI/DW strategy aligned with the strategic plan of the organization?

   1. Very low - Entirely unfulfilled
   2. Low - Unfulfilled
   3. Moderate - Undecided or uncertain
   4. High - Filled
   5. Very - Entirely filled

15. To what extent is the BI/DW environment aligned with core business processes?

   1. Very low – BI/DW is not used for any core business processes
   2. Low - BI/DW is used for some core business processes
   3. Moderate – BI/DW is used for most core business processes
   4. High – BI/DW is used for all key core business processes
   5. Very high – BI/DW is used for all processes throughout the organization

16. To what extent do the end users trust the data in the BI/DW environment?

1. Very low- End users do not trust the data due to errors, exceptions, or omissions
2. Low- End users often trust the data in their own departments/groups
3. Moderate- End users somewhat trust the data. They reconcile it with more trusted sources before using it
4. High- End users trust and use the data to large extent
5. Very high- End users trust and rely on the data for all critical decisions

17. Indicate the percentage of the BI/DW budget that is spent on change management?

1. < 5%
2. 5 - 15%
3. 15– 30 %
4. 30 - 45 %
5. > 45 %

A1.4 Recognition of Challenges Questions

Indicate on a scale 1-5 to what degree you recognize the following statements? 1 corresponds to completely unrecognized and 5 corresponds to fully recognized.

18. Substantial amount of man hours are wasted on retrieving data (i.e. the end users waste time on retrieving data instead of analyzing data)

1

2

3

4

5

19. There are multiple definitions on the same object and a large need for "one version of the truth"

1

2

3

4

5

20. There are different types of technologies solving the same task, e.g. different departments use different applications for the same purpose

1

2

3

4

5

21. All required BI competencies are present in the organization, but still the business value is not captured

1

2

3

4

5

22. Low reliability and transparency in data, which leads to redundant work

1

2

3

4

5

23. Few BI consumers per report and low reuse of data give a high cost per report

1

2

3

4

5

24. Reporting focused on looking backwards and less on identifying business opportunities

1

2

3

4

5

Appendix 2 – Survey Result

Figure A1a shows the respondents classified by industry and firm size. The size of the answering companies varies, as can be seen in table A1a. They all fit the criteria of large companies, a part from two smaller companies that are also included in the survey. Their results are considered relevant since they are both near the limit of a large company (TIllväxtverket, 2011). Figure A2 provides an overview of the positions/roles of the respondents. All of the respondents are highly familiar with their company's IT landscape and BI environment.
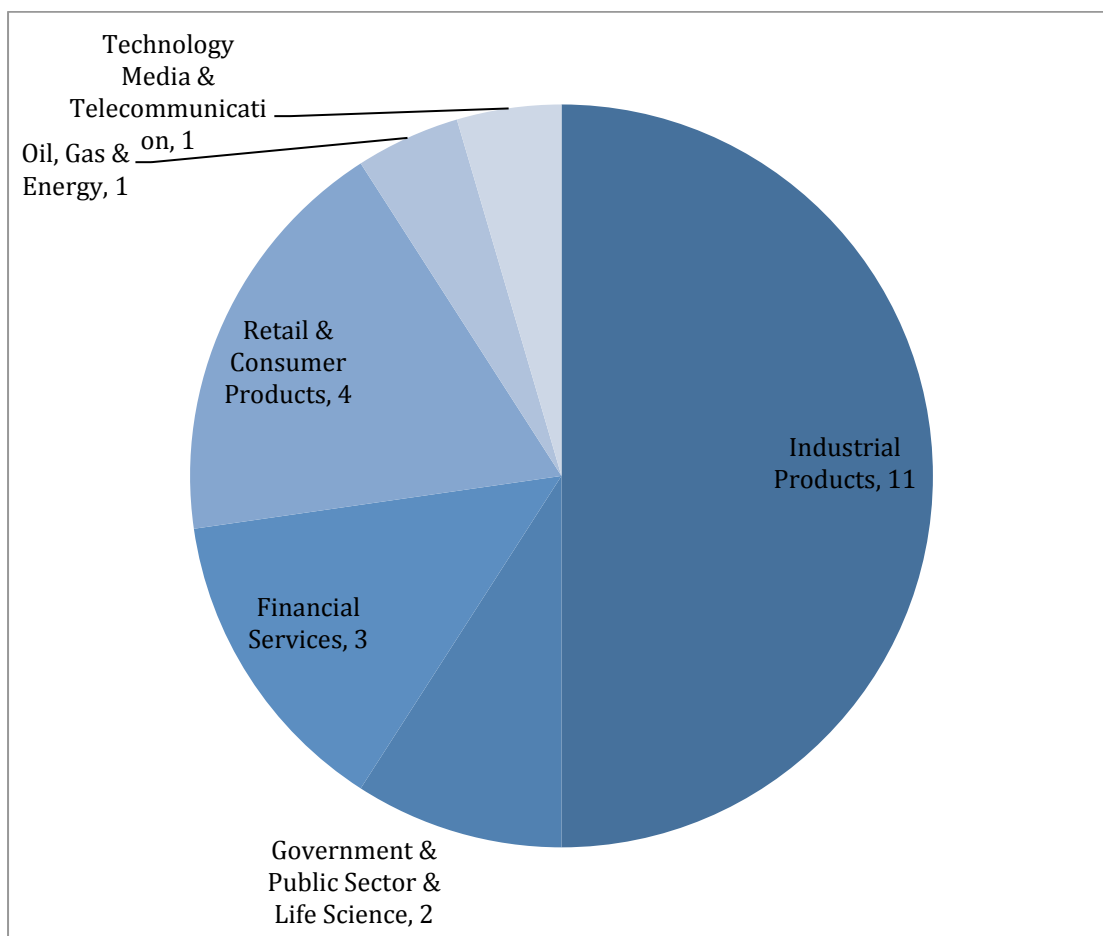

Figure A2 Survey respondents per industry

Annual revenue (in Millions Euro)	N	%
<50	2	9
50-500	3	14
500-2,500	2	9
2,500-10,000	3	14
10,000-50,000	1	5
>50,000	10	45
No answer	1	5
Total	22	100

Number of employees	N	%
<250	2	9
250-500	0	0
500-1,000	3	14
1,000-3,000	2	9
3,000-10,000	4	18
>10,000	11	50
Total	22	100

Table A1a: Respondents by annual revenue and number of employees

Answerer position	N	%
CIO/Head of IT	8	36
Head of IT - Business Unit Division	3	14
Manager/Head of BI	6	27
other IT Manager	2	9
Other	3	14
Total	22	100

Table A1b: Positions/roles that the respondents have in the company

The companies answered 7 questions related to their technical maturity and 6 question related to their business maturity. In table A2b (technical questions) and table A2c (business questions) below the questions and answers are presented for each of the questions.

Question	Answer alternatives	Answers
What best describes your BI/DW architecture?	Desktop- or user-generated reports (e.g. Excel Sheets)	9,09%
	Multiple, non-integrated data marts or package solutions	13,64%
	Multiple, non-integrated data warehouses	45,45%
	A single, central data warehouse with multiple dependent data marts (Inmon), conformed data marts (Kimball), or no data marts	31,82%
	The single, central data warehouse is extended to suppliers and customers.	0%
To what degree has your company implemented standards for the technology and tools that are used in the BI/DW environment?	Very low – None defined	9,09%
	Low – Defined some	22,73%
	Moderate – Defined about half	31,82%
	High – Defined most	36,36%
	Very high – Defined all	0%
To what degree has your company defined, documented and implemented definitions and rules for key terms and metrics?	Very low - None defined	4,55%
	Low – Defined some	40,91%
	Moderate – Defined about half	36,36%
	High – Defined most	18,18%
	Very high – Defined all	0%

To what degree do people and groups in your company adhere the defined standards and rules?	Very low – No one adhere or there are no standards	0%
	Low – Few people and groups adhere	22,73%
	Moderate – Some people and groups adhere	54,55%
	High – Most people and groups adhere	22,73%
	Very high – All people and groups adhere	0%
What best describes the BI end users access of metadata?	The end users can not access any metadata	18,18%
	Some of the end users use metadata reports that are distributed periodically	36,36%
	There are several meta data repositories accessible for the end user	27,27%
	There is a central repository accessible to the end user with up-to-date metadata	9,09%
	The end users can easily access up-to-date, relevant, and integrated metadata	9,09%
To what degree can the BI end users access the information they need?	End users can access none of the data they need from a single user interface	4,55%
	End users can access some of the data they need from a single user interface	50%
	End users can access most of the data they need from a single user interface	36,36%
	End users can access all the data they need from a single user interface	9,09%
	End users can access all the data they need, including real-time data, from a single user interface	0%
What best describes the BI applications that are used in your company?	A standard set of statistical reports	27,27%
	Ad hoc reporting and/or OLAP	54,55%
	Dashboards and scorecards	18,18%
	Predictive analytics such as data mining and text mining	0%
	Real-time BI applications	0%

Table A2b: Question and answers from the survey corresponding to the technical maturity

Question	Answer alternatives	Answers
Who in the organization use the BI reports for decision support?	Top management	4,55%
	Top management and key players in certain business areas	22,73%
	Users throughout the organization to moderate extent	63,64%
	Users throughout the organization to high extent. Few decisions depend on tacit knowledge	9,09%
	Users throughout the organization to full extent. No decisions depend on tacit knowledge. External actors such as suppliers and customers might use the reports	0%
What best describes how your company perceives the purpose of your BI/DW environment?	Random resource- An IT system needed to run the business	13,64%
	Operational resource- A tool used for reactive actions, e.g. "fire fighting"	13,64%
	Tactical resource- A tool for tactical decision making and planning	50%
	Strategic resource- A tool used proactively for achieving business goals	22,73%
	Competitive resource- A key tool used for gaining or keeping market share	0%
To what extent is the BI/DW strategy aligned with the strategic plan of the organization?	Very low - Entirely unfulfilled	9,09%
	Low - Unfulfilled	18,18%
	Moderate - Undecided or uncertain	59,09%
	High - Filled	9,09%
	Very - Entirely filled	4,55%
To what extent is the BI/DW environment aligned with core business processes?	Very low – BI/DW is not used for any core business processes	4,55%
	Low - BI/DW is used for some core business processes	40,91%
	Moderate – BI/DW is used for most core business processes	40,91%

	High – BI/DW is used for all key core business processes	13,64%
	Very high – BI/DW is used for all processes throughout the organization	0%
To what extent do the end users trust the data in the BI/DW environment?	Very low- End users do not trust the data due to errors, exceptions, or omissions	0%
	Low- End users often trust the data in their own departments/groups	4,55%
	Moderate- End users somewhat trust the data. They reconcile it with more trusted sources before using it	59,09%
	High- End users trust and use the data to large extent	36,36%
	Very high- End users trust and rely on the data for all critical decisions	0%
Indicate the percentage of the BI/DW budget that is spent on change management?	< 5%	27,27%
	5 - 15%	31,82%
	15– 30 %	31,82%
	30 - 45 %	0%
	> 45 %	9,09%

Table A2c: Questions and answers from the survey that corresponds to the business maturity

The participating companies then had to indicate on a scale 1-5 to what degree they recognized the propositions. 1 corresponds to completely unrecognized and 5 correspond to fully recognized. In figure A2d the mean recognition of the propositions is shown.
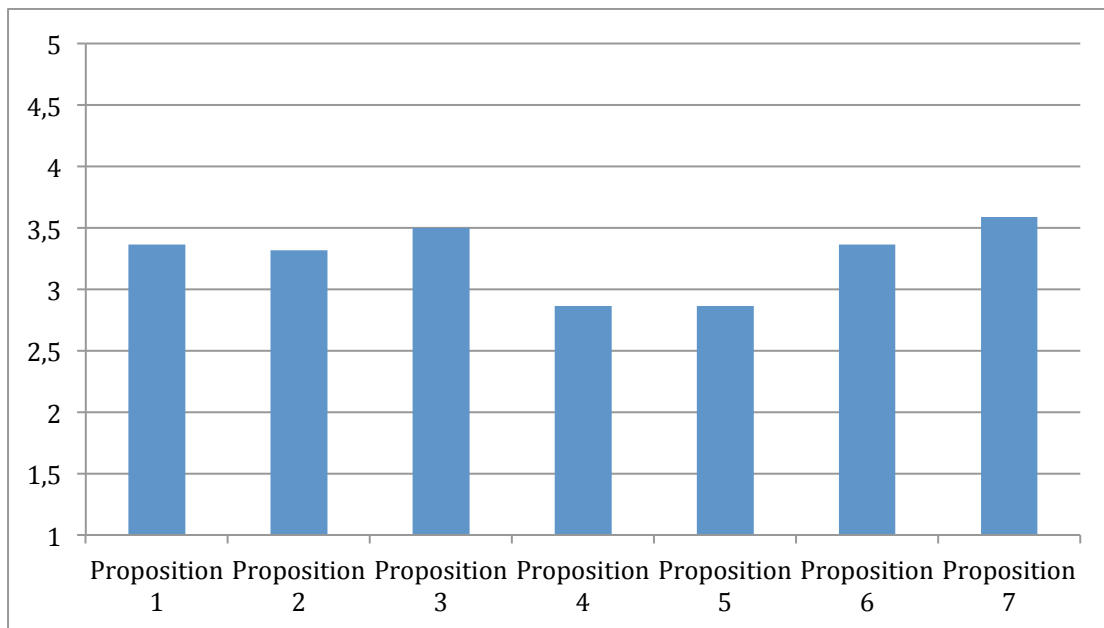

Figure A2d: Mean recognition of the propositions

Appendix 3 – Survey Emails

A3.1 Preparation Email

The preparation email that was sent out 2 days before the survey was sent out is shown below.

(Subject field): Business Intelligence Survey

Dear [%%First Name%%],

In a few days you will receive a survey that we will appreciate if you would participate in. The survey is part of a master thesis conducted at the Faculty of Engineering at Lund University, in cooperation with EY. The object of the survey is to get an overview of the BI maturity and challenges among large Scandinavian companies. The survey will serve as a basis to further investigation in the subject.

As a thank you for your participation you will receive an executive summary of the survey results within two weeks from deadline. It will include your BI maturity compared to other companies in your industry, and with all companies.

It will take you 12-16 minutes to fill out the survey. The deadline for completion is October Xth 2013 at 12.00 CET.

You start the survey by clicking on your unique link here: [%%Survey Link%%]

NB! All persons invited to respond to the survey – including you – have been identified through research and comparisons of all Scandinavian companies.

Thank you for your cooperation.

Best regards
Emma Sikander and Sofia Öberg

A3.2 Survey Email

The email that came together with the survey is shown below.

(Subject field): Business Intelligence Survey

Dear [%%First Name%%],

This survey is part of a master thesis conducted at the Faculty of Engineering at Lund University, in cooperation with EY. The object of the survey is to get an overview of the BI maturity and challenges among large Scandinavian companies. The survey will serve as a basis to further investigation within the field.

As a thank you for your participation you will receive an executive summary of the survey results within two weeks from deadline. It will include your BI maturity compared to other companies in your industry, and with all companies.

It will take you 12-16 minutes to fill out the survey. The deadline for completion is October X[th] 2013 at 12.00 CET.

You start the survey by clicking on your unique link here: [%%Survey Link%%]

NB! All persons invited to respond to the survey – including you – have been identified through research and comparisons of all Scandinavian companies.

Thank you for your cooperation.

Best regards
Emma Sikander and Sofia Öberg

A.3.3 Remainder Email

The remainder email that was sent out to all that had not yet responded three days after the survey was first sent out is shown below.

(Subject field): Reminder: Business Intelligence Survey

Dear [%%First Name%%],

A few days ago you received a survey that we would appreciate if you would participate in. This survey is part of a master thesis conducted at the Faculty of Engineering at Lund University, in cooperation with EY. The object of the survey is to get an overview of the BI maturity and challenges among large Scandinavian companies. The survey will serve as a basis to further investigation within the field.

As a thank you for your participation you will receive an executive summary of the survey results within two weeks from deadline. It will include your BI maturity compared to other companies in your industry, and with all companies.

It will take you 12-16 minutes to fill out the survey. The deadline for completion is October X^th 2013 at 12.00 CET.

You start the survey by clicking on your unique link here: [%%Survey Link%%]

NB! All persons invited to respond to the survey – including you – have been identified through research and comparisons of all Scandinavian companies.

Thank you for your cooperation.

Best regards
Emma Sikander and Sofia Öberg

Appendix 4 - Interview Guide

A4.1 Introductive Questions

1. Shortly describe the goal and proceedings of the thesis.
2. Explain the overall agenda and goal of the interview.
3. Present the IVC and how we perceive the Business intelligence process.
4. How do you work with BI?
    a. What are your BI responsibilities?
    b. How is your BI team organized (cross-organization, size, level of the company etc.)
    c. Are there any currently ongoing BI projects within your company?

A4.2 Maturity Models Questions

1. Present their overall maturity level based on the survey result.
2. Go through the maturity model sub category by sub category.
    a. Where do they believe they are at in each sub category and why?
    b. Why do they not improve?

A4.3 Propositions Questions

1. Discuss their recognition level of propositions according to the survey results. Go through the propositions one by one.
    a. Do they recognize them as big?
    b. What might be the cause of the recognition?
    c. Do they try to reduce the proposition and in that case how?

A4.4 Business Impact Questions

Distribute the pain chain with empty boxes for the tactical challenges.

1. Explain the pain chain.
    a. Do they agree on the strategic challenges?
    b. Do they agree on that the propositions affect IT processes?
2. What tactical challenges do they believe are linked to IT processes?
    a. Together fill out the pain chain.
3. What is your BI budget?

4. Where are the resources placed? (License, training, change management, maintaining, new investments, report making)
5. Who/what group is sponsoring BI projects? (CIO, IT department, top management)
6. How is the impact of BI/ BI success measured? (What KPIs do they use)
7. Do they think the BI investments are successful/ useful enough? (ROI)
    a. Cost savings- in long term or in short term?

A4.5 Other Challenges Questions
1. Are there any other operational difficulties that they face that we haven't discussed?
2. With BI in focus- what are their greatest concerns/challenges? If so, what is preventing them from fulfilling their BI goals?
3. If so, how do these challenges impact the business? Link to strategic level.
4. Is there anything else they would like to add?
5. Inform them that we will be in touch with the outcome of the interview, and that they can contact us if they have any further questions or something more to add.

Appendix 5 - Interview Result

In this paragraph the result from the interviews conducted are presented.

A5.1 Interview with Company A

A5.1.1. Background

Company A is a large, Danish company in the retail and consumer products industry. It has about 41,000 employees and an annual revenue of more than 50,000 millions euro. Company A is present all over the world, though their main focus is in the Western Europe, Eastern Europe, and Asian markets. This is also where all production is located. This in depth interviews focuses on the West European division. Company A has experienced a steady growth, mainly through acquisitions, which has resulted in multiple IT systems within the organization. There is now an ongoing project where standardized processes will be introduced across Western Europe with the roll-out of BSP (Business Standardization Program). As a consequence of this SAP will be implemented as the common software. The goal is to establish a central supply chain to ensure on-shelf availability of Company A's products across Western Europe, to have a consolidated overview of this part of the industry and to use KPSs more efficiently. The common way to operate will provide a more efficient BI solution for the organization as a whole, however each separate country will loose their specially adapted solution, which means the countries' specific performance may decrease.

A5.1.2 Business Intelligence Maturity

Architecture

Due to company growth through acquisitions of other companies there are today many different IT solutions within the company. As for Western Europe, each country has their local DW where information is sent from to the centralized DW. Only information that is valuable to stakeholders are sent and consolidated, which means there is no clear overview of other data e.g. production information. The SAP project will implement SAP as the common ERP system and BusinessWarehouse will be the common BI solution. Only the HR function

will not be part of this standardization project, since they have very different information needs. Currently Company A is at maturity level 3 but the SAP project aims to place them at level 4.

Standardization

Previously the standards for key terms and metrics and technology and tools have differed between different countries, since the BI environment has not been the same. This has caused confusion and difficulties in consolidating different data. Currently Company A is at maturity level 3 but once SAP is implemented there will be general standards for key terms and metrics as well as for technology and tools, i.e. this number will increase.

Data Quality

There are some standardized data control activities and some that is done manually when there have been data quality issues. All metadata comes from SAP and special access is needed to see the metadata. Once an employee has access he/she can also go into SAP and modify data. Therefore access is only given to super users who knows how to handle the data, and who needs to be able to see the metadata. Super users are familiar with SAP and. For other users it is considered sufficient not to access any metadata. Company A are currently on a maturity level of 3 and do not wish to increase this level due to safety reasons.

BI Applications

Such BI applications are in place so that users can access all the data they need from a single user interface. Standard sets of statistical reports are used to a large extent as well as scorecard and dashboards. Company A is currently at maturity level 4.

Use of BI

The finance department use BI in a proactive manner to foresee the future and plan actions accordingly. Decisions are based on BI reports to a high extent. The finance department is at maturity level 4. The sales and supply chain department do not depend on BI as much, since they started applying BI more recently. They use BI in an ad hoc and random way and is seen as "bonus information". Mainly

power-users and executives benefit from BI. The sales and supply chain departments are at maturity level 1.

Strategic Alignment

The current project is closely aligned with the overall company strategy. A more consolidated BI environment will enable performance improvement, efficiency enhancement, and reduced costs. Growing customer demand in Asia will be satisfied through investments and focus on that market. Currently there are a few reports and KPIs produced that are not really required, especially in the supply chain and sales department where BI is newer. Company A is thus currently at maturity level 3, but they aim to increase this number through the project since required KPIs and data will be identified and the applications adapted accordingly.

Acceptance

In the finance department users trust and use the delivered data, and Company A is at maturity level 4. In the sales and supply chain department data users do not trust the data since it does not contain all or the right information they require. The sales and supply chain departments are at maturity level 1, but this number is aimed to increase through the current SAP project since information requirement will be identified so that the BI tools can be adapted accordingly.

Process Integration

BI is mainly separated in different business processes. All processes and information assets are mapped and BI is incorporated in each of the processes. There is an understanding of the overall processes, however there is currently little interaction between them. It is possible to access other departments' reports, but this is not normally done. There is also a BI team that governs the BI environment. The finance department use BI as an integrated part in their business process, whereas for the sales and supply chain departments it is not as integrated. Company A is currently at maturity level 3.

A5.1.3 Operational Business Intelligence Propositions

Retrieving data: Substantial amount of man hours are wasted on retrieving data

This is a challenge at Company A. Many users, e.g. controllers mean that they spend much time making and preparing the reports before using it. However, they do also mean that when preparing the reports themselves they understand the information better and can therefore make better decisions. In that sense, part of their work would include preparing the reports. All the same, users spend time retrieving the data, when they could have used the time for other things.

One version of the truth: Multiple definitions on the same object; there is a large need for "One version of the Truth"

Currently this is a challenge within Company A. The different countries' varying and separated BI systems have caused multiple definitions of the same objects (e.g. how many days is a week and what off invoice incudes). This is a problem that Company A aims to minimize through the implementation of SAP, since standard definitions will then be implemented.

Technologies: Duplicated technologies solve the same tasks

Currently this is a challenge within Company A. The different countries' varying and separated BI systems have ben run parallel producing the same data. Then flat files have been sent to the head office to be consolidated. This has caused redundant work both when preparing the data and when consolidating all the countries' data. This is a problem that Company A aims to overcome through the implementation of SAP, when all countries will be working in the same BI environment, and a better overview of all processes will be available.

Competencies: Required BI competencies to satisfy needs are already present in the organization, but an overview is missing

This is a challenge at Company A, and something they mean is difficult to overcome. Users know that there are BI tools available and how to use them, but since they do not see the bigger picture they do not understand how they could profit them best and make most use of the available information.

Transparency: Low reliability and transparency in data leading to redundant work

This challenge varies across different departments. The finance department mostly trusts data, though there have been occasions when the input data has been incorrect or data has been missing. Since most users prepare the reports themselves they know what they calculate and where the data comes from, and thus trust and use the information. At the sales and supply chain departments users tend to not use the data as much, and they often seek information from other sources as well or make decisions based on other factors such as experience or knowledge.

High cost: Few BI consumers per report and low reuse of data give a high cost per report

This is a main challenge for Company A. Since users modify and make their own reports only they are adapted to their own needs, and only themselves will use it. Consequently the number of BI users per report is low. The SAP project will decrease this problem since a number of standard reports will be implemented, making the reports useful to more users.

Reactive rather than proactive: Reporting focused on looking backwards and less on identifying business opportunities

The BI system is mainly used in a reactive manner for reporting on what has happened. However it is sometimes used more proactively, e.g. in terms of lowering production costs. The SAP project will make it possible to act more proactively since their will bee a better overview of the whole Western Europe organization, which means that the supply chain and production can be better optimized, and actions can be taken through managing resources across countries.

BI Processes: The organization has a large amount of parallel BI processes, many of those lacking standards, documentation and alignment

This is a challenge at Company A. The business units function separately and thus they do not profit from possible synergies in terms of BI. All countries also have their separate BI processes, which means many of them are run parallel.

The SAP project aims to minimize the parallel BI process, and there will be cross-functional standards, documentation and alignment.

A5.1.4 Business Impact

Company A agreed on the strategic challenges in the pain chain model and that the propositions affect IT processes. Important tactical challenges that they face are especially inefficient use of resources, inability to correctly allocate costs, decreased flexibility, increased time-to-market, and less information to support aligned processes. Company A does not measure BI success or impact but rather see it as necessary investments to improve the efficiency and effectiveness in the company. Today the different systems are too scattered and it is difficult to keep a good overview of the company. There is no fixed BI budget but they do believe that change management is important and will invest in this in each company once SAP goes live. Company A mainly invests in BI because of long term cost savings.

A5.2 Interview with Company B

A5.2.1 Background

A5.2.2 Business Intelligence Maturity

Architecture

One of the strategic goals established in 2010 was to implement an enterprise DW, but then it where decided to implement SAP. While waiting for SAP to be implemented it is not worth the investment to try to reach an enterprise DW. The departmental DW is therefore still the main architecture of Company B and they are at maturity level 3. In figure A2.1 below the BI architecture of Company B can be seen.
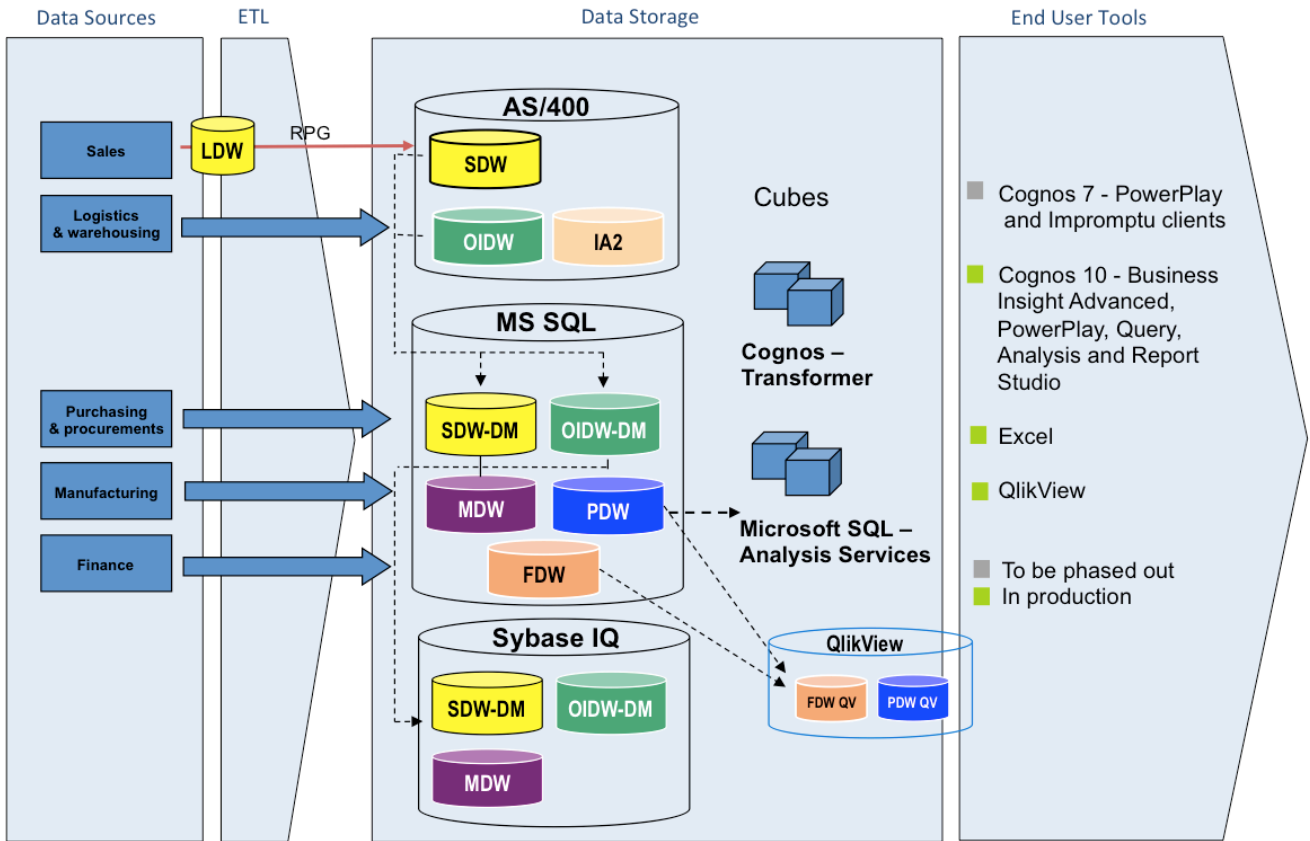
Figure A2.1: BI architecture at Company B

As can be seen the BI environment is very complex. This is only a simplified picture of it. The shortenings in the figure stands for:

- MCSS = Manufacturing Control System
- MPSS = Master Production Scheduling
- COH = Customer Order Handling
- MPSS has different levels ... MF, MV, FV, (PV)
- MP = Masterpiece
- SDW - Sales Data Warehouse
- SDW DM - Sales Data Warehouse Data Mart
- LDW - Local data warehouse (a local part of SDW)
- OIDW - Order & Inventory Data Warehouse
- DWIM - Data Warehouse for Inventory Management (a local part of OIDW, is on its way to be removed and replaced by OIDW DM)
- PDW - Purchasing Data Warehouse
- MDW - Manufacturing Data Warehouse

121

- Supprf - Supplier Delivery Performance (This is a old solution with very ad hoc reports)
- SDP - Supplier Delivery performance (current solution of a dashboard with only standardized reports)
- FDW - Finance Data Warehouse
- FDW QV - Finance Data Warehouse QlikView
- CustServ - customer satisfaction

Standardization

Technology and tools are mostly standardized, e.g. 95% use Cognos as the analytical application. There are some local solutions that differ. In terms of key terms and metrics the level of standardization is low. However, Company Bmean that the users know what they are doing and that there is no real need or demand from management to increase standardization. Company B is currently at level 3 looking at the key terms and metrics while the technology standardization is reaching maturity level 4.

Data Quality

There are some standardized data control activities (e.g. identifying entries that deviates beyond a specific tolerance level, checking that data is correctly loaded into repositories). Other control activities such as automatically measuring order values measurements are difficult to do due to too many product types with different correct values. Metadata is generally not available to users. In some cubes there have been incentives to add descriptions about the data, but it has not been prioritized since there have been other more urgent issues. Company B means that there is currently no need for making metadata available to users, since they trust that the data is correct. Company B is currently at level 2.

BI Applications

Company B has started to use dashboards and scorecards in order to provide all users with the same information. Currently all users have access to the DW and they build and modify their reports themselves, which is something a standardization project aims to minimize. Company B is currently at level 3 but might increase because they will develop more dashboards and scorecards that

will satisfy the needs of most users.

Use of BI

BI information is used in a both reactive and proactive manner at Company B. Users throughout the organization use and benefits form BI, also knowledge users. Company B is currently between level 3 and 4.

Strategic Alignment

The BI environment is supporting business processes and there is ownership of the BI initiatives. Company B is currently at level 3.

Acceptance

There have been a few issues in terms of data quality but generally there are little omissions and errors in the data and information. But when it occurs there might take some time to regain the trust from the users. Users generally trust and use the data. Company B is currently between level 3 and 4.

Process Integration

Mainly the BI environment is integrated in each separate business process but there is some information exchange between individual processes. The information assets as well as the processes are mapped. Company B is currently at level 3.

A5.2.3 Operational Business Intelligence Propositions

Retrieving data: Substantial amount of man hours are wasted on retrieving data

This is a challenge at Company B. The users generally modify and build their own reports, which leads to much time spent on retrieving data. The users are used to the flexibility of being able to create the exact report that they need. A current BI project aims to reduce this time. There will be more standardized reports that the users can use as they are.

One version of the truth: Multiple definitions on the same object; there is a large need for "One version of the Truth"

This is not a main challenge at Company B, but there are issues when different formats lead to confusion on specific objects.

Technologies: Duplicated technologies solve the same tasks

There are some duplicated technologies, e.g. Qlikview is used in some business processes. The technologies are overlapping and often providing the same information. At some departments it might be necessary to have different technologies but overall Company B aims to have one technology throughout the organization. Duplicated technologies imply higher costs in terms of software license and more required knowledge and training since users and developers must be able to understand multiple systems.

Competencies: Required BI competencies to satisfy needs are already present in the organization, but an overview is missing

This is a challenge for Company B. Many employees use old versions of tools they in a way they have always done, and they do not know how they could best profit from the BI environment. The users must be educated so that they can use the new tools. An education plan for the more up to date tools is planned for next year and will improve this situation.

Transparency: Low reliability and transparency in data leading to redundant work

This is not seen as a challenge within Company B since users trust the data to large extent, even if e.g. the metadata is not accessible to large extent. Users still base their decisions on the provided information.

High cost: Few BI consumers per report and low reuse of data give a high cost per report

This is a challenge for Company B. Since the users make and adapt their reports themselves the reuse of the reports is low. There is continuous work being done in this area, and it will be even further improved when SAP BW is rolled out. The SAP project will establish a standard set of reports, which will reduce the numbers and costs of licenses and enable more users to use the same reports and higher reuse of data.

Reactive rather than proactive: Reporting focused on looking backwards and less on identifying business opportunities

This is not a big challenge for Company B. BI information is used proactively

when it is possible and useful.

BI Processes: The organization has a large amount of parallel BI processes, many of those lacking standards, documentation and alignment

This is not a big challenge for Company B. The BI processes are sometimes parallel in separate business processes, but they are well aligned and there are implemented standards for how the users should build and load information and data.

A5.2.4 Business Impact

Company B agreed on the strategic challenges in the pain chain model and that the propositions affect IT processes. Important tactical challenges that they face are especially inefficient use of resources, inability to correctly allocate costs, decreased flexibility, inability to do customer segmentation, less market and customer insight, and less information to support aligned processes. Company B have tried to measure the cost savings related to BI through hardware savings etc. but they mean that those are short term savings that should not really be the goal of the investments. Unfortunately it is difficult to estimate the long term savings and because of this it is difficult to use as an argument for the top management. Therefore mainly smaller amounts of money is able to get from the top management, and they apply for money little by little. Company B underlines that there must be a better communication between the IT and business side of the BI projects. The IT department often do not realize what needs to be done. This means that even though they do have the competencies to do changes and develop the systems, they do not since they are not aware of that it is needed. BI changes are crucial in the company now since they experience very slow processes due to the cubes.

A5.3 Interview with Company C

A5.3.1 Background

Company C is a Danish company providing drilling services to oil companies all over the world. They have approximately 3,300 employees of which about 80% work offshore on oilrigs. Company C is a part of a large concern with several units and has their head office in Denmark. Only specially approved electrical

equipment is allowed on the drill floor where the operations take place. This means that employees cannot use standard office tools as PCs, laptops or tables to access performance data while working on the drill floor. Instead the information (mostly KPIs) is displayed on a board in meeting areas and on the computers in the office. Company C is currently changing ERP system from SAP to IFS, which is planned to go live in late 2014. Today they use Microsoft as a BI solution, which they will keep.

A5.3.2 Business Intelligence Maturity

Architecture

The different business units in Company C do not share the same data warehouse apart from a few exceptions e.g. HR. This is due to that the different business units have different needs and there are few benefits of having a common data warehouse for all of the units in Company C. It would be a complex enterprise warehouse that mostly benefits the biggest units, since the other units would have to wait for them. Company C has a main data warehouse that is used by almost all departments. Company C is looking into sharing their data somewhat with their customers and suppliers. They are currently having a pilot project where they are sharing data with an equipment supplier to do proactive maintenance. Company C is on maturity level 3 but is increasing toward maturity level 4 due to the implementation of the new ERP system. The aim is to reach maturity level 5.

Standardization

All the KPI are well standardized and documented. There are some key terms that still are used differently between the different departments in Company C e.g. down time of the drilling equipment. The metrics used in the ERP systems and the KPIs are defined but there are still some terms and metrics that are not defined. The standardization of key terms and metrics are on a maturity level 4. The standardizations of technology and tools are weaker and reach maturity level 3. The BI reporting has been running department-by-department and therefore there are several techniques and tools used. They are currently having vast amount of systems in their IT landscape including oracle, Qlikview, SAP

Microsoft etc. They are now trying to make the list shorter although it is hard to make everyone agree and accept. They cannot keep on running the BI as departmental projects, they have to be consolidated. The maturity of the technology standardization might increase when the new ERP system is in place. The aim is not to have a too strict tools and technology standardizations because this might decrease the agility of the systems.

Data Quality

There are standardized data control activities (e.g. customers check and sign data, "outlier reports" that identify entries that deviate beyond a specific tolerance level, and manual verifications where data quality is an issue) that proactively improve the data quality. Some data quality issues remain and they work on making metadata more visible and accessible (this drives a higher degree of ownership and quality input from users). All the data included in the KPI has well-documented and available metadata in a PowerPoint including sources and how it has been calculated. This has been used in operation for a couple of years and is helping building trust to the data. The metadata makes it easier for non-knowledge users to understand the data. The data that is not included in the KPI lack accessibility of metadata. Currently Company C has maturity level 2. They would have to make the metadata more accessible and user friendly to reach higher maturity, preferably through more technically advanced metadata.

BI Applications

Company C is using dashboards, scorecards and reports and is on maturity level 3. All users can access the scorecards through a portal. Other data and underlying cubes are not accessible to users although it would be preferable. Some information is not available due to restrictions and security e.g. financial information. Company C is not aiming for real time (in operations) due to safety reasons. The employees should not risk distraction during the operation itself, but only as part of a post-operation analysis.

Use of BI

The utilization rate of BI is high throughout the whole organization. Much of the reporting consists delivering KPIs, which shows what happened and not what is going to happen. However the data is also used as a tool for maintenance, looking at what actions to take in the future. This is important since the maintenance planning is essential to maintain low downtime of the drilling. They want to maximize the drilling time and the ultimate goal is to drill 24 hours a day. The aim is to use the data to do forward planning and they are currently on maturity level 3.

Strategic Alignment

The BI initiative in Company C is a top down project. It did not start as an IT project but as a performance management project. The performance drivers were identified, the processes were looked at and mapped, and then it was concluded what reports were needed. The BI solution was thus developed to support the performance and create better visibility of the organization. The employees understand how BI is supporting the organization on the high level. There is a high strategic alignment and they therefore reach maturity level 4.

Acceptance

The workers trust the data to high extent, but sometimes reconcile the correctness of the data with other data sources before trusting it. This indicates a maturity level 3. The trust in the information has increased over time and Company C has seen that it has increased a lot with increased data quality. Decisions are rarely based on pure data, factors such as personal experience and knowledge, and how and by whom the information is presented also matters in the decision process. Company C means that "people don't trust data, people trust people". There is a general acceptance of how executives make decisions and the issues they decide on seem so complex that data alone is insufficient as a decision base. Because of this it is extremely difficult to reach maturity level 5 where BI information drives the business and is the sole decision factor, and as for Company C, this is not something they strive for.

Process Integration

Company C underlines that it is not about having fancy tools and applications, it's more important that the information is used in the processes. About 60% of the BI effort is put on the use of information and taking action. Each BI project has an owner on the IT side as well as on the business side. The company is currently at maturity level 3.

A5.3.2 Operational Business Intelligence Propositions

Retrieving data: Substantial amount of man hours are wasted on retrieving data

The data that has been inserted and mapped in the DW is easy to find and use. The data that has not yet been inserted and mapped in the DW is hard to find and thus time consuming for the user. This challenge is depending on the maturity of architecture and the applications available to the user.

One version of the truth: Multiple definitions on the same object; there is a large need for "One version of the Truth"

Since different departments define key terms and metrics differently Company C do have some confusion issues between departments. Sometimes different departments have different views of numbers of the same thing (e.g. downtime). However, "one version of the truth" is not seen as a major problem since when working across departments the users are often aware about the different definitions.

Technologies: Duplicated technologies solve the same tasks

As explained earlier there are several technologies used in the organization, some of them solving the same task. The aim is to reduce the number of different systems. The problem is largely affected by the maturity in architecture, technology standardization and applications.

Competencies: Required BI competencies to satisfy needs are already present in the organization, but an overview is missing

This is not seen as a problem at Company C, actually they would describe it to be the opposite. The company is lacking competences and technology to move further in maturity. They will need to invest in more advanced technology (e.g.

data mining, predictive analysis etc.) and hire people that have the knowledge to do the maintenance and analysis, such as statistical knowledgeable persons.

Transparency: Low reliability and transparency in data leading to redundant work

There is a high reliability in the data that is mapped and where they have metadata available. Thus this is not seen as a main challenge at Company C. They do however underline that there are still several reports that could be used but are not produced due to lack of data input. There are still functions that are not covered in the BI system. In those cases the reliability of data is much lower.

High cost: Few BI consumers per report and low reuse of data give a high cost per report

This is not an issue because the reports/KPI that is produced is well integrated in the performance processes and the users trust and use the data. There are sometimes reports that are not used as much or even not at all, and in those cases the cost per report is higher. However, this is not considered a big problem at Company C.

Reactive rather than proactive: Reporting focused on looking backwards and less on identifying business opportunities

Company C are currently working on this issue. According to them, this should be seen as an opportunity rather than a challenge. They have recently achieved a high enough BI maturity to explore this opportunity, and starting to look into how to use BI reports to plan ahead (e.g. maintenance projects).

BI Processes: The organization has a large amount of parallel BI processes, many of those lacking standards, documentation and alignment

There are parallel processes in the company due to different business problems needing to be solved. They will try to eliminate some of them, but there will always be a few parallel BI processes in the company since the information requirements differ. The alignment between the processes has room for improvement, which is depending on standardization and architecture.

A5.3.3 Business Impact

Company C agreed on the strategic challenges in the pain chain model and that the propositions affect IT processes. Important tactical challenges that they face are especially less information to support decision-making, inability to correctly allocate costs, decreased flexibility, inability to do customer segmentation, less market and customer insight, and less information to support aligned processes. Company C's work with BI started out as a performance management project and they therefore believe that their BI is well aligned with the business needs and strategic goals of the company. In Company C BI is seen as an iterative program and small investments are made continuously. They believe this is the best way to work with BI since there is always a need for modifications and adaptions.