UNIVERSITY OF AGDER

Real Time Business Intelligence and Decision-Making

How does a Real Time Business Intelligence system enable better and timelier decision-making? An exploratory case study.

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This Master's Thesis is carried out as a part of the education at the University of Agder and is therefore approved as a part of this education. However, this does not imply that the University answers for the methods that are used or the conclusions that are drawn.

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Preface

This master' thesis has been written as a final report in the masters degree program of Information Systems at the University of Agder. The University of Agder describes the course of IS-501 as: *The Master's thesis provides an opportunity to work in-depth with a specific subject area while carrying out a project for a public or private organization. Students will gain insight into applying theoretical knowledge and scientific methods to a specific problem* (University of Agder).

The master thesis has been prepared as an exploratory case study and conducted in a construction and home improvement supplies company in the south of Norway. The CIO of Byggma ASA, Roy Kenneth Grundetjern was interested in our topic. Together with the other managers of Byggma ASA he had a desire to receive more accurate and fresh information from their daughter companies.

We would like to thank all contributors for the great response and valuable support. We are especially grateful for the priority this thesis have been given by the involved parties: Roy Kenneth Grundetjern, CIO of Byggma ASA and the interviewed staff of Fibo-Trespo AS, Huntonit AS and Uldal AS. Thank you to Finn Christiansen, who has done a great job of proofreading our thesis to ensure quality of the thesis.

We would also like to thank our supervisor, Associate Professor Dag H. Olsen for support and guidance throughout this course of study.

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Executive Summary

Today's businesses need support when making decisions. Business intelligence (BI) helps businesses to make decisions based on good pre-analysis and documented data, and enables information to be presented when and where the decisions need to be made. Real time business intelligence (RTBI) presents numbers in real time, providing the decision makers at the operational and tactical layers with data as fresh as it can be.

Little research has previously been done on how a real time business intelligence solution can benefit an organization in means of changing current decision processes. This thesis aims to show why there is a need for a real time business intelligence solution and how that can change the current decision processes and make them more efficient. Further it indicates that there are challenges to the current decision processes that need to be addressed.

This study has been conducted as a qualitative exploratory case study in the Byggma group, with 16 face-to-face interviews at the three plants of Huntonit AS, Fibo-Trespo AS and Uldal AS, and an additional meeting observation at Fibo-Trespo AS. The interviews were conducted in two phases. The first phase included 13 interviews that focused on the needs for a decision support system and the knowledge level in the organization. The second phase was conducted by selecting three specific respondents from the first phase that were given different scenarios to describe the current decision processes in detail by using an interview method called the thinking-aloud-event-protocol. This phase also included the meeting observation at Fibo-Trespo AS.

The results indicate that many decision processes were affected by the lack of fresh and reliable data available to the decision-maker. The factor of intuition, especially the use of a "gut-feeling" was a contributing factor to the decision processes and a factor that the plant directors would usually approve of. The research showed that there is a need for a real time business intelligence solution because the employees do not have the most reliable and fresh information to make decisions at the operational and tactical layers. Furthermore there were challenges with the current decision processes that would also need to be addressed in order to change the current processes.

The study concludes that a real time business intelligence solution would be beneficial for supporting the operational and tactical layers of decision-making within an organization. By implementing an RTBI solution, it would provide the decision-maker with fresh and reliant data to base the decisions on. Visualization of the current decision processes showed that by adding a real time business intelligence solution it would help eliminate the use of intuition, as there would be more data available and the decisions can be made where the work is performed. Furthermore the results show that there are potential challenges with the current decision processes that need to be addressed in order to achieve the benefits of such an implementation:

- Processes need to be automated.
- There needs to be agreement on what should be measured in real time.
- Employees need to be ensured they will not loose their relationship to the numbers.
- There is a need for a data warehouse in the current IT architecture.

The case study contributes to research by visualizing how a real time business intelligence solution can shorten a complex decision process by giving the correct information to the right people. It also shows that factors used when there is not sufficient information available, can be eliminated. Further it suggests that organizations need to address potential challenges as part of a pre-project of a real time business intelligence implementation.

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1 Introduction

Technology is changing rapidly, and IT is becoming a more integrated part of businesses' strategies and vision. As businesses are becoming more and more competitive, there is a need for technology that can assist businesses in reaching their goals and to be able to compete in a rougher market. In order to do that, decisions has to be made at a fast pace, with sufficient and reliable data.

"Companies that are able to effectively harness the copious amounts of information IT systems generate will have the inside track on the competition: Gaining better understanding of customer needs, identifying trends earlier, and using the resulting lead time to capitalize on opportunities." (Tapscott, 2008, p. 1).

To assist businesses with decision-making, decision support systems (DSS) were introduced at the beginning of the 70's (Frolick & Ariyachandra, 2006). Olsen (2011) describes decision-making as: "*… a process where an individual or a cluster of individuals recognizes a choice or judgment to be made"(p. 1).* The person that is faced with the initial problem is called the decision-maker, and the existence of a problem is because the decision-maker has desires to achieve some state of affairs (Cleland & King, 1983).

There are several factors that are affecting the decision-making within organizations, and two of these factors are intuition and rationality (Sadler-Smith & Shefy, 2004). Research has shown that the use of "gut-feeling" in strategic decision-making is especially prevalent within the computer industry, but that it is still important in other industries. It is also a factor that is accepted by senior mangers in regards to making decisions (Khatri & Alvin, 2000). According to Eisenhardt (1989): *Fast decision makers use more, not less, information than do slow decision makers. The former also develop more, not fewer, alternatives, and use a two-tiered advice process"(p. 543).*

By using a decision-support system, one will be able to reduce the use of factors such as intuition when making decisions, by having a better data foundation to base the decisions on. One decision support system that is becoming more and more used is business intelligence (BI). Business intelligence can be defined as: *"…the process of turning data into information, and then turning it into knowledge (Golfarelli, Rizzi, & Cella, 2004, p. 1),* and it is a process that involves getting data in and getting data out (Watson & Wixom, 2007). Managers early on desired a system that could help them analyze their data efficiently and effectively because they wanted to know the situation their business was in, and that is how BI was born (Golfarelli et al., 2004).

By adding an additional layer to business intelligence, the real time layer, you get real time business intelligence. With the real time layer businesses will be able to receive fresh and accurate data at all times, to support their decision-making processes connected to their strategies and goals. Such a system can help eliminate blind spots within the organization, and help gain competitive advantage (Turban & Volonino, 2010).

By having accurate, fresher and a bigger amount of data, businesses will be able to make decisions in a faster pace, and eliminate tedious complexity of the decision-making process.

1.1 Motivation

As students in the masters' degree program of Information Systems at the University of Agder, we were introduced to the topics of decision-making and business intelligence. We were able to do term projects and assignments on these topics, and in addition a case study with an organization that had implemented BI at the top management level. These were contributing factors that made us interested in real time business intelligence. The idea of having continuous and fresh data triggered our interest in how that could affect decision processes within an organization and how it could help them gain competitive advantage.

By doing term projects on these topics, we became interested in seeing how decisions are made in organizations today, and what type of factors that are actually affecting these decisions when one does not have sufficient or reliable data to base decisions on. Further, we have an interest in researching how an implementation of a decision support system such as real time business intelligence (RTBI) can help eliminate the affecting factors in the decision-making process and increase the efficiency of the business.

For us as researchers we are also interested in these topics because real time business intelligence is a fairly new trend in relation to previous research, and we would like to add to that research.

1.2 Research Question

There has been little research on real time business intelligence implementation in practice, and how it affects business processes and decision-making processes. Wixom et al. (2004) presents us what lessons Continental Airlines learned from implementing real time business intelligence, but we have not been able to find any research addressing what actual benefits a real time business intelligence implementation can have on current decision processes. To better understand the potential of real time business intelligence in a construction and home improvement supplies company, we have decided on the following topic for our thesis: How does a real time business intelligence system enable better and timelier decision-making. To answer this we need to look at how such an implementation will affect the current decision-making processes, and what potential benefits one can gain from the implementation.

Based on that, we will answer the following research questions:

1. What are the needs and benefits of a real time business intelligence solution to support decision-making?
2. How does the introduction of real time business intelligence affect the decision-making processes?

1.3 Structure of this thesis

This is a guide for the reader, and shows how this thesis is structured from start to finish.

Theory

This chapter takes the reader through relevant theory to understand more about the complexity of a decision-making process and how business intelligence and real time business intelligence can support this process. The chapter also explains relevant theory on key performance indicators, data warehousing, architecture and how to succeed with a BI-implementation.

Research Approach

The research chapter is a descriptive chapter of our research approach used in this thesis, techniques, strategy and the methodical approach. It also presents the companies and corporation where the research was conducted, as well as our role as researchers.

Results Phase 1

Phase 1 shows the initial results of the first round of interviews. These findings have been divided into 6 sub chapters; Challenges, Necessities & Usefulness, Organizational Differences, Competence, Indicators, and IT architecture.

Results Phase 2

Phase 2 is the second round of interviews conducting in this research, and focuses on the decision processes within one plant, as well as a meeting observation done at the specified plant.

Analysis & Discussion

In this chapter, the results of the research are analyzed and discussed compared to relevant literature from the theory chapter. The focus is on the decision processes, the situation without a decision support system and how the situation can be with a decision support system.

Conclusion

The conclusion of the research is presented in this chapter. The conclusion is based on the results, analysis and discussion in the previous chapters and focuses on how the implementation of a decision support system can provide managers and employees with a better foundation for decision-making, and what changes will occur within the organization.

Implications

This chapter focuses on implications for further research in the field of decision-making, business intelligence and real time business intelligence. It also implies what could be interesting to research in future masters' thesis'.

Limitations

The limitations of the research are presented in this chapter.

1.4 Terminology

This thesis contains a number of terms (table 1), which is summarized in this chapter. The terms will be used later in the report.

Table 1 - Terminology

Term	Explanation of term
API	Application Programming Interface
ARIS	Architecture of Integrated Information Systems
BI	Business Intelligence
BPM	Business Performance Management
BPM	Business Process Management
BPO	Byggma Process Optimization
BPR	Business Process Reengineering
CIF	Corporate Information Factory
CIO	Chief Information Officer
CRM	Customer Relationship Management
DSI	Decision Support Interface
DSS	Decision Support System
DW	Date Warehouse
EDI	Electronic Data Interchange
EIS	Enterprise Information System
ERP	Enterprise Resource Planning
ETL	Extract, Transform & Load
GUI	Graphical User Interface
HMS	Health, Environment and Safety (Norwegian: *Helse, Miljø og Sikkerhet*)
IFS	An ERP system
IS	Information Systems
KPI	Key Performance Indicator
LEAN	Process oriented manufacturing methodology
OEE	Overall Equipment Efficiency
OLAP	Online Analytic Process
OLTP	Online Transaction Processing
OPM	Operational Performance Management
PMS	Performance Management System
POS	Point of Sale
ROLAP	Relational Online Analytic Process
RTBI	Real Time Business Intelligence
TAEP	Thing Aloud Event Protocol

2 Theory

2.1 Decision-Making

Decisions are being made in organizations every day, both small everyday decisions and decisions related to the organization's strategy. According to Cleland & King (1983) any decision problem involves several important elements, and a decision may be viewed as the final outcome of a process, or a choice between various options, and the option you choose involves a commitment to an action (Jacobsen & Thorsvik, 2007; Olsen, 2011). According to Olsen (2011): *"Decision making can be described as a process where an individual or a cluster of individuals recognizes a choice or judgment to be made" (p. 1).*

Within decision-making, there are three important points that must be addressed when it comes to information; Information collection; systemizing, analyzing and interpreting the information; and then communicating the information to the right decision-making forums (Jacobsen & Thorsvik, 2007). The decision-process can be seen as a unity of pre-decision, decision and post-decision stages (Zeleny, 1982).

The person that makes the decisions is called the decision maker, and that person is faced with the initial problem (Cleland & King, 1983). "*The decision maker's desires to achieve some state of affairs – objectives - are the reason for the existence of a problem" (Cleland & King, 1983, p. 85).* According to Cleland and King (1983) these objectives should have a connection with the organizations overall strategy and goals. The heart of any decision problem is that there are alternative actions to take, and a state of doubt as to which action is the most suitable one (Cleland & King, 1983). Keeney (1994) however, argues that it is values and not alternatives that should be the primary focus of decision-making. Michael Hammer (1990) introduced his principals of reengineering in 1990, and of them was; "*Put the decision point where the work is performed and build control into the process" (p. 111).* With businesses having a hierarchical structure, the decision-makers are often the managers, and Hammer believed that the persons that actually work on the specific process should have the power to make decisions regarding it, because they have more knowledge. By doing this, Michael Hammer indicated that one would get a flatter organizational structure (Hammer, 1990).

Furthermore, we can also say that there are two basic approaches to decision-making, the outcome-oriented approach and the process-oriented approach (Zeleny, 1982). In the outcome-oriented approach, the approach is understood if one can predict the right outcome, and an example of this can be using a normative decision analysis to help predict the outcome (Zeleny, 1982). The process-oriented approach is one where the process is in center and that knowledge of the specific process will help make the decision, and this approach has descriptive, prescriptive and normative features (Zeleny, 1982).

Zeleny (1982) says that although decision trees can be used when making decisions, they should not be used when it comes to dealing with complex decisions. It is also important to have in mind what kind of environment these decisions are being made in, because that can actually affect the decision-making.

2.1.1 Intuition and Rationality

As businesses and their environments are becoming more and more complex and unpredictable, there is a demand for faster and more accurate information for the decision-maker. However, with decision-making, there are several factors that play a role, two of these are intuition and rationality.

Intuition and rationality are two capabilities that are often mentioned in relation to decision-making (Sadler-Smith & Shefy, 2004). According to Simon (1987) intuitive decision-making was often neglected in the past, and the focus was on the tools of operations research and systems such as expert systems in decision-making. Intuition means that executives are allowed to pick up on important, but weak signals, whilst rationality enables executives to act on those signals (Sadler-Smith & Shefy, 2004). Khatri and Alvin (2000) did a study that showed that the use of "gut-feel" in strategic decision-making was much greater in the computer industry than the banking and utilities industries. They also found it interesting that senior managers actually accept this factor in the decision-making process (Khatri & Alvin, 2000). These executives based their acceptance on the fact that 'gut-feeling' comes from years of experience in the specific field, and that tools could not substitute that. According to Khatri & Alvin (2000) that may be true to a certain extent, but it is important to base the decision on a combination of relevant information and that 'gut-feeling'. Cleland & King (1983) are of the same perception, saying that a common error made by those who base their decision on intuition is that they fail to see that there are other alternatives.
Sadler-Smith & Shefy (2004) argue that gut feelings are inevitable when it comes to decision-making, but that one can still learn from it by testing out its validity over time.

Eisenhardt (1989) found through research that intuitive synthesis had a positive effect on the performance in environments of "high-velocity". Further Eisenhardt (1989) say that through her study of eight microcomputer firms, the conflict and integration among strategic decisions are critical when it comes to the pace of the actual decision-making. Research showed that *"Fast decision makers use more, not less, information than do slow decision makers. The former also develop more, not fewer, alternatives, and use a two-tiered advice process"* (Eisenhardt, 1989, p. 543). The explanation of these findings is not clear, but Eisenhardt suggests that it might be because the fast decision-makers use "real time" information, whilst the slow decision-makers use "planning" information. Eisenhardt (1989) says that the microcomputer industry is an extreme situation, but that these findings can offer lessons for other organizations as the world is changing and in turbulence.

Rationality is an important term when it comes to decision-making. In decision theory, the concept of rationality is about how to make decisions regarding what you should do when you are facing a problem (Jacobsen & Thorsvik, 2007). There are two perspectives on the individual decision maker (Olsen, 2011), we can say that we have perfect rationality or bounded rationality (Jacobsen & Thorsvik, 2007). "The economic man" is the standard perspective in decision theory when it comes to perfect rationality; the decision maker takes into account all available information when making a decision. "The administrative man" thinks rationally, but within a limited range of information, and is therefore a decision maker with bounded rationality (Olsen, 2011). To be able to have perfect rationality, one must therefore have a lot of information available, whilst one with limited rationality would have less information to work with.

2.1.2 The Decision-Making process

As we are focusing on a methodology that can help decision-makers, it is important to know what steps the decision-maker has to go through in order to make the final decision.

The decision-making process follows a series of steps (Turban, Sharda, & Delen, 2011):

Intelligence

The intelligence phase is where the decision-maker examines the reality, in order to identify and define the problem. The decision-maker is searches for conditions that call for a certain decision.

Design

This phase concerns trying to find or develop and analyze possible courses of action for the rest of the process. The design phase involves creativity, meaning that you are searching for alternative solutions, and then analyzing these different solutions.

Choice

In the choice phase, the actual decision and the commitment to follow a certain course of action is made. The decision-maker compares the best solutions that are available, and then selects the best of these solutions.

Implementation

In the final phase, the implementation phase, you put the solution you have worked on in to action.

The following diagram illustrates the process (figure 1):

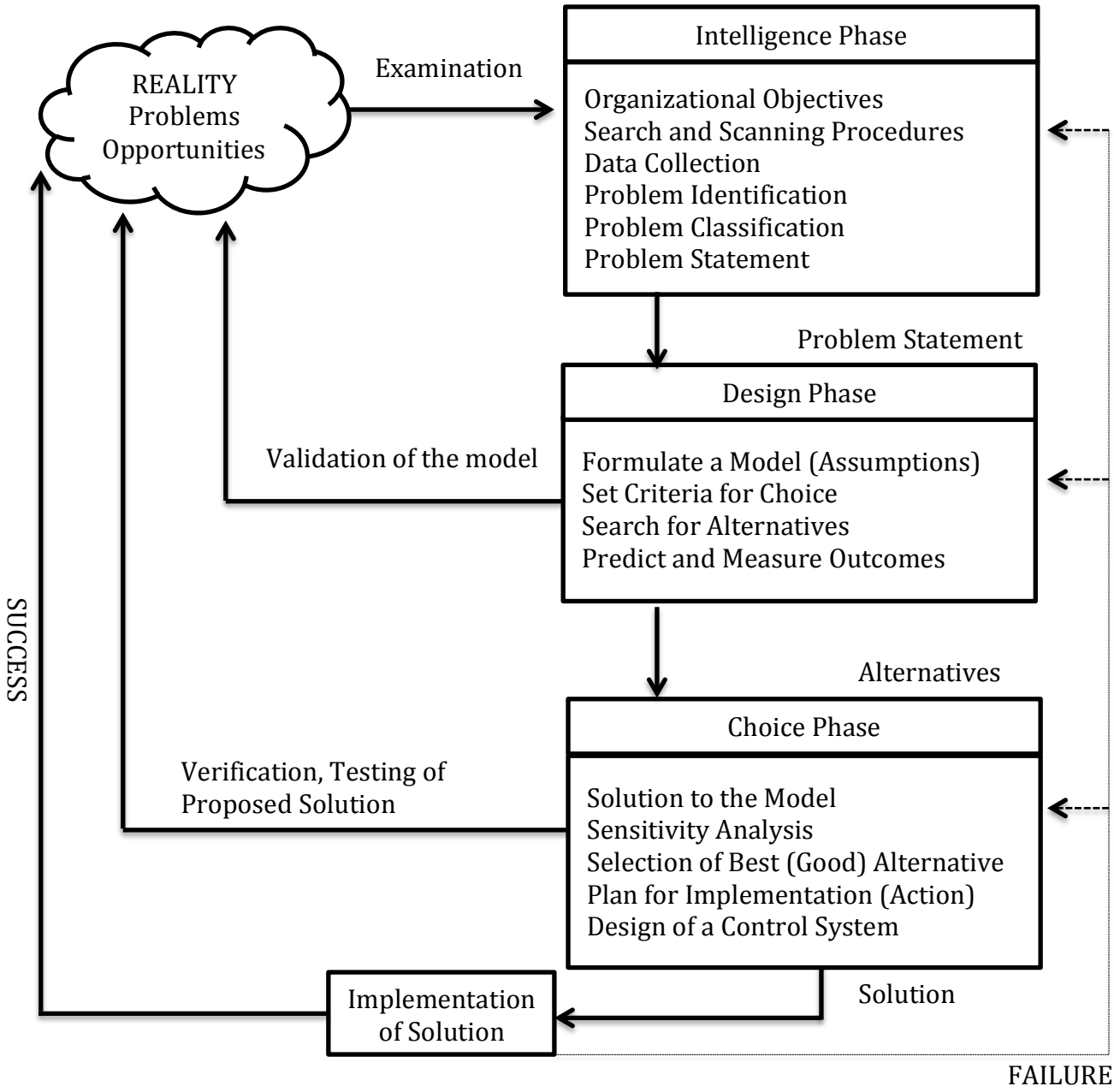


Figure 1 - Four steps of decision-making process (adopted from: Turban et.al., 2011)

It is important to remember that after the implementation, the process does not stop. Continuous monitoring of the processes is crucial in all organizations, to be able to always achieve the best results and to gain competitive advantages.

Davenport's (2010) study on decision-making in organizations through the use of information, focused on the specific initiatives an organization has taken to improve decision-making processes, and what steps that have been taken to ensure better and more reliable information to decision makers. Results showed that there was still little focus on improving decision-making processes in organizations, and that only a couple of the surveyed organizations had taken a step in the right direction by introducing the

"decision groups". These groups were introduced to focus on improving the decision-making processes.

2.2 Business Intelligence

In order to assist businesses with making decisions, decision support systems (DSS) were introduced in the beginning of the 1970's (Frolick & Ariyachandra, 2006). Over the years many applications emerged and expanded the domain, and in the early 90's business intelligence was introduced (BI) (Watson & Wixom, 2007). Business intelligence was born in order to satisfy the requests of managers for efficiently and effectively analyzing the data in the enterprise, in order to understand the situation their business is in, and to improve the decision-making process (Golfarelli et al., 2004).

Golfarelli (2004) defines business intelligence as *"…the process of turning data into information, and then turning it into knowledge (Golfarelli et al., 2004, p. 1).*

According to Turban (2011) BI is seen as the solution that will help organizations leverage their information in order to make intelligent decisions. It is a process that involves getting data in and getting data out, and was designed to support decision-making (Negash, 2004; Watson & Wixom, 2007).

Business leaders around the world have an enormous amount of data to work with, and a lot of this information is also of bad quality. According to Rodrigues (2002) the information that an enterprise possesses is mainly 90% unstructured and 10% structured, and business intelligence aims to solve that problem. BI gathers data from multiple sources in the organization through a data warehouse, and these sources can be ERP-systems, CRM, SCM, and so on.

Decision-making and strategic formulation no longer need to rely on knowing "what happened", but can now be supported by comprehensive intelligence as "what happens now" and "what is most likely to happen" (Tapscott, 2008). According to Tapscott (2008) there are three broad approaches that are helping to build BI solutions that provide employees who work with information the right to make better-informed decisions that are more in line with corporate objectives. These three approaches are: simplicity and relevance, agility, and integration, and will contribute to improved decision-making (Tapscott, 2008).

By looking at the "Business Intelligence Framework" (figure 2), we get a better overview of Management's primary activities: getting data in and getting data out (Watson & Wixom, 2007).

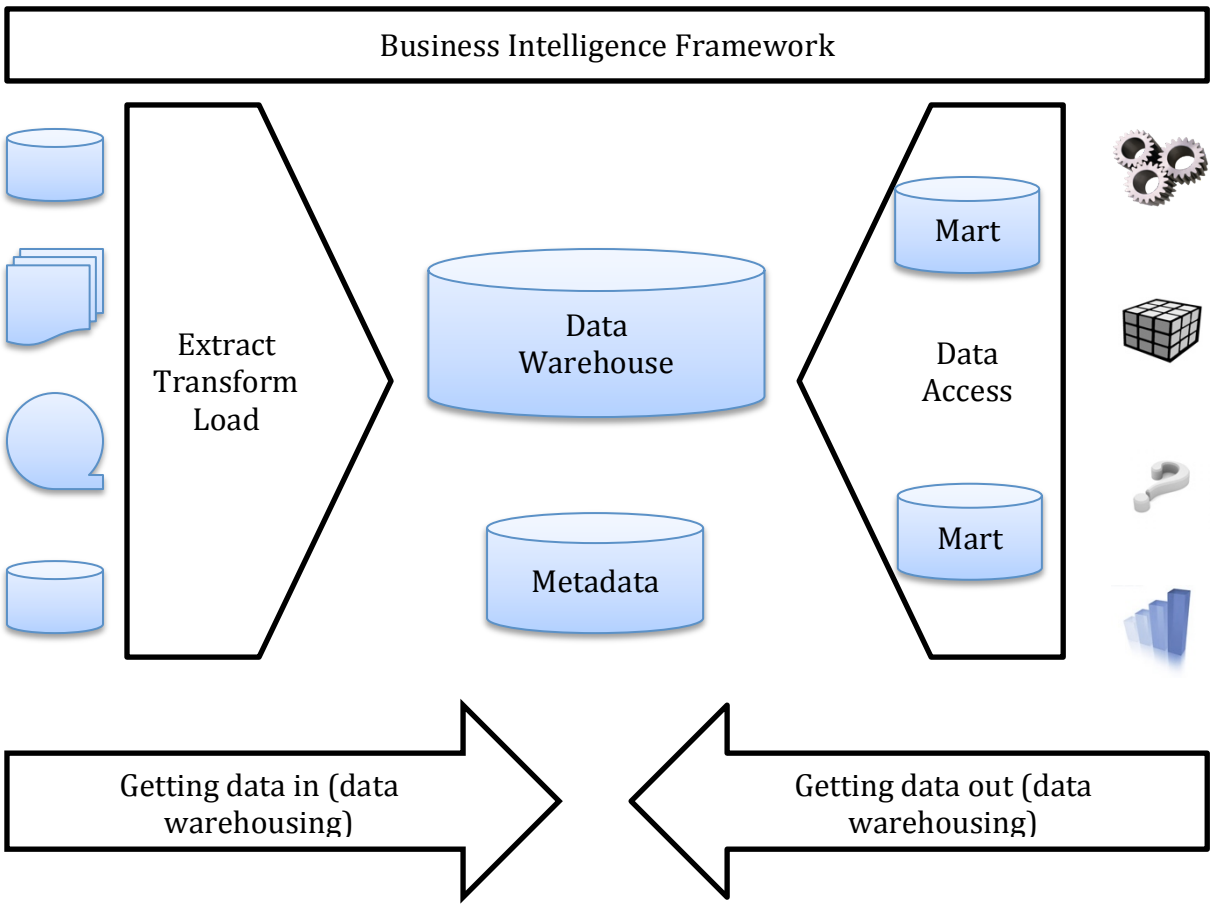


Figure 2 - Business Intelligence Framework (adopted from: Watson & Wixom, 2007)

With the underlying architecture in place, and a BI solution, the process will go as follows:

- Information is extracted from the various information systems that an organization holds.
- The information is transformed into static data and stored in the data warehouse. As the data is static, it cannot change.
- Business intelligence collects that data, and turns it into useful information, and then knowledge by showing the data in graphs, cubes and so on.

Research has shown that BI can be an enabler to an already competitive environment by providing the decision-maker with more reliant information. According to Watson & Wixom *(2007): "The future of Business Intelligence is bright. BI is changing how companies are managed, decisions are made, and people perform their Jobs "(p. 99).*

2.3 Real time Business Intelligence

As an additional layer to business intelligence, real time business intelligence (RTBI) can be added to give the businesses information that is fresh and urgent. RTBI has received more and more focus the previous years, but the focus has mainly been on identifying the concept. For businesses to be able to improve their performance and to follow their competitors and the market trends, it is becoming more and more important for

businesses to get information in real time (Azvine, Cui, & Nauck, 2005). According to Turban and Volonino (2011) a system that provides the user with real time information can help eliminate blind spots within the business, and being able to view the information fast enough is a necessity. Watson et al. (2006) say that: *"The purpose of real time BI is to increase revenues and decrease costs. Companies that successfully implement real time BI can dramatically improve their profitability" (p. 7).*

Real time does not always mean instantaneously, but it means that the data is as fresh as the business needs it to be (Watson et al., 2006). It is therefore important for us that the meaning of real time in this thesis does not have to mean data that is only a few seconds old, but that the data is as fresh as it can be. According to Hackathorne (2004), real time business intelligence is much more than time, it also conveys a rich sense of urgency within the organization. Real time business intelligence can also be envisioned as a seamless transition from data to information, and then into action (Azvine et al., 2005). When a business is to implement such a tool or philosophy, it is critical that the business understands it and can see the real value of such an implementation (Hackathorn, 2004). Businesses need to understand that the purpose of BI is not to achieve results quickly, but to make sure it is creating value for the organization (Hackathorn, 2004). Business intelligence provides companies with a holistic overview of their business, and monitors the financial health of the organization (Vortex-Technologies, 2004). However, taking real time measures of the operational level of an organization will give the business the chance to constantly measure their performance, both machines, orders, etc. (Vortex-Technologies, 2004). Whilst strategic BI analyses historical data, operational BI gives measures in real time, enabling the organization to make decisions based on what is happening right now as the results are immediate (Vortex-Technologies, 2004). Furthermore, Vortex (2004) explains that there are more KPI's that need to be measured at the operational level in order to execute their work efficiently.

In the 90's Continental Airlines had major business problems, and needed a plan on how to move the business up and forward (Watson et al., 2006). They came up with a "Go Forward Plan", with four interrelated parts that would help them make rapid improvements within the organization (Watson et al., 2006). By developing their data warehouse and preparing it for real time data, they moved from worst to first within 2 years, measured in many airlines performance metrics. The success of measuring real time data helped Continental focus more on their costumers and on building on their operational success (Watson et al., 2006). Continental Airlines used real time business intelligence to measure the following indicators:

- Revenue management and accounting
- CRM
- Crew operations and payroll
- Security and fraud
- Flight operations

Furthermore Watson et al. (2006) state that: *"Those organizations that recognize the progression of decision support early on, may instead be able to lay groundwork to facilitate a more comfortable transition to real time BI over time" (p. 17).* This shows us that if the organization early on sees the potential of such a support for decision makers, they will be able to have a smoother transition from using normal measures to using real time measuring.

In order to be successful with real time BI, organizations must focus on and overcome both organizational and technical challenges (Watson et al., 2006). Organizational challenges include having the support of the organization and top management, and having financial support. Technical challenges include having the correct hardware and software available, as well as having the right tools to support the implementation (Watson et al., 2006). Continental airlines made the right decisions on what data there was a need to show in real time, and that made them a leader within this field (Watson et al., 2004).

According to Azvine et al. (2005) real time business intelligence will also be available to everyone in the organization, so that all employees can be updated on measurements and the overall performance of the business.

The case with today's business intelligence solutions is that they do not go beyond reporting (Azvine et al., 2005). Azvine et al. (2005) propose a vision of RTBI where it *"is the seamless transition from data into information into action" (Azvine et al., 2005, p. 2)*. Today's BI systems have trouble realizing this, and basically suffer from two bottlenecks; there are not enough experts and analysts to run the software, thus hindering the transition from data to information. And because today's versions do not go beyond reporting, there is a problem when transitioning information into action, and it becomes a more manual process then one would want (Azvine et al., 2005).

The following figure illustrates current business management systems, and how manual intervention breaks down the information flow between strategic, tactical and operational layers (figure 3) (Azvine et al., 2005).

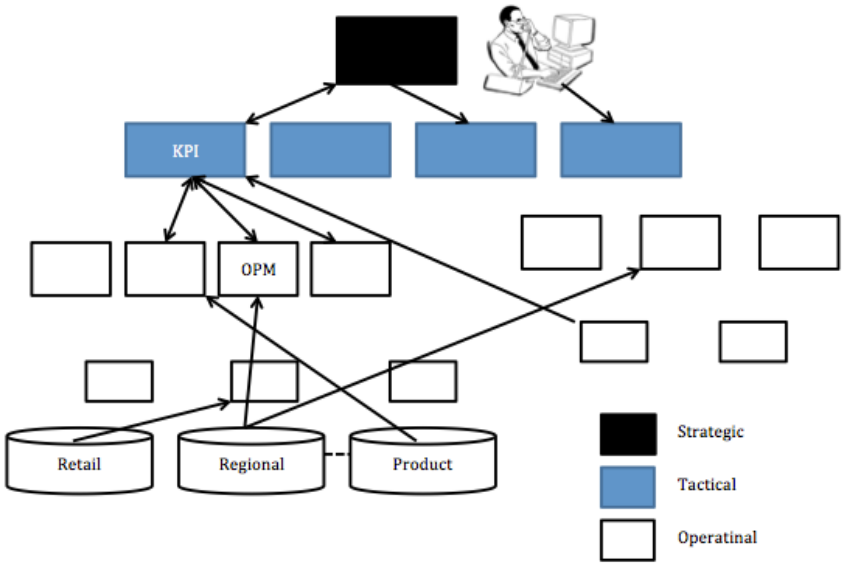


Figure 3 - Strategic, tactical and operational layers (adopted from: Azvine et.al., 2005)

The challenge here is how to automate the manual processes by using intelligent technologies, and how to represent this data as real time. This is also a challenge when there are several layers that need to be automated.

Azvine et al. (2005) envision that RTBI will give decision-makers even more control, expanding to the dashboard metaphor by adding "*a steering wheel, levers and pedals to*

the control suite, and enable business managers to change parameters of processes in real time" (Azvine et al., 2005, p. 3). Furthermore they address the fact that there are technical challenges to make such a vision work, dividing these challenges into three layers: an analytical layer, a data integration layer and an operational layer. In the analytical level, they believe that there will be no need for experts, as the "analyst-in-the-middle" represents a time lag within this process.

By taking the factors and elements that Azvine et al. (2005) propose, the RTBI framework would look like this (figure 4):

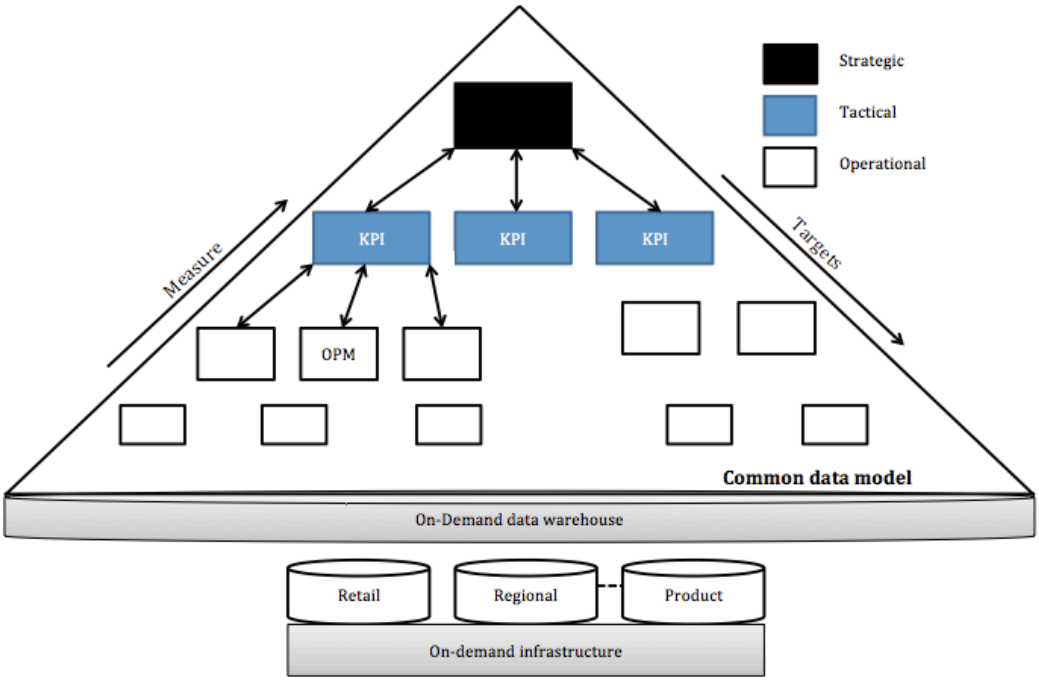


Figure 4 - Propose on RTBI Framework (adopted from: Azvine et.al., 2005)

By adding the layer of real time business intelligence to a decision support system, the hope is to gain benefits such as a more effective decision process and to reduce costs in the organization.

Many researchers say something on what RTBI is, but there are no studies that focus on visualizing what effects such an implementation can actually have on decision processes. From what previous research say, there is a need to expose this further by researching what potential benefits an organization can gain by implementing a real time business intelligence solution, and what effects that can have on the organization.

2.4 Data warehousing

Data warehousing is seen as an important enabler for business intelligence, because BI is used to analyze data that is stored in the warehouse (Turban & Volonino, 2010). In fact, it is said that data warehouse (DW) is the core component of a business intelligence infrastructure foundation, and it contains all transactional data that the organization holds, which is specified for querying and reporting (Hill, Ariyachandra, & Frolick, 2011). Data warehousing was introduced in the mid-to late 90's, and became one of the

most important developments in the IS field (Wixom & Watson, 2001). Research also showed that in the late 90's, data warehousing was at the top of the list for many CIO's, together with e-commerce (Wixom & Watson, 2001). Managers and other decision-makers in an organization need quick access to correct and consistent data throughout the enterprise, which they leverage in order to improve business processes and performance (Turban & Volonino, 2010). Business environments are becoming more competitive and global, and decisions are made based on what data is available to the decision-makers, and that data can be stored in a data warehouse (Wixom & Watson, 2001).

A data warehouse is a collection of data where all transactional information of an organization is stored, but it is not the same as a database; *The main difference is that databases are designed and optimized to store data, whereas data warehouses are designed and optimized to respond to analysis questions that are critical for business" (Turban & Volonino, 2010, p. 96)*. Data warehouses are considered to be powerful problem-solving tools that enable easy access to information (Massa & Testa, 2005). The information that is stored in a data warehouse is static, and cannot change (Turban & Volonino, 2010). This is mainly because information stored in a data warehouse is used to analyze the organization, which is difficult to do if the information stored continues to change (Turban & Volonino, 2010).

The end-users of the data warehouse are users such as analysts, managers and operational personnel, and there are data suppliers who are responsible for providing them with the data (Wixom & Watson, 2001).

A data warehouse has many characteristics, and all types of DW's share the following nine characteristics (Turban & Volonino, 2010):

- Organized data
- Consistency in data
- Time Variant – data is kept over a longer period
- Nonvolatile
- Relational structure
- Client/Server architecture
- Web-based support
- Integration using various sources
- Real time capabilities

There are many benefits of a data warehouse, and these are both business- and IT-related (Turban & Volonino, 2010). When looking at it from the business perspective, decision-makers are able to make better decisions because of access to precise information, whilst from the IT-perspective the information is delivered more effectively (Turban & Volonino, 2010). Amongst the areas that benefit from a data warehouse are: Marketing and sales, Pricing and contracts, Forecasting, Sales performance, and financial (Turban & Volonino, 2010). Although data warehouses provide several advantages for an organization, many of these projects fail because of the complexity of the development process and the organizational focus on goals and strategies (Böhnlein & Ulbrich-vom Ende, 2000).

"One major problem in building a data warehouse is to identify and consider information needs of potential users. Often they are not able to formulate their demands either" (Böhnlein & Ulbrich-vom Ende, 2000, p. 1).

As we can understand from previous research, there are many factors that are important when building, implementing and running a data warehouse. When all factors are in place, Turban and Volonino (2010) visualize the relationship between the DW and BI (figure 5) as following:

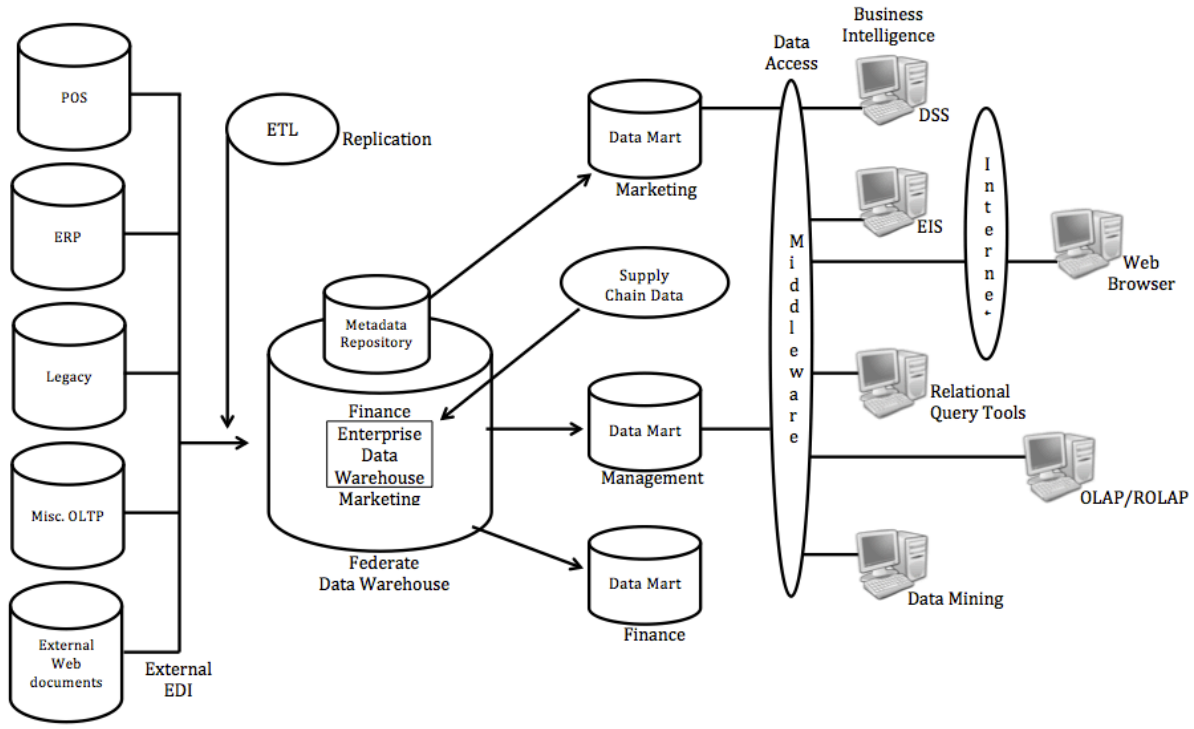


Figure 5 - How BI system works (based on: Turban & Volonino, 2010)

On the left side, data is collected from the different departments of the organization, before they are transformed into standard formatting. After being transformed, the data is loaded into the data warehouse. This process is called Extract, Transform, Load (ETL) (Turban & Volonino, 2010). After the data has been cleaned and stored, it is transformed into static data, and can be used for analytical and operational purposes. By using a BI-solution, the organization will then be able to collect and use that specific data to create reports, analysis and so on.

2.5 Data warehousing architecture

There are two gurus in the field of data warehousing, with two specific and contradictory architectural approaches (Breslin, 2004).

2.5.1 Corporate Information Factory – Bill Inmon

Bill Inmon is known as one of two gurus in the field of data warehousing (Breslin, 2004). Inmon has developed a logical architecture; the corporate information factory (CIF), which is intended to deliver BI and business management capabilities driven by data provided from business operations. This architecture has proven to be a stable and

enduring approach for any size enterprise wanting to build strategic and tactical decision systems (Imhoff, 1999). In order to have a successful BI-system you need a data warehouse, and that's what Inmon tries to point out with his conceptualized architecture.

The CIF was first introduced in the early 1980's and is the physical essence of the notion of an information ecosystem and is a top-down approach. The architecture is generic in its structure and is unique to each company as it is shaped by business, culture, politics, economics, and technology (Inmon, Imhoff, & Sousa, 2001).

There is a long list of components that the CIF is based up on. All of these components create the foundation for information delivery and decision-making activities (Inmon et al., 2001):

- External world
- Applications
- Operational data store
- Integration and transformation layer
- Data warehouse
- Data mart(s)
- Internet/intranet
- Metadata
- Exploration and data mining warehouse
- Alternative storage
- Decision support system

The model could be separated into to part as the *getting data in (producers)* and *getting data out (consumers)* to better understand and understand how the components need to be configured to process data and how they fit into the overall architecture (Inmon et al., 2001).

The figure (figure 6) below shows the full picture of how the CIF's architecture and how to components relates to each other and the flow of information from producers to consumers. Producers (getting data in) in the CIF capture data (integration and transformation) from the operational systems and assemble it (data management) into usable format (data warehouse or operational data store) for consumption by the business consumers. The CIF consumers (getting data out) require the information produced (data delivered), manipulate it (data marts) and assimilate it into their own environments (decision support interface or transaction interface) (Imhoff, 1999).

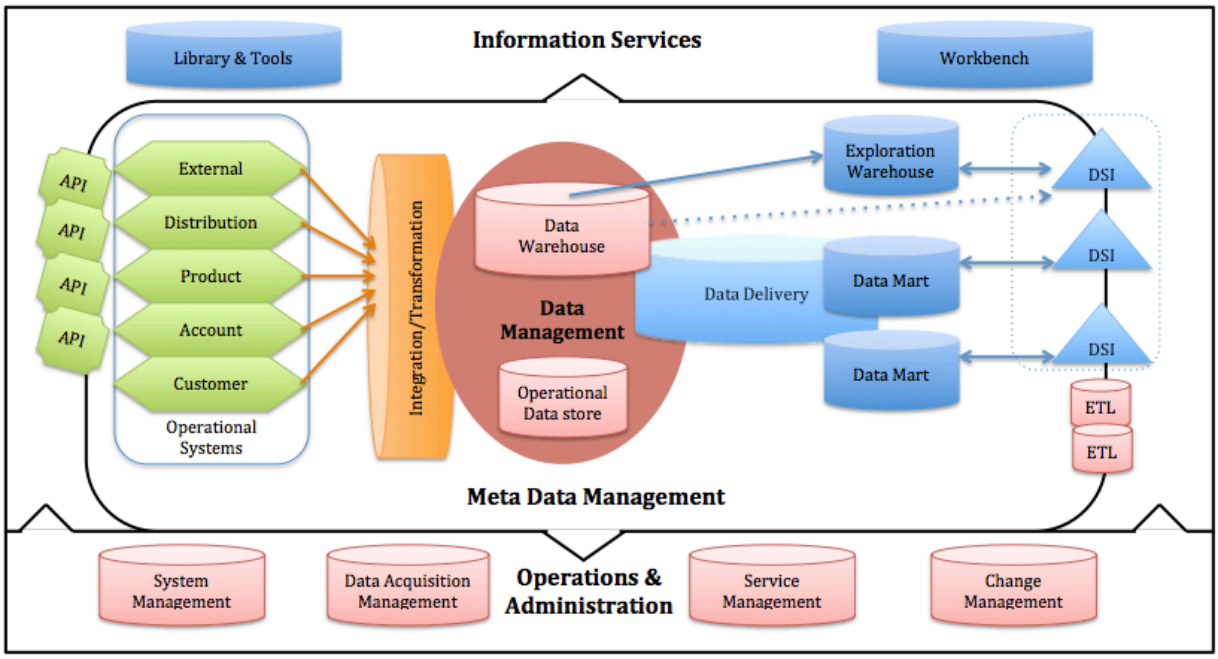


Figure 6 - Corporation Information Factory (based on: Imhoff, 1999)

As mentioned earlier it can be easier to understand the whole architecture be dividing the model into getting data in and out. See figure 7: getting data in vs. getting data out. Inmon's CIF depends on producers that enter the raw data and make it available for consumption across the enterprise (Imhoff, 1999).

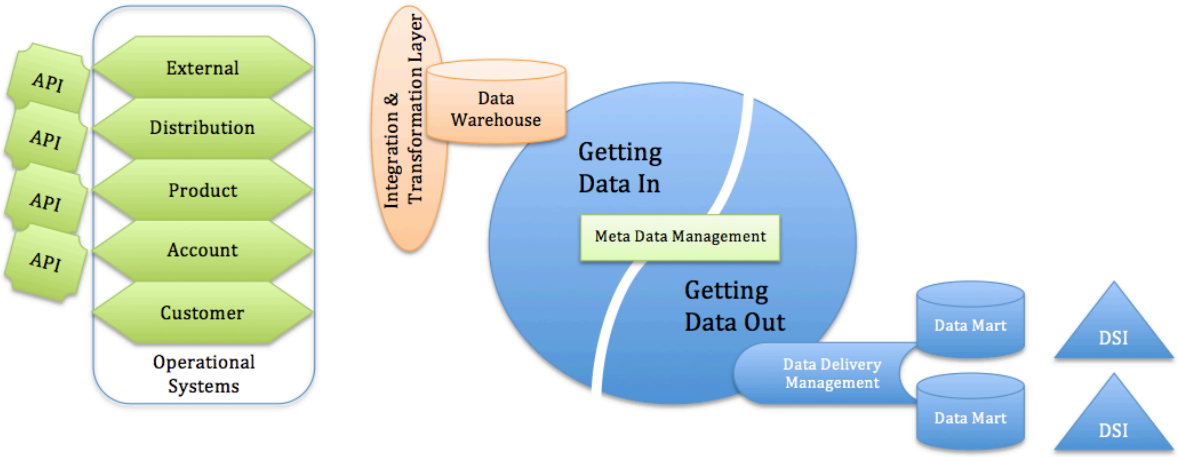


Figure 7 - Getting data in vs. getting data out (based on: Imhoff, 1999)

2.5.2 Dimensional Modeling - Ralph Kimball

Ralph Kimball is the creator behind the dimensional model, also called the star schema. It is a data warehouse architecture, which focuses on using a so-called bottom-up approach (Breslin, 2004). Kimball believes that one should be process oriented, and has based his architecture on it. Whilst Inmon has an enterprise-wide focus, Kimball focuses on the core processes of the organization, and drilling these down before rolling them out. By having several data marts, these will then be connected with a data bus, before connecting everything to a data warehouse.

The data marts are all based on one single business process, and because that process can be of importance to several departments, no one is perceived as the owner of that specific mart. Business processes are defined quite broadly by Kimball, being everything from point of sale to shipments, which are all cross-organizational. The sum of the data marts are connected to the data warehouse bus, which is the part that allows this architecture to be an integrated whole. The first process to be chosen should be the business process that has the most impact.

By using the data bus architecture, all data marts must use a standardized conformed dimension (Breslin, 2004). That means that keys, attribute definitions, column names and attribute values are consistent across all business processes. The star schema presented below (figure 8) is made out of four dimension tables, and one fact-table that connect them together.

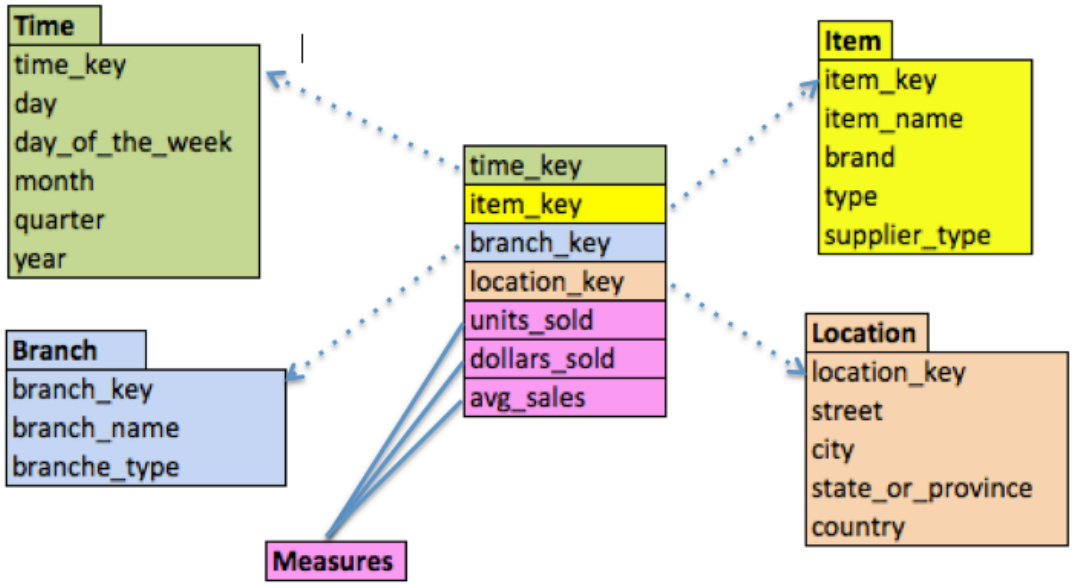


Figure 8 - Star Schema (adopted from: Breslin, 2004)

Kimball has an end-user focus with his approach, and the architecture should make it easy to query the databases. The end-users are not IT-savvy, which Kimball believes is an important aspect.

To be able to implement this architecture, Kimball proposes a unique methodology – The Four-Step Dimensional Design process. The four steps are (Breslin, 2004):

- Select Business Process
- Declare the grain
- Choose the Dimensions
- Identify the facts

First, select a business process that is important, and has the most impact for the organization. Declaring grain means that you need to decide what level of detail the data warehouse will contain. Atomic is the lowest level of granularity, and here it cannot be further subdivided. By choosing a grain at this level is highly wanted for most, since the data can be aggregated as wanted (Breslin, 2004). If you choose a more summarized level for the data, the queries below the summarized level cannot be fulfilled, and

Kimball says that the warehouse almost always wants data from the lowest possible grain (Breslin, 2004). After declaring the grain in which the data should be shown, the correct dimensions have to be chosen. In the figure above (figure 8), the dimensions are item, time, branch and location. These dimensions have different attributes. After defining the dimensions, it is time to decide what facts should be included in the fact table. The primary keys are included, as well as other facts that would be important for the specific table.

By following all these four steps, the result is the star schema shown above (figure 8).

2.5.3 Inmon Vs. Kimball

There are both similarities and differences between these two types of architecture. Both models use the Extract, Transform, Load (ETL) process, and the use of time-stamped data. The biggest difference is that Inmon's is relational and uses a top-down approach, whilst Kimball's is dimensional and uses a bottom-up approach. The two models have a different execution process, but the data attributes and results from the queries are similar to each other.

The following table (table 2) shows the pros and cons of the two architectures:

Table 2 - Inmon vs. Kimball: BI architecture

	Inmon	Kimball
Pros	- "Enterprise-wide" - Data driven - Strategic	- Process oriented - Good for analysis – Drill down, roll up - Focus on end-users - Tactical
Cons	- No focus on end-users - Long time before solution is given to the customer	- Less flexible - Redundancy - Data takes longer time to load

2.6 Key Performance Indicators

As business environments are shifting at a faster pace than before, and are more competitive, it is crucial that they measure their performance (Kennerley & Neely, 2003). Many businesses are measuring their performance, but they fail to manage their measurements to ensure that they do in fact reflect their organizational context. To ensure that a decision support system gives an organization the correct benefits, it is important that the right measuring creates value for the organization.
According to Kennerley and Neely (2003) the organizational context of a business changes rapidly, and it is important that the measuring reflects that change. A strategy is crucial for any organization, and when that strategy is in place, KPI's are tools that can be to measure the performance and success of that strategy, to help the business to reach its goals. *"Traditionally businesses have measured their performance solely in*

financial terms. This limited approach has been challenged, with the introduction of the concept of key performance indicators (KPIs) for non-financial results" (Beatham, Anumba, Thorpe, & Hedges, 2004, p. 93). According to Beatham et al. (2004) key performance indicators measure the performance of a specific process, and whether it is done right.

When it comes to measuring, all levels of an organization can be measured, all the way from the floor level to the C-level executives. Indicators that can be measured are; user acceptance, employee satisfaction, quality assurance, and testing (Beatham et al., 2004). Performance measurement of a specific activity within an organization will lead to the ability to make better decisions regarding what changes should be made:

"*Leading measures do offer the opportunity to change. They are measures of performance whose results are used either to predict future performance of the activity being measured and present the opportunity to change practice accordingly, or to enable future decisions to be made on future associated activities based on the outcome of previous activities*" (Beatham et al., 2004, p. 106).

Deciding what processes should be measured can be difficult, and therefore it is important that the organization chooses the right people to make these decisions, meaning that those people should have sufficient knowledge on the organization (Beatham et al., 2004). It is common that the processes and activities chosen are those that are critical and require constant measuring and monitoring.

For KPI's to be used successfully, they need to be a part of a Performance Measurement System (PMS) (Beatham et al., 2004). When developing these measures, it is important to have knowledge of what types and applications of measuring that are available.

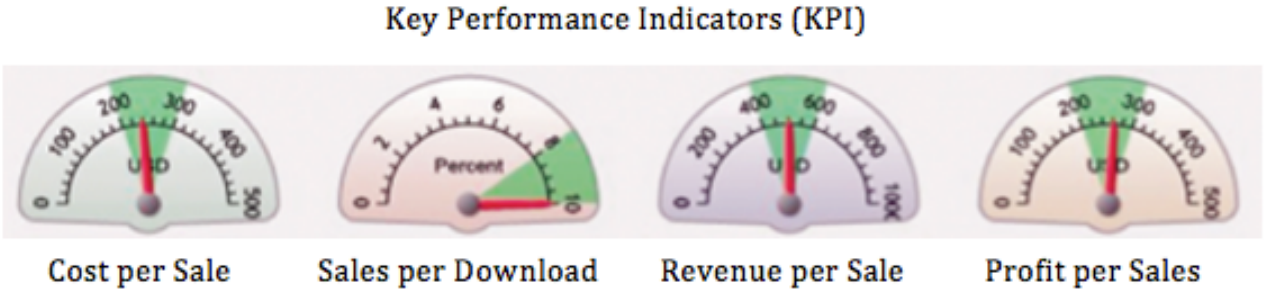


Figure 9 - Key Performance Indicators (adopted from: Turban et.al., 2011)

This is a visual overview (figure 9) of certain key performance indicators within an organization, shown in a dashboard. By implementing business intelligence, the indicators will be shown in a dashboard, indicating their performance.

2.7 Business Performance Management

For a business to get the most out of a BI and RTBI implementation, there is a need for focusing on the processes.

According to Golfarelli et al. (2004) Business Performance Management (BPM) is looked at as the new approach to business intelligence. BPM can also be known by names such

as enterprise performance management or corporate performance management, and its roots can be traced back to the 1970's, when decision support systems (DSS) were introduced (Frolick & Ariyachandra, 2006). Furthermore, a BPM standards group was established in 2003, in order to help the industry understand the concept (Frolick & Ariyachandra, 2006). It offers an organization an approach that is IT-enabled, in order to effectively formulate and execute their strategy (Frolick & Ariyachandra, 2006).

Business Performance Management focuses on the whole enterprise, and BPM solutions run on timely data that provides support for operational, strategic and tactical decision-making, whereas BI provide support for strategic and tactical decision-making (Frolick & Ariyachandra, 2006). Although it includes data warehousing, it also requires a reactive monitoring component: "*BPM includes DW but it also requires a brand new set of solutions that rely on different technologies and deeply impact on the overall architecture of the BI platform" (Golfarelli et al., 2004, p. 2)*. Data warehousing will function together with an analysis tool, but the problem is that it does not cover the whole need of the business: *"DW is not enough to this end since its technology is neither suitable for the grain nor for the freshness of the collected information, that should quickly flow throughout the different levels of the company" (Golfarelli et al., 2004, p. 5).*

The four core processes the BPM framework consists of are (Frolick & Ariyachandra, 2006):

- Strategize
- Plan
- Monitor and analyze
- Take corrective action

"These four core processes form a closed loop that captures business strategy, which is then translated into strategically aligned business operations" (Frolick & Ariyachandra, 2006, p. 43).

Golfarelli et al. (2004) presents a framework (figure 10) which they believe will improve the use of BI within an organization. This framework builds the BPM closed loop, meaning the importance of including the whole organization and a focus to provide the decision-maker with the relevant information (Golfarelli et al., 2004).

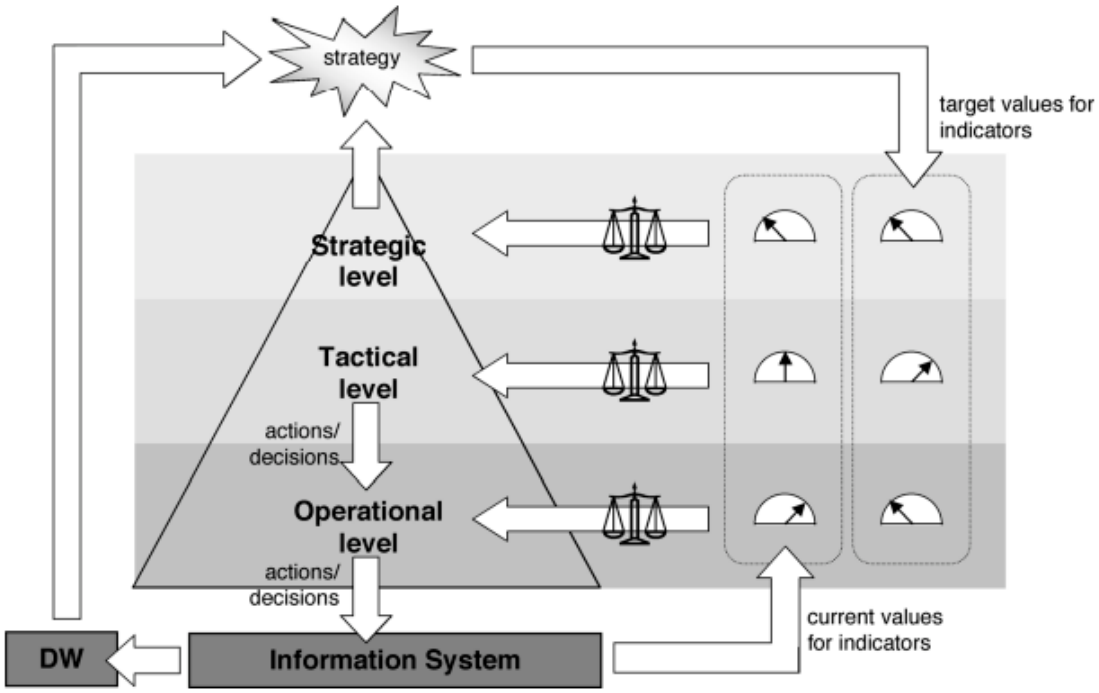


Figure 10 - The closed-loop in the BPM approach (Golfarelli et.al., 2004)

"The closed-loop in the BPM approach" (figure 10) gives an overview of the framework with an organizational focus. The organization will produce information through actions and decisions that are registered in an information system and then transferred to a data warehouse. By looking at the model, we can see how BI can be used on all levels of an organization, and how the information provided can be measured to show that information in real time. By measuring the information in real time, it will help the organization manage the daily decisions. The framework shows us that the strategy placed on top is where the organizations wish to be, and by measuring where they actually are at one specific moment in time, Business intelligence can be used to reach that goal by making better decisions on a daily basis.

According to Golfarelli et al. (2004) organizations have to step away from the belief that decisions are to be made on the top of a hierarchical structure and gain a more process oriented view, in order for this approach to work. In a process oriented organization it is also important that the decision-makers have access to the BI tools and the relevant data, and this will increase the chance of the business actually being able to follow their strategy. It al comes down to putting the decision authority where the decision is actually being taken (Hammer, 1990). A key barrier to implementing BPM is the resistance to change within an organization, as well as organizational politics (Golfarelli et al., 2004).

According to Golfarelli et al. (2004): "*This single integrated concept is focused on enhancing corporate performance. BPM provides an opportunity to align operations to organizational strategy and evaluates its progress over time toward goal attainment" (p. 7)*.

2.8 Business Process Reengineering & Business Process Management

As part of an adaption to a decision support system, it is important that the organization focus on their business processes. Depending on the maturity of the organization and its equipment, there might be necessary to improve and automate these processes.

In 1990, Michael Hammer introduced the concept of reengineering. In the 1990's the focus was on "business processes", mainly because of competitive pressure and to improve corporate responsiveness (Grover, Jeong, Kettinger, & Teng, 1995). The concept was introduced because of recent changes in the business world where IT was in focus, and was based on US companies. US companies had processes that were ineffective, and believed that IT-systems could help these processes become more effective (Hammer, 1990). Instead of researching the process, and actually finding the error, they would automate it by implementing IT-systems and computers, and by that not finding the true essence of the problem. Hammer (1990) believed that instead of automating the current process, it would be more valuable to "reengineer" it, by breaking the old way of doing things by rebuilding the processes.

Based on experience, he introduces 7 best-practice principles of reengineering:

1. Organize around outcomes, not tasks.
2. Have those who use the output of the process perform the process.
3. Subsume information-processing work into the real work that produces the information.
4. Treat geographically dispersed resources as though they were centralized.
5. Link parallel activities instead of integrating their results.
6. Put the decision point where the work is performed, and build control into the process.
7. Capture information once and at the source.

Hammer (1990) further suggests to think big, because reengineering will trigger organization-wide changes. Everything related to the process itself must be refashioned, and the importance of management support is high: *"If managers have the vision, reengineering will provide the way" (Hammer, 1990, p. 112).*

Written in the early nineties, this is still a concept that is current. However, there might not always be a need for starting on scratch, but instead automating the current processes. That is the concept of Business Process Management (BPM), where the focus is on automation of the current workflow in the business, because it is relatively mature (Ultimus, 2003). Rosser (2010) defines BPM as: "*…a discipline to treat business processes as assets, to drive operational excellence and agility. Many technologies, tools and services can help achieve BPM goals (…) To achieve the best results, organizations must assess processes, determine requirements and follow an effective process for technology selection, deployment and management" (Rosser, 2010, p. 1)*.

By implementing BPM an organization can gain a lot of advantages. Gartner group presents 6 important principles in BPM (in (Ultimus, 2003)). These principals is said to be as current today as the day they were introduced:

1. Convert paper-based business process into electronic processes that eliminate paper forms, file folders, documents, and the inefficiencies associated with these.

2. Completely automate steps by integrating with enterprise applications.
3. Add intelligence to forms to reduce errors of omission (required data not filled out) or inaccurate data (e.g. pull part numbers from a database, rather than having user enter it).
4. Incorporate control features that ensure integrity of processes and compensate for human or system failure.
5. Provide real time feedback about the status of processes.
6. Measure the time and cost of processes so that they can be optimized.

The important lesson to learn from BPM is that the focus is on using technology to support the processes and not adapting the current process to support the existing technologies (Ultimus, 2003).

To roughly summarize the two concepts we could say that BPR is yesterday's way of thinking, while BPM is today's way of thinking.

2.9 Challenges with BI implementations

As with any other system-implementation, there are specific challenges related to an implementation of a business intelligence and real time business intelligence system.

According to Atre (2003) businesses fail to implement business intelligence because they look at it as just another IT-project. It is important for businesses to understand that BI is not a system or product that is being implemented, but a *"constantly evolving strategy, vision and architecture that continuously seeks to align an organization's operations and direction with its strategic business goals"* (Atre, 2003, p. 2). In previous years, the alignment of IT strategies and organizational strategies has not been focused on; "*We argue that the inability to realize value from I/T investments is in part due to the lack of alignment between the business and I/T strategies of organizations"* (Henderson & Venkatraman, 1993, p. 1). This is crucial in order to be able to retrieve value from such a project and implementation (Williams & Williams, 2007). For an organization to achieve success, it has to be able to make better decisions more rapidly than before, streamline it's operations and shorten the product development cycles, use existing product lines to maximize their value, and focus on the marketing segment and their customers and suppliers (Atre, 2003). Although a BI implementation is more then an IT project, it still has some of the same characteristics as other IT-projects, they bring high-risk and have potentially high costs.

Atre (2003) introduces us to the 10 challenges businesses have to be aware of when implementing business intelligence. These challenges are presented in the table (table 3) below.

Table 3 - 10 Challenges when implementing BI

Challenge	Explanation
1. Cross-Organizational Collaboration	Organizations have to have a wide focus, where customers and markets are the drivers for making change. Information needs to be integrated on

	all levels, for decision support purposes.
2. Business Sponsors	All BI-projects need a champion, a supportive and committed sponsor that can establish the right objectives for the application, making sure that it supports the strategic vision and goals of the organization.
3. Dedicated Business Representation	A BI-projects should have shareholders from all levels, not just technical. It is important to involve the business side as well as the IT department. - Business executives - Customers - Key business partners - The finance department - Marketing personnel - Sales and customer support - IT
4. Availability of Skilled Team Members	The project team needs to have skilled members in all sections, from implementation to analysis. Mandatory skills include: - BI Business analysts - KPI expert - Balanced scorecard experts - Data warehouse architects - Cube developers and implementers - Personalization experts (web-based generic BI apps)
5. BI Application Development Methodology	All BI-projects must have a plan to follow, as well as objectives and milestones. - Project deliverables (map goals to strategic objectives) - Project scope (align deliverables with the applications deployment phases and timelines)
6. Planning BI projects	BI planning is an iterative process where resources, timelines, deliverables, plans and scope are continuously adjusted. There has to be a detailed project plan for the project itself. Activities in the plan include: - Determining project requirements - Determining the condition of

	source files - Determining or revising cost estimates - Determining or revising risk assessment - Identifying critical success factors - Preparing the project charter - Creating a high-level project plan - Kicking off the project
7. Business Analysis and Data Standardization	Data out is just as important as data in when it comes to BI projects. Source data is a big issue, and issues include: - Identifying information needs (identifying business issues related to the application objectives – help identify data sources) - Data merge and standardization (ability to understand scope, effort and importance of making required data available)
8. Impact of Dirty Data on Business Profitability	Businesses need to identify the important data, and from that identify what data is clean and what data is dirty.
9. Importance of Meta-Data	Context is important. Meta data is essential in BI projects, and there are two types: - Technical meta-data: Information about the application and databases, helps IT staff manage these. - Business meta-data: Information on data stored in the application and databases for the business users.
10. The Silver Bullet Syndrome	By using a small number of tools, the activities can map to the same overall map. BI projects are identified by their huge scope, and they cover multiple technologies and environment. No Silver Bullet.

3 Research Approach

This chapter describes the approach we have used for the research in this master thesis. Firstly, we describe the research perspective that has been chosen, and our philosophical view. We further present our research design, the choice of case and the corporation and companies involved in the study. Then we present the research strategy and methodical approach involving the data collection and the data analysis. Lastly we present the quality of the research based on the use of theory, limitations, validity and our role as researchers.

The strategy of inquiry in this thesis is a qualitative approach, which can be defined as: *"a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem" (Creswell, 2009, p. 4).*

According to Creswell (2009) researchers can choose from five different approaches; narrative, phenomenology, ethnography, case study and grounded theory. In this master thesis, a case study has been the approach by studying events in a specific corporation. A case study can be defined as *"an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident" (Yin, 2003).* We have conducted an exploratory case study in 3 plants owned by the same corporation, in the construction and home improvement supplies industry. The primary data sources have been interviews and one meeting observation.

3.1 Research perspective and philosophical view

Selection of philosophical perspectives affects research practice and must therefore be identified. There are several ways to view this perspective. Myers (1997) argues that one can look at qualitative research from the positivist, interpretive and critical perspective, illustrated in this figure (figure 11):

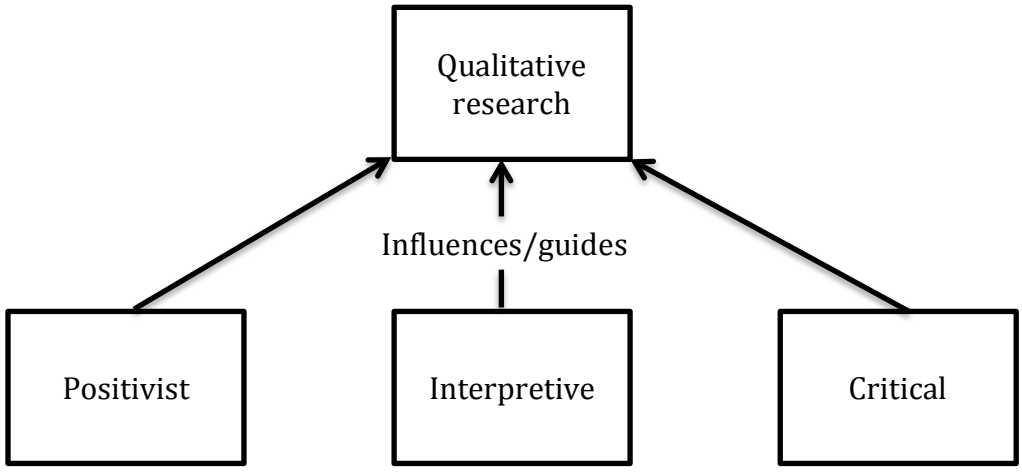


Figure 11 - Research perspective and philosophical view

Creswell (2009) looks at the philosophical perspective as a world view, and the term is defined as follows: *"A basic set of beliefs that guides action"* (Guba, 1990, p. 17). World Vision is shaped by the course of study, supervisor and faculty types of beliefs and

previous research experience. The different world visions imply that researchers prefer qualitative, quantitative or mixed method. Creswell (2009) discusses four different worldviews: Post positivism, constructivism, participatory and pragmatism.

We have chosen Creswell's *social constructivism* as a worldview, which is an approach to qualitative research. We see this philosophical worldview as an interpretive inquiry where we as researchers interpret what we see, hear and understand during the course of this research (Creswell, 2009). Interpretative research in information systems (IS) is now a well-established part of the research field (Walsham, 2006). In social constructivism the individuals seek to understand the world they live and work in (Creswell, 2009). They develop a subjective understanding of their experiences. The goal is to base as much of the research on the participant's point of view of the situation being examined. The questions are typically open-ended and general, as the aim is to listen to the participant (Creswell, 2009).

3.2 Research Design

The aim of this study was to examine needs and challenges related to the decision processes within plants in the construction and home improvement supplies industry. By analyzing the current decision processes, we would be able to map out how a real time business intelligence system could assist in decision-making. We have taken a starting point in relevant literature on decision-making, business intelligence and real time business intelligence. We have also looked the top challenges for success with an implementation of such a solution, as well as what architectural components are underlying, and how such a solution should be implemented. That part of the thesis is based on relevant literature and theory. Based upon the literature presented, we then carried out an exploratory case study, divided into two phases, Phase 1 and Phase 2. Phase 1 focused on the overall knowledge of the employees interviewed, as well as a means of mapping out what needs there are for information in real time, and what factors affect how one makes decisions currently. Phase 2 focused on more in-depth interviews with 3 persons, the intention being to further map out the current decision process by introducing the respondent to certain scenarios based upon his role in the organization. Subsequently, the results were categorized, before being analyzed and compared to previous theory.

Figure 12 is a model of our research design, based on an idea by Dubé and Robey (1999). The model summarizes the research strategy carried out in this thesis. The literature review is the theory on the right side, and was the first step of the research strategy. Then, the interviews conducted with employees of the Byggma cooperation and the plants of Huntonit, Fibo-Trespo and Uldal were categorized, analyzed and discussed against the theory from the literature review. Based on the discussion of the results, we concluded by answering the initial research questions.

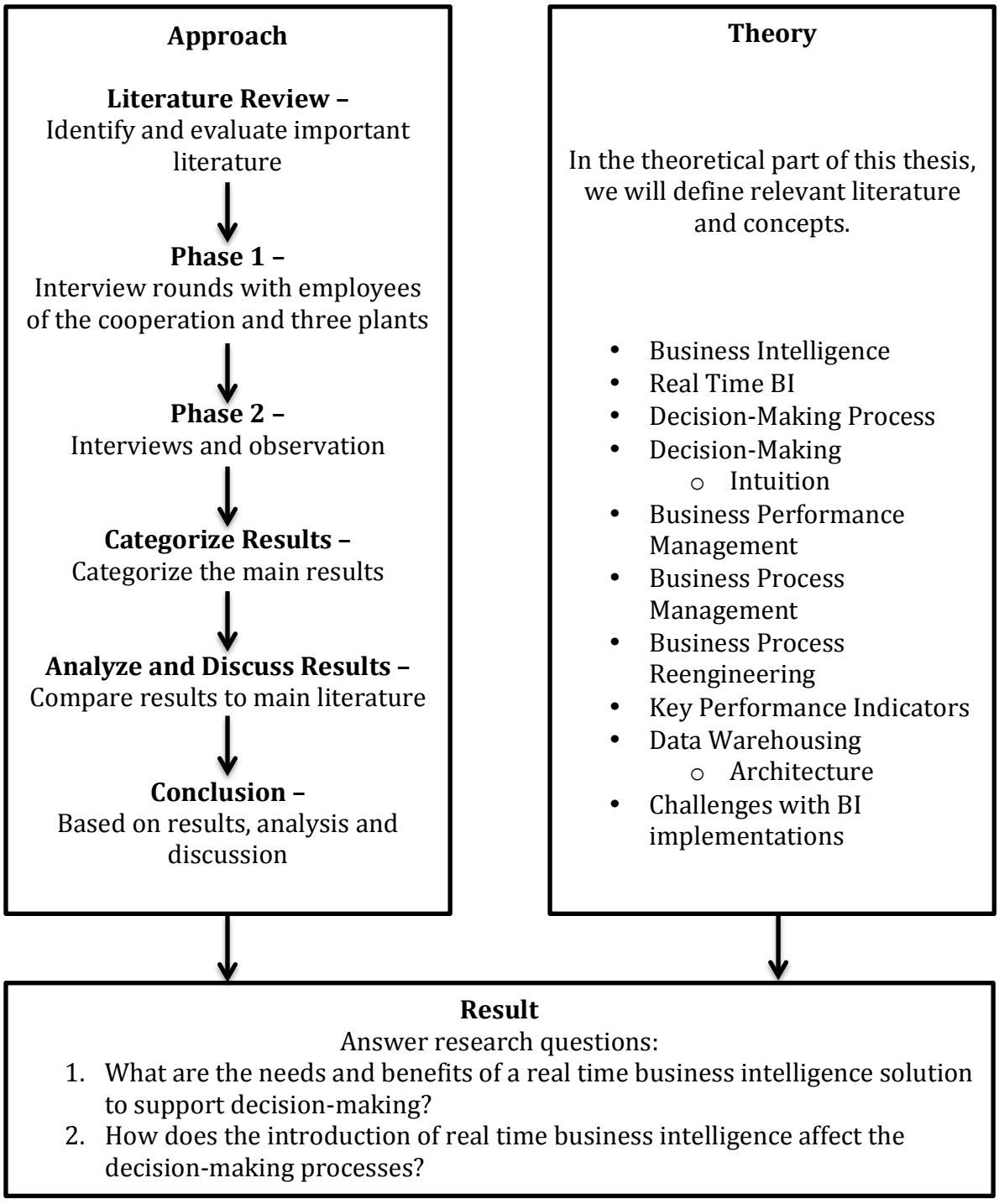


Figure 12 - Research Design (based on: Dubé and Robey, 1999)

3.2.1 Choice of Case

We have chosen to study an organization that is in need of a system to support decision-making, because they have a need for more accurate and reliable information. The University of Agder and our supervisor had already communicated with the specific corporation about a master's thesis, and set up a meeting where we could discuss the theme of the research. The CIO of the corporation had thoughts on the need for real time information, and since this was a topic already proposed by the researchers, it was the theme that was chosen. We have been part of a pre-study in an organization that wishes

to implement a business intelligence system, and to get its information in real time. The focus has been on the current decision-making process, and what factors that affect it, in contrast to what an implementation of a real time business intelligence system can assist with when it comes to these processes. The IT architecture has also been an underlying and critical aspect, as there are some changes and additions that need to be made in order to have the correct support for such a system.

3.2.2 About the Corporation and Companies

Byggma ASA
Byggma ASA is a Norwegian corporation that manufactures and sells construction products to the Scandinavian and Northern European markets. The corporation was established in 1997 and is headquartered in the south of Norway, in Vennesla. The Byggma group consist of several production plants:

- Huntonit AS
- Fibo-Trespo AS
- Uldal AS
- Forestia AS
- Scan Lamps AS
- Masonite AS
- Aneta AS

Several of these plants are located in and around the area of Kristiansand, and through a discussion with the CIO of Byggma ASA, we decided to focus on three plants: Huntonit AS, Fibo-Trespo AS and Uldal As. An explanation of these plants will follow.

Huntonit AS
Huntonit AS is a factory that offers wall panels and roofing sheets, ready painted for the customer. The factory was founded in 1948 with production start in May 1950, and is located in Vennesla, southern Norway. Huntonit has approximately 190 employees, and has a yearly turnover of approximately 450 million NOK.

Fibo-Trespo AS
Fibo-Trespo AS is a market leader in the Norwegian market when it comes to wall panels for wet rooms, and had a turnover in 2011 of 400 million NOK.
Fibo-Trespo AS is located in Lyngdal, southern Norway, and was established in 1952 by Mosvold Shipping. Later, in 1987, it was sold to Norske Skog before it was sold to Byggma ASA in 1998. The company has 101 employees and Byggma ASA is the owner with 100% of the shares.

With a committed director and board members, Fibo-Trespo decided to implement the LEAN process in 2009. They decided to call their LEAN method for Byggma Process Optimization (BPO), and are working hard to educate and help the other companies in the Byggma group to start their LEAN processes.

Uldal AS

One of the leading manufacturers of windows and doors in Norway, Uldal AS is located with a plant and a sales office in Birkeland, southern Norway and a plant and sales office in Varhaug, outside of Sandnes. In 2011 they had a yearly turnover of 158 million NOK. Gunnar Uldal established the company in 1942 as "Uldal Trevarefabrikk". Who ran it together with his brother Albert Uldal. Since then, Uldal AS has been kept in the family. In 2004, Byggma ASA goes in with 100% on the owner side of Uldal. In Birkeland, Uldal As serves as the second largest industrial workplace.

Uldal As has 76 employees located at their plant and sales office in Birkeland.

3.3 Research strategy and methodical approach

3.3.1 Data Collection

The data collection for this thesis has multiple sources: interviews and observation. We had two primary phases of data collection, Phase 1 and Phase 2 (table 4).

Table 4 - Data Collection Phases

Data Collection		
	Method	Procedure
Phase 1	- Interviews, face-to-face, semi structured.	- Audio-taped, notes, transcribed
Phase 2	- Interviews, in-depth, face-to-face, unstructured - Observation, participants	- Audio-taped, notes, transcribed, - Field notes,

All interviews were taped and then transcribed immediately afterwards. We then coded the interviews by using a matrix, which according to Yin (2003) helps make the data analysis easier. All interviews were conducted in Norwegian, since all respondents were Norwegian. It was important for us to carry out the interviews in the respondents' mother tongue, since it would be easier for them to express themselves in Norwegian.

Phase 1

The first phase, Phase 1, involved interviews of 13 persons, the CIO of the corporation, and 4 employees of each plant. For this phase we used the snowball effect, by letting the plant directors choose the objects. Together with our supervisor we agreed upon what plants we would focus on, and then the CIO of the corporation connected us to the plant directors of each company. We chose this method because it was interesting for us to see the amount of knowledge in relation to the role the object had in the organization. As well as being able to identify in what parts of the enterprise there is a need for accurate and fresh data. A table (table 5) of the respondents for the first round of interviews can be seen below.

Table 5 - List of respondents from round one of interviews

Role	Company
IT-Director / CIO	Byggma ASA
Plant Director	Fibo-Trespo AS
Production Manager	Fibo-Trespo As
Marketing	Fibo-Trespo AS
Finance Manager	Fibo-Trespo As
Plant Director	Huntonit AS
Assistant Production Manager	Huntonit AS
Shift Manager	Huntonit AS
Plant Chief	Huntonit AS
Plant Director	Uldal AS
Production Manager	Uldal AS
Chief Accountant	Uldal AS
Customer Service Manager	Uldal AS

By using the snowball effect, we were able to get objects that covered many critical aspects within the organization, from the director to the person in charge of customer service.
The interviews were conducted face-to-face at the specific plant, and were semi-structured. We used a semi-structured interview guide to carry out the interviews (Appendix A & B). The guide included critical questions that we wanted the respondent to answer, as well as factors that we wanted the respondent to touch upon without us mentioning them. That involved us having to find ways where we could try and guide the interviewee in the right way, but without actually revealing the factors that we desired they would mention.

Phase 2

The second phase, Phase 2, involved three in-depth interviews of persons who we believed gave us interesting and important information in the first phase. These interviews were face-to-face, but had an unstructured approach. We sat down with 3 different persons and discussed the most critical decision processes within their work areas. The persons were given two critical scenarios connected with their role, and went through the entire decision process from the start of the problem, to how that problem was solved or how it should be solved if it was to occur. We also asked the respondents to give examples of scenarios they had already been through, where the decision-process was affected by the lack of available information. These scenarios proved to be valuable for the research, and it was these processes that were used when we later visualized the current decision processes. For this part of the study, we used the "thinking aloud event protocol" (Fuglseth, 1989) as the method for these interviews. Pen and paper were used to visualize the decision processes, and transferred to ARIS express at a later point. This phase also included an observation of a morning meeting, where we were observers as participants. Observing as participants means that our role was known to the other participants before the meeting began (Creswell, 2009). The main idea behind observing this morning meeting was to get an impression of how numbers are presented and shared within the organization, and how the employees are informed of the current state of the production every morning.

Thinking aloud event protocol

In the second phase of interviews we used a method called thinking aloud event protocol (TAEP). We found that this could be a good interview technique to use in order to get the interview objects to thinking aloud when they were given certain scenarios. Thinking aloud event protocol is based on a cognitive model that aims to explain decision-making processes from the decision-maker receive information about an event or scenario until he or she take action (Fuglseth, 1989).

The idea of using this method is to get the interview objects/testers to familiarize themselves with a particular situation and say everything that comes to mind. By doing this we where able to get very specific information on the processes and scenarios we wanted. Under the interview we also did some practical drawing of the processes to get the interviewees to validate and confirm that we saw the same "picture". Further on we where able to track each step of a decision process to visualize it in this paper using a process-modeling tool.

ARIS Express

In this paper we needed to look at specific processes that we discovered throughout the second interview round using the TAEP method, which the interview objects helped us illustrate in detail. To model these processes we used ARIS Express (Software-AG, 2009) an application for modeling business processes. ARIS Express is a tool meant to support modeling of organizational charts, business processes, IT infrastructure, data models, system landscapes and so on in business process analysis and management.

3.3.2 Data analysis

According to Creswell (2009) *"..the process of data analysis involves making sense out of text and image data" (p. 183).* Creswell (2009) argues that the analysis can be seen as the process of peeling back the layers of an onion because it is the process of digging deeper and deeper into the data in order to get an understanding of it. For our data analysis, we decided to follow Creswell's (2009) model for data analysis, which presents the data analysis process from specific to general (figure 13).

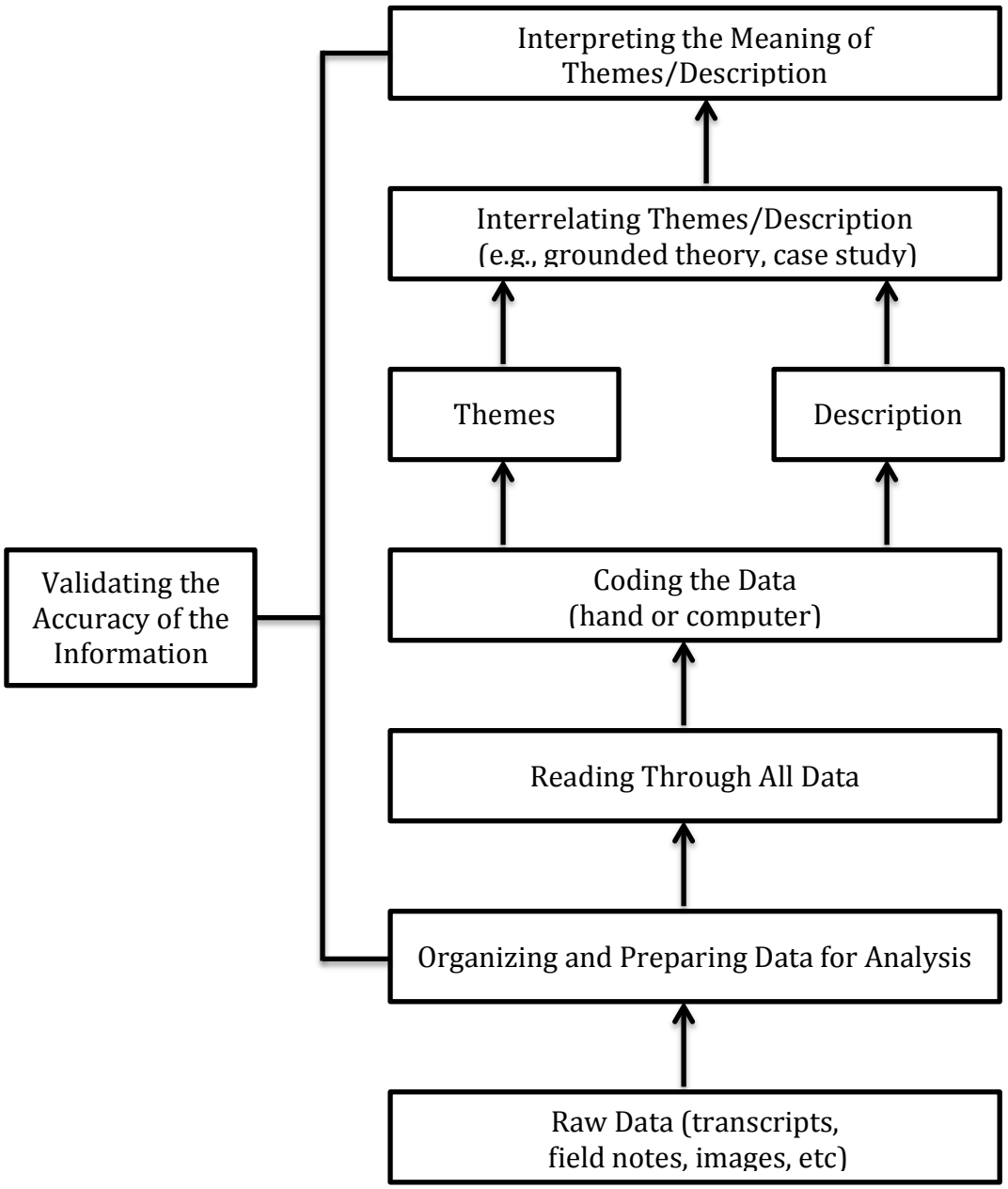


Figure 13 - Model of data analysis (adopted from: Creswell, 2009)

These steps will be presented in the following pages, with explanation of how the analysis of the data was carried out.

Step 1

The first step was to organize and prepare the raw data from the interviews for the analysis. The raw data were the transcriptions from the interviews of both phase 1 and 2, as well as notes that were taken during the interviews.

Step 2

The second step was to read through all the data from the interviews, and to get a sense of what information was received and what views and ideas the participants had on the different themes. We could then get a sense of how credible the information was and phase out some interviews, as they did not provide too much information. Here we also

realized that we should conduct a new round of more in-depth interviews with key persons, to get a deeper view into the current decision processes. As decision-making has been the underlying theme of this thesis we also arranged these three new interviews during this step.

Step 3

After reading through the data, we began the coding process. As mentioned in *step 2* we read through all the interviews, and used markers to point out important findings. We then created a matrix (Appendix C) where we defined categories based on these findings. Based on the findings in the interviews, we decided to define 6 categories; Challenges, Necessities and Usefulness, Organizational differences, Competence, Indicators and Architecture. These findings were also translated, as all interviews were conducted in Norwegian. By presenting the data in a matrix, we had a good overview of important and interesting topics. These topics were connected to our research question and the theme of the thesis, and connect to the previous literature study.

Step 4

In this step we used the 6 categories previously mentioned, and began on the *Results* chapter. During this step we also carried out the second phase of interviews based on what we had found during the coding of the interviews conducted in the first phase. It was important to find quotes from the respondents that could support the theme of the thesis, and to further support the needs and challenges of a real time business intelligence system.

Step 5

Based on the 6 previous categories, we found the underlying factors that could connect them with our research question. We then developed a model (figure 14) for further analysis, with the main categories as to what our analysis and discussion would be based upon:

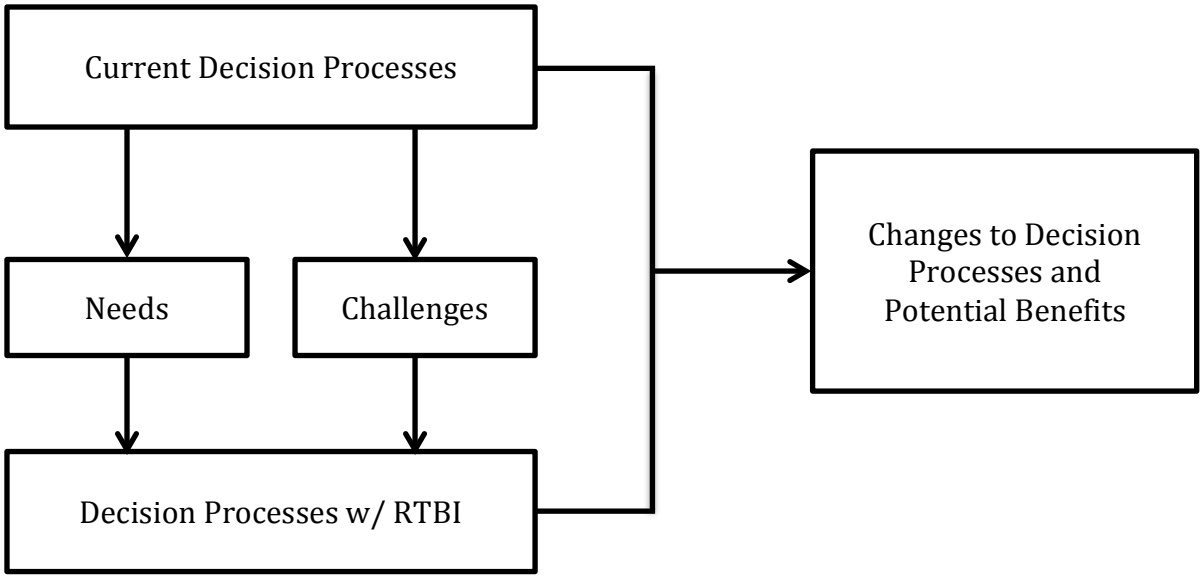


Figure 14 - Model of our discussion

This model (figure 14) was used as the foundation for our analysis and discussion of the results. By looking at the current decisions processes discovered during the interviews and in-depth interviews of this research, we first addressed the need for a decision support system. The need for such a system was an important factor here, and gave us a chance to analyze and discuss the factors that were affecting the current decision processes. By researching how decisions were currently made, we investigated what potential challenges that needed to be addressed in order to implement a real time business intelligence solution. These challenges will require the organization to work hard, and are essential components and factors that will support better decisions within the organization. By addressing the need for such a solution, as well as the underlying challenges, we were able to visualize how the current decision processes could change with a real time solution.

Step 6

The final step was to use the model we created (figure 14) to relate the results of the study to the relevant theory and literature presented in this thesis. Because we decided to have one chapter that focused on the results of the research, we decided to combine the analysis and discussion and connect it to previous literature and theory on the subjects. We believe that by combining the two, we would get a more structured chapter and a chapter that better suited our structure. When interviewing employees with different roles, we found that the interpretation of one thing might differ from person to person because of individual differences in background knowledge. After analyzing the results and discussing these against relevant literature, we presented a conclusion.

3.4 Quality of the research

3.4.1 Use of Theory

According to Walsham (1995) there are three ways of using theory when doing research:

- As an initial guide to design and data collection.
- As part of an iterative process of data collection and analysis.
- As a final part of the research.

He further stresses the fact that it is important for the researcher not to be too consumed in the theory. If that happens, there is a danger that the researcher only sees what the theory suggests, and does not take into account what the research shows (Walsham, 1995). In this research, theory has been used in all three ways, and has served as a basis for the thesis.

In the initial phase of this study, we used previous theory to provide an understanding of the concepts and would be used in the thesis. It was important to do research to be able to inform the topics and approach of the early empirical work of this study (Walsham, 1995). Walsham (1995) argues that: *"It is desirable in interpretive studies to preserve a considerable degree of openness to the field data, and willingness to modify initial assumptions and theories" (p. 76).* By informing and creating an understanding, we believe that the theory was used in the correct way and we were able to look beyond the theory and see that there are other options as well (Walsham, 1995).

The data collection of this research provided us with a lot of important information. During the collection and analysis we saw interesting findings that we wanted to address, therefore we had to expand, revise and abandon certain theory during this phase (Walsham, 1995).

Theory was used as a final part of the research by suggesting further steps to solve the potential challenges that will emerge when wanting to change the current decision processes.

3.4.2 Limitations

As this is a single exploratory case study of a Norwegian company in the construction and home improvement supplies industry, the results are limited to the organization involved. The study has been based upon specific processes connected with the Byggma ASA Corporation and their daughter organizations Huntonit AS, Fibo-Trespo AS and Uldal AS, and the results are therefore unique to these organizations.

3.4.3 Validity

According to Creswell (2009) qualitative validity can be defined as: *"the researcher checks for the accuracy of the findings by employing certain procedures … qualitative reliability indicates that the researcher's approach is consistent across different researchers and different projects" (p. 190).*

We used several strategies to contribute to the validity of this report, and Creswell (2009) recommends use of multiple strategies. For this research, the following strategies were used:

Member checking was done to be sure that the information written down was accurate. All interviewees were given a copy of the case findings and the analysis, so that they could validate the description we gave as correct.

We have also used a rich, thick description to add to the validity of this study. We have done that by thoroughly describing the current decision processes in the organization. The processes have been visualized using ARIS express, and the focus was on what factors that are currently affecting them. We have also ensured that we described the plants, and focused on their differences in the findings of the study.

As this is a real-life situation, it has also been important for us to present any negative information or discrepancies discovered during the study. This helps to give a more realistic picture of the world and the situation. And will help make our findings more valid.

3.4.4 Our role as researchers

Creswell (2009) state that it's important to identify elements that may shape the researchers' interpretation gained during the course of study. These elements can be personal background, history, values, bias, and the fact that one has gained entry to the organizations studied.

We had no previous knowledge or acquaintance with the organizations of this case study. The only knowledge we had of the topics were previous projects and lectures at the University of Agder. We have been the key instrument of data collection for this study, which has been done through interviews and observation. It has been important to maintain this role throughout the study.

Walsham (1995) states that there are two roles the researcher can take on, either as an 'outside observer' or as an 'inside researcher'. The role of the outside observer is one doing formal interviews, but has no direct involvement in what is going on in the field or by providing feedback to the participants. The inside researcher has more of an active role, by doing action research or being a participating observer.

We have had the role of outside researchers throughout this study, by interviewing and observing in the plants. This study has been done through formal interviews, as well as through observation and visualization of decision processes together with employees. Although we have observed in a meeting, we have not had an active role in the study.

4 Results

We have structured our results in six different categorize from phase 1: Challenges, Necessities and Usefulness, Organizational Differences, Competence, and IT architecture. These are categories we find useful to structure and present the results.

4.1 Results from Phase 1

The following results evolved from the first phase of our research, conducting interviews with 13 persons: the CIO of Byggma ASA, and 12 employees from the three plants Huntonit AS, Fibo-Trespo AS and Uldal AS.

4.1.1 Challenges

Findings from the interviews indicate that there are many factors affecting the current decision process in the different plants, and that there are many challenges with regards to the way things are currently running.

All three plants have adopted the LEAN methodology, and have meetings every morning in all departments. The information that is being used in these morning meetings is historical numbers, dated from the day before. These numbers show the results from the various processes based on how they did the day before compared to where they want to be, based on previous months, years and the organizational strategies and goals. A whiteboard is placed on the wall in the factory, and here historical numbers are written down, either with a red or green marker. The red marker indicates that the numbers are not where they should be, whereas the green marker indicates that it's going well. These numbers are one of the factors used to make decisions within the organization. In regards to these morning meetings, there is always the possibility of deviation in the numbers;

"When it comes to our morning meetings, there is always some deviation. Then you have to analyze to be able to find the reason for that deviation, which will affect you to do things a bit differently so that the same thing does not happen again" (Plant director, Uldal).

The plant manager at Uldal noted that the focus needs to be on the how to make red numbers green, instead of focusing on why they were red in the first place, and that a lot of this has to do with the leader, making sure that the focus is right. The findings also indicate that a "gut-feeling" also influences many decisions. According to the chief accountant at one of the plants: *"It is not only numbers that are the basis for the decisions being made. It is also the plant director that sort of has a "gut-feeling".* The person in charge of marketing at one of the plants is also clear that decisions at many times are based upon "gut-feeling" and intuition. The three plant directors said that an important part of their work is the time they spend in the plant itself, on the "floor". One plant director said: *"When you are a leader, you cannot just sit here in the office and do your thing, you have to be in the plant and see what is going on".* The time they spend on the "floor" proves to be an important aspect of the decision-making process: *"For the decisions that are being made, a lot of the foundation is retrieved down in the plant".*

Furthermore the plant directors and the finance manager agreed that there is one important challenge when it comes to automating the processes. They are afraid of being too dependent on the numbers, and not having the time to take a trip down to the factory itself. They still want to be able to take a walk down to the production area and

see what is going on there, and also be able to see what numbers are actually posted on the whiteboard that day; *"It counts for enormous amounts of information now, so I go down there every once in a while, to get a feeling of how the production is flowing. They have a production meeting down there that gives a lot of information on how things are flowing" (Financial Manager, Fibo-Trespo).*

As of today, most processes are manually driven. According to the plant director of Fibo-Trespo: *"A lot of information is retrieved manually. There is also a lot of information that we could have automated more".* He furthermore stated that there is a purpose behind the manual processes: *"We have done it a bit on purpose because we want the people to have a relationship and ownership to the numbers, which can also have an effect on the final figures".* The plant chief at Huntonit commented that a lot of their processes are manual, and that has a lot of disadvantages; *"One thing is that it is not effective, because a lot of people are tied up to it. Another thing is that a lot of the information is wrong, and you do not get the right connection between different things. We have a lot to go on in that area". The p*roduction manager at Fibo-Trespo tries to explain how it works presently; "*The people that work on the line, they have to write it down for each cargo they move. They write it down one place, then they have to write it down on the production label, then into an excel sheet, before they then have to write it into the IFS system. After doing that, they start with a new cargo. They might move between 20 and 40 each day, so that is a lot of writing as well"*.

The plant director at Huntonit noted that they have an older factory, where an automation of processes would result in new equipment. The equipment that would be needed here is extremely expensive, and everything would need to be changed in order to change the manually driven processes. *"If you are going to buy new machines at this plant, it will be in a 3-digit million amount. If you were to build new machines today, it would not have been done here in Norway, but in a place where the costs are much lower",* he commented. Another important aspect of these manual processes is that one cannot fully trust the numbers. The numbers are punched in by one person after each shift, and then sent to the person in charge, who can then make decisions based on these numbers. The numbers are punched in via Excel sheets, and they are retrieved from Access or the production itself. The plant director at one of the plants said: *"There is a big danger combined with how we do it today. We have persons punching everything into the system every day".* However, this plant director also has some thoughts when it comes to a new system; *"I don't think I could fully trust electronic numbers after all".* Furthermore he says that it is because he feels that people blindly trust numbers given by an electronic system, whilst he is always a bit skeptical because he uses the knowledge he already has from the historical numbers to assess if he can trust the numbers he receives.

There is a lot of redundancy at the moment, according to Production manager at Fibo-Trespo: *"We might have 3 or 4 people here every day punching in the same numbers to receive different reports, and that is a waste of time".* The process for punching in numbers is: *"First you write down the numbers on a piece of paper. Then, you insert it into an Excel sheet, before it is punched electronically in the IFS system. Then they give that information to the "Planner", and then he has to verify that it is ok. After that the manager of that specific department has to find those numbers and then punche them into a new Excel sheet to get the report that he wants and needs. It would be much better if there were a button to push. I want that" (Production manager, Fibo-Trespo).* The plant director at

Fibo-Trespo commented that he spends a lot of time stressing others with questions regarding specific numbers, because he does not have the full knowledge of why these numbers are as they are: *"In the long run I wish that we could have information easier available. That way I would not have to strain people with what and how much we have billed today. I would like to have access to that myself".*

The current information systems that are being used vary from plant to plant. IFS are their current ERP vendor, and all three plants use this system to a certain extent. The database being used is Microsoft Access, and at Fibo-Trespo the person in charge of marketing is also the person who writes queries to the database. The decisions regarding what queries one needs, is made based upon a persons need in a specific area; *"There is no system supporting it, it is more of a choice to try and assess if it is smart or not".* He furthermore added that: *"I am very careful about making something I don't see as useful. The employees have a need or wish, and then I assess that, and act as a counterweight to ensure that this is something we actually need and gives us value".* The current ERP system has several support systems, which is not viewed as a positive thing: *"It is not the best idea to have all these third-party tools that we have. I try to be a bit constrained regarding our needs".* Currently, there is no system within the organization that supports the creation of a reporting tool, according to the marketing-responsible.

The three different plants vary in age, when it comes to people, equipment and the factory itself. Most respondents said that there has not been a clear difference in motivation when it comes to age, but that there have been situations where some people have been negative to the changes that have been presented by the board and the plant director. These opponents, have turned around after a while and are now more positive than others; *"In the beginning there were some opponents. There will always be some of those, a few saboteurs. But after a short time they come around and join the team" (Marketing, Fibo-Trespo).* There have also been some challenges regarding the amount of time that has been put into certain implementations, such as the LEAN-methodology. All respondents are clear that it takes time, and that this is an on-going process for the organization. They have decided to start with the top management, and then educating employees and rolling it out one step at a time. That can result in some people not being sure what is going on, since the adoption of this methodology is done step by step, by letting some departments and people try first, and then rolling it out through the organization.

An important aspect of project implementation within the plants has been the support of top management, that the project itself is rooted in the organization. According to plant manager at Uldal: *"The most important thing is that the executive group understands what is being implemented and that they want it. We have to want it and be able to understand what it is. We cannot look at it as a constraint".* All respondents said that it is an important factor that the executive group feels an ownership to the project, and that this factor is very critical. By having that focus, the employees will understand that this is something the executives believe in and want to go for.

4.1.2 Necessities and Usefulness

Findings from the interviews show that there is a need for an information system that can provide the employees of Byggma ASA and the three plants in particular, with up to date information as a support for making decisions. At the moment only historic data

can be provided for some processes, and in many cases there is a need for more accurate information. And for Byggma ASA and all the plants to be able to compete in today's market they need correct and reliable data to make decisions. As one of the plant directors stated: "*Not having the correct data to base our decisions on, it can result in wrong decisions that can cost the organization a lot of money".* The CIO stated that there is shown to be a need for real time data in several different areas; *"We have several areas where there has been reported that they need real time data, in the logistics division and in the sales office. The same needs you also have in production".* He further noted that the sales office wants to be able to continuously see what they get in, and that the office of logistics want to see how much has been packaged, counted in for example numbers or kilos.

After doing the interviews at the three plants we see that the plant directors see today's data as obsolete. They need data that is more up to date, that fits the timeframe they are in. This is a common denominator throughout Byggma ASA. The production manager at Uldal also stated that today's data was too old, and that there is a need for more accurate data; *"When it comes to the computer, the data could be more up to date".* The interviews also show that the manual process of data entry also contributes to not trusting the reports generated, and the foundation for decisions is impaired. The plant director and production managers where unanimous on the fact that a real time business intelligence system with graphical user interface, and being able to see all KPI's in a dashboard is a necessity to be able to be at the top of the "*game*". This will enable them able to have a better support foundation for decisions, make them more effective and give them more trust in the data generated in the system.

After Byggma ASA started to introduce LEAN, which they call Byggma-Process-Optimization (BPO), the employees have been introduced to using a whiteboard each morning where they update the most important production numbers etc. This is done in a morning meeting, which lasts maximum 15 minutes, and is held by everyone standing in a circle. Every morning there is one person that is the leader of that meeting, and this person is responsible for presenting the data. The leader of the meetings is a rotating role from week to week. For the leader to have understandable data to present it requires a process of retrieving data from the ERP-system and using formulas to get the numbers they need. This has forced the employees to get a relation to the data they are presented each morning. The plant directors all mentioned that they felt it was necessary for the employees to have a relation to the data presented through a BI perspective and they felt that this was achieved throughout the BPO-work;

"There is much we could have automated, but we've probably done it a bit on purpose because we want that number which is put up on the board, employees must have a relationship to it. So when you have to do a job on collecting data and making a calculation on it so it creates some sense of ownership. But the time is right, mature enough now to begin and improve the efficiency and automate this process." (Plant director, Fibo-Trespo)

A major aim for a RTBI-solution is to reduce the time retrieving data each day. As of today there is one employee, a self-appointed person who builds queries for all employees for the needs they may have on what kind of data reports are made on. This is time consuming and this person already has his calendar fully booked on his actual work schedule. The company believes that a BI-solution will reduce the time and money

spent on building queries and the time spent on processing the queries. This will make them more effective so they can concentrate on the things that actually bring money into the company.

All respondents had wishes as to what numbers were needed in real time, and all had needs in reference to their role in the organization. The CIO said that operations and production would need it, but that the management would also need a more superior look on the organization as a whole. When asked if there were critical processes that needed to be measured, one respondent said; *"I feel I have control for the most parts, but some of it is time-consuming to obtain. What we do miss, if we are thinking about what we lack, is information on what is going wrong in the production. We don't have a good system for that" (Production Manager, Uldal).*

Another important aspect of a production plant is that they have a lot of customer data stored in their CRM system, and the marketing responsible gets a lot of information from this system. The people interviewed at Uldal believes that data on competitors is not an important aspect, because their customers normally give that information to them themselves if they are not happy with the prices they are given; *It's feedback from customers for the most part. They often say: You are now a lot more expensive compared to others, or now you are well on price. (Customer Service Manager, Uldal).*

The person in charge of marketing is currently creating the queries for the existing ERP system stated that the organization would have the courage to split up a real time solution, meaning that there needs to be focus on the different departments and that you build up each one with numbers and measurements, so that there wont be too much information at once. He furthermore noted that the screens that will possibly be placed out in the plant, should irritate the employees; *"It has to irritate in the right way, so that they will be proud if they have done a good job or do more if they see that they have done a bad job".*

When it comes to availability of the data, there are contrasts in opinions. Some respondents are clear that there should be complete availability for all, meaning that everyone should have access to all data. Others, such as the plant managers, are more reluctant, and believe that one should have access to the data that one needs, but that data regarding finances for instance, should be available only to those who need it. Production chief at Huntonit stated; *"There has to be enough and sufficient information, because it can quickly turn into too much".* He believes that the important information has to be defined, based on the requirements of the user; *"It really has to be customized to fit the user".* Furthermore he says that as there are different departments within the plant, there is a difference in knowledge as well, and numbers have a different meaning for different persons; *"It can be that they want to measure one thing that does not tell me anything, but that tells them a lot more".*

Simulation of trends is also important to the plants, and to have that information available when you want it and to see what deviation that can have on the bottom line. Plant chief at Huntonit believes that forecasting and simulating trends is an absolute: *"It is extremely important. At least I believe so. If you can quickly go in and create a model with different conditions then before, and then you get an answer of what the result could be by doing those changes. That is important".*

4.1.3 Organizational Differences

Fibo-Trespo is the newest of the three factories, and also has fairly new equipment. This was the first plant that started the ongoing process of the BPO-process, and has undoubtedly come the furthest. Findings indicate that this plant have good experience with previous implementations and project management. Findings also indicate that Huntonit needs to spend more money on automating processes, as they are not able to just renew one machine, but have to renew most of the equipment at the same time to be able to automate the processes. The assisting production manager says that in order to be able to automate their processes, they have to mount something on the machine that can help measure that specific process.

All plants have employees in a big age range, but this does not mean that the older people are more reluctant to change then the younger employees. But the older employees that have been employed for a number of years have their way of doing things and has been through lot of trying and failing according to projects meant for improving business process and they tend to have attitude towards projects like this. The findings also indicate that all plants have had employees that have been more reluctant to change such as the Lean process, and that they have had to take these people aside and talk to them in private. Those employees where given the option to either follow the project or find a new job.

"If you want to continue to work here, then you must accept the changes that come, or find a new job" (Production manager, Fibo-Trespo).

The employees who were given this option stepped up and are now of the most active in the work of getting BPO to succeed. Age may be a reason for reluctance to the BPO-project but from the interviews there more to it than that, including work habits and experience with failed projects.

Shift manager at Huntonit says that they have a way of doing things, and that they have used that same approach for as long as they have been there. He says that he believes people are doing it the way they are used to because they do not know any better way, and indicates that it might be because most people have been working at that plant and are not familiar to other plants.

The findings also indicate that there is a good relationship between the people working in the production and the people in the top management at all three plants. However, one employee at Huntonit said that he is not sure how much influential power they would have on the top management. At Fibo-Trespo however, the plant director has been very firm and tough, and that they want their organizational structure to be quite flat, and that after starting the LEAN process, the people "on the floor" has had more influence as they are actually the people that know the processes down in the production.

Each plant produces different products, and based on this they have their own needs of information systems that supports the production. Uldal is in the window-production industry where there is information systems specially designed for this kind of business called Calwin, developed by Prodit. Prodit is a Norwegian based it-company that develops software for the window and door industry. Fibo-Trespo uses self-made SQL-

queries to access data from the database for production and sales. Huntonit said that they use a production planning system, NV plan, to handle production according to sales and orders.

All of the factories in the Byggma ASA group have an ERP system supporting the organization, but most of the data usages are handled by smaller systems supporting their individual needs.

4.1.4 Competence

The findings show that the competence level when it comes to Information Technology is varied within the organizations and the different plants. The plant directors, plant chief and the financial manager had more knowledge of IT and business intelligence in particular when asked to explain during the interviews; *"I guess BI is about these KPI's that are being measured. We have not used that here. I have had it presented on a couple of different occasions, but I cannot brag about having any specific knowledge of it" (Plant director, Huntonit).* The other respondents were unsure and when asked to explain they did not know what to say, some responses received were; "No" and "I have heard about it. But I do not know what it is". The people that have been active in the LEAN process, and taking part in the discussion groups, seemed to have more knowledge on issues connected with the current ERP systems, and on what effects a certain type of system would have on their work routines. All the plant directors at the three plants are board members in Byggma, and work together quite a lot. That lets them exchange experiences and discuss.

The perception of definitions and systems seems to differ from one person to another. The perception of the organizations information systems also differs within the organization itself. Some respondents believe that their plant has a data warehouse, whilst other indicate that the data warehouse is indeed their database that is already connected to the ERP system. The CIO indicated that there was a data warehouse, when asked about it he said; *"We get information out in cubes, yes. So we have the tools in a way, which can be built to contain these types of things".* Others said that this so-called data warehouse was in fact just the database where information is stored, but that the need for a data warehouse is there: *"Now that we are implementing a new ERP-system we will have a unique opportunity to build it up and structure it in a new way that makes it possible for us to have a data warehouse" (Marketing, Fibo-Trespo).*

One plant director stated that he did not believe that age has anything to do with knowledge within the organization, but that he did believe some of it affected him; *"As you know, I am in the other end of the scale. Luckily I have younger daughters that teach me".*

From the interviews one could also understand that a lot of internal education is going on within the organization. The plants arrange study groups for the executive team once a week; *"We have reading groups where we read chapter by chapter and get up ideas and thoughts".* The ongoing LEAN-implementation has given the employees good practical competence when it comes to project implementation; *"We want to make a model for the different project phases we have gone through. We have 9 phases in this model. I have made a schema for each of the phases, which makes it easier to remember what factors that are important and so on" (Production Manager, Fibo-Trespo).* In the time before

Fibo-Trespo started with LEAN, they spent a lot of time educating their employees; *"We chose 17-18 persons and gave them a deeper training on the topic. We had a theory-practice approach. First we spent time on the theoretical base to get an understanding of the concept and the process, then we started with the practical work. An important combination." (Plant Director).* Further, the management team at Fibo-Trespo sees that they have created value with their implementation and on-going work with LEAN, and have made the information available to the other organizations: *"We use something called the 5 S, it is about everything being clean and shining, and to be setting a standard for the rest" (Production manager, Fibo-Trespo).* With the new LEAN methodology, the hierarchy is not as it used to be at this plant. The plant director stated that it has switched to become a more flat structure, and even on some points being the opposite way of how it used to be: *"We have turned the pyramid around. The commitment is on top and we have focus on the operators in the system, the people that are doing the value-adding work, and the rest of us are there to support and carry that process. We started with the traditional leader on top, but have turned it around and that's what works".*

The plant managers at Huntonit and Uldal says that they have learnt a lot from the LEAN process in Fibo-Trespo, and that has helped them when they started with the process: *"The plant director at Fibo-Trespo has been sort of a mentor for the rest of us, since they were the first to start and has come the furthest in the process" (Plant director, Uldal).*

The plant managers have an overall overview of the organization, whilst the production managers and others at a lower level of the organizational structure have knowledge on their own department and field, but nothing more. All three plant managers had some knowledge of business intelligence, and the CIO had some knowledge as well; *"We know what we want, to put it that way. Know what we want in the user interface, but how we build it technologically and technically, we do not know today" (CIO, Byggma ASA).*

Some of the training within the organization has also had a negative impact on workers, as Fibo-Trespo used a so called "Standing in a Circle" approach where one of the persons in the executive team was standing next to a machine and writing down everything that happened for a whole day. According to the production manager: *"We began with it, and it became a big thing, because the workers thought we were out to get them. We were just supposed to write down how they handled the machine and such, but we should have been better at informing them. They did not have the same understanding. We in the executive team have had more training, and it was easy for us to believe that others had the same knowledge".*

The CIO believes that practical training is an important aspect of educating their employees to gain more competence in the field; *"You cannot just sit there and look at a screen and have it presented, they have to do what is necessary through practical training".* He also says that the way the plant director has used a mix of theory and practice at Fibo-Trespo has helped the organization; *"He is a practical course type, they don't just talk theory and how it should be done, but he puts up a whiteboard and gets people together and have them read a couple of chapters in the book. Then they conduct study-circles. You kind of have that, raise the competence level in stages by having both practical and theoretical learning".* To fully help the three plants in the implementation of the new ERP system and in the LEAN methodology, the organization has engaged an external consultant.

4.1.5 Indicators

At the moment, all numbers that are being measured in the plants are historical numbers, and the reports that are made based on these numbers are monthly. All three plants have introduced the morning meeting and regular use of the whiteboard where they have all their key process indicators. This is what they measure and make changes based upon the numbers, which is presented every morning. The data here is presented with green (positive) or red (negative) markers. They all replied that the indicators that they are heavily interested to measure are how is the sales office doing, how are we on orders, do we deliver on time, and how is production. And in the question of popularity in the range of products, are there any products that we may need to reconsider to stop producing, an important KPI for Byggma ASA is the stop margin - Why where there stops in one or more production lines? - What caused the stops? What caused product faults? Several employees of the three plants point out that this is important to measure. For now, stop and errors are only measured by punching it in manually. At Uldal, the production manager says that there is a need for measuring if glass breaks in the production of windows, or if something goes wrong in the painting department; *"I feel that that should be more up to date"* (Production manager, Uldal).
Here they also follow up and have continuous work to avoid any stop in production.

From our interviews we can se that this is the main concern for the production managers and plant directors. A key factor that relates to the above indicators is product quality. According to the production managers they use Overall Equipment Efficiency (OEE) to check the availability in production lines, how they exploits the production line and the quality on production.

"It is also the fact that we can see the reasons why there have been stops and that we can create a list of stops and go down to do something about it, that is very important" (Production Manager, Fibo-Trespo).

And as we can see from the interviews, each plant is dependent on raw material they buy from their suppliers. Stock level, volume in monetary terms of raw material is a measure they want in real time. The plant director at Fibo-Trespo said: "*Some of the things we want to bring out a little quicker, and when in the middle of a period is the stock level of raw material side and the volume in dollars and dimes".*
This information is only brought to them from monthly reports and is too cumbersome and difficult to create reports based on the date you want.

An overall parameter for the indicators above is the economic aspect. *"You could have as many thoughts about the people you want to, production and products and be as happy as you want. But if you don't earn money on it you might as well close down" (Plant Director, Huntonit).* As he said this, he also mentioned that if you have happy employees, you have employees that work well and get things done. Chief accountant at Uldal mentions one indicator that would be necessary in real time: *"Sales statistics is important. Where are we according to our budget and goals? That is two of the main factors".* Further the chief accountant also mentions that it would be very important to know how much money that goes out at any time.

The interviews indicate that all three plants believe that there is a need for real time information regarding production, sales and orders. The board of Byggma ASA is in need

of an overview of real time information for the different plants when it comes to how many orders they have had during the day and at specific times of the day, as well as the financial perspective.

4.1.6 Architecture

The current database and IT architecture has only been given a vague description in the interviews, because most of the respondents does not have the knowledge of what it looks like. As previously mentioned, there are different perceptions of a data warehouse, whether or not the organization has this. But for now, the architecture only contains databases that are directly connected to the ERP system, and no data warehouse.

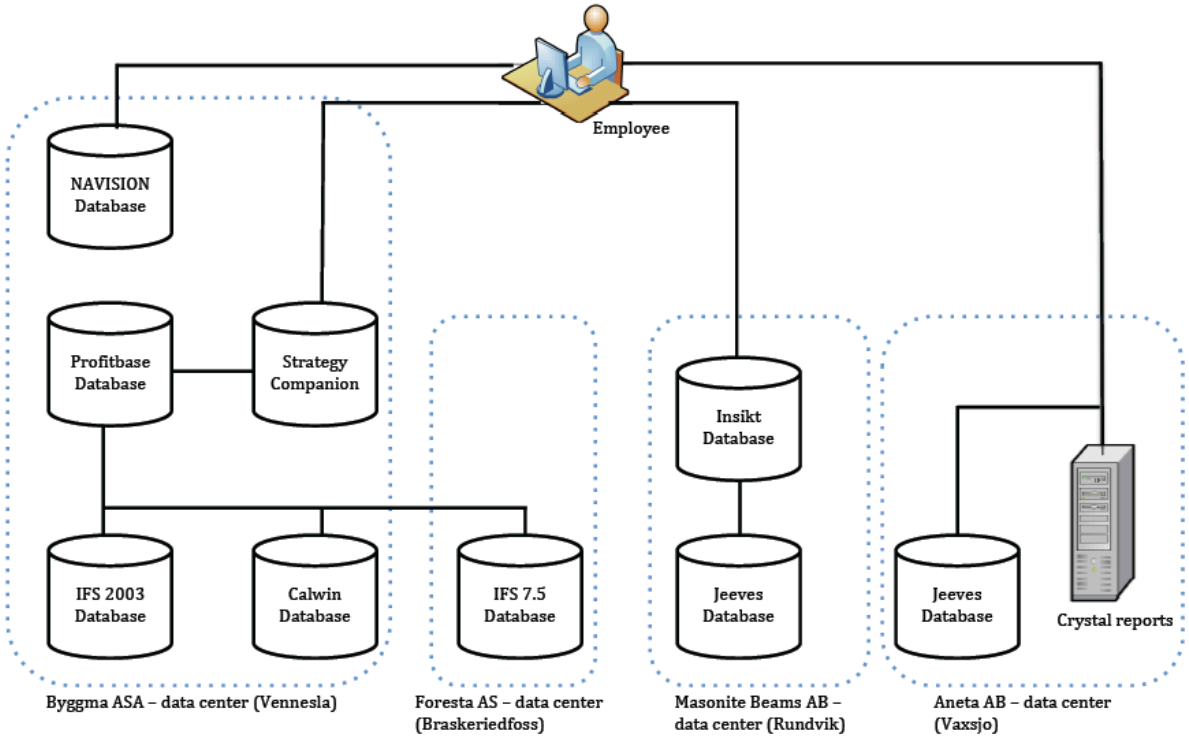


Figure 15 - Byggma ASA IT architecture

The current architecture (figure 15) consists of an ERP system that is common for all three plants – IFS. In addition to that ERP system, one of the plants also uses an information system that is tailor-made for their business. The organization as a whole is currently in the transition mode while changing their ERP system in favor of a completely new solution. This will provide some changes for the current database architecture, but there will still be no data warehouse. The step to change ERP system is a big step for the organization – Byggma ASA, since they have had several different ERP systems in the organization for years.

All respondents except one believe that it is better to focus one a few core processes when implementing a new information system in their organization. They believe that one should choose the most critical and important processes to start with, to get fast results in order for people to believe that this is the way to go; *"I think it's important to take some things first. That is my opinion. It might not be the correct way, but for my part I think it's important to take core processes first to see key numbers" (Chief accountant, Uldal).* Only one respondent believed that one should roll out the project over the entire

organization at once, that way everyone will feel included; *"If you are going to start with the core processes, you have to figure those out. And that can take time. So I believe that we should roll it out right away and take it from there" (Production manager, Fibo-Trespo).*

4.2 Results from Phase 2

4.2.1 Current Decision Processes

Round two with interviews at Fibo-Trespo we got the plant director to describe a situation in recent time. This situation was a request from a customer. The customer who was Byggmaker contacted the sales office requesting a sales campaign in a specific week on a specific product. Further on with the next interview we used this situation as a scenario for the production manager and asked him to describe the process for us. This allowed us to model the processes in ARIS. To give the costumer an answer, they need to know if Fibo-Trespo has capacity to produce and deliver this product on time. To be able to see the capacity on production and products in stock it is necessary to collect data from four different databases, stock, intake of orders, production plan and backlog of orders. To collect this data the production manager imposes chief of logistics, chief of sales office and production planner to get data from their area of responsibility and pass it over to him. This data is then used in a model Fibo-Trespo has put together in MS Excel. The model presents the status of the different divisions in the plant in a graphical GUI as well as table of the data collected. The data they use here is this year's data and historical data two years back in time. This allows them to simulate and predict the influx of sales for certain periods.

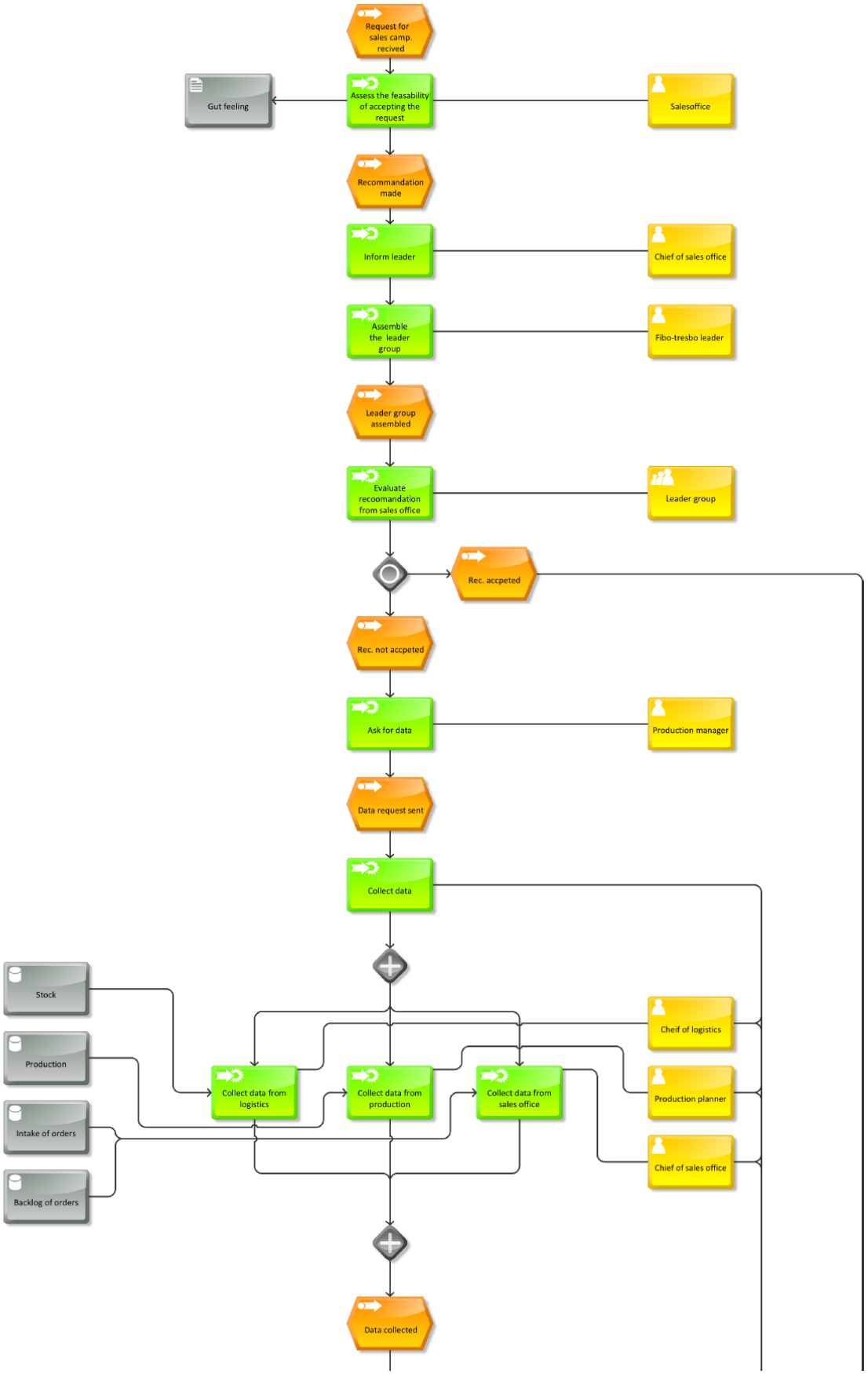
In this section we describe the situation as mentioned above to visualize the process. Below, figure 16 shows the modeling we have done in ARIS of this process (the model is stretching over two pages).
The situation occurred when Fibo-Trespo received a message from the customer that they wanted to run a sales campaign. At this point the sales representative didn´t have the needed information to approve or deny the request. After chatter in the office, there where divided opinions whether they could accept or not. This led to a meeting of the leader group to discuss the situation. At the meeting they concluded that it was necessary to gather information from three different divisions, stock, sale and production. The information needed was stock, intake of orders, backlog of orders and production. To retrieve this information the production manager took the responsibility and required this data from the chief of logistics, chief of sales office and production planner. The reason the production manager didn't retrieve the information himself is because lack of system licenses (employees share the same license) and that each department have a better understanding/overview of their own areas.

"I have access to IFS, but it's five or six that uses the same user. And they will not purchase additional licenses. I could have gone in (ERP-system) to do the same as the production planner, done the same as sales office, done the same as logistics. Checked myself. But every department has a better overview" (Production manager, Fibo-Trespo).

This is the main time-consuming task of this process. The plant director told us that they received the request one Friday and where able to give response to the costumer Wednesday, four business days later.

When the production manager received the needed information from sales office, logistics and production he could start the work of creating a model where they could simulate what a sales campaign would do to the production and company.

The next step was to gather the leader group again and discuss the model to evaluate the situation and simulation the model displayed. The production manager presented the model and explained the to the leader group the facts they where shown. The leader group then agreed on an outcome and passed the message on to the sales office so they could contact the customer and reply.



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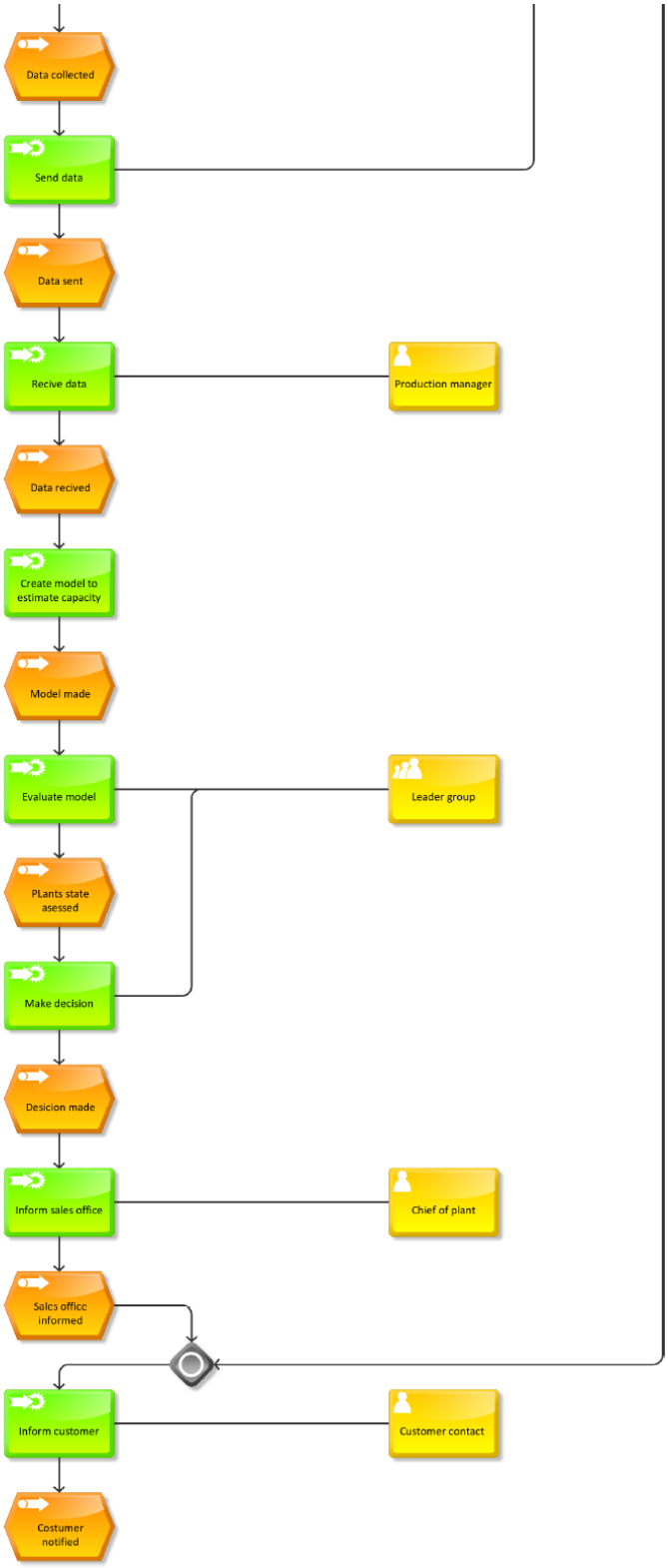

Figure 16 - Decision-making process: Sales campaign request

Another scenario that we got described was a situation where they lacked raw material for a specific product. This scenario occurred in January. For Fibo-Trespo it was important to be able to run the production at an acceptable level and to keep producing goods, keep employees in work and deliver products they where able to produce. This situation meant that they had to identify what they could work with until they got the needed laminates back in stock, not to mention make room on the storage for raw materials for the laminate that were on its way. The production manager took the responsibility of gathering information. Information the production manager needed was from sales; what was sold. Logistics; what they had in stock. Production; what kind of products were in production. Raw materials; how much and what was in stock of raw materials.

The production manager sent out the message to the divisions mentioned above, and the message said that this information had to be sent to him. He needed this information to create a new plan for production. This plan had the criteria to make room for the incoming raw materials, keep production going, keep the customers happy by delivering orders. And keep the loss at a minimum.

"I must get the scheduler to check how we are doing in relation to the time when we can run it, and then get procurement office to check whether we have the raw materials to make it run. Get the warehouse to check on what we have in stock, check if it matches the amount of stock in relation to the IFS. And then you have to notify the call center so they know what they need to procrastinate" (Production Manager, Fibo-Trespo).

Below you find an illustration of the process described above (figure 17). We start out with the fact that they lack raw materials and the production manager takes the responsibility to gather data from the four databases. In that matter he gives orders to the persons in charge of each division to send the data over to him instead of accessing the databases.

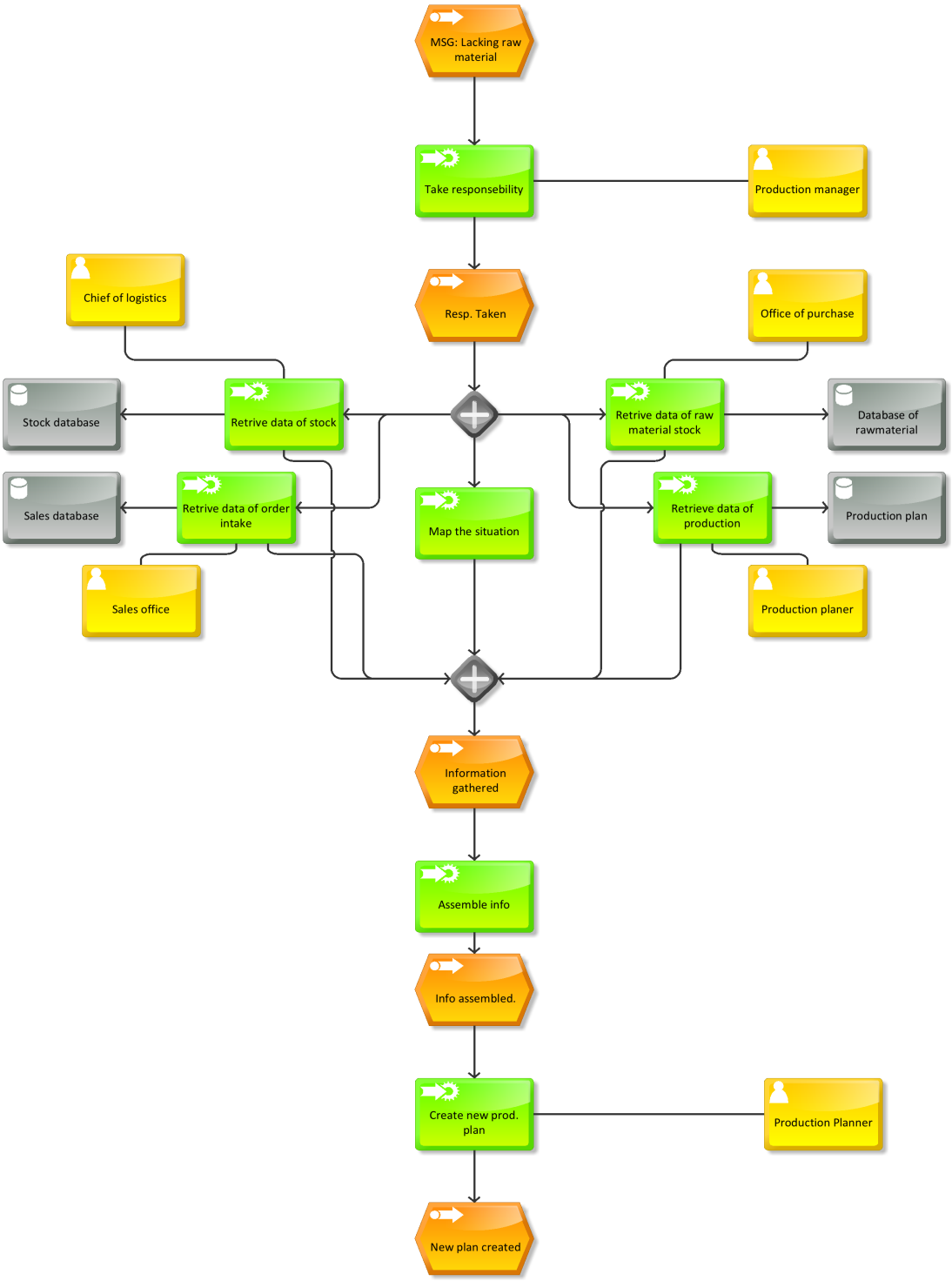

Figure 17 - Decision-making process: Lack of raw materials

4.2.1 Meeting observation

During the second phase we were able to be participating observers during a morning meeting at Fibo-Trespo. During the meeting we were able to take pictures of the whiteboard as well as taking notes.

This morning meeting was introduced to the plant together with LEAN, and is a way of informing the leaders of the respective departments on numbers from the previous day in production, sales, HMS, and so on. Every week a new person is in charge of the meeting, but all department leaders have numbers that they present at the meeting. This meeting lasts for maximum 15 minutes, and starts precisely 8.50 every morning. There is a clock attached to the wall over the whiteboard, where the time from 8.50-9 is marked with green. This is the initial meeting time every day. The time from 9-9-05 is marked in yellow, indicating that if they need more time, they have 5 minutes extra.

To be able to present some of these numbers, the production manager starts work at 6 am to query the database for yesterdays numbers regarding incoming orders. This has to be done at an early stage because it is heavy work for the database, and at the same time they only have a limited number of licenses in the system. Then, the leaders of the various departments also queries their respective information, such as production numbers, sales numbers, logistics numbers.

The numbers are written down on the whiteboard every morning before each meeting, and are written with either a red or green marker (figures 18 & 19). The red numbers represents numbers that has not performed according to the set goals, whilst the green numbers indicates that the numbers have performed according to the goals or better than it. A percentage of the numbers, in consideration with the expected numbers, are also shown.

Figure 18 - Picture of BPO-whiteboard at Fibo-Trespo

Before the meeting started, the plant director introduced us and told that we were masters' students working on a thesis on real time data, to inform the others of what we were doing there. After that, the meeting started, with the meeting leader shortly informing on numbers from his department, and then letting the others inform, department after department. During the meeting all employees informed the participants of their numbers, and what could be the cause of for example a red number. For example, one person said that they had been one person less working the day before because one person suddenly had to leave, and that that had an impact on the numbers.

Figure 19 - BPO-whiteboard close-up

This morning meeting gives the employees and the plant director an overview of how the plant performed the day before, and how one should work in order to achieve the goals that has been set. The plant director also said that these meetings have been very effective, and that the overall performance of the workers increases if there are red numbers on the whiteboard.

The main results in this research chapter are summarized on the next page.

4.3 Summary of Phases 1 & 2

From our two phases of interviews and observation we have categorized the results of this study into three topics: Decision-making today, challenges and potential benefits.

Phase 1

Decision-making today

- From the results we can see that the operational numbers are important indictors to measure.
- Does not fully trust electronic numbers.
- Redundancy, operational numbers are punched in up to three times each.

Challenges

- Afraid of loosing their relationship with numbers.
- Afraid of loosing valuable time spent "on the floor".
- Does not trust electronic numbers.
- The plants vary in age and size.
- New equipment can potentially cost a lot of money.

Potential Benefits

- They spend too much time on retrieving and calculating production, and sales data to make decisions.
- Big potential to reduce the amount of employees it takes to make a decision that depends on operational measures and sales history.
- Employees are asking for an RTBI-system supporting daily business.

Phase 2

Decision-making today

- Morning meetings need to physically retrieve and calculate production data (operational measures), which the morning meeting leader lists on the whiteboard each morning.
- Complex processes to carry out a decision.

Challenges

- Currently no data warehouse.
- Several databases that information is retrieved from.

Potential Benefits

- Digitalizing the whiteboard to interact with a potential RTBI-system.
- LCD-monitors presenting operational data used in morning meetings.

Based on these three topics we created a model to use in the next chapter of analysis and discussion of the results (figure 14).

5 Analysis & Discussion

Based on the results there are three topics that need to be discussed in order to fully understand the value and benefits an implementation of a real time business intelligence system can have on decision-making. First, we need to look at how the current decision processes work and what factors that affects them. Then, we need to look at what challenges needs to be addressed with such an implementation. Lastly, we will discuss what potential benefits a company in the construction and home improvement supplies business may have with the implementation of a decision support system such as real time business intelligence.

Decision-making today

Today's decision-making in the three plants is partially based on data retrieved from the different information systems they hold. Information from the operational level is punched into the databases and is retrieved by using queries assembled in MS Access. That is consistent with Rodrigues (2002) who says 90% of information in today's businesses is actually unstructured. Having unstructured information that needs to be collected every morning is time-consuming and not especially supportive of an efficient decision process (Golfarelli et al., 2004). A great contributor to the decision-making seems to be the factor of intuition, by using "gut-feeling". It seems like this factor is especially important because the decision-maker does not have the correct information available. As we could see in the models of the current decision process at Fibo-Trespo (figures 16 & 17) the sales representative acted on "gut-feeling" because there was no other information to base the decision on. The senior managers did not seem to accept the replies given from the sales office, that is not consistent with previous research which found senior managers have a tendency of accepting "gut-feeling" in decision-making (Khatri & Alvin, 2000). It might seem that the use of "gut-feeling" is more accepted if the person making the decision has worked in the company over a longer period. One could say that an immediate reason for the sales representatives acting on their "gut-feeling" was that there was a lack of competence and they therefore chose to act on past experience (Khatri & Alvin, 2000).

The plant directors implied that they used these factors themselves when making decisions because they have experience with events from previous years. That is consistent with the fact that their employees said they turn to the plant director if they cannot find sufficient information because he usually has a "gut-feeling" related to experience with the company. That implies that the senior managers might not have believed that the employees in the sales office had sufficient experience to base their intuition on, but instead saw greater value of digging into their databases to find support (Khatri & Alvin, 2000). As figure 16 shows, the moment that the managers at Fibo-Trespo had the correct information at hand they were able to make a decision. However, from the initial request was received at the sales office till the decision was made, a lot of time was spent searching for the correct information. Eisenhardt (1989) says that the decision-maker with less information makes slower decisions then those with more information available. In this situation the sales representatives did not have many alternatives and were not able to choose the most appropriate decision (Cleland & King, 1983). We could say that the lack of information available made the employees at Fibo-Trespo spend more time searching for it, because they were not aware of what type of information that they actually possess in their information systems. By not having the correct information available for the employees at the sales office the decision was not

made where the work was performed. Instead it had to be taken further into the organization. That is in contrast to one of the principles of Hammer (1990) which implies putting the decision where the work is performed, meaning that the person doing the work should be the one making the decision in that area. The foundation of today's decisions is connected to possible challenges for a system that will support real time decision-making.

Challenges when implementing a real time business intelligence system

To be able to implement and effectively utilize a real time business intelligence system, there seem to be several challenges connected to the decision process that need to be addressed. One of the main challenges for the Byggma group is that most of the processes at the three plants are manually driven, meaning that the data is punched into the database after every shift in order to be retrieved by employees who create queries. As mentioned earlier, the findings indicate that this has an effect on the decision-making process because the correct information is not available. That relates to Golfarelli (2004) who found that it is important to focus on business processes in today's competitive market. Research shows that in order to improve processes and performance, there is a need for quick access to correct and consistent data (Wixom & Watson, 2001). For that to happen, the business needs to take initiative and actually want to change the processes (Davenport, 2010). Connected to automating processes are potential costs as the three plants have equipment that varies in size, age and complexity. The plant director at Huntonit states that because they have an older factory and older equipment than Fibo-Trespo, there are also higher costs related to a possible automation of their current processes. According to Hammer (1990) it is important to take advantage of technology and processes so that the work is more efficient and there is a possibility of reducing costs. With older equipment, it is important that the process is in focus, and that it might be a better idea to reengineer, by buying all new equipment and creating new processes. Hammer (1990) states that businesses often believe that improving old processes by automating them is the correct way, while in fact the error lays within the process itself. The Huntonit plant has older equipment than Fibo-Trespo and Uldal, and might have a bigger problem with automating already existing processes because of availability of parts. It is important that the process-change is directed towards efficiency and control (Hammer, 1990).

Fibo-Trespo has newer equipment, and their processes may have been reengineered when they began the LEAN process. Based on that, it might be smarter to automate the current processes, as these might be more mature. By using the concept of Business Process Management (BPM) Fibo-Trespo could focus on the workflow of their existing processes by automating these. Here, the focus is on operational excellence and agility, and with a successful implementation of LEAN they might be more agile than the other plants. As many processes within a business are invisible, it is important to make these visible, and to have a focus on them. By focusing on automating current processes, the plants will be able to shorten the product development cycles and make more rapid decisions, which can be contributing factors to achieving success (Atre, 2003).

Having a relationship to the numbers seems to be an important factor in the three plants, and a contributing factor to the current decision-making processes. An important part of the strategy in the organization has been to create a relationship between the numbers and the employees, by letting employees take part in retrieving the numbers

that are presented at the morning meetings (figure 18 & 19). The plant directors believe that this has given them an ownership to the numbers and that this is valuable to them. The fear of loosing that relationship affects how some employees look at information systems - they believe they cannot fully trust electronic numbers. Plant directors and production managers believe that if they have all information available on the computer, they will not spend the same amount of time down in the production area as they would normally do. However, an introduction of a real time business intelligence system will need this strategy to be aligned with the organizational strategies, which means that there will still need to be a relationship between the goals and the actual performance (Henderson & Venkatraman, 1993). Employees will still be able to retrieve numbers from the information systems, but it will take less time than before because there is more information available. An implementation of an RTBI system will also give more people access to the same information, because one of the main points of RTBI is that more people can be updated on measurements and be able to see the overall performance (Azvine et al., 2005).

In order to achieve the wanted value from an RTBI system, the organization needs to agree on what processes should be measured in real time. According to Watson et al. (2004) an important aspect of real time business intelligence is to be able to make the right decision on what processes should be measured in real time and what should continue to be measured historically. At the moment, Byggma ASA only measures their financial terms with a business intelligence solution. This is consistent with Beatham (2004) who claims that there has been a limited approach when measuring businesses because there has only been a focus on the financial terms. As of now there seems to be some disagreement on what the most critical measures are, although all employees agree that operational measures are important. This relates to previous research which says that by measuring the operational level in real time one can get immediate and fresh data(Vortex-Technologies, 2004). The plant directors said that because their main business is to produce, most decisions made are related to the production. Previous research claims that more decisions are taken at the operational level (Watson et al., 2006). In order to choose the right processes for real time measuring, Byggma ASA and their daughter companies should be thorough when choosing who should decide this. It is important that the people choosing what processes to measure have sufficient knowledge on the organization and the industry (Beatham et al., 2004).

To be able to implement real time business intelligence, the IT architecture needs to be prepared for this (Azvine et al., 2005). The core component of such a decision support system is a data warehouse, and at the moment it does not seem like this is something the Byggma group possesses (figure 15). Through the research we saw that there were various perceptions of what a data warehouse was, even though all employees knew that the data they punch in is stored somewhere. There seemed to be a lack of knowledge and that the concepts of database and data warehouse were mixed and believed to have the same meaning. That is not consistent with theory, which says that the main difference between the two is that a database stores data whilst a data warehouse responds to analysis questions that are critical to the business (Turban & Volonino, 2010). To be able to support the processes that the organizations wish to automate and measure in real time, they need to adapt a data warehouse that supports the criteria for decision support in a tactical, strategically and operational level (Azvine et al., 2005; Imhoff, 1999). In order to implement a data warehouse, the organization

needs to agree upon what architectural method they want to use (Breslin, 2004). As some employees believed it is better to focus on the core processes when implementing RTBI, one employee believed that it would be better with an organizational-wide focus from the beginning. This is consistent with Breslin (2004) who states that there are two architectures for data warehousing; the corporate information factory focuses on the whole enterprise as a top-down approach while dimensional modeling focuses on the core processes of the organization as a bottom-up approach. As an implementation of a data warehouse requires that the organization follows a specific architecture, Byggma should focus on their employees. Previous project within the plants have shown that people want results, and that there is a wish to see the potential value of the change. One way to do it could be that they have an organizational-wide focus involving all departments, but still focus on quick-wins by finishing one process first so that the employees sees the value of a real time business intelligence solution.

Potential benefits of an RTBI implementation

Of all the data that an enterprise possesses, only 10% is structured (Rodrigues, 2002). Business intelligence aims to solve this issue and creates a better structure for data storage. Business intelligence requires a data warehouse as a part of the architecture. By having a data warehouse you appoint dimensions to your data, which the data warehouse will structure and present as information through a specified graphical user interface (GUI).

By taking the decision-making processes we have modeled in ARIS (figure 16 & 17) in collaboration with the plant director and production manager we see that the processes are complex and time consuming. They need to involve one employee from each division they want to retrieve data from, to build a model to create a foundation to base their decision on.

By following Tapscott's (2008) three approaches (simplicity and relevance, agility, and integration) you are able to improve the decision-process by providing the employee with information and the right to make better-informed decisions. By using the existing processes and re-model them to be supported by a RTBI-system (figure 20 & 21) we have tried to give examples on how the processes can be streamlined and reduced in terms of people involved and time spent on each decision. As presented here, we have eliminated the central part of the existing processes where those responsible for the process ask employees of different divisions to retrieve data and send back to the person in charge. By doing this we have the opportunity to place the needed information through a custom GUI where the event occurs and needs to be handled. As we are placing the information where the situation occurs we are able to act and make the decision in the right place, and thus reduce time spent on building the information foundation one needs to make the decision (Hammer, 1990). This will provide the benefits an organization wants, as mentioned above. An additional benefit is that by placing information in the right place, employees from the division that were previously needed to retrieve data can know concentrate on their main activity. This is also positive for the leaders, since they no longer need to be a part of the decision.

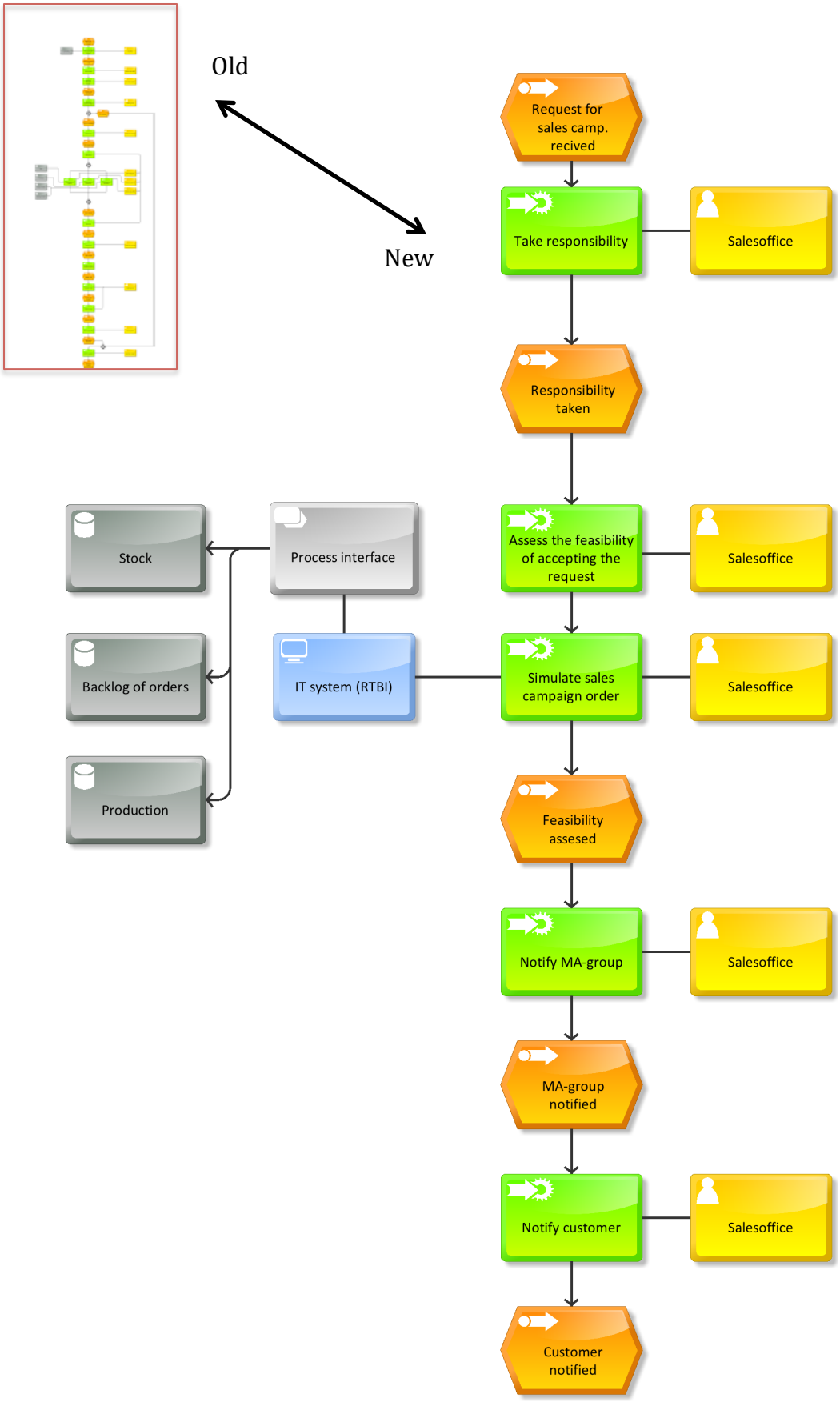

Figure 20 - Decision-making process: Sales campaign request with RTBI

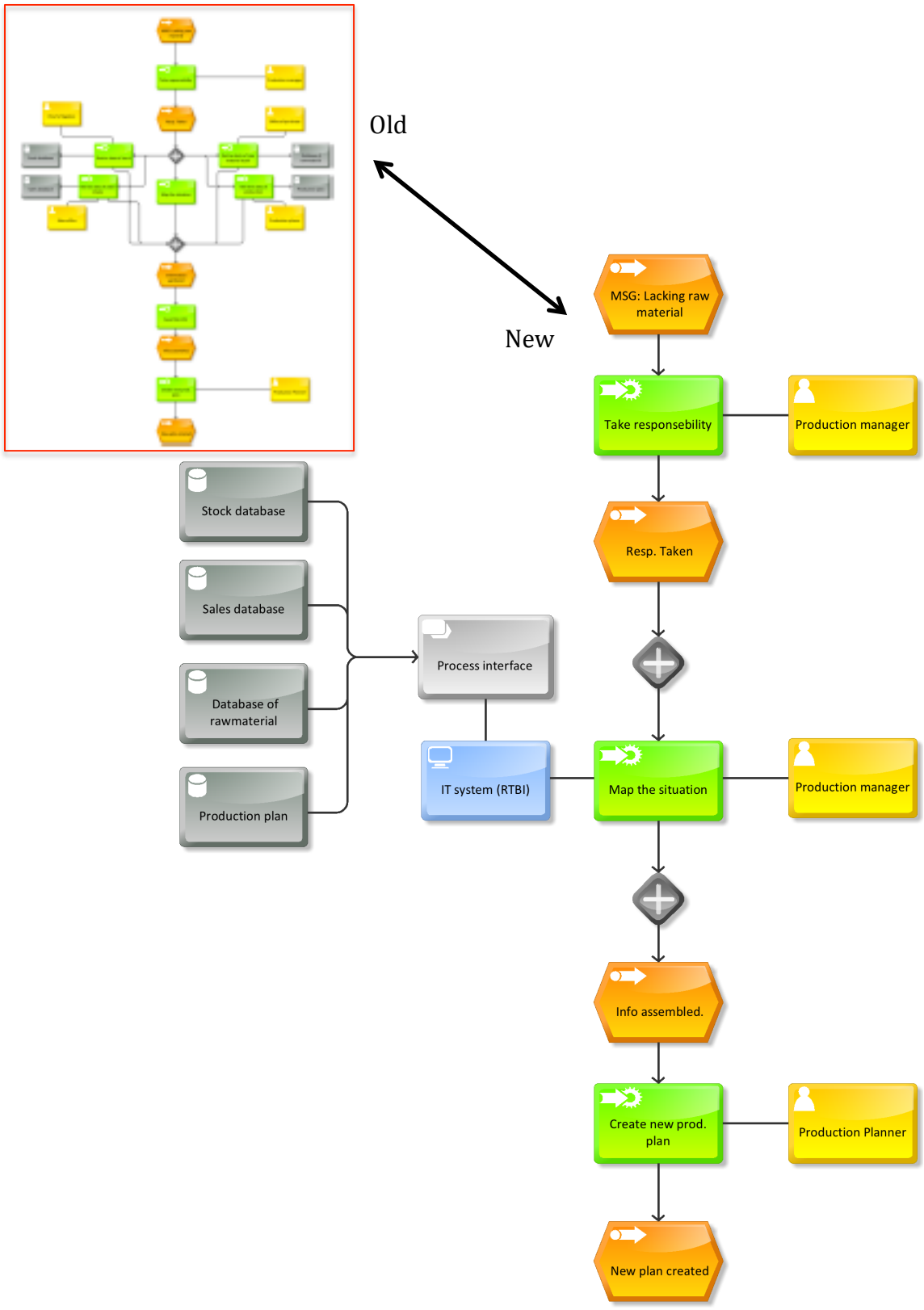

Figure 21 - Decision-making process: Lack of raw materials with RTBI

At the three plants the data is being punched in to make it available, and this is done up to three times for the same data to make it available through out the organization. Byggma ASA will gain potential benefits from automating their processes of registering production data. This will ensure that the data isn't redundant and that employees can gain trust in the numbers they need.

Research has shown that by implementing an RTBI-system businesses can save both time and money by making the information available when and where it's needed (Rakshit, Krishnamurthy, & Yu, 1996). Introducing new technology or new approaches to handle business processes is expected to give benefits to the company. When introducing new software or technology to an organization it will affect the work processes, and a demand for change appears. As Markus (2004) points out we need to be aware of how technology projects affect the organization. She defines this as a term called "technochange". The term technochange implies that we need to look at software implementation projects as organizational projects with focus on organizational change.

"By treating technochange situations as if they were IT projects, these organizations risked being blindsided by implementation problems and unintended consequences. In addition, they missed significant opportunities to benefit from IT-enabled organizational performance improvements" (Markus, 2004).

To realize benefits there must be change either in a system or in a work process. Ward and Daniel (2006) define benefits as: "an advantage on behalf of a particular stakeholder or group of stakeholders". In this study the benefits of the processes will be to get a better structure for how data is stored and presented, reduce the number of employees involved, limit the time spent on each decision, and increase customer satisfaction by reducing the time spent on customer response. Adding a RTBI-layer to the company will reduce the costs related to decision-making processes (Watson et al., 2006).

6 Conclusion

As we have carried out an exploratory case study, we have seen that there are several factors that affect how decisions are being made in an organization. Key operational and tactical decisions are made based on intuition because of the lack of information available to the employees. There is a big potential for a real time business intelligence implementation as today's decisions are taken on a poor foundation. A real time business intelligence implementation can result in significant benefits for the organization, by reducing the time spent making a decision, and by giving the decision-maker sufficient information for his decisions. That will result in a more effective decision process and reduced costs, as the decisions are made in a timely manner in a competitive environment. As we saw in the results the current decision process (figure 16) took 4 business days from request till the decision was made, by adding a real time business intelligence system this process can be shortened to take approximately a couple of hours at the longest (figure 20). Furthermore, in this study we see that there are potential challenges related to a real time business intelligence solution: processes are manual, employees are afraid of loosing their relationship to current numbers, there needs to be consensus on what should be measured in real time, and the IT architecture lacks the main component of a real time business intelligence solution.

A crucial challenge is the fact that the organization has manual processes resulting in data having to be physically punched into the systems. For Fibo-Trespo and other plants in the same situation to be ready for a real time business intelligence implementation, these processes need to be automated. Although that in the short term can result in higher costs, the long-term value of automating is much greater. Depending on the maturity of the organization and its processes, one can choose to reengineer the process, or automate the current process. We suggest that extensive analysis of the current equipment and the costs for new equipment should be done in order to know what would be more profitable for the organization.

It is also important that the strategy of the real time BI solution is aligned with the organizational strategy. With automated processes, the organization will have information systems that can speak with each other, and provide faster and more accurate information to the decision-maker.

An organization needs to pick the right processes to measure, which is difficult and critical to succeed. It is important that the correct people with sufficient knowledge in the organization choose these indicators and discuss their opinions. We further suggest that the organization should create a team of people who can work together to choose the right indicators, and that these indicators should be processes at the tactical and operational level.

Findings in this research also indicated that the directors were afraid of losing the relationship that the employees have to the numbers. With the introduction of a RTBI system, we do not believe that the relationship will be lost, but most likely it will be strengthened. Employees will be able to have a full overview of indicators at all times, with an LCD screen down in the production area constantly showing numbers in real time. Because the directors and managers will have more information available they will be able to make faster decisions, which can result in actually having more time to spend in the production area.

The core component of a real time business intelligence solution is a data warehouse, and that has to be in place before starting the adaptation of such a system. That data warehouse also needs to be prepared for real time. When the underlying architecture is in place, one has to choose how to proceed, whether to go for an organization-wide implementation or to start with the core processes of the organization. We suggest that there should be an organizational focus, by implementing RTBI organization-wide. However, to be able to give employees 'quick-wins' one could do a mix of the two methods, by focusing on the organization but complete one process at an early point so that employees and the organization can see results.

By being able to see the organizational needs and the value of such a support system for decisions, as well as addressing the challenges that will occur, we believe that the decision processes will be more effective and that the decision-makers will be able to make faster decisions with more information to base them on.

Figure 20 and 21 show us that by adding the layer of real time business intelligence, the decision-maker will have access to correct and fresh data at all times. That eliminates several persons from the current decision process, because the information will be available where the initial decision is made. According to Eisenhardt (1989) decision-makers with more information available, make faster decisions. By improving the decision process, organizations are able to gain benefits. The value of improving the decision processes is reducing time spent retrieving information and increasing response time to customers, which is beneficial to the company in terms of reduced costs and more satisfied customers.

7 Implications for further research

We argue that although this is a single exploratory case study, it can create a foundation for further research in the field of real time business intelligence and decision-making.
To further support the findings in this thesis, one could do a case study in an organization similar to the ones researched here and see how decisions are being made at the operational and tactical level. That could help address the fact that there is a need for real time business intelligence systems to support decisions in this area.

It would be interesting research to take part in an implementation of an RTBI solution from start to finish, by taking part in the pre-project phase, the project phase and the post-project phase in an organization. This could provide an opportunity to analyze the actual benefits of implementing RTBI in the company.

An implication for further research would also be to come back when Byggma ASA has implemented real time business intelligence and see how that has changed their decision processes, and if it has eliminated the factors that are currently affecting the process. It would also be interesting to research what organizational differences have occurred after an RTBI implementation, and if the decisions are now made where the work is performed. By looking at organizational results from before and after RTBI was implemented, one could see if this has had a positive or negative effect on the numbers which can be related to what indicators that were chosen to be measured.

Another implication would be to research an organization that is in the starting phase of implementing real time business intelligence, and to research the method used during the implementation. It requires knowledge to start with such a big project, and it would be interesting to see if the competence and knowledge level of the drivers has an affect on the organization during this phase.

8 Limitations

This is a single case study, performed in a Norwegian corporation in the construction and home improvement supplies industry. These results are limited to discoveries made during 16 interviews in the three mentioned plants. The results are in no way generalizable to other organizations, but can be used as a guide for organizations in the same situation and industry.

Ideally we should have been part of the whole process from start to finish when it comes to the implementation of RTBI, but a project like this will take years to complete.

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10 Appendix

Appendix A: Interview guide Fibo-Trespo

Introduksjon	Starter med en intro, avklarer at det blir opptak av samtalen. -Opptak, taushetsplikt	Om oss, prosjekt. Hvorfor vi ønsker dette intervjuet.
Spm 1	Kan du introdusere deg selv, hva er din bakgrunn i bedriften?	Navn, stilling, Prosesser/kritiske momenter
Spm 2	Hva trenger du av informasjon for å utføre dine arbeidsoppgaver?	Nøkkeltall/data type / hvor kritisk Hva er prioritet/Kritisk
Spm 3	Er det et system som støtter beslutninger i dag?	Finnes det tilgjengelig noe system i dag? For alle eller kun på spesifikke nivåer?
Spm 4	Kjenner du til begrepet Business Intelligence?	Hvis ja. Forklar/utdyp
Spm 5	Har du noen spesielle krav/ønsker mot et slikt system?(RTBI)	Type informasjon Tilgjengelighet
Spm 6	Ut i fra dine arbeidsoppgaver, hva mener du er kritiske prosesser å måle? +Hvor ligger evt slik data+	KPI *Ledere: markedsdata* Gunstig sanntidsdata Operasjonell sanntidsinfo
Spm 7	Hvilke fordeler ser du for deg at en slik løsning kan gi deg ut i fra dine oppgaver?	Effektivisere Forenkle Beslutningsstøtte
Spm 8	I forhold til dette Lean-prosjektet dere har hatt, hvordan var de forskjellige prosjektfasene ved denne innføringen?	Hvordan gikk dere frem/introduserte dette. Stemning i bedriften Hele bedriften tok del, eller bare deler? - Hva var viktige suksess faktorer?
Spm 9	Hvordan stiller du deg til innføringen av et BI(RTBI) prosjekt?	Motsetninger? Viktige faktorer for innføring?

Appendix B: Interview guide Huntonit & Uldal

Introduksjon	Starter med en intro, avklarer at det blir opptak av samtalen. -Opptak, taushetsplikt	Om oss, prosjekt. Hvorfor vi ønsker dette intervjuet.
Spm 1	Kan du introdusere deg selv, hva er din bakgrunn i bedriften?	Navn, stilling, Prosesser/kritiske momenter
Spm 2	Hva trenger du av informasjon for å utføre dine arbeidsoppgaver?	Nøkkeltall/data type / hvor kritisk Hva er prioritet/Kritisk
Spm 3	Er det et system som støtter beslutninger i dag?	Finnes det tilgjengelig noe system i dag? For alle eller kun på spesifikke nivåer?
Spm 4	Kjenner du til begrepet Business Intelligence?	Hvis ja. Forklar/utdyp
Spm 5	Har du noen spesielle krav/ønsker mot et slikt system?(RTBI)	Type informasjon Tilgjengelighet
Spm 6	Ut i fra dine arbeidsoppgaver, hva mener du er kritiske prosesser å måle? +Hvor ligger evt slik data+	KPI *Ledere: markedsdata* Gunstig sanntidsdata Operasjonell sanntidsinfo
Spm 7	Hvilke fordeler ser du for deg at en slik løsning kan gi deg ut i fra dine oppgaver?	Effektivisere Forenkle Beslutningsstøtte
Spm 8	I forhold til prosjekter, vi har jo vært hos Fibo Trespo og der har de innført Lean, er dette noe dere har innført eller planlagt å innføre? Andre prosjekter som har blitt innført? (IT)	Evnt hvorfor/hvorfor ikke – hvilke faktorer påvirket denne beslutningen. - Hva var viktige suksess faktorer?
Spm 9	Hvilke faktorer og momenter er viktig under innføring av et prosjekt i deres bedrift?	Her kan vi prøve å komme inn på de forskjellige KSFene. Nøste litt i forhold til hva slags miljø det er her, osv.
Spm 10	Hvordan stiller du deg til innføringen av et BI(RTBI) prosjekt?	Motsetninger? Viktige faktorer for innføring?

Appendix C: Analysis Matrix (6 pages)

Challenges	
Not enough knowledge on numbers, Seek to others for information on numbers, Important to spend time "on the floor", Foundation for decisions can be found in the plant, Alot of information retrieved manually - but with purpose to have a relationship with numbers	PD, FT
Does not fully trust the numbers, Important to spend time on the floor, The Huntonit plant has older equipment which means it would be very expensive to get new and then automate while FT is newer, numbers punched in manually. Is updated on previous days numbers by the PC every morning, does not have an overview himself. The information today relies on the people.	PD, Hunt.
Deviation in numbers during morning meetings, Tendency to focus on red numbers instead of green, Important to spend time "on the floor. A challenge when almost all processes are manually driven. Today we rely on the persons, because we have to rely on them punching in numbers correctly.	PD, Uld.
The executive group has to understand why the factory is implementing a system or technology and why,When using Calwin I need to make sure that the system has enough space for orders coming in, and I have to make room.	PM, Uld.
I base my decision on the numbers that I am given in the system, but these numbers are punched in manually from the people in the production, so that is a challenge. I have to trust these numbers, even though they can be wrongly punched in. For now, I am used to the fact that these numbers has been punched by someone. It is also a challengewhen you have different systems for different things, you have to get something from that system and something from that system - its easy to write down some wrong numbers.	Ass. PM, Hunt.
A lot of redundancy because different people punch in the same numbers, Too much time is used to punch in numbers. In production information is stored like this: Writes it down- Writes it down on the production number-Writes in on an excel sheet and then into the IFS system.	PM, FT.
"Gut-feeling" and intuition affect decision process, Queries to the database made based on needs of the employee, Too many third party tools for ERP system, Some opponents and sabouteurs - but they come around in time. The reports that we make are always one month behind.	Mark,FT.
Since there is only historical numbers, we have no chance of seeing how things can turn out, by for example forecasting. The challenge today is that we have different reporting for different numbers, som are by day, some by hour, some by per week and some maybe per month. Also things are in different formats, and different people have different access. So you try and make rules for who will do the updating.	FM, FT
A gut-feeling is used in many cases when making decisions - asking people with more knowledge on the plant	CA, Uld.
Numbers punched in manually by one person	SM, Hunt.
We have to punch in all numbers, so that takes us more time then it should. Some people are also thinking that the LEAN implementation is maybe going slow, they are wondering what is going on since we have decided to be thorough in the implementation and take as much time as we needed. I would also see it as a challenge, to get a new system in that will have to work together with Calwin	CSM,Uld
The manual processes causes a lot of disadvantages- it is simply not effective	PC, Hunt.
The BYGGMA board needs to have an overview of the situation from day to day and hour to hour as this is not possible now.	CIO,Byggma
When an implementation is taking a long time people needs to see results to be able to know it is going somewhere, Most respondents say there are not clear differences in motivation when it comes to age etc.	All

PD: Plant Director
PM: Production Manager
FM: Financial Manager
CA: Chief Accountant
CSM: Customer Service Manager
PC: Plant Chief
Ass. PM: Assisting Production Manager
SM: Shift Manager
CIO: Chief Information Officer
Mark: Marketing

Necessities & Usefulness	
Not everyone should have access to the same information, it should be based on the roles of that employee. Some information is more sensitive. I dont have sufficient knowledge on what solutions are out there, but I need something that you can define yourself, like what areas you need information from. That you can choose what the dashboard visualizes.	PD, FT
By not having the correct data to base decisions on, it can result in making the wrong decisions. The information should not be available to all, but in order of which role one has. Needs of a more efficient solution that can help employees faster decisions.	PD, Hunt.
Information should be available according to ones role. Need visuals of processes, dashboard. Is also interested in applications for tablets and smartphones, that should be available to those who wants to use it.	PD, Uld.
The current data is too old, there is a need for newer data. We need a system that is effective, and where you do now have to use a lot of time to get reports and graphs etc.	PM, Uld.
We need a system. To get things systemized. Today I have several systems I need to use in order to create one report. And I need to use excel too. So something that can work together.	Ass. PM, Hunt.
I want to be able to see for myself if we are ahead or behind while we are producing. That is the most ideal. We need to know what we make money on and what we dont make money on. It is useful because it can make people work better, they see that they are doing good and want to continue that trend.	PM, FT.
A BI solution will help increase the time and money spent on building queries. It will also increase the time spent on processing these queries. Customer data is found in the CRM system, and is an important aspect of the production. The organization should have the courage to split up a BI solution - focus on different departments, not too much information at once. The screens that comes with the BI solution should be placed inside the plant, in the production area, in order to irrate the employees.	Mark,FT.
Since the numbers end up with me, I need to have a relationship to what we have actually made, to ensure that the numbers are correct. I dont want to report the wrong numbers to the board, which means I need more numbers to be able to be sure.	FM, FT
There is a need for saving time and being more effective. More automation.	CA, Uld.
I am very interested in being able to see how much we are producing on one machine every shift. And if we do not reach our goal, to know why we did not do it, why there was a stop etc.	SM, Hunt.
No need for data on competitors, as their customers usually inform them if they are more expensive than others etc.	CSM,Uld
The information has to be customized in accordance with whom is going to use the information, and there has to be suffifient and enough information. If there is too much information it will be difficult to know where to start. People have different knowledge on different topics, and there is also a difference in the numbers because they have different meaning based on the person reading it.	PC, Hunt.
Necessity for correct and reliable data to be more competitive, Has been reported from the plants and board that there are several areas which is in need of real-time information. Means that operations and production would need numbers in real-time and that management would need a more superior view on the organization.	CIO,Byggma
Only historic data at the moment, and there is a need for more accurate data and information. By not having to spend time on queries, one can spend more time on what actually generates money for the companies	All

Organizational Differences	
Open for change, and persistent when it comes to employees and their relationship to change. If you work for us you need to be able to be a part of the change. When some employees expressed their reluctancy to the change that came with the LEAN process, they were given an ultimatum - either go with the change or find a new job.	PD, FT
Fibo Trespo is a fairly new plant, with newer equipment. Huntonit would be more expensive when wanting to change processes and equipment since it is older and has much older equipment.	PD, Hunt.
Have their own special information system that is specific for the window industry - Calwin. Will always use this, and it can be connected to their ERP system by IFS. Believes that the numbers might help one think differently.	PD, Uld.
Have their own information system for specific for the window business, Calwin.	PM, Uld.
If we are going to implement BI/RTBI we have to mount something that can measure these things, in order to have automated processes instead of manual.	Ass. PM, Hunt.
There will always be some that are not open to change. We had to take them in and give them an ultimatum.	PM, FT.
	Mark.,FT.
We have had a leader that has been very tough and firm, and said clearly that this is something that we would make and be good at (LEAN).	FM, FT
FT has come further with LEAN, so we look to them.	CA, Uld.
Here at this plant, we do a lot of things the way it has always been done. People dont know any better, and most people have only been here so that is why I believe…I dont know how much we could acffect the top management. But there is a good relationship with the management, of course.	SM, Hunt.
As of now, in our Calwin system, I am able to get the last information on orders and so on.	CSM,Uld
Does not see any specific difference in age, regarding knowledge and how to do things.	PC, Hunt.
Our ERP system delivered by IFS, supporting all organizations, but smaller systems handle the data usage in the different orgs.	CIO,Byggma
People in all ages in all plants, and people that have been there a couple of years to people that have been there decades. All plants produce different products, therefore there are individual needs when it comes to information systems that will support the production.	All

Competence	
Alot of time was spent to educate employees before the start of the LEAN process. 17-18 persons were elected to be part of that group. Focus on the fact that there is now a more flat structure, and that that is a wish from the board. After the LEAN implementation , the persons on the other side of the hierarchy has more responsibility.	PD, FT
Has a bit knowledge on BI, knows that it is about measuring indicators, has had it presented at a few different occasions, but does not know anything in specific. Does not believe that age affects knowledge, says that he is at the other end of the knowledge-scale when it comes to technology, but has family members that help him and teach him.	PD, Hunt.
The PD at FT has been a sort of mentor for the rest of us(plants), since they have come the furthest and have most knowledge on LEAN. So that is a way we share our competence. Meetings. Leadergroup and Leadertraining every Wednesday. Does not believe in the effect of having a consultant to help them with something, believes things have to go in a slower pace.	PD, Uld.
We did not want to present LEAN to the other employees before all department leaders had read up on the topic, and were able to answer questions. We have also been able to go to a leaderschool, to gain knowledge on the topic. That has been very positive.	PM, Uld.
We have a coordinator which assists me with keeping the structure, in accordance with the LEAN process. So the company has hired a coordinator to help the different managers of the different departments.	Ass. PM, Hunt.
Because of the success with the LEAN implementation, PM says that Fibo wants to create a model with phases, that other employees of the other plants can look at when they start their implementation. It will make it easier to remember the phases and the different factors affecting. Did something that did not work in the LEAN process, and realized this by trying to do it differently. Did not give sufficient information, people did not understand - Standing in a circle	PM, FT.
Says that there is no datawarehouse in the organization, but that they have several databases connected to the information system. Says that with a new ERP system in place, they will we able to build it up and structure it in a way that they can also have a data warehouse	Mark.,FT.
We have written and created projectplans and propulsion plans, so we have made som standards that are important to us. Now there is one person is FT that is sort of a "bottleneck" on the queries, which I think is not good. More people should be able to do it.	FM, FT
No knowledge on BI/RTBI	CA, Uld.
No knowledge on BI/RTBI. Has also just recently gained knowledge on the LEAN process, as his team has not been a big part of that during the beginning.	SM, Hunt.
No knowledge on BI/RTBI. Learns a lot from the discussion group they have with LEAN.	CSM,Uld
Has some knowledge on BI, and that it is about measuring numbers and creating analysis and reports based on that.	PC, Hunt.
Some knowledge on BI/RTBI, knows what it is, and what it primarily does, but not specificly how they can benefit. When asked, has been unsure if they have a datawarehouse or not. I know what we want and need, as a system, but now how to build it and how it should be implemented techonologically.	CIO,Byggma
Study groups and meetings throughout the organization every week. Not all have knowledge on BI, but everyone sees the advantages this system can give them.	All

Indicators	
We need to see the stops, and indications on what went wrong, that is highly important for our production. This needs to be in real time. Stock level of raw material and the volume in dollars and dimes is also important.	PD, FT
Marketdata is important to measure. Ingoing orders. Also the production for the three lines that we have. An painting of wall panels. The most important for me is also the financial perspective, always. If you dont earn money on it, you might as well stop.	PD, Hunt.
First and foremost interested in the production. How that is going. But to be able to produce, we also need to see numbers, and orders. I need to be able to think about the whole supply/value chain in general.	PD, Uld.
It would be of great help to see what is going on in the production. If glass is breaking or for instance if something would to go wrong in the painting departmen. That should be more up-to date for us. We use OEE to check availability in product lines and product quality.	PM, Uld.
We need to register stops on the production line. We have it now, but it is always registered at the end of the day, so not in real time. Key numbers should also be available to everyone in the organization on a screen in the produciton area. Also in accordance to the monthly account balance, to have that available.	Ass. PM, Hunt.
OEE is used to measure and check the product lines. It can see both quality and stops, and how much the production lines is available. That is one parametre. I want everyone to have access to production technical things. The economy does not have to be available to everyone, there is no point. I need to know how much i produce of things we earn money on and loose money on.	PM, FT.
The main thing I believe is important is that the organization has the courage to split it/divide it. So that it should look the same if you are on the top of the hierarchy or the bottom. And there should not be too much information. People have to be able to relate to it in some way. It should all come down to the fact that the numbers should trigger one to keep doing their best, almost like a competition.	Mark,FT.
A big need for market data, but we already have a system that helps us with that, but that system is too slow and he has to do it manually. And also the financial situation itself. I would also like to see an overview of the plant and processes here.	FM, FT
I am interested in what we have and what we do. For me, liquidity management is important. To know how much money that has to be paid to get a status	CA, Uld.
To have an indicator regarding painting of the wall panels, that would indicate when paint should be replaced and so on. That would make it more effective for us. Production data, stops etc.	SM, Hunt.
But to get a report out, i physically have to og into the system and order it. But what I cant see and would like to, is how we are doing according to our budget. To be able to have that visually, are we reaching it, how many orders to we have acc. to our goals. And, service towards the customer, are we sending out proposals quickly and on time.	CSM,Uld
Sales is extremely important. To be able to forecast sales for a certain period, to see what trends might be coming. And also when it comes to storage. The financial aspect is alfa and omega here, and very important to me. By having that continously I would be able to make changes fast, make fast decisions and maybe simulate something. Simulating according to models, put in other conditions and get a quick answer.	PC, Hunt.
The board of Byggma is interested in an overview of sales, and this has to be in real-time. But does not need specific information on how things are going in the production, more interested in orders during each day, and money coming in, ie the financial perspective	CIO,Byggma
Morning meetings and whiteboard with information on all three plants. Whiteboard has important numbers, which are received every morning, and written either with red or green marker. Sales office, order status, delivery time and production status are important for all employees to be measured.	All

Architecture	
In general, I would not say that we have a good structure when it comes to data collection. Things are stored in different places. IFS is our current system, but we have many other side applications, tools, because IFS itself is not flexible enough for our needs. It also comes down to the capacity, when many people are using the system at the same time to query the database, it is slow or even hangs. We only have a certain amount of licenses available.	PD, FT
There are several layers of information, based on roles. Information is collected fromt he databases.	PD, Hunt.
Today we have our information systems that give us our data. That is our databases connected to the ERP system. But a lot of numbers are punched in manually.	PD, Uld.
We use our own system Calwin that is connected to the IFS, we have to push a button to transfer things.	PM, Uld.
No specific decision support system, but you look at the numbers registered in the database. ERP system, then excel to make reports. No connection between things, have to og through many different applications in order to get what you want. The process of geting data out is related to the architecture.	Ass. PM, Hunt.
Access is used to get out productiondata, and also sales. That data is collected from IFS.	PM, FT.
There is no specific system that supports decisions now, but have their own ERP system with their databases that they can query. We have a cube on the financial side, but that is it. We need to build a datawarehouse that can store all information we have.	Mark.,FT.
	FM, FT
Difficult to say if there is a DSS. But we do all the invoicing in Calwin and then weekly transfer the files to IFS: Salesstatistics in Calwin. So we have two systems.	CA, Uld.
Uses an informationplanner, which is a tools they use. One person punches in information, and he collects it from here. We have two systems that we punch in the information to.	SM, Hunt.
Only uses Calwin. Finance and accounting uses IFS. Everyone else (organizations in Byggma) uses IFS.	CSM,Uld
We have our information systems, and use an information system in the production and logistics called NV plan. We use that to collect numbers and data regarding products, storage etc. It is also used for planning. It stores historic data.	PC, Hunt.
We have cubes that we get information out of. These are the databases connected to our IFS system.	CIO,Byggma
A lot of the information is stored in the databases by manually punching in the numbers. Then, they can be collected and extracted into the systems to have queries and so on. All in all, no matter what role one has, it seems like there is not a lot of knowledge on the architecture. When asked, all respondents expect one (PM at FT) says that the implementation should focus on certain processes first, instead of the whole organization.	All