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BUSINESS INTELLIGENCE AND MANAGEMENT CONTROL

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1 INTRODUCTION

1.1 Background

Information technology (IT) is used in almost all parts of modern organizations. IT is especially highly utilized in tasks involving information analysis and presentation. Due to the advancements in IT, organizations also create and deal with increased amounts of data. (Yigitbasioglu & Velcu 2012, 41.) Information technology not only allows data storage but also supports creating new information, which in turn supports the creation of more complex organizations (Dechow, Granlund & Mouritsen 2007, 625). Information technology is therefore a critical part of modern organizations and, due to these information creation abilities, it is also a critical part of management control. It is also important to note that management control needs to be studied in relation to technology and context. The technological infrastructure greatly affects the way management control is perceived. (Dechow & Mouritsen 2005, 731.)

The relationship between management control systems (MCS) and information technology has been studied quite extensively in the past (see Granlund & Malmi 2002, Dechow & Mouritsen 2005, Dechow, Granlund & Mouritsen 2007, Rom & Rohde 2007). The studies focus mainly on integrated enterprise systems (such as Enterprise Resource Planning systems, ERPs). Before the new ICT innovations were properly established, great hopes were set on the fact that they would change the ways modern organizations operate. Most of the studies show that organisations do not use the potential of these systems to enhance the existing management control systems (MCSs), but simply use the systems to support the old systems. There has been a "moderate impact" compared with the expectations. (Granlund & Malmi 2002.)

Both academic and professional literatures recognize the insufficient abilities of enterprise systems to report and analyze in the manner required for advanced management control systems. (Granlund & Malmi 2002, Kay 2006, Gnatovich 2007, Williams 2008). Enterprise systems have vast databases with considerable amounts of data, but the average user lacks the abilities and tools to utilize the data beneficially. One solution suggested for this issue is business intelligence (BI). Business intelligence systems are designed to be the tools that enable the utilization of the data in a meaningful manner. (Brignall & Ballantine 2004, Williams 2008.)

Business intelligence has gained popularity as the number of products, services and implementations has grown immensely during the last two decades (Chaudhauri, Dayal & Narasayya 2001, 88). The reason for the growth can be allocated to three main factors. Firstly, the data volumes have exploded for many reasons. The use of advanced

transactional systems combined with the technological progress in improved data storage capabilities and the enormous growth of connection technologies have greatly increased the amount of data. Regulatory changes, such as the Sarbanes Oxley act, have also added requirements for data collection. Due to these developments, managers nowadays encounter vast amounts of data, which is gathered in greater frequencies and finer detail than before. The sheer existence of data does not lead to better decisions – in fact this can be quite the contrary. Only by being able to utilize the correct data can better decisions be achieved. (Sabherwal & Becerra-Fernandez 2011, 10–11)

Secondly, a number of companies also face ever increasing decision making problems in complicated competitive situations. The fact that processes are more complicated and the amount of usable information has grown has also contributed to more complex decision making scenarios. The line between financial and operational analysis is more blurred than previously. For example, deteriorating profitability might be caused by macro-economic market circumstances, the actions of competitors, or production delays. The user is interested in knowing what the cause of the problem is, regardless of its origin. BI has entered the arena with a promise of integrating all necessary sources of data and giving managers well analyzed and true information on which to base their decisions. The sooner the answer is provided, the more rapidly the search for the solution can be started. (Kay 2006, 51)

Thirdly, the pace of change has increased. Environmental changes happen faster and have more radical effects. Organizations need to react faster in order to respond before the window of opportunity closes. A system that enables responding to changing situations needs to be able to convert data into information, integrate this information into one source, and communicate this source to users – and do this all in a short time period. (Sabherwal & Becerra-Fernandez 2011, 10–11; Turban, Sharda & Delen 2003, 23.)

However, it is relevant to note, as with the ERP systems earlier that the mere existence of capable software does not guarantee the emergence of new, innovative ways of management control. The use of these systems deems whether they are strategic or not. (Granlund 2011, 10.) In a recent study, Elbashir, Collier & Sutton (2011, 156) stated that business intelligence systems are not just for decision support. By providing business analytics and corporate performance management (CPM) capabilities, they also transform the vast amount of data in corporate databases into information that is required for advanced management control systems. (Elbashir, Collier & Sutton 2011, 156.)

There have been almost no studies about the relationship between business intelligence and management control, and the understanding of recent developments in the field remains very limited (Granlund 2011, 10). The results of the very few published studies show promise of BI as enabler of new forms of management control (see Chou, Weng & Wu 2011).

1.2 Objectives and limitations

The objective of this study is to develop deeper understanding about how business intelligence is or could be used for management control. The research questions can be formulated as follows:

- What kind of control systems use or could use the data and information enabled by the BI system?
- How the BI system is or could be utilized – as the data or information feeder or directly as the tool?
- Has the BI system enabled new forms of control or changed old ones, and if, how?
- Does the BI system support some forms of control that the literature has not thought of, or is the BI system not used for some forms of control the literature suggests it should be used?

In a recent study Elbashir, Collier & Sutton (2011, 157) refer to BI systems as "an integrated MCS", addressing the notions of a few recent studies (cf. Chenhall 2003, Malmi & Brown 2008) where MCS being studied in isolation has been criticized. According to Elbashir et al. (2011), BI does not support a single aspect of control, but a wide variety of different types of control. In this study business intelligence systems are studied with regard to the notion of BI as an "integrated MCS" presented by Elbashir et al. (2011). The contribution of this study is better understanding about the use of a BI system in management control and a framework presenting the uses of these systems in different application areas.

There is no universal answer to questions "what is the right amount of BI?" or "which tools should our company use". The correct amount of BI depends on the need for the answers BI can offer, and the need should be derived from the company's strategy (Williams 2011, 29–30). This study focuses on the question of in which areas of management control business intelligence is or could be used. Therefore, the direct effects of business intelligence systems on process performance and decision support are not in the scope of the study. Also, the workings of the management control system package and their interrelations, other than directly linked to BI systems, are not studied. Additionally, this study neither tries to answer what a proper type of control system for certain types of organizations is nor does it try to answer how to define what the correct systems are.

1.3 Methodology and methods

Qualitative approaches focus on interpretation and understanding, with the goal of developing a holistic understanding of the subject matter (Eriksson & Kovalainen 2008, 5). The amount of studied cases is quite small, and the analysis is conducted as thoroughly as possible (Eskola & Suoranta 1998, 18). The purpose of this study is to gain a deeper understanding of the ways a business intelligence system is utilized in management control. Therefore, in order to shed light on the subject matter and to develop a deeper understanding for the reasons underlying the different types of use of business intelligence systems in management control, a qualitative case study was deemed as the most useful appropriate approach.

The study is conducted as an extensive case study. According to Eriksson & Kovalainen (2008, 119), in an extensive case study several cases are studied, and the focus of the study is to map common patterns, mechanisms, and properties in a chosen context in order to develop, elaborate, or test a theory. An extensive case study is suitable when trying to generate knowledge that extends beyond interpreting and understanding a single case. It is relevant to note that statistical generalizations cannot be made based on a case study (Eriksson & Kovalainen 2008, 124–125). Lukka & Kasanen (1995, 85–86) have argued that high quality case studies may produce credibly generalizable results. In descriptive case studies, generalization can be made, as long as the researcher understands and communicates the real business context and uncovers deep, general and structural relationships. Through the contextual generalization rhetoric, by producing a convincing linkage of history, institutions and markets around the case a valid argument of the generalization can be achieved.

One limitation of qualitative research has to do with objectivity. In qualitative research objectivity is somewhat impossible to achieve. The way to pursue objectivity is to realize the subjectivity in the researcher and to take this into account. (Eskola & Suoranta 1998, 17–18.)

The data for the study was collected via interviewing a person in three different case organizations. These organizations include the Welfare Division of the City of Turku, one large insurance company and one large industrial manufacturing company. The case organizations were selected based on the knowledge that they utilize a BI system. These organizations and the interviewees are presented more thoroughly in chapter 4.2. The interviews were conducted as semi-structured interviews, in which topics and issues are decided beforehand, but variation according to the interviewee's knowledge and interests is possible (Eriksson & Kovalainen 2008, 87.) In total, 3 interviews were conducted, with their length varying from 56 to 94 minutes. The interviews were recorded and transcribed. The transcribed interviews were then coded thematically and analyzed.

The analysis phase was conducted using the applicable techniques from Yin's (2009, 136 – 160) five different analytic techniques. These techniques are 1) pattern matching, 2) explanation building, 3) time-series analysis, 4) logic models, and 5) cross-case synthesis. In pattern matching the empirical data are searched for patterns and these are compared with the propositions developed earlier in the theory phase. In explanation building causal links in the empirical data are iteratively searched for and the results are presented in a narrative form. The third technique, time-series analysis concentrates following the developments of specific events over time. In the fourth technique, logic models, complex cause-and-effect -chains in the empirical data are followed and the findings are compared with the results the theory would have suggested. The fifth and final technique, cross-case synthesis, focuses on analyzing the different case organizations or studies. (Yin 2009, 136 – 160.) Of these five techniques, especially numbers 1, 4, and 5 were applicable in the study and thus were used.

1.4 Structure of the thesis

The second chapter in this study explains what management control is and what management control systems are. Relevant theoretical frameworks of management control and the concept of management control as a package are introduced. The third chapter discusses the role of ICT in management control. It also introduces Business intelligence systems and examines their relation with management control. The case organizations, empirical data, analysis and results are presented in the fourth chapter. The fourth chapter ends in conclusions and discussion. The fifth chapter is the summary of the thesis.

2 MANAGEMENT CONTROL

2.1 Introduction

In this chapter different concepts of management control and management control systems (MCS) are introduced. The chapter begins with an introduction to management control. After the introduction each subchapter will introduce one framework of management control.

The earlier view of a management control system was that it is a system that provides financial, quantifiable information to assist managerial decision making. (Chenhall 2003, 129) The narrow way of perceiving management control is to think of it in terms of narrow cybernetic control. A good example of this kind of a system is a thermostat, in which a single feedback loop acts as the control system. The temperature is measured, compared with the preset standard and corrective action taken if necessary. (Merchant & Van der Stede 2007, 4–5.) As time has passed, the term has developed to also include such information as external market and customer information, non-financial information regarding process performance, decision support and personal and social controls. The traditional way of seeing MCSs as passive tools that provide information to assist managers has also been challenged by the sociological way of viewing MCSs as active entities that empower people in reaching their own goals. (Chenhall 2003, 129.)

The modern outlook on management control systems emphasizes broader types of control, such as hiring standards and direct supervision, rather than simply focusing on measuring performance. The modern management control systems focus on encouraging, enabling and, if needed, forcing employees to act in ways that are compliant with the organization's needs. Some forms of management control are proactive rather than reactive, meaning that they are meant to prevent problems instead of fixing them. Examples of these systems are segregation of duties and computer passwords. (Merchant & Van der Stede 2007, 4–5)

Management control and management control systems can be defined in many ways. Simons (1995, 5) states that "management control systems are the formal, information based routines and procedures managers use to maintain or alter patterns in organizational activities". Merchant & Van der Stede (2007, 5) emphasize that management control systems influence employees' behaviors in desirable ways and therefore enhance the organization's ability to achieve set goals. Malmi & Brown (2008, 290–291) somewhat combine these two views and state that management controls are the systems, rules, practices, values and other activities management uses to regulate employee behavior and align it with the company's strategy and objectives. The researchers also

state that complete systems consisting of these controls are management control systems.

The following sub-chapters present a selected set of management control frameworks in more detail. Multiple frameworks were selected due to all of them having a different approach on what it means to be a MCS. All of the selected control systems are well established within MCS research. There is, of course, some overlap between the frameworks. As can be seen in chapter 3.2.2, BI systems should be able to be beneficially used within all of the frameworks, however simultaneously acknowledging that BI systems are not completely suitable for all aspects of the said frameworks.

2.2 Levers of control

Simons (1995) calls his control system framework "the levers of control". As can be seen in Figure 1, this framework consists of four types of control systems: beliefs systems, boundary systems, diagnostic control systems, and interactive control systems.

Simons (1995, 34–38) defines a beliefs system as "… the explicit set of organizational definitions that senior managers communicate formally and reinforce systematically to provide basic values, purpose and direction to the organization." This belief system is communicated through official documents, such as credos and mission statements. The beliefs systems are used more often in modern companies than their predecessors. This change is explained to stem from increasing complexity – in the new environment it is very hard for the employees to understand the organization's purpose and direction from implicit signals. A beliefs system's purpose is to be value-laden and inspirational. This can be achieved when the beliefs system is vague enough to allow all organizational participants to commit to the values and purpose. Because of this vagueness, these systems cannot be used with the organizational incentives; performance cannot be measured against them.

The second type of system, boundary system, can be defined as the limits set for desirable actions in the organization. These systems are a collection of rules dictating what employees should not do. They are not intended to explicitly tell the subordinates what to do, but instead allow using creativity in solving problems that arise. The beliefs system and the boundary system work in unison: the beliefs system gives direction and purpose for opportunity seeking in an unrestricted space, whereas the boundary system sets the limits for this opportunity seeking and thus guides the employees to use their abilities within a desired, focused space. (Simons 1995, 39–41)

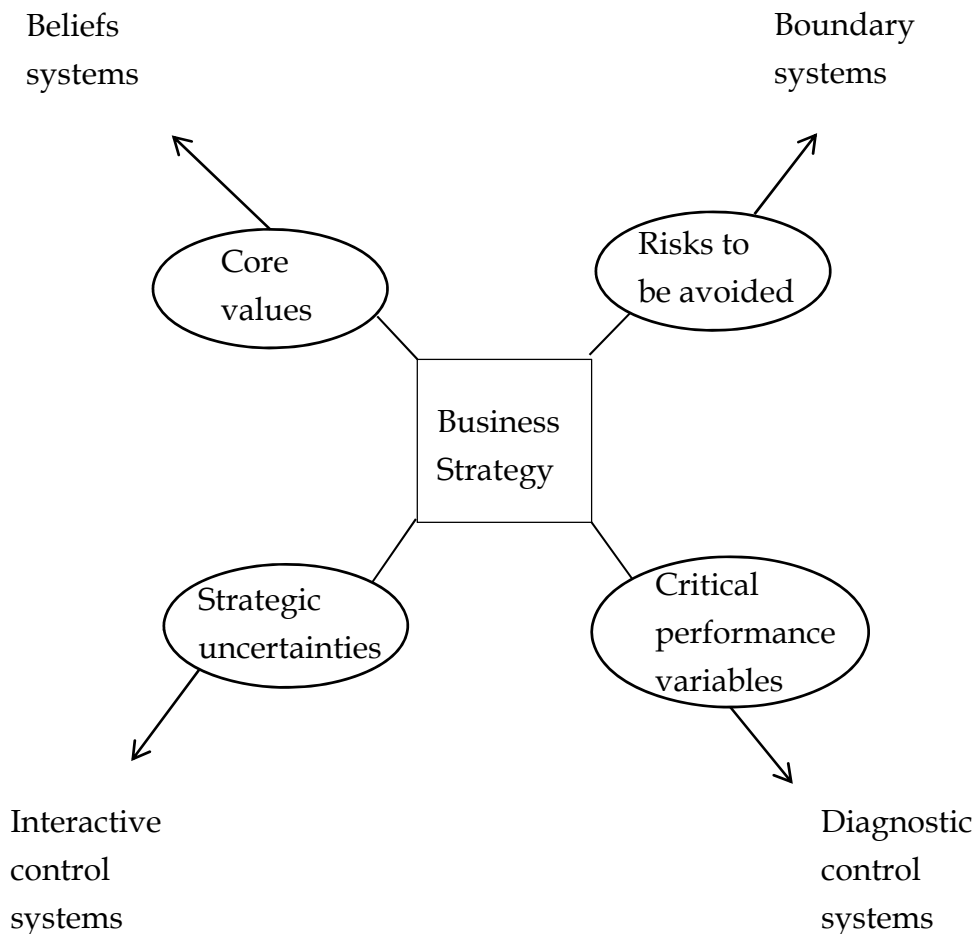

Figure 1 Levers of control (Simons 1995, 7)

The formal boundary systems establish two kinds of regulations: business conduct boundaries and strategic boundaries. The boundaries set on business conduct are more common. They are usually derived from society's laws, organization's belief systems or official codes of behavior set by industry and professional associations. Senior management creates boundaries especially when environmental uncertainty is high or when internal trust is low. Even though these restrictions limit the freedom of action, they can also be welcomed by the employees. The second type of regulations, the strategic boundaries, are meant to specify the types of arising business opportunities the organization wants to take part in. This is done to focus resources on the types of business deemed most useful. (Simons 1995, 42–48.) The role of information technology in boundary systems is to enable continuous monitoring (Vaassen 2002, 209).

The third control system type, the diagnostic control system, is defined as "…the formal information systems that managers use to monitor organizational outcomes and correct deviations from preset standards of performance." They are the bread and butter of management control systems. Diagnostic control systems have three distinctive quali-

ties: 1) the capability to measure the outputs of a process, 2) presence of predetermined standards, against which performance can be compared, and 3) the ability to correct deviations from the predetermined standards exists.

Diagnostic control systems are based on measuring the critical performance variables. These metrics reflect the important success factors of a selected strategy. The most common examples of diagnostic control systems are profit plans and budgets. (Simons 1995, 63.) These systems are used to free the managers from the burden of constant supervision by allowing management-by-exception, and therefore save time from managers as the business runs without constant supervision (Simons 1995, 70; 121). The diagnostic control systems also work well as bases for rewarding, because they are based on explicit formulas, and thus are objective. Consequently, the employees know what they have to accomplish in order to get rewarded. (Simons 1995, 79.) ICT provides possibilities for enhancing the diagnostic control systems due to the highly codified nature of the information these systems operate with. However, it is relevant to note that these systems are not meant for continuous monitoring of subordinates, but for focusing managerial attention on strategy formulation and exception handling. (Vaassen 2002, 210.)

The fourth type of control system, the interactive control system, works in a complementary manner to the boundary systems. As the boundary systems set the limits within which the employees need to operate, the interactive control systems focus the attention of the organization toward the strategic uncertainties. Their intention is to enable the formation of new strategies via responding to new opportunities and threats. The key in these systems is monitoring information throughout the organization and the subsequent sharing of this information amongst the employees. (Simons 1995, 91.) Interactive control systems are defined as ”…formal information systems managers use to involve themselves regularly and personally in the decision activities of subordinates.” These systems have four special characteristics: 1) The information generated by these systems is repeatedly overseen by the highest levels of management, 2) operating managers at all levels of the organization give frequent and regular attention to the systems, 3) the data generated by the system is discussed in face-to-face meetings between managers, subordinates and peers, and 4) the systems challenge the underlying data, assumptions and action plans and place them under debate. (Simons 1995, 95–97.) Managers are key players in the effective utilization of interactive control systems, and they use staff groups as assistants in collecting and distributing data. (Simons 1995, 122.) As the main goal of the interactive control systems is to enable communication, it is important to keep these systems simple to use in order to allow people throughout the organization to understand them. Using ICT can improve the interactive control systems in at least three ways: 1) IT allows transforming complex data into easily understandable graphs and tables, 2) information about global markets, such as customer behavior

and effectiveness of marketing campaigns, can be acquired and fed to planning systems and 3) modern databases enable making what-if analyses. (Vaassen 2002, 210.)

Ahrens & Chapman (2004, 278) point out that, rather than the technological properties, it is the nature of the communication surrounding the control system that determines whether it is diagnostic or interactive in Simons' framework. The researchers also state that Simons made the point that the functioning of the interactive and diagnostic systems is dependent on the boundary and beliefs systems, which set the goals and limits of discussions.

Simons' (1995) levers of control is a fairly simple, yet thorough framework. The major pitfalls in the framework are related to the lack of taking the interrelations between the systems into account.

2.3 Objects of control

The framework of Merchant & Van der Stede (2007) distinguishes control as a critical function of management. Management control tries to overcome three types of problems related to employees: 1) lack of direction, 2) motivational problems, and 3) personal limitations. Firstly, problems related to lack of direction are caused by the employees not knowing what the organization expects of them. Therefore, one aspect of management control is to inform the employees about the expectations the organization has for their performance. The second problem type, motivational problems, as the name suggests, are problems that occur when employees for one reason or another are not willing to perform their task in the best possible way. This behavior can appear as effort aversion as well as worse cases of stealing, falsifying or abusing organizational resources. The third type of problems, personal limitations, stem from the limits in abilities that employees have, and the inability to perform their tasks in an optimal way due to these inabilities. These inabilities might stem from lack of intelligence, training or experience, or the job might just be impossible to perform for anyone. (Merchant & Van der Stede 2007, 9–11.)

Organizations try to reduce their exposure to the before mentioned control problems in four different ways: 1) activity elimination, 2) automation, 3) centralization, and 4) risk sharing. The first way of mitigating exposure, activity elimination, means appointing a certain activity to a third party in its entirety. This excludes the organization from the potential profits and risks related to the activity. Reasons for eliminating an activity are for example the lack of belief of the management in the organization's capability to perform the activity, or believing that outsourcing the activity will be more efficient. Automation, the second way of mitigating risk, means deploying computerized systems to perform activities. Compared with humans, computers are more consistent in their

behavior, they never tire, and they are always accurate. The third way of mitigating risk, centralization, means allocating more decision making power to a single part of the organization. Usually, the decision making power is allocated to the top management. Allocating all decision making power to the top management can lead to problems, as the scope of control can grow too big. The key for this is to centralize only the key decisions. The fourth way of mitigating exposure, risk sharing, is partially the same as activity elimination. The difference is that in risk sharing only part of the risk related to the activity is outsourced. For example, buying insurance or starting a joint venture are forms of risk sharing. (Vaassen 2002, 203–204.)

For those controls that cannot be economically avoided, control systems need to be put in place. Merchant & Van der Stede (2007) make a distinction between results controls, action controls, personnel controls, and cultural controls. The first type of control systems, results controls, are controls that reward for performance. The act performed can be almost anything measurable and the reward can be anything from monetary compensation to promotions and recognition. The organization does not make the employees act in certain ways; rather the employees are empowered to perform in ways that they believe will yield the best results. It is relevant to note that results controls do not work in situations where the employee's actions do not affect the results or in situations where the results cannot be measured. (Merchant & Van der Stede 2007, 25.) Results controls are indirect controls, being applicable only to the outcomes of activities and processes rather than on the activities and processes themselves (Vaassen 2002, 205).

Results controls consist of four phases: 1) defining the dimensions in which results are required; 2) measuring performance on these dimensions; 3) setting targets for performance; and 4) providing rewards that encourages to desired behavior. When defining the dimensions, it is critical to select the correct measures. Employees will try to improve the dimensions that are measured, and if they are not congruent with the organization's objectives, the employees will guide the company in a wrong direction. The actual measuring of the metrics can be done on multiple types of objects: the metrics can be objective financial measures (such as net income), objective non-financial (such as market share) or subjective (such as development as a sales person). After the metrics have been selected, a target value for each metric is chosen. This target setting serves two purposes, providing goals and helping the employees interpret their performance. After the targets have been set, the actual performance can be compared with the target. Based on the performance, the last element of a results control system, rewarding, is performed. The rewards (or punishments) can be either extrinsic or intrinsic and they should take into account the personal preferences of the employees. (Merchant & Van der Stede 2007, 28–32.)

The second type of control systems, namely action controls, are put in place to make sure that some actions occur (or do not occur). They can be utilized if the managers are capable of defining the scope of desired and undesired actions. Action controls focus directly on the actions of the employees and are therefore a very direct form of control. Action controls have four different forms: 1) behavioral constraints, 2) pre-action reviews, 3) action accountability, and 4) redundancy. The first type of action control, behavioral constraints, can be physical constraints, such as passwords or locks, or administrative constraints, such as expenditure limits per person. One type of administrative control is the separation of duties, in which certain sensitive tasks have been divided in a way that prevents a single person performing it. Pre-action reviews are the second type of action controls. As the name suggests, in pre-action reviews the employees submit their plans for review before they are put into action. The reviewer can approve, disapprove, or ask for modifications in the plans. The third type of action control, action accountability, means that employees are held accountable for the actions they take. To ensure proper action accountability, four steps need to be taken: 1) defining the range of acceptable actions, 2) communicating the decisions, 3) observation, and 4) rewarding or punishing based on actions. The fourth and final type of action control is redundancy. Redundancy is the act of assigning more than the minimum amount of resources, such as machines or employees, to perform a task. These extra resources can be assigned either as a backup or just to improve quality.

Action controls are usually aimed at preventing undesirable behavior. Some forms of action accountability are also designed to enable detecting undesirable behavior. Action controls are effective when the organization utilizing them can determine the entire scope of desirable (and undesirable) actions and ensure that the actions occur (or do not occur). Defining the scope of the desired actions is no simple task. The more complex a task, the more difficult defining the scope of actions for that task. Gaining knowledge of the desirable actions happens either by trial and error, meaning the observation of different solutions to the same problem and seeing which produces the best result, or by being informed by others, such as consultants. Ensuring that the organization completes the desirable actions is done by tracking the actions of the employees. (Merchant & Van der Stede 2007, 76–82.)

The third type of control systems are personnel controls. Personnel controls are designed to make it more likely that the employees will perform according to the organization’s needs. Personnel controls consist of selection and placement, training, and job design and provision. The first type of personnel control, selection and placement, means hiring the right workforce and placing them in posts that are suitable for their skills and in which they serve the company best. The selection of the right employee to the right place can be done by using three judgment criteria: education, experience and personality. The second type of personnel control, training, ensures that that the em-

ployees on payroll develop and sustain their skills. It should lead to having the employees making similar decisions as the managers would do in the same situations. The third type of personnel control is job design. Job design means that the employees have the resources they need to effectively perform their tasks at their disposal. (Merchant & Van der Stede 2007, 83–84; Vaassen 2002, 205–206.)

The fourth type of controls are cultural. Cultural controls are put in place to change the organization's behavioral norms and to guide the employees to enforce these norms. Cultural controls enable group pressure toward individuals who stray from group norms and values. Merchant & Van der Stede (2007, 85–86) state, that "cultures are built on shared traditions, norms, beliefs, values, ideologies, attitudes, and ways of behaving." These cultures tend to stay relatively fixed, even though strategies and goals adapt to changing environments. There are five complementary instruments that form a coherent organizational culture. First, organizations try to form and express their culture for example through codes of conduct, organizational credos and statements of organizational vision and mission. These are formal, written documents that state the ways in which the management would like the organization to work. Second, group rewards, unlike individual performance-based rewards, promote goal congruence in the employees. Third, employee rotation ensures that employees receive a wider view of the workings of the organization and can act more in accordance of organizational goals instead of subunit goals. Fourth, culture shaping means of control, are physical and social arrangements, such as dress codes and vocabularies. These give the organization a common, pervasive feel that enhances identification with the group. Fifth type of culture changing instruments is the tone from the top. The tone from the top means the example set by the managers, and can be defined as the consistency between manager's behavior and their statements. (Merchant & Van der Stede 2007, 85–88; Vaassen 2002, 207–208).

Objects of control -framework has quite a lot of overlap with the Levers of control -framework presented in chapter 2.2. The main differences are the more direct linking of the rewards with the performance (results controls) and a stronger emphasis on the employees (personnel controls). By utilizing action controls, the framework also has a rigid way of ensuring that certain important actions will be performed, whereas the focus on the Levers of control -framework is more in preventing unwanted behavior (see boundary systems). The objects of control -framework has some shortfalls, as it neither takes the interrelations between different control systems into account, nor does it have a control system which would prepare the organization for strategic uncertainties.

2.4 Enabling and coercive control

Adler & Borys's (1996) framework makes the division between different types of management control based on what the usability of the control system is like, whereas the previous frameworks presented made the division based on different application areas the control systems are used for. Although Adler & Borys use the word "bureaucracy" instead of control, the meaning is the same. In their framework they divide control to coercive and enabling control. The enabling forms of control are those that are seen as valuable resources that help the employees in reaching their goals, whereas coercive forms of control are seen as substituting to commitment, rather than improving it. The coercive controls are meant to force compliance instead of giving advice. (Adler & Borys 1996, 69.) An enabling system is designed in a way that involves the users in inevitable contingency situations. Every possible scenario cannot be forecasted and therefore it is necessary for the user to have the freedom to make adjustments to the system. Workers are encouraged to discuss problems regarding organizational rules and standards and are therefore contributing to the development of these rules. (Ahrens & Chapman 2004, 279.)

An enabling control system has four features that separate it from coercive ones. These features are repair, internal transparency, global transparency and flexibility. Repair is concerned with unexpected situations. For example, in a coercive control system environment, the aim for the equipment the employees use is to be foolproof. If (and when) something eventually breaks, the employee performing the job does not have the possibility of repairing the problem and instead a specialist must be called in to fix the problem. Conversely, in an enabling system the user is involved in the repair. The ease with which the user can repair a system is one sign of a highly usable system, and as a consequence of this usability, the systems do not suffer as much from breakdowns that stop the process. For example, undo-commands in software are a form of repair in a system. In addition, deviations from the standard are frowned upon in a coercive system. Superiors define what the best way to perform a task is, and it becomes the only way to perform, whereas in an enabling system the workforce takes part in defining the best practices, and they are also constantly challenged to improve them further and rewarded if improvement happens. (Adler & Borys 1996, 70–71.)

The second form of enabling control, internal transparency, has to do with the quality and amount of information about the system the users have available. A coercive system displays equipment status in cases of malfunction, and even then in a language that is only comprehensible to a technical specialist, not the user. In an enabling system the users are expected to encounter unexpected situations and therefore should be familiar with both the systems internal logic and its current status. System status should be available on demand, but at the same time taking into account that the information pre-

sented should be comprehensible and useful to the observer. Thus, to avoid information overload only the relevant information should be presented to the user. (Adler & Borys 1996, 72.) Internal transparency can be increased by making processes available to organizational members in new ways. For example, budgeting can be integrated into operational planning, variance categories can be designed to be operationally more meaningful, or pre-calculated tables that show the effects of variations in processes can be prepared. (Ahrens & Chapman 2004, 280.) Information systems wise, the single data set and thoroughly mapped processes, on which integrated information systems are based upon, form a very good foundation for building a control system with good internal transparency. When the processes are clearly mapped and the causalities are more easily tracked, the users can get a better understanding about the effects of their actions. (Chapman & Kihn 2009, 155.)

The third form of enabling control, global transparency, means whether the user in a single part of the system has a view to the other parts of the system. In a coercive system the right to observe the process outside one's own responsibility area is heavily restricted. By contrast, in an enabling system the operators have a very broad view to the system and their understanding about the entire process is seen as a valuable thing in itself. Understanding the bigger picture enables the users to notice possibilities for improvement also outside their own specialization areas. (Adler & Borys 1996, 73.) In other words, global transparency sheds light on the relationship of local actions vis-à-vis organizational strategies and goals. Enabling control is not merely about decentralization or delegation – it is about harnessing local creativity and flexibility. (Chapman & Kihn 2009, 156.) Budgets are the most common tool of making the processes transparent throughout the entire organization, but usually they are made visible only on a "need-to-know" basis. Making them available for a greater part of the organization and communicating major organizational targets more openly might lead to greater cooperation between different departments. (Ahrens & Chapman 2004, 280.)

The fourth form of enabling control is flexibility. Flexibility of the system is the ability to take situational modifiers into account during the process. A coercive system tries to minimize the user's participation in the process, leaving the operator to only perform the actions that cannot be automatized. Even then, the goal is usually to reduce the user into a data inputting role and let the machine make the decision based on this data. The enabling system works in a dissimilar way, and tries to build systems that give advice and help, giving the user the possibility to either hand over to the machine or perform the necessary decisions himself. Additionally, flexible systems also allow users to configure their interfaces to better suit the user. (Adler & Borys 1996, 74.) One example of flexibility is allowing the users to customize the reports they receive based on their own specific needs (Ahrens & Chapman 2004, 280–281). Flexibility also means that the control systems can be turned off when not needed. For example, integrated information

systems allow viewing and creating some exceptions quite easily. However, it is relevant to note that total, unconstrained flexibility might be harmful. (Chapman & Kihn 2009, 156.)

The framework of Enabling and coercive control is more focused on what qualities a certain management control system can possess rather than for what type of control it is meant for. A single, for example cybernetic control system, can be built in an enabling or a coercive way. This framework does not overlap with the others described in this study – instead it adds another set of qualities that can be observed about a single control system.

2.5 MCS as a package

Management control system research has greatly emphasized researching single themes or practices. It is unreasonable to think that a single control system works in isolation from other organizational control systems. The interrelation between the single systems in the organization should be taken into account when conducting research about management control. (Chenhall 2003, Malmi & Brown 2008.) As companies have more than one single management control system, some or all of which have possibly been implemented for and by different interest groups, the whole package of systems needs to be studied as a whole, in order to understand if the company succeeds in realizing the benefits of control (Malmi & Brown 2008, 291).

Malmi & Brown (2008, 290) make a distinction between pure decision support and control. They argue that systems which only support decision making and leave the decisions made unmonitored are not MCSs, but mere management accounting systems. Conversely, Chenhall (2003, 129) argues that decision support systems are also MCSs. In this study both of the views are acknowledged. If a decision is made, and the effects of this decision are left completely unmonitored, there is no way to ensure that the decision made was in accordance with the strategy and the goals. Management can only hope that the decision does not conflict with the strategy. However, the mere existence of a decision support system can be conceived as moving from intuitive decision making towards management by facts (see Granlund & Malmi 2002, 315), which can be seen as a strategic goal in itself.

The management control systems package can be seen in Figure 2.

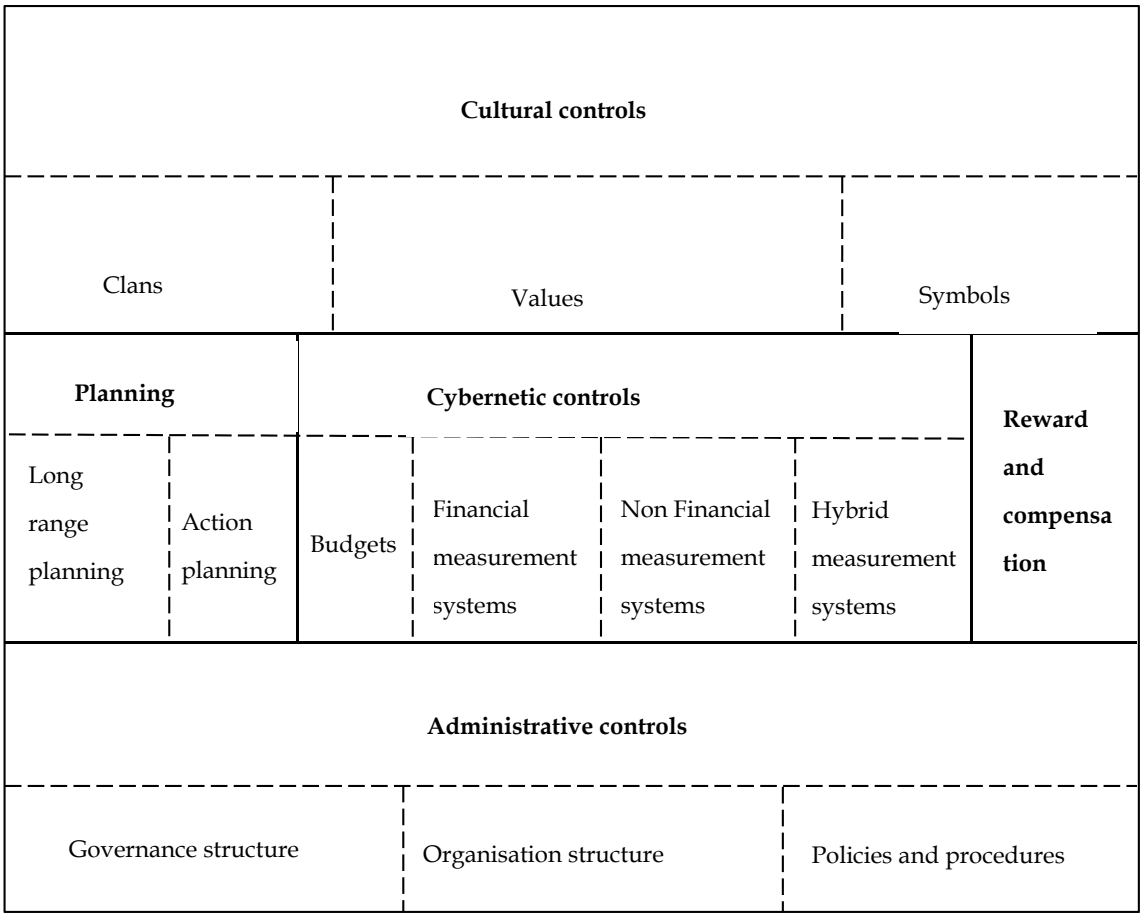

Figure 2 Management control systems package (Malmi & Brown 2008, 291)

As can be seen in the figure, Malmi and Brown (2008, 291–295) divide the control systems package into five broader categories. These categories are planning, reward and compensation, cybernetic, administrative, and cultural controls. The first category, planning controls, are used for setting the goals for the organization and thus directing behavior. Additionally, coordinated planning enables ensuring that all of the departmental goals are in line with the higher level organizational goals. Planning can be further divided into two different types: action planning, with a scope less than 12 months, and long term planning, with a scope of over a year. Unlike Merchant & Van der Stede (2007), Malmi & Brown (2008) do not wish to categorize planning solely as a financial tool. They continue to state that planning as a process that includes employees and tries to increase their commitment to the plan differs greatly from a task list on future activities. The second category, cybernetic control, consists of systems in which a feedback loop (see chapter 2.2) is used. In a feedback loop quantified target values for a measure are set, measurements about the phenomenon made, possible variances between the target and the actual performance are calculated and analyzed, and new targets are set if needed. The linking of behavior to targets and assigning accountability for measures and variations justifies calling the cybernetic control systems as MCSs instead of being

merely decision support systems. Malmi and Brown mention four widely studied types of cybernetic control systems: budgets, financial measures (such as EVA), non-financial measures, and hybrid measures (such as the BSC).

The third category of control systems, reward and compensation systems, focus on motivating the employees and groups within the organization in order to achieve goal congruence. The actual rewarding is mostly based on the performance measured with the cybernetic controls. However, Malmi and Brown emphasize that companies can also provide rewards for other reasons, such as in order to retain employees or encourage cultural control by utilizing group rewards (see chapter 2.3, cultural controls). (Malmi & Brown 2008, 293.)

The fourth category of control is administrative control. Malmi & Brown divide administrative controls into three groups: organization design and structure, governance structures within the firm, and procedures and policies. Organization design and structure can be seen as a control system because specific ways of organizing the organization yield certain types of contact and relationships. The second group, governance structure includes the formal accountabilities and lines of authority, and the way coordination, both vertical and horizontal, is organized. The third group, procedures and policies, are the specific operating procedures and rules that state how processes and operations should be carried out in the organization. These rules and policies include the action control of Merchant and Van der Stede (2007) (see chapter 2.3).

The fifth and final category consists of the cultural controls. The cultural controls mean values, beliefs and social norms which are established and influence employee behavior. Malmi and Brown (2008) use three different aspects of cultural control: value based controls, symbol-based controls, and clan controls (see Ouchi, 1979). Value based controls (see beliefs systems in chapter 2.2) are the explicit organizational definitions managers use to communicate and reinforce values, purpose and direction. These values are communicated for example in the form of mission and vision statements, and statements of purpose. Symbol based controls are the visible expressions an organization creates, such as building designs or dress codes (see cultural controls in chapter 2.3). The clan controls are based on the socialization process employees go through. This is related to the somehow homogenized groups (such as professions) or different, organizationally restricted groups within an organization (such as departments). Clan controls are utilized through ceremonies and rituals which strengthen the values and beliefs of the participants.

Malmi & Brown (2008, 298) conclude that a better understanding of which particular elements in the control system package are beneficial can be obtained by examining all the separate control systems and their interrelations, instead of focusing on a single control system. They also continue to state that this is true with regard to the potential substitute and complement effects of the separate systems.

The MCS as a package framework has quite a lot of overlap with the Levers of control and Objects of control -frameworks. Malmi & Brown also take into account the interrelations between the single control systems. However, the framework lacks interactive control systems and boundary systems entirely.

3 BUSINESS INTELLIGENCE

3.1 Defining Business Intelligence

The origins of business intelligence (BI) systems stem from decision support systems, which appeared in the 1970s when managers began using computer applications to aid in decision making and reporting. These systems had no analytical capabilities and were based on two dimensional reporting. During the 1980s these systems evolved and started to provide multidimensional ad-hoc reporting, forecasting and drill down capabilities. The term BI was coined by the Gartner Group in the 1990s. The development of technologies such as executive information systems (EIS), online analytical processing (OLAP) and data mining have added to the field and today BI is a "broad category of technologies, applications, and processes for gathering, storing, accessing, and analyzing data to help its users make better decisions". (Wixom, Watson & Werner 2011, 61; Turban, et al. 2011, 19.) Figure 3 illustrates the tools and technologies that may be a part of a BI system.

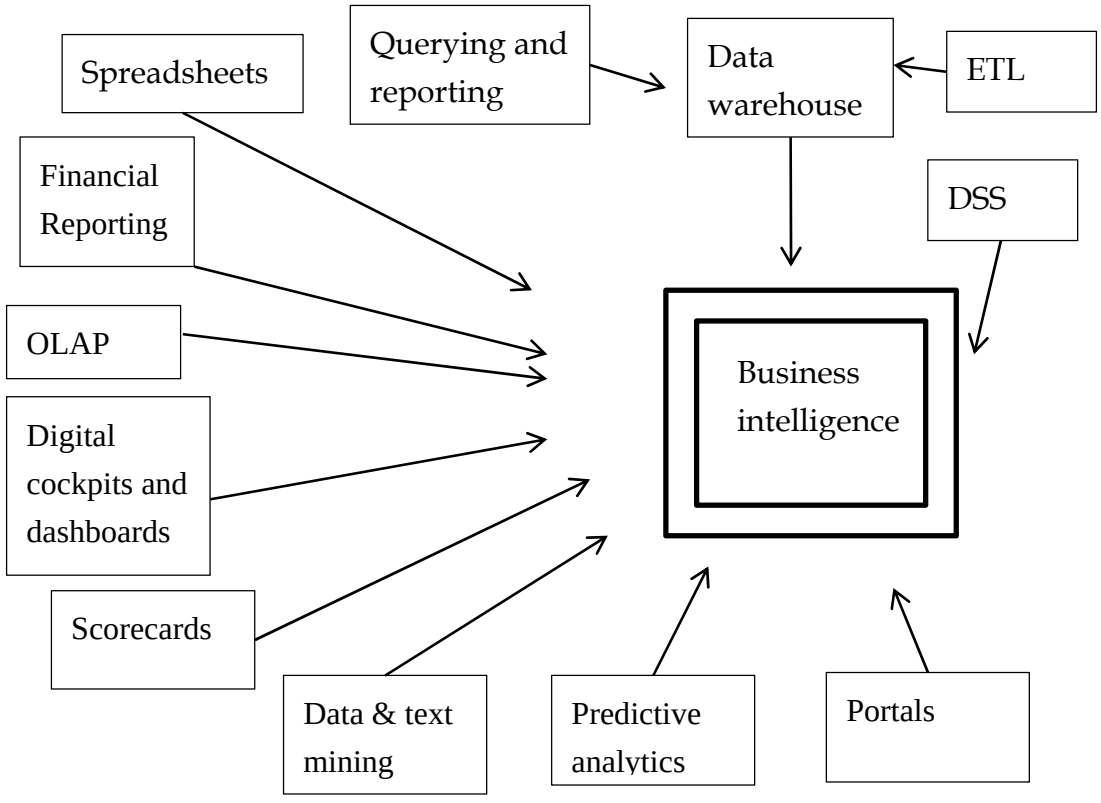

Figure 3 Elements of business intelligence (based on Turban et al. 2011, 19)

As Gnatovich (2007, 49) mentions, the vendors of BI tools have consolidated heavily within the last few years. Four big companies, also known as “mega-vendors”, dominate two thirds of the entire market. In 2007 several multi-billion dollar deals were made, where SAP purchased Business Objects, Oracle purchased Hyperion and IBM purchased Cognos. Microsoft is the only big player which has grown by making only smaller acquisitions. The big vendors mentioned by Gnatovich are also key players in the industry at the time of writing, in the year 2013: SAP’s Business Objects and Netweaver BI, Oracle’s Oracle Business Intelligence Suite and Oracle BI Enterprise Edition, IBM’s Cognos 8 and Microsoft’s SQL Server Reporting Services. Some of the smaller vendors include SAS, MicroStrategy, Information Builders and TIBCO.

Defining business intelligence is not a straightforward task, due to the excess of different definitions in the literature. Williams (2011, 27–28) states that as a term business intelligence is not at all clearly defined. It encompasses many technologies, data management aspects, different applications and information analysis and presentation methods. BI developed from data warehousing and analyzing historical data, but nowadays the lines between BI, business performance management (see chapter 3.2.3) and content management have become hazy.

According to Williams’ (2008, 2) own definition, business intelligence is “a structured, business-driven approach to leveraging business information to improve performance and profits.” These improvements are made possible by integrating business information, analytical tools, and decision support with core value chain activities. Hannula & Pirttimäki (2003, 593) state that BI systems are used for data analysis and reporting. They are used in both operative and strategic levels of the organization to support decision making.

Negash (2004, 178) defines business intelligence in the following way: “BI systems combine data gathering, data storage, and knowledge management with analytical tools for presenting complex internal and competitive information to planners and decision makers”. He also states that this definition holds the implicit view of delivering actionable information at the right time, to the right place and at the right form to assist decision makers. Also, according to Elbashir, Collier & Daverns (2009, 138) BI comprises specialized tools for data-analysis, querying and reporting. They should improve organizational decision making and have a positive effect on a range of business processes. BI systems come with a specialized IT infrastructure, comprising of data warehouse(s) and ETL (Extract, transform, load) -tools. These two definitions are similar to the previous ones, but they add the technology as the enabling component.

Sabherwal & Becerra-Fernandez (2011, 6) say that the term business intelligence has been used in at least two different ways. Sometimes business intelligence means the

process, through which the organization acquires, analyzes and distributes the relevant information and knowledge. BI has also been used to depict the end-product of the process above, meaning the information and knowledge useful to the organization. They also state that the BI technology is the tool for gathering the data from various sources, analyzing and transforming it, and then distributing it to relevant users. (Sabherwal & Becerra-Fernandez 2011, 6.) This definition adds one more component to the previous ones, namely the end product of information and knowledge that is distributed to the users. Even though many of these definitions hold decision making in their core, as stated earlier, Elbashir, Collier & Sutton (2011, 156) also point out that business intelligence systems are not just for decision support. These systems also provide other capabilities that enable transforming the vast amount of data in corporate databases into information that is required for advanced management control systems.

The somewhat differing use of terminology between authors provides additional challenges for defining what business intelligence is. For example, Gnatovich (2007, 48) wishes to separate business intelligence from business analytics, citing that business analytics is the “BI of the future”. Gnatovich states that business analytics is more focused towards the needs of business users, predicting future events and guiding action instead of just informing. Business analytics focuses enabling the users getting answers to their self-developed questions without the need to ask help from the IT-department. The author makes an important notion and states that the most important thing in involving new people to the BI is that the system is flexible enough to do your own queries. The pre-installed reports and queries in the data warehouse or cubes will likely not be capable of answering questions that arise in everyday business situations and therefore the flexibility of the system is vital. (Gnatovich 2007, 49-50.) Even though these notions are important, emphasizing these capabilities perhaps do not justify renaming the whole subject of business intelligence as business analytics. In this study the term business intelligence encompasses also the capabilities Gnatovich sought after.

Based on the literature review, the most comprehensive definition of business intelligence is introduced by Shollo & Kautz (2010). Shollo & Kautz (2010, 4–5) conducted a thorough review of BI literature and noticed that BI can be defined in different ways: as a process, a product, a set of technologies or some combination of the three. The first definition holds BI as a continuous process, in which data is gathered and stored. This data is then transformed into information through analysis and the information is transformed to knowledge. The second common definition arises when BI is understood as both a process and a product. The process in this definition is almost similar to the definition earlier: it is the methods that are used to gain useful information in order to make better decisions. BI as a product means the relevant information and knowledge that enables making predictions about the behavior of the environment the organization is located in. The third common view is that of simultaneously combining the process,

product and technology. In this view technology is the tool that enables the gathering, transforming and using the data, information and knowledge. (Shollo & Kautz 2010, 5–6.) This framework can be seen in Figure 4, in which the BI concept is divided into three pillars: products, processes and technologies.

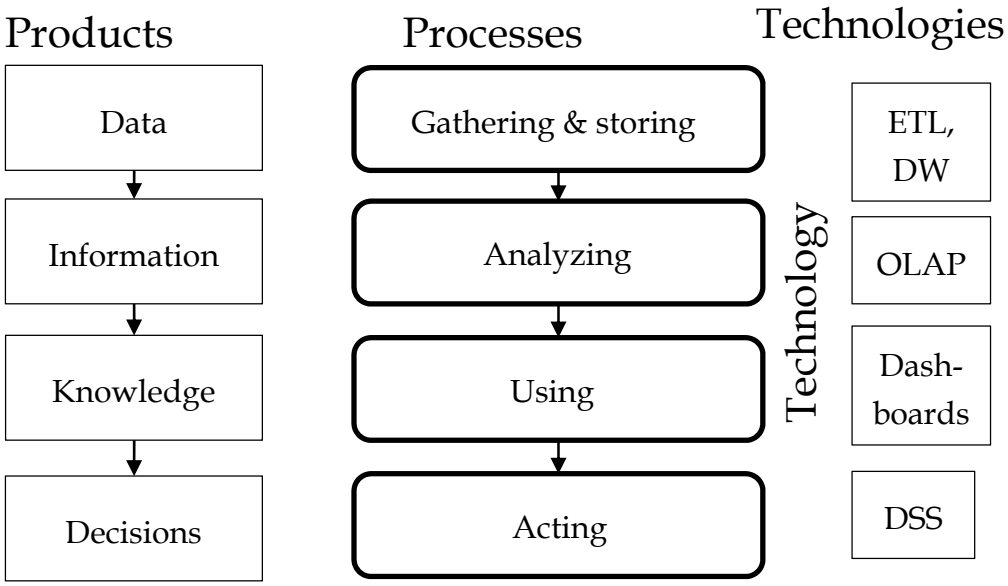

Figure 4 BI conceptualization (modified from Shollo & Kautz 2010, 9)

First, data is collected and stored. Second, the data is analyzed and transformed into information. Third, the information is further analyzed and transformed into new information and knowledge. Finally, this information and knowledge are used when action is required. All of these steps are enabled by appropriate technologies. (Shollo & Kautz 2010, 9.) This definition of business intelligence as a product, process and technology is used in this study. Each of these three different views is introduced in the following sub-chapters.

3.1.1 Business intelligence as a process

The main phases of the BI process are: gathering and storing of data, analyzing the data and information, using information and knowledge, and decision making (Shollo & Kautz 2010, 6–9). The first phase, gathering and storing the data, consists of gathering the data and storing it in a data warehouse. It is enabled technical by the information integration capabilities. The data can be structured or unstructured and it can come from internal or external sources (Negash 2004, 181–182). The second phase, analyzing data and information, handles the ways of analyzing the data, transforming the data into information, filtering and aggregating this information and providing it for the users

(Shollo & Kautz 2010, 7). This phase is supported by the technological insight creation capabilities. Goal oriented and metric driven methods, such as corporate performance management (CPM) and balanced scorecard (BSC), are used in analyzing strategically relevant data and extracting information from the data. (Golfarelli, Stefano & Iuris 2004; Yi-Ming & Liang-Cheng, 2007, both according to Shollo & Kautz 2010, 7). The relationship between BI and CPM will be further explored in chapter 3.2.3.

Discovering new patterns and relationships in the data is also done by utilizing exploration methods. These exploration methods use technologies such as data and text mining (see chapter 3.1.3) and document visualization in the pattern discovery. Visualization, or visual analytics, means the use of computer graphics to create graphical representations of large information sets. The goal of visualization is to enable knowledge discovery from large amounts of information. Because realizing patterns from large amounts of raw data requires a tremendous amount of experience, visualization assists in making the information more understandable. A performance dashboard is an example of data visualization. It has the same purpose as a car dashboard – to give the right amount of relevant information in an easily understandable way. (Sabherwal & Becerra-Fernandez 2011, 151, 154.) The quality of business intelligence as an analysis tool is compatible with the view that one of the reasons for implementing BI is to provide enhanced analytical abilities to pre-existing ERP systems (Elbashir et al. 2008, 138). BI is implemented even though some evidence exists that companies are using only a fraction of the analytical capability embedded in their ERP systems (White 2004, 6). One explanation for this is the fact that the more sophisticated management accounting tools of the ERP systems have been too complex and cumbersome to use when compared with standalone software (Granlund & Malmi 2002, 310). The ERP systems can often provide only operational reports of recent events, and they do not answer to the need for ad hoc, forecasting, and exception reports (Chou, Tripuramallu & Chou 2005, 343).

The third phase of the business intelligence process, using information and knowledge, focuses both on using existing knowledge to interpret information and creating new knowledge from existing information. This phase is supported by the technological presentation capabilities. Knowledge is defined as subjective and personal, and simultaneously stemming from organizational repositories, documents, practices, processes and norms. This means that even though knowledge is based on a similar foundation for all organizational actors, the knowledge itself varies from person to person. (Cheng, Dai, Xu & Shi 2006, 590.) New knowledge on the other hand is created through human analysis of information (Negash 2004, 180). As the patterns that emerged from using techniques such as data mining and trend analysis are further analyzed, new knowledge can be created (Cheng et al. 2006, 586). The final phase, decision making, means using the information in the system and the knowledge gained to make better decisions (Shollo & Kautz 2010, 9). This issue of management by facts is perva-

sive throughout the business intelligence domain. The idea behind this is to use information systems to reduce intuitive decision making and focus on the facts. One of the problems behind this train of thought rises from the fact that managers have already for long been able to access more information that they are able to utilize (Granlund & Malmi 2002, 315). Therefore, the key does not lie in the amount of data or information, regardless of its meaningfulness or quality. The important thing is how the information is conveyed to the users in a way they can best utilize it.

3.1.2 Business intelligence as a product

The view of business intelligence as a product concerns the role of data, information, knowledge, and decisions. The information and knowledge enable predicting the behavior of the external and internal environment with a degree of certainty. (Shollo & Kautz 2010, 5.) The first three can be perceived as assets of the system, whereas the decisions are the end product of utilizing the first three. This framework can be seen in Figure 5.

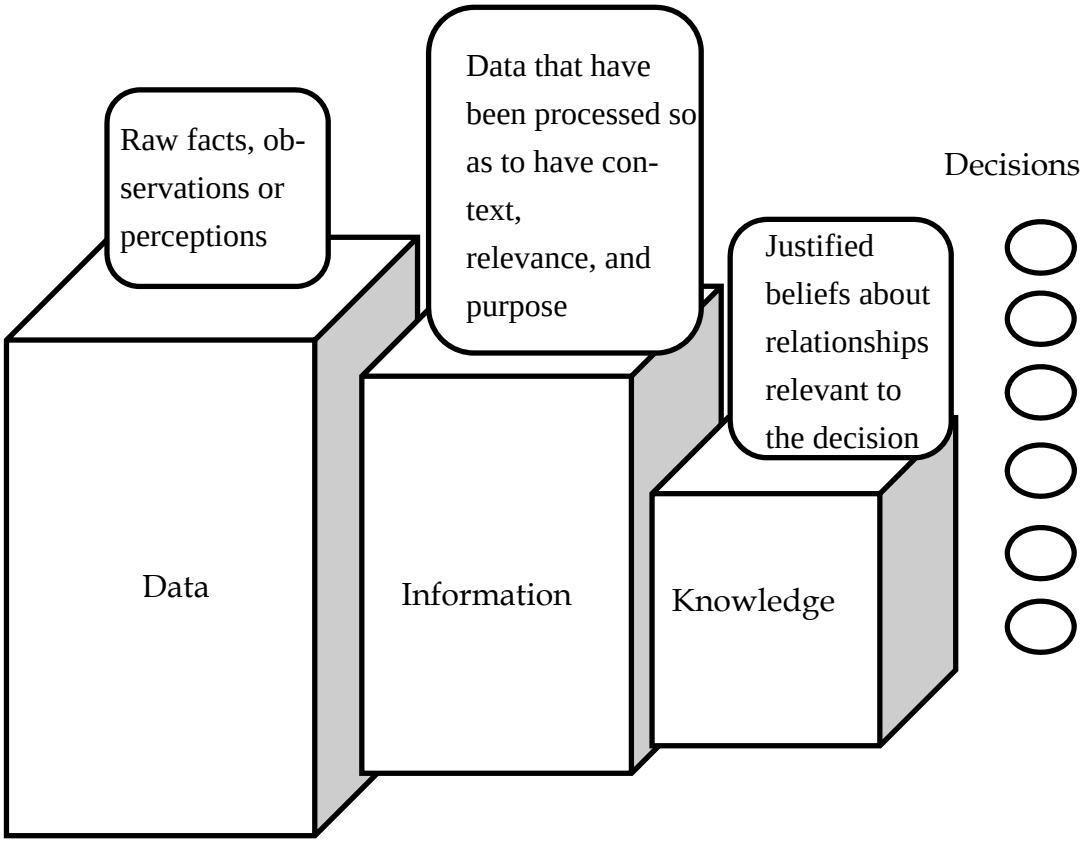

Figure 5 Data, information, knowledge, and decisions (Sabherwal & Becerra-Fernandez 2011, 5)

Sabherwal & Becerra-Fernandez (2011, 5) describe the differences between these four different products. Data can be facts, observations or perceptions, the truth value of which can be true or untrue. Data are just raw numbers or assertions that do not necessarily have further meaning or do not have a clear context. Data are for example how many and what types of products a single sales order in a grocery store contains. Information is a subset of data, including only data that retains context, relevance and purpose. Information is acquired through manipulating raw data to better understand the patterns underlying in the data. For example, the daily sales of hamburgers in a restaurant is relevant information for a manager. With this information the manager can better make decisions about pricing and purchases. (Sabherwal & Becerra-Fernandez 2011, 4–5)

Knowledge differs from information, but not in the same way information differs from data. Knowledge is not a richer set of facts. Instead it consists of a justifiable set of beliefs about relationships between different information. For example, combining the information about the daily sales of hamburgers and all other products that use bread with the level of bread in the inventory can be used to formulate the quantity of bread that needs to be ordered. The quantity ordered can be perceived as information, but the combination of the relevant prior information that led to that estimation is knowledge. Therefore, knowledge can be defined as deeper understanding of a subject matter, based on justified beliefs about the underlying relationships between different sets of information. The justification can be logical, mathematical or simply based on empirical observations. (Sabherwal & Becerra-Fernandez 2011, 5.)

Business Intelligence (BI) provides decision makers with information and knowledge that helps them to make better decisions by providing them with the capability of asking the right questions and the offering a possibility to also obtain answers to the questions. BI makes this possible by gathering (multiple) sources of data in a place where the user can twist and turn the data in a necessary way to formulate the correct questions and see the answers in ways that are comprehensible. The data sources can be internal or external, multiple sources can be used simultaneously, the data can be structured in multiple different ways and the data can be both quantitative and qualitative. BI submits this data and information to analytics and then presents this new information in an easily understandable way, such as through scorecards and dashboards. The goal is to provide knowledge for the users. (Sabherwal & Becerra-Fernandez 2011, 6.)

3.1.3 Business Intelligence as a technology

A business intelligence solution has four synergistic technological capabilities: organizational memory, information integration, insight creation and presentation. Each of

these capabilities is enabled by specific technologies. As can be seen in Figure 6, organizational memory serves as the foundation for the rest of the BI capabilities. Organizational memory is the mostly quantitative data in internal operational databases. (Sabherwal & Becerra-Fernandez 2011, 26.)

The data a BI system operates with can come from multiple internal sources, such as legacy or ERP systems, or external sources, such as statistics organizations (Turban et al. 2011, 334). These sources may contain data that is of variable quality – for example, two different databases may have different names for the same product. The second capability of the BI system, the information integration, enables using this data. Information integration means combining structured data and information from the internal organizational memory with unstructured internal and external data into the same storage in a suitable manner. (Sabherwal & Becerra-Fernandez 2011, 33–35.) The data need to be cleansed, integrated, and standardized before any analytical operations can be performed on it. This cleansing of the data is performed by using extract-transform-load (ETL) -tools. As their name suggests, these tools first extract the data from the source systems, cleanse and turn the data into usable form, and load the data into the data warehouse (DW). (Chaudhuri et al 2011, 90.) The data warehouse is a pool of data; a repository of current and historical data that is potentially interesting or useful for the managers of the organization. It is a subject oriented (meaning the ability to divide the data based on the subject matter, such as sales by customer), time-variant, nonvolatile collection of data that supports the managerial decision making process. (Turban at al. 2011, 329.) The data warehouse uses a relational database management system (RDBMS) for storing and querying. (Chaudhuri et al 2011, 90)

It is important to note that business intelligence is not transaction processing. Unlike transaction processing systems, BI does not use the constantly changing operational databases. Using a BI system does not result in transactions, i.e. changes in the data. Instead BI is used for analysis by utilizing data warehouses, which contain a view of the organization's situation at a single point in time. One of the main causes for using a data warehouse is that the transactional databases are designed in a way that is effective for recording transactions, but very ineffective for analysis. Therefore, the information in the data warehouses is reorganized and structured in a way that better supports querying and analysis. (Turban, Sharda, Delen & King 2011, 38.)

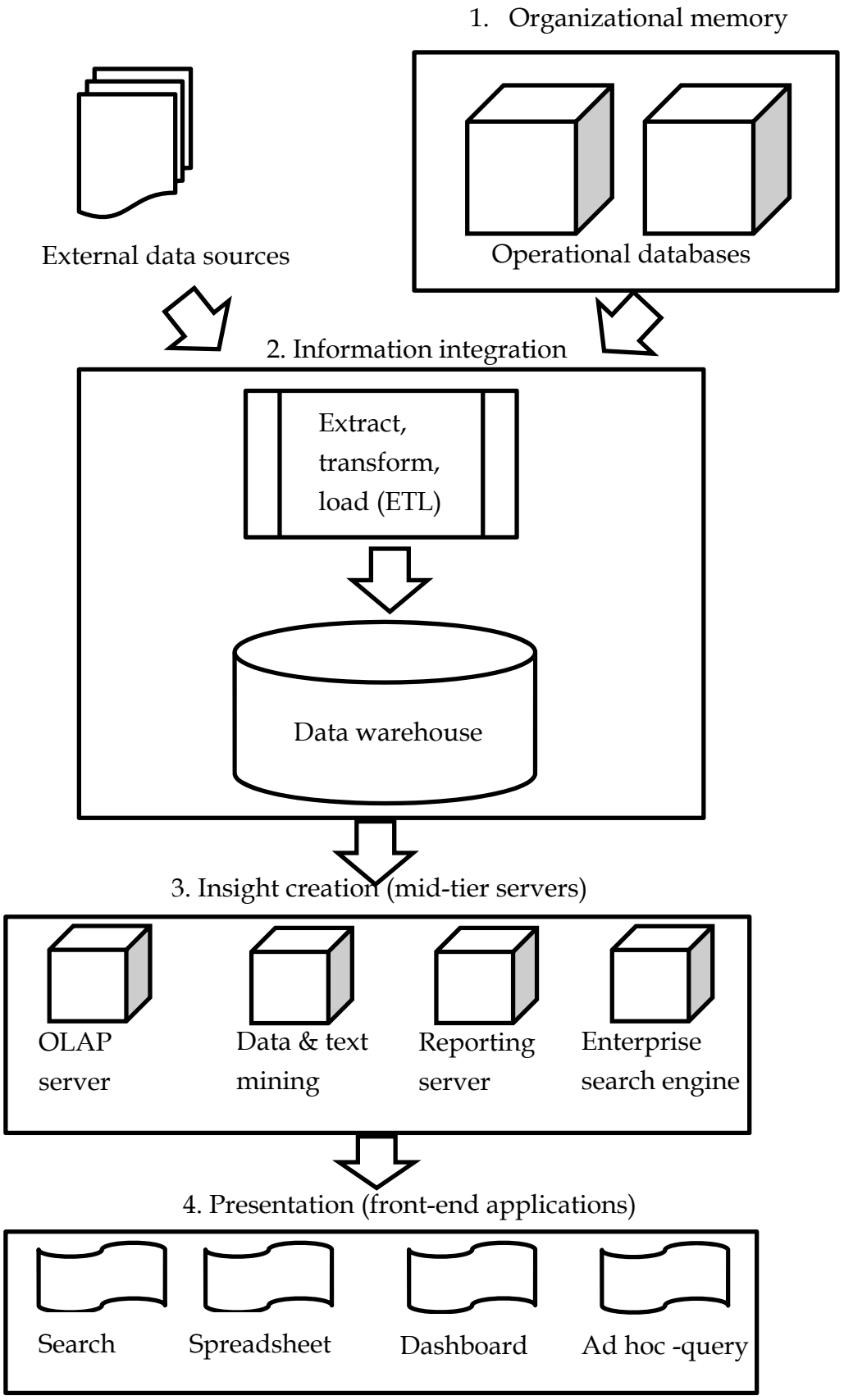

Figure 6 Business intelligence architecture (Based on Chaudhuri et al. 2011, 90; Sabherwal & Becerra-Fernandez 2011, 26)

The third capability of business intelligence technology, insight creation, means applying analytics to create new insights from the data in the data warehouse (Sabherwal & Becerra-Fernandez 2011, 36–38). The actual operations on the data are performed by mid-tier servers that provide dedicated capabilities for different types of use. The foundation for interacting and presenting the data in a BI system are online analytical processing (OLAP) features. OLAP is a term used for querying data, which is usually precalculated to give faster answers. The data in OLAP is usually presented in data cubes, meaning that the measures can be presented in a multidimensional view. For example, sales figures for a product are measures, and time or a certain sales area (for example a country) are dimensions. Therefore, an OLAP cube could consist of the sales figures for a product family in the entire world during the past five years. The user could then drill down or roll up the data, selecting for example the sales of two products in Mexico last January, or any other combination. The amount of dimensions is not limited to two, so the user can achieve very complex queries with relative ease. The most popular queries are pre-calculated and stored into memory to make the queries faster. (Sabherwal & Becerra-Fernandez 2011, 149–151.) Pivoting the data is also supported in the OLAP servers. The reporting servers enable the creation and distribution of predefined reports. The enterprise search engines allow the users to search the data warehouse for text and structured data. For example, for one particular customer many different types of documents, such as email messages, support call information, and purchase histories, can be searched for. The data mining and text analytic engines enable finding in-depth patterns in the data by using different algorithms, such as linear and logistical regression, decision trees, or neural networks (computational models that are capable of machine learning and pattern recognition). These patterns can be used to build predictive models that can for example assist in identifying new market opportunities. (Chaudhuri, Dayal & Narasayya 2011, 90.)

The presentation capability is the fourth capability of BI technology (Sabherwal & Becerra-Fernandez 2011, 40–42). The front-end applications that enable presenting the data are the visible part of the BI system for most of the users. The front end can consist of spreadsheets; dashboards, scorecards and other performance management applications; different portals for conducting searches and performing ad hoc -queries; and viewers for the data mining models. The data existing in the dashboards or created by ad hoc queries is usually visualized some way. Visualization can aid in recognizing patterns and outliers. (Chaudhuri, Dayal & Narasayya 2011, 90.) An example of a visualization in a dashboard can be seen in Figure 7.

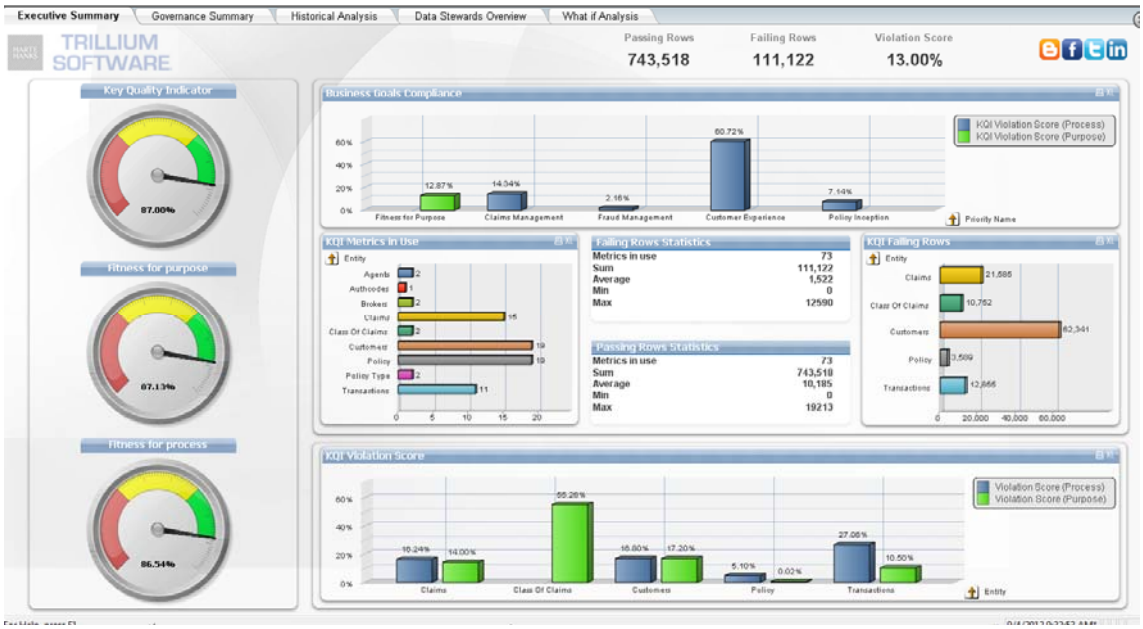

Figure 7 Example of a dashboard (Qlikview, 2014)

The visual features of the dashboards are important, but they alone are not sufficient to ensure a working dashboard. Additionally, the functional features of the dashboard need to be in order. Together the functional and the visual features need to reflect the purpose of the dashboard. For example, if the dashboard is meant to be used as a planning tool but it lacks the ability to perform scenario analysis, the functional fit between the intended use and the features is poor. Additionally, if the dashboard is used to communicate the strategy (as in the balanced scorecard) and the performance measures are displayed in a way that does not reflect the strategy, the visual features of the dashboard are poor. (Yigitbasioglu & Velcu 2011, 44.)

Even though the relationship between business intelligence and decision making is emphasized on many of the definitions of business intelligence, it is relevant to note that BI systems and decision support systems (DSS) are not the same thing. Turban, Sharda & Delen (2011, 24) point out that as business intelligence systems evolved from decision support systems, they are quite similar in some areas. Both rely on for example data mining and predictive analysis tools. The authors continue to point out that there are also major differences between these systems. First, BI uses a data warehouse as a base for all its functionalities, whereas DSS does not require a data warehouse in order to work. Second, DSS are constructed to support specific, direct decision making situations. DSS makes a decision based on preset parameters, whereas BI systems provide information and the ability to analyze it, leaving the user responsible for the decision making. Therefore, the BI system provides an indirect way of decision support. Third, the orientation of BI is more of a strategic and executive nature while DSS is geared toward analysts. Fourth, BI systems are usually constructed by using commercially

available products, when DSS systems can often be custom built. Fifth, BI methodologies and tools stem more from the practical domain, as DSS was mostly developed in academia.

3.2 Business intelligence and management control

3.2.1 Governance

The focus of this study is on BI's relation to management control. To ensure that the control systems are used in accordance with the strategy and goals of the organization, some form of governance is needed. The Latin phrase, "quis custodiet ipsos custodes?" (in English "who watches the wathcmen?") (Juvenal, 1st/2nd century) encapsulates this problematization – how to control that which controls.

Business intelligence governance consists of four different mechanisms: 1) the guiding principles, 2) decision making bodies, 3) decision areas and decision rights, and 4) oversight mechanisms. These governance structures and mechanisms are put in place to ensure that the management, development and use of BI are done in a desired way. (Leonard 2009, according to Sabherwal & Becerra-Fernandez 2011, 246–247.)

The first mechanism, the guiding principles, are the beliefs that guide BI goals and vision. They can be explicit statements, such as: "information is a corporate asset, and needs to be managed as one", or "information needs to be standardized, integrated, shared and reused in the entire organization." The second mechanism are the decision making bodies. These bodies are individuals or groups that have the power to make BI-related decisions. These bodies also comprise the sponsors and input providers. Wixom et al. (2011 69) point out that BI governance should include enough of committed business sponsors.

The governance structure should enable sharing information and practices between business functions, allow opinion sharing, enable altering priorities and provide input into BI decisions (Wixom et al. 2011, 69–70). The governance bodies should usually contain members from both business and IT, with a broad enough representation of the different functional areas and organizational levels. (Leonard 2009, according to Sabherwal & Becerra-Fernandez 2011, 246–247) Two specific groups are usually mentioned. These groups are the governance committee and the steering committee. The governance committee focuses on the BI development. The committee holds meetings about the need for BI development. Through discussion, similarities and redundancies in the needs are discovered. These different needs will be prioritized based on their value creation abilities, in order to appoint the resources to the most valuable projects. The

BI governance committee should comprise people from all of the departments involved in BI together with people from the IT-department. The IT-department members function as subject-matter experts on an as-needed basis. The composition of the committee should reflect the composition of the organization, as it is important that every team's perspective and priorities to are brought to the discussion. The other group is the BI steering committee. The goal of the committee is to align the BI solution with the organization's strategy and processes. It consists of senior members of the organization which should meet regularly to resolve conflicting priorities, discuss new opportunities, and address other possible issues. (Howson 2008, according to Sabherwal & Becerra-Fernandez 2011, 246–247.)

The third mechanism is the definition of the decision areas and decision rights. The decision making rights are allocated to users, for example based on organizational roles. Three different types of decision areas are usually recognized: investments in BI, BI project status, and BI adoption and utilization. For all of the areas, responsibilities and accountabilities are assigned. The fourth governance structures are the oversight mechanisms. They are the formalized policies and procedures for the BI governance and evaluating progress. The procedures guide through business case and budget approvals, define the mechanisms for BI project tracking, and state how the training is done. These templates and tools are usually developed simultaneously with the BI project and are refined and institutionalized over time. (Leonard 2009, according to Sabherwal & Becerra-Fernandez 2011, 246–247.)

3.2.2 The uses of business intelligence in management control

As mentioned earlier, the effect information systems have on management control has been studied quite extensively. These studies have showed that most of the organizations have not used the new information systems to enable new forms of management control. Some have even stated that information systems rather just extend and augment existing control systems, instead of introducing entirely new forms of control. (Orlikowski 1991, 10, 39.) Granlund & Malmi (2002, 314) suggested that for example an ERP implementation, a very resource-binding effort, could possibly divert resources from other innovative and important development projects in the accounting domain and therefore act as a stabilizer.

Regardless, the possibilities of the information systems on management control are recognized in the literature. For example, Granlund & Malmi (2002, 301) stated as their working hypothesis that "a well-built data warehouse underlying the corporate information system should make it easier to build new management accounting constructions". However, the results of the study showed that the effects of an ERP implementa-

tion on new forms of accounting and control were very limited (see Dechow & Mouritsen 2005). The reasons behind this limited effect were mostly pointed to the complexity or limited capability of the system. The embedded applications were either of poor quality or too complex to use, which led to the continuing use of stand-alone software. (Granlund & Malmi 2002, 313.) One interesting finding in the research is that in some companies the data in the ERP database was not accessible easily enough. One company even built their own data warehouse for profitability calculations purposes. The researchers also pose the question of "...whether the ERPS will become flexible enough as databases to allow various types of reports…" and an "easier and faster access to (standardized) operational data", or "…will companies implement separate data warehouses, also incorporating other than internal company transaction data as a primary source of data for end-users". (Granlund & Malmi 2002, 307.) The evidence from the growth of the BI market suggests that the latter proposition was more correct. It seems that the ERPs did not evolve enough, and the analytical and reporting abilities were obtained by purchasing and implementing BI systems.

What then is the relationship between BI and management control? Elbashir et al. (2011, 157) suggest that BI systems are unlike conventional MCS innovations. Instead of supporting a single control system (e.g. BSC), they provide a possibility to considerably expand planning and cybernetic controls. In addition to enhancing planning and cybernetic controls, they also support administrative and reward controls. BI systems can be called an "integrated MCS", because they are used in so many fields of the entire management control systems package.

In order to see to which extent business intelligence is used (or could be used) in management control, a two-phase analysis was performed. First, a literature review about the areas of use for business intelligence was conducted. Different uses of business intelligence were gathered and divided based on the management control frameworks presented in chapter 2. The results of this analysis can be seen in Table 1. In the second phase of the analysis the rest of the control systems introduced in chapter 2 were analyzed in order to determine whether they could be utilized with business intelligence.

Table 1 The uses of business intelligence in management control

Cybernetic control and rewarding (Cybernetic control, Reward and compensation (Malmi & Brown 2008); Diagnostic control (Simons 1995); Results control (Merchant & Van der Stede 2007))		
BI uses	***Enabling technology***	***Text in***
Clearer relationship between operational performance and financial results	OLAP, dashboards	(Williams 2008, 28)
Tools for performance management	Dashboards, reports	
Precise and granular information for cost analysis	Dashboards, OLAP, ad hoc queries	
Tools for monitoring and improving customer service and product quality	Dashboards, dashboard alerts	
Improved customer retention	Data mining, dashboard alerts	
Helping IT move past being the provider of standard reports into providing help in improving business performance and profits	Integrated reports & automated distribution, ad hoc queries	
Real-time information about performance, enabling the identification of aspects that need improvement	Dashboard alerts, ad hoc queries	(Sabherwal & Becerra-Fernandez 2011, 14–19)
Better access to information, less time extracting and manipulating data	OLAP, portals, dashboards	
Improving customer service through identifying frequent problems in products	Dashboards	
Collecting and analyzing performance data about processes and providing information about the efficiency of workflows	Dashboards, internal alerts	(Whiting 2006, 1)
Better customer service through better knowledge of customer preferences	Data warehouse, data mining	(Watson, Wixom, Hoffer, Anderson-Lehman & Reynolds 2006, 10)

Planning (Planning (Malmi & Brown 2008); Diagnostic control (Simons 1995))		
BI uses	***Enabling technology***	***Text in***
Easily accessible, high quality historical information to support planning, forecasting, and budgeting	ETL, data warehouse, portals	(Williams 2008, 28)
Historical information for demand management and capacity planning	Data warehouse, predictive models from data mining	
Creating loyalty programs based on customer profile	Data mining	(Sabherwal & Becerra-Fernandez 2011, 14–19)
Capability to analyze long- and short term business scenarios	Data warehouse, predictive models	(Chou, Tripuramallu, Chou 2005)
Enabling customer segmentation and target marketing	Data mining	(Watson et al. 2006, 10)
Predicting future staffing needs	Data warehouse, predictive analysis	(Wixom et al. 2011, 67)
Enables planning the locations of future field offices based on the employee demographic data	Data mining, location based visualization	
Interactive control (Simons 1995)		
BI uses	***Enabling technology***	***Text in***
Identifying new market analysis through pattern and trend recognition	Data and text mining, analytical tools, data visualization	(Sabherwal & Becerra-Fernandez 2011, 14–19)
Better anticipation of customer reactions to process changes through using analytical tools	What-if analyses, data mining	
Faster responses to new situations through alerts about surprising events and trend monitoring	Dashboards, alerts, OLAP	
Enabling communication about strategically relevant topics through providing relevant information in a fast manner	Dashboards	(Chou et al. 2011, 15)
Identifying dysfunctional parts of strategy through empirical evidence	Data and text mining, analytical tools	
Better customer segmentation and more precise campaign targeting	Data mining	(Williams 2008, 28)

Boundary systems (Simons 1995)		
BI uses	***Enabling technology***	***Text in***
Detecting abnormal events within processes, such as pinpointing a potentially fraudulent transaction or a customer order that exceeds a credit limit	Dashboard alerts	(Whiting 2006, 1)
Prompting managers to take corrective actions, such as notifying about insufficient inventory levels	Dashboard alerts	
Setting boundaries on what kinds of customers are targeted in sales	Reporting	(Chou et al. 2011, 11)
Profiling suspicious bookings and ticket transactions	Dashboard alerts	(Watson et al. 2006, 10)
Administrative control (Malmi & Brown 2008); Global transparency (Adler & Borys 1996)		
BI uses	***Enabling technology***	***Text in***
Providing access to information for a greater number of individuals in the organization	Dashboards, portal	(Sabherwal & Becerra-Fernandez 2011, 14–19); (Chou et al. 2011, 13)
Limiting number of third party intermediaries in obtaining information	Ad hoc -queries	
Providing access to all organizational data for all employees, which has enabled constructing new applications that would have been impossible otherwise.	Data warehouse rules	(Wixom, Watson, Reynolds & Hoffer 2008, 111)

The grouping of the different control system types in Table 1 is performed based on the qualities of the control systems. In cybernetic control, the “cybernetic control” and “reward and compensation” (Malmi & Brown 2008) were grouped with “diagnostic control” (Simons 1995) and “results control” (Merchant & Van der Stede 2007), as these classifications consist of cybernetic control and rewarding. Planning is a combination of “planning“ (Malmi & Brown 2008) and the applicable parts related to planning of “diagnostic control” (Simons 1995).

As can be seen, based on the literature, the classification of Elbashir et al. (2011) is functional. The business intelligence systems mostly support different cybernetic and planning controls. The cybernetic controls mostly utilize the dashboard and visualization capabilities, whereas the planning capabilities are mostly supported by the historical data. There is also some support for reward controls, mostly due to the fact that rewards are connected to the cybernetic controls. Additionally, administrative controls are used in conjunction with global transparency, as the information is provided to a larger user base. As Elbashir et al. (2011) refer only to the MCS as a package framework (Malmi & Brown 2008), they have not been able to utilize the boundary and interactive systems (Simons 1995) when conducting their analysis. Business intelligence can be used as a boundary system for certain unwished actions, such as warning if credit limits

are exceeded. However, the ability to use the business intelligence systems as an interactive control system is perhaps the most important factor that was missing from the classification of Elbashir et al. (2011). As stated earlier, Vaassen (2002, 210) mentioned three ways information systems can enhance interactive control: 1) transforming complex data into easily understandable graphs and tables, 2) external information can be fed to planning systems, and 3) databases enable making what-if analyses. All of these three capabilities are core elements of a business intelligence system – in other words, the robust tools for pattern recognition, visualization and predictive analysis should enable focusing on emerging possibilities and threats.

As can be seen, these examples of possible uses of BI include only a portion of the systems described in chapter 2. The fit between the rest of these systems and business intelligence will be analyzed in the following paragraphs. In Simons' (1995) framework the only control system type that is not part of the initial analysis is the beliefs system; and in the MCS as a package framework (Malmi & Brown 2008) the only type of control not supported are the cultural controls. No part of business intelligence is especially suitable for the beliefs systems or cultural controls. For instance, beliefs systems are mostly communicated through different official documents. Therefore it is perhaps justified to state that the fit between business intelligence and these two is not that meaningful.

In Merchant's and Van der Stede's (2007) framework the control types left out are action controls, personnel controls, and cultural controls. Business intelligence can be utilized in parts of the action control, namely in administrative behavioral constraints, such as monitoring expenditure limits; and in the monitoring phase of ensuring action accountability. Both of these can be achieved by using the alerts in dashboards. Conversely, business intelligence is of little use in pre-action reviews and redundancy. Also, business intelligence cannot properly be used as a personnel control system. In addition, similarly to the beliefs system in Simon's framework, the cultural control cannot be enforced by using business intelligence. The only exception to this inability is group based rewarding, in which the business intelligence system works in the same way as in individual based rewarding.

With regard to enabling and coercive control (Adler & Borys 1996), business intelligence fulfills many of the prerequisites for an enabling system. As stated, an enabling control system has four features: repair, internal transparency, global transparency and flexibility. With regard to repair, the business intelligence systems can be built in a way that enables the user to repair the system if they break or something unexpected happens. However, as the underlying systems are quite complex, this might not be very easy. The possibility for internal transparency is high with business intelligence. The process statuses and relations can be made visible throughout the system, as the system is based on a single dataset and the processes are clearly mapped (Chapman & Kihn

2009, 155). The third form of enabling control, global transparency, can also be highly achievable with business intelligence. The relative ease different user rights can be set up in the BI system, combined with the presentation abilities of dashboards can be a powerful tool in delivering global transparency. However, unrestricted visibility might also prove to be detrimental – the segregation of viewing rights by role, task, and preference can help the users in battling information overload. Flexibility, the fourth form of enabling control, can also be achieved with business intelligence. BI systems leave the decision making power to the user, and the reports the users receive can be customized. Also, it should be possible to create what-if analyses when analyzing data compared with just routine reports (Chapman & Kihn 2009, 155). With every aspect of enabling control it should be pointed out that the possibility of building an enabling system does not mean that the business intelligence systems actually in use in the organizations are built in an enabling manner.

To conclude the chapter, BI based on literature review on management control systems and the qualities of BI systems, a potential fit between BI systems can be seen with cybernetic control, planning, interactive control, boundary systems, rewarding, and administrative control. Some possible fit can also be seen with parts of action controls, and enabling control. No support was found for beliefs systems, cultural controls, personnel controls, or some parts of action controls.

As shown in the previous analyses, BI is mostly related to the planning and cybernetic controls. Together with rewarding, these forms of control constitute corporate performance management (CPM), which is presented in the following chapter.

3.2.3 Corporate Performance Management

Corporate performance management (CPM) is also known as business performance management (BPM), enterprise performance management (EPM), or strategic enterprise management (SEM). Essentially they all mean the same thing: selecting measures that the organization wishes to improve, measuring the actual performance and tweaking the system if necessary. CPM is an umbrella term that covers the processes, methodologies, metrics and technologies for monitoring, measuring and managing business performance. (Turban et al. 2011, 397, 404.)

Williams (2008, 2–3) discusses using balanced scorecard, a very popular performance management methodology, and business intelligence together. He states that the BSC initiatives and BI initiatives are often launched and managed separately, even though there would be substantial benefits in aligning them. Performance management requires both a) the ability to measure performance and b) to manage and improve this performance. The latter section requires capabilities that the BSC does not inherently

have, and therefore BI could supplement. As BSC focuses on measuring performance in different dimensions and, by doing this, focuses managerial attention to the core processes, it does leave some questions open. The BSC literature does not answer questions such as where does the performance measurement information come from, who is responsible for gathering it, what is the quality of the information, what tools can be used to improve the processes, or how to make the right decisions to improve these processes? Williams (20008) states that this is not criticism towards BSC – the limit for the scope of the system has to be drawn somewhere. He rather points out that BI and BSC could complement each other. Both the BI and the BSC are aimed at using business information to improve the performance of core activities of the value chain. They focus on the same processes and usually use the same data. Lack of coordination will therefore likely lead to redundancies and overlapping activities. Absence of alignment might even lead to a false sense of security. If the management considers the BSC as being adequate not only for measuring performance, but also as the tool for improving the underlying processes, some performance improvement possibilities might be lost. (Williams 2008, 3–4.)

Williams (2008, 4–5) continues to state out that the coordinated BI and BSC initiatives will manifest as organizational alignment, business process alignment, budget alignment and data and technical architecture alignment. Organizational alignment shows as clearly defined and mutually reinforcing division of tasks, a combined part of which is the shared responsibility for linking the BSC's performance measurement with BI's performance management and improvement. The business process alignment means that both the BI and the BSC team are focused on the same business processes in the same order of priority. This coordination will lead to improvements in the core processes, and it will do it in a coordinated and prioritized manner. Budget alignment simply means that the initiatives share a common performance measurement budget. Lastly, data and technical alignment means that both of the teams work with the same data and technical architecture. This architecture should enable an automated BSC process and show consistent information – consistency meaning that both the systems should report the same performance for the same processes.

In literature, dashboards and scorecards are sometimes used almost interchangeably, mixing methodologies with presentation tools and vice versa. Despite this, there are differences between them, as in the previous example. As methodologies, scorecards are tools for aligning and monitoring strategy, and for charting the progress of the strategic goals (e.g. as in BSC); whereas dashboards are perceived as tools for the tactical level of performance evaluation. (Turban et al 2011, 408–409; Eckerson 2006, 67.) However, as visual presentation tools on a computer screen, both of them are just visual display mechanisms for performance management.

As there are different needs for different types of information coexisting in an organization simultaneously, a single presentation of information is not sufficient in an organization. Therefore, to cater for these different needs, multiple ways to present the information are required. One way of classifying the visual presentations is to divide them into three different levels, based on the uses they are constructed for. These separate levels, strategic, tactical and operational, all serve a specific audience and different needs. Table 2 summarizes the differences between the different levels of dashboards.

Table 2 Types of performance dashboards (Eckerson 2009, 13)

	Strategic	***Tactical***	***Operational***
Focus	Execute strategy	Optimize process	Control operations
Use	Management	Analysis	Monitoring
Users	Executives	Managers	Staff
Scope	Enterprise	Departmental	Operational
Metrics	Outcome KPIs	Outcome and driver KPIs	Driver KPIs
Data	Summary	Detailed / summary	Detailed
Sources	Manual, external	Manual / core systems	Core systems
Refresh cycle	Monthly / quarterly	Daily / weekly	Intraday
"Looks like a…"	Scorecard	Portal	Dashboard

As can be seen in Table 2, the strategic dashboard (also known as a scorecard) is used by senior executives for strategy execution, performance management and setting goal congruence. They are mostly used for monthly or quarterly strategic review or operational planning sessions. This dashboard focuses on strategic metrics, which are outcome (also called lagging) type KPIs. They are often aggregated from lower level KPIs. The tactical dashboards, on the other hand, are designed to enable mid-level managers to control performance and pursue goals on a departmental level. They enable managers to identify problems and search for solutions for these problems. These dashboards consist of both driver (also called leading) and outcome indicators. Lastly, the operational dashboards are used by the workforce to monitor core process performance on short notice. These dashboards comprise solely of driver indicators. (Eckerson 2009, 13–14.)

It is important to note that the different levels of dashboards are connected. KPIs are shared, but the focus of observation is different based on the organizational level. As Eckerson (2009, 14–15) states "strategy rolls down and metrics roll up". This means that the KPIs are derived from the strategy, and for each organizational level a suitable form of this KPI that reflects the performance on that level has to be defined. Then, starting from the bottom, these lower level KPIs are aggregated to calculate the performance of the next, upper level KPI. However, it is relevant to note that not all of the lower levels KPIs are used to form an upper level KPI. There are many operational KPIs

that are not deemed strategic, but are still very relevant for the performance of the organization.

The organization needs to understand the relationships between the KPIs. A strategy map is one way to define the causalities. However, as it is more focused on the relationships of the strategic objectives rather than the causalities of the KPIs, a metrics map that displays the cause-effect flows between the KPIs is more suitable for improving understanding in the organization. When these causalities, which are also known as vertical relationships between the KPIs, are clearly defined, the top management gets a line of sight on the performance of the company on all levels, and they are able to drill down to details if they wish. This cascading also enables for the workforce to see how their performance is linked to the whole of the organization. (Eckerson 2009, 16.) An example of a strategy map software can be seen in Figure 8.

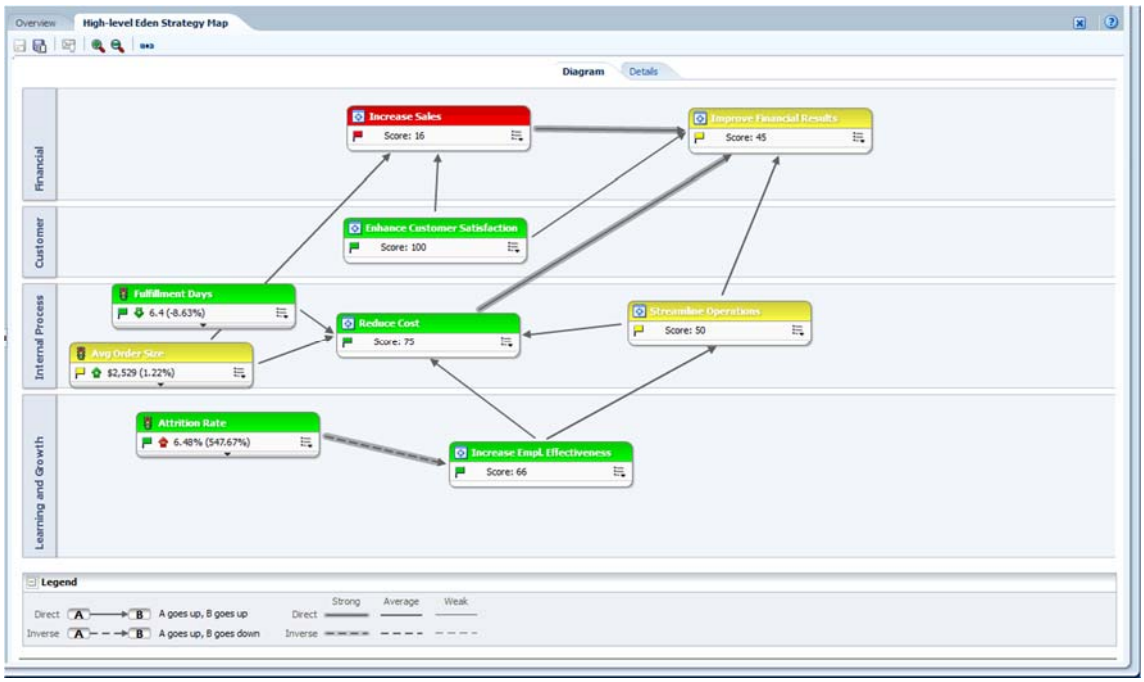

Figure 8 Example of a strategy map (Oracle, 2014)

The way of linking the metrics and presentation methods is a critical part of Eckerson's (2009, 4) definition of performance management. This definition can be seen in Figure 9.

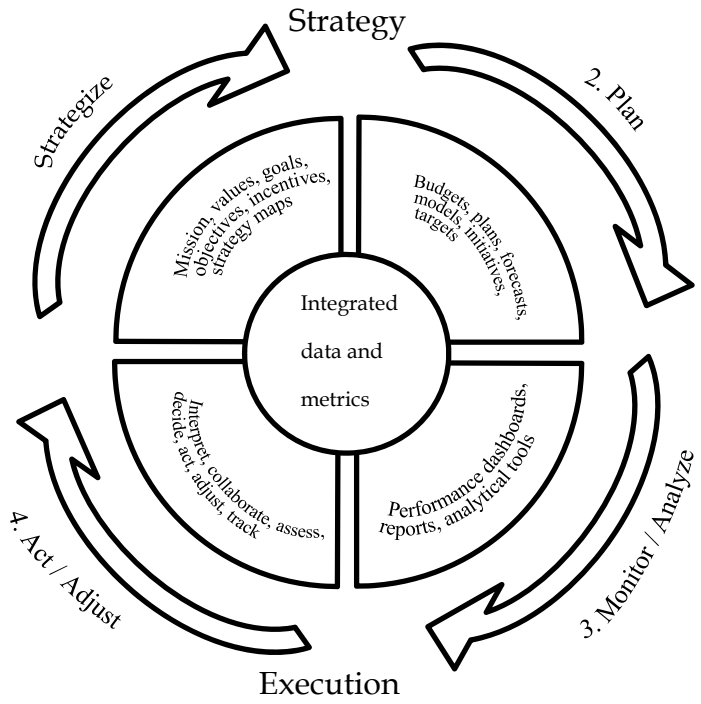

Figure 9 The performance management cycle (Eckerson 2009, 4)

As can be seen in the figure, performance management is seen as strategy driven cycle, meaning that the targets of process improvements are derived from strategic standpoints. The optimum results are achieved by devising goals and targets (i.e. strategizing), developing plans to achieve the goals (i.e. planning), monitoring performance against the goals (i.e. monitoring) and revising action if needed (i.e. adjusting).

In essence, Eckerson's (2009) model of performance management is a combination of strategy formulation, planning, and cybernetic controls; all of which have been combined in a process loop. Although combining a management control framework with a closed loop process improvement framework is quite intriguing, undergoing the strategizing process in every turn of the cycle is not sustainable.

3.3 Framework for business intelligence in management control

Based on the analysis conducted in the previous parts of this chapter, a framework for business intelligence as a tool for management control was constructed. The framework can be seen in Figure 10. This framework is mostly based on the applicable parts of the

MCS as a package (Malmi & Brown 2008) and Levers of control (Simons 1995) frameworks. It also uses the notions of business intelligence as an integrated management control tool (Elbashir et al. 2009) and the process loop in performance management (Eckerson 2009). It is also compatible with the definition of business intelligence as a product, process, and technology presented in chapter 3.1.

As management control is used to align employee behavior with the company's strategy and objectives (Malmi & Brown 2008, 290–291), the framework is based on the strategy and goals as a starting point. These are given from outside the scope of the control system. High level metrics, that are in accordance with the strategy, are selected based on their ability to ensure reaching the goals. The BI cycle, that can be seen below the metrics, tries to answer to the demand set by the strategy and the goals.

In the center of the cycle lies the integrated data. This is based on the process of gathering and storing the data, made possible by the ETL and data warehouse -technologies. This repository of data is the basis for all of the operations in the field of business intelligence. As was discussed in chapter 3.2.2, BI is best suited for planning, cybernetic, and interactive controls. These controls form the core of the BI cycle, which is represented by the bigger arrows in Figure 10.

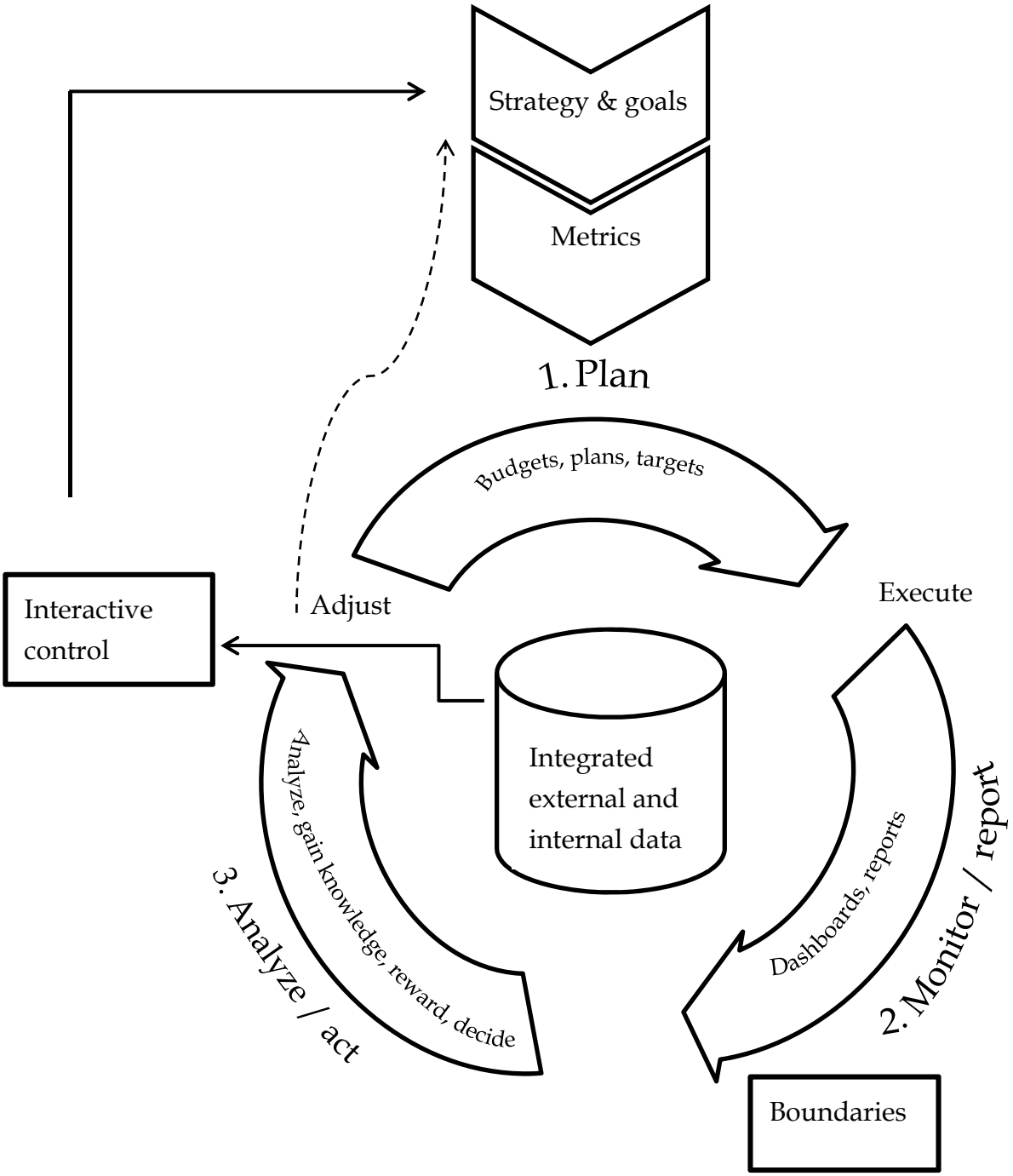

Figure 10 Business intelligence in management control

The first step of the cycle is planning. This capability is most supported by the vast amounts of historical data, which can be used when predicting the future performance. In this phase, plans are made and targets are set. The targets that are set in this phase act as the goals for the processes, which are monitored and adjusted in phases two and

three. The actual activities occur in the “execute”-phase after the plans are made. Step two, monitoring and reporting, consists of monitoring the process performance in the company. As a BI process (see chapter 3.1.1) this is the phase of turning data into information, supported by presentation technologies such as reporting and dashboards. The monitoring and analysis are performed through utilizing the integrated metrics that penetrate through all organizational levels. These metrics are presented in a way that takes into account the different needs and abilities of the users – i.e. there are many different dashboards and reports for different user groups. The different dashboards can be divided for example according to the strategic-tactical-operational -levels suggested in chapter 3.2.3. Additionally, as the underlying data can also come from external as well as internal sources, it is possible to for example benchmark the organization’s own performance against competitors, which is not a part of conventional CPM systems (such as the BSC). Also, if the organization has set boundaries (see Simons 1995) on the processes, they are taken into account in the monitoring phase. The third part of the cycle is called analyzing and acting. This phase consists of performing a deeper analysis, interpreting the causalities behind the level of performance, rewarding if applicable, deciding on further actions, adjusting the processes if required, and performing the adjustments. As a process, this phase relates to turning the information gained on the previous step into knowledge, and using this knowledge in decision making (see chapter 3.1.1). As can be seen, rewarding control systems are also inbuilt in this phase. After the third step, adjustments in the processes are made if necessary, after which a new cycle begins with new target setting, monitoring and adjusting.

Even though the strategy is taken as a “given”, the control systems can have an effect on it. There are two scenarios in which the strategy is affected. These scenarios are represented by the thin arrows. Firstly, the dotted arrow represents a situation that occurs when the corrective actions taken have no effect on the performance measures. As variances from set targets occur in the monitoring phase, the managers usually point the employees to adjust processes and operations so that the goals can be achieved. These adjustments might yield results and the goals can be achieved. In this case new targets are usually set and the cycle begins again. However, as the KPIs are based on strategy and strategy again is more or less based on assumptions, it is possible that the assumptions are wrong. No matter how much the processes are tweaked, no substantial results are gained. If this is the case, the fault can lie in the strategic assumptions. Therefore, in order to improve performance, the strategy needs to be changed. (Turban et al. 2011, 385). This option is used whenever the normal cycle does not yield the results it should. The second possibility for strategy alteration is represented by the two thin black arrows that leave from the integrated data towards interactive control. These arrows represent using business intelligence directly as an interactive control system, meaning that the strategy change prompting new knowledge must not necessarily come from the plan-

monitor-analyze -cycle. Through utilizing insight creation technologies, such as data and text mining or predictive analysis tools, new patterns, possibilities and threats may emerge.

The enabling or coercive forms of control were left out of the framework on purpose. As mentioned in chapter 3.2.2, business intelligence is well suitable for being used in an enabling manner. Whether an organization decides to use business intelligence in an enabling manner or not depends on the strategy and organizational culture. Also, the governance structure should be robust enough to enable properly following the strategy and the organizational goals.

4 BUSINESS INTELLIGENCE AND MANAGEMENT CONTROL IN THE CASE ORGANIZATIONS

4.1 Introduction

In this chapter the case organizations, interviewees, empirical data, analysis and results are presented. Three interviews were conducted between 26th of April 2012 and 15th of May 2012. Their length varied from 56 to 94 minutes. The interviews were electronically recorded and then transcribed. These transcribed interviews were then coded thematically. Both an individual and a cross-case analysis were performed on all the thematically arranged interviews. Each of the interviewees was the subject expert within their organization, and thus a thorough description about the organizations was obtained, despite the relatively low number of interviews.

The chapter begins with the introduction of the case organizations and the interviewees. Following this, the interviewees' view on the meaning of the term business intelligence and the organizations' business intelligence landscape are presented. The next subchapter describes the various ways the organizations use business intelligence in management control. The chapter ends in conclusions and discussion.

4.2 The case organizations

4.2.1 Organizations and interviewees

The first case organization is the Welfare Division of the City of Turku. This organization will be referred to as Organization A. The organization has over 4 500 employees. The interviewee is a director of the R&D department. The R&D -department has ten employees and its tasks consist of developing and coordinating the governance system for the Welfare Division. They are also responsible for developing the possibilities of technology use in the division. The department also manages and develops the business intelligence of the division. (Organization A, Interview 26.04.2012).

The second case organization (Organization B) is an insurance company that operates in multiple countries and has more than 5 000 employees. The interviewee works as a Systems specialist in a multinational data warehouse department for private (consumer) insurance business. He has over ten years of experience in data warehouse and business intelligence projects. The local department is responsible for the upkeep of the na-

tional data warehouse and also participates in implementing a new company-wide data warehouse. (Organization B, Interview, 10.05.2012)

The third case organization (Organization C) is a Finnish factory of a global industrial manufacturer. The company has more than 14 000 employees worldwide. The interviewee is an executive responsible for the financial management of one global business area. (Organization C, Interview, 15.05.2012).

4.2.2 The ICT system architectures

The ICT system architecture of organization A comprises multiple healthcare and social services production systems, such as Pegasos, Effica and WinHIT. They are used to process customer data such as customer information, visits and diagnoses. The organization also uses SAP ERP system for financial transactions, as the financial module is in use in the entire City of Turku. The ERP has been in use since 2011. Purchase invoices are circulated via Rondo-software. Bookkeeping, payment data, procurement, budgeting and financial planning are all in SAP, and financial reporting is done with SAP Business Warehouse (BW). (Organization A, Interview 26.04.2012).

Organization B has a wide variety of information systems. In the private insurance division multiple systems both for customer data and different types of claims (personnel or property) exist. Some of the programs are very old mainframe applications written for example with COBOL. Some graphic user interfaces have later been added on top of these systems. There is no ERP system in use. (Organization B, Interview, 10.05.2012)

Organization C has a very fragmented IS architecture. This fragmentation is attributable to the formation of the business via acquisitions within the last thirteen to fourteen years. As an acquisition was made, its systems were added to the existing portfolio. This led to the current situation in which the system landscape consists of multiple legacy systems, or systems which are relatively old and not integrated. Almost all the local organizations have their own ERP systems – for example, at the four Finnish factories three different ERPs are used. For bookkeeping the organization uses and old System 21. (Organization C, Interview, 15.05.2012).

As can be seen, the system landscapes in all of the case organizations are quite complex; in none of the organizations an integrated ERP can be said to be the tool that is being used for most aspects of operations. Davenport (1998, 122) stated that an ERP system enables integrating data throughout the organization. However, as Granlund & Malmi (2004, 304) pointed out, integration can also be achieved without ERP systems by integrating separate software. The interviewee in Organization C stated similar thoughts:

> *This is a very diverse ensemble. We must ask ourselves what is controlled locally and what globally.* ***This kind of multifaceted system architecture does not necessarily impede global control if systems that function globally are built on top of them.*** *If we consider controlling the whole corporation, on top of these (different) systems a uniform group level reporting (system) has been built and it factually resides in a single data warehouse.* ***This ensures that we have a single, global system for the historical financial data, forecasting and budgeting.*** *(Organization C, Interview, 15.05.2012, emphasis added.)*

4.3 Business intelligence

4.3.1 The definition of business intelligence

The interviewees were asked what the term business intelligence means to them. The interviewee in organization A stated:

> *"In a way it is all the information flows that are present and are needed in managing. BI is understanding this ensemble of information flows and the need for this information (in the organization). And then, through the use of technology, being able to help in making the information more attainable so that one has all the information needed for guiding and managing actions." (Organization A, Interview, 26.04.2012, emphasis added)*

Interviewee B stated that there are a lot of different definitions of business intelligence, even within their organization. He said that BI means the technological infrastructure, the data and metadata, and the objective that is being pursued by using the system. He continues to say that in their department BI is more about the consistent refinement and reporting of the information, whereas he considers tasks such as data mining and ad hoc analysis not to be a part of BI – other than in a way that these operations are performed in the same environment as the BI tasks. (Organization B, Interview, 10.05.2012). This somewhat surprising exclusions of data mining and ad hoc analyses can perhaps be explained by the task description of the interviewees' organization. As they work in the BI department and do not perform these tasks, it is understandable that the interviewee excludes them.

The interviewee in organization C started to define business intelligence by stating that management by facts is an old concept that has been impossible to perform in a large scale without modern information technology. He sees BI as the latest part of a

continuum that started decades ago with the development of KPIs, linking them to strategies and combining these KPIs in a causal way, such as in the BSC. The interviewee in organization C also asserts that access to information is no longer only the prerogative of the top management – technology has brought information to almost everyone in the organization. He considers business intelligence to be an attention direction tool, or a tool for management by exception, instead of it being a strict tool for decision making. He, similarly to the interviewee in organization B, considers BI to have some form of continuity and repetitiveness, as opposed to larger strategic one-off analyses. However, he asserts that BI does have some ad hoc nature, but more on a tactical than strategic level. He also sees that BI is based on the underlying data, and that the data needs to be presented in a way that is easy and fast for the end user to process.

The interviewee in organization C also considered business intelligence to have both an internal and external aspect. The internal aspect consists of performance measurement within the organization, whereas the external aspect comprises market analysis type of information about customers, suppliers, competitors and raw materials. Especially the external data can be of varying forms and it can be difficult to analyze. It is important to note that organization C does not integrate the external data they obtain to any central repository (see chapter 4.3.2).

4.3.2 Case organizations' business intelligence technology and organization

Organization A has a self-built data warehouse and they use QlikView for reporting. At the time of the interview they were also testing Microsoft's powerpivot. The organization also uses Microsoft's Sharepoint for briefing and document management. The interviewee mentioned that the number of data sources and amount of data in the DW have been increased in incremental projects. They started with more strategic level data and have since moved onto a more operational level. The DW gathers operational data from the two healthcare and social services production systems, Pegasos and Effica. Financial and working hour data are gathered from SAP. The organization has two fulltime employees working with the administration and development of the data warehouse. They have outsourced the upkeep of the data warehouse server. The governance of the BI system is done by an IT management team which guides the prioritizing and investment decisions. The amount of active users is still quite low, despite the "entirely open" nature of the data warehouse. As said by the interviewee, QlikView is considered as being perhaps too hard to use for many of the users. The organization is in the middle of reviewing what tools and options are given to specific user groups. The goal of the organization is to provide all the managers of the organization with some possibilities of utilizing the BI system. Most of the end users will probably only receive prebuilt re-

ports, some more advanced users will be given the ability to format these reports, and a very small population of the users will have the capabilities to “do everything” with the data. (Organization A, Interview 26.04.2012). The BI system architecture of organization A can be seen in Figure 11. The dotted arrows represent connections that are in a test phase.

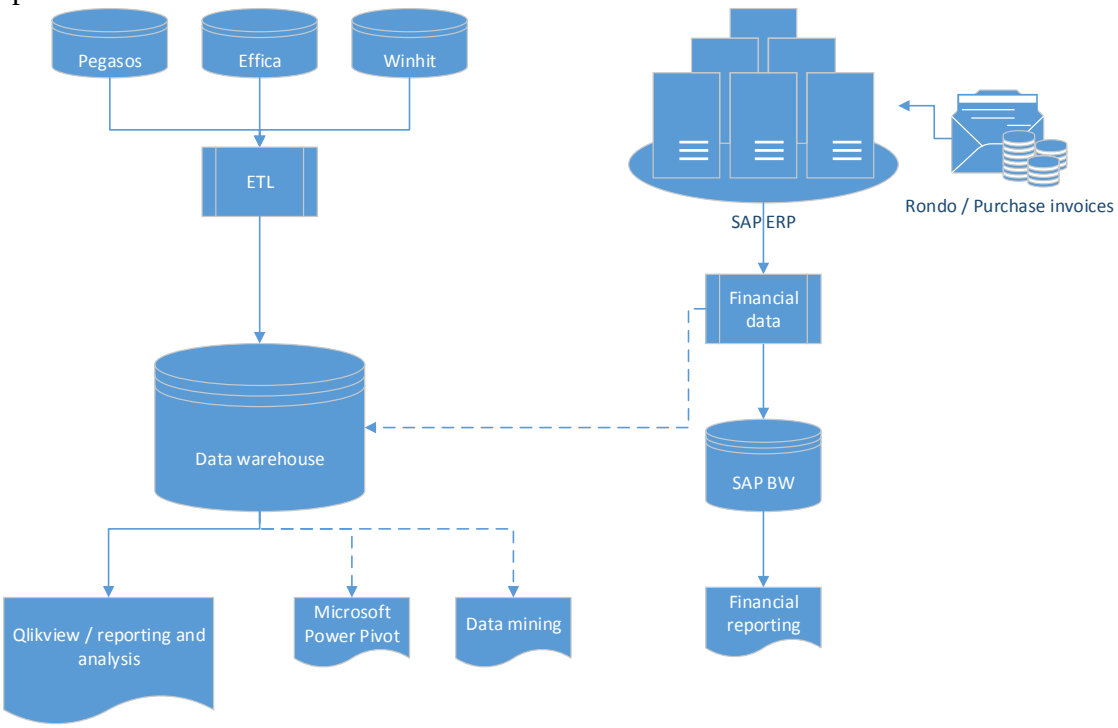

Figure 11 BI system architecture of organization A

Organization B was at the time of the interview in the middle of building a shared Enterprise data warehouse (EDW) for all the Nordic subsidiaries. The project, which is still ongoing, has faced challenges due to the tens of source systems it needs to fit together. As the Nordic EDW has not yet been implemented fully, the local organization still utilizes the Finnish data warehouse which has been implemented in mid-nineties. The data model in the old data warehouse is not very suitable for reporting purposes and therefore a few specified data marts (smaller data warehouses built for certain specific purposes) with better schemas have been built to enhance reporting performance. The organization main reporting tool for the organization is Cognos. SAS is also used in other parts of the organization. The local organization has approximately twenty source systems, such as a system for insurance data, a system for claims and payments, a system for customer data, one that keeps record of service transactions, and another for HR data. There are also external source systems, such as information regarding customer marketing blocking, a connection to the Finnish Transport Safety Agency, and to the Finnish national statistical institution. There are also some connections to partners, such

as to a Finnish retailer's bonus card system. This plethora of source systems creates problems, as there is no official master data management which would solve problems arising for example from conflicting data. There are approximately 40 employees in the Nordic DW-organization. With regard to prioritizing the time of the DW-organization, the interviewee stated:

> *"For prioritization we have these prioritization meetings with people from the IT side and the business side. It all comes down to what the business side wants. Prioritization is without a doubt their task. We have a limited amount of resources and business side has a limited amount of money to spend. These resources are allocated based on the outcome of these meetings. There is a very long list of wishes, requests and needs. We have time to fulfill only the most critical of these wishes." (Organization B, Interview, 10.05.2012).*

This governance structure is devised by selecting a user from IT and then selecting a counterpart for this user from the business side. This is done, because a big portion of the DW-organization's working time is divided between different business areas with diverse interests and therefore prioritizing is needed. The organization also has an IT management team, which guides the upper level decision making. BI related topics are only a part of the management team's strategic level decision making. The BI system in organization B is used by a wide variety of users, ranging from customer service agents to upper middle management. The interviewee suspected that the upmost management relies more on the information they receive from controllers and analysts, as the organization does not have a specific management portal. (Organization B, Interview, 10.05.2012). The BI system architecture of organization B can be seen in Figure 12. The organization uses more source systems than are shown in the figure, part of the source systems were left out of the figure due to space limitations.

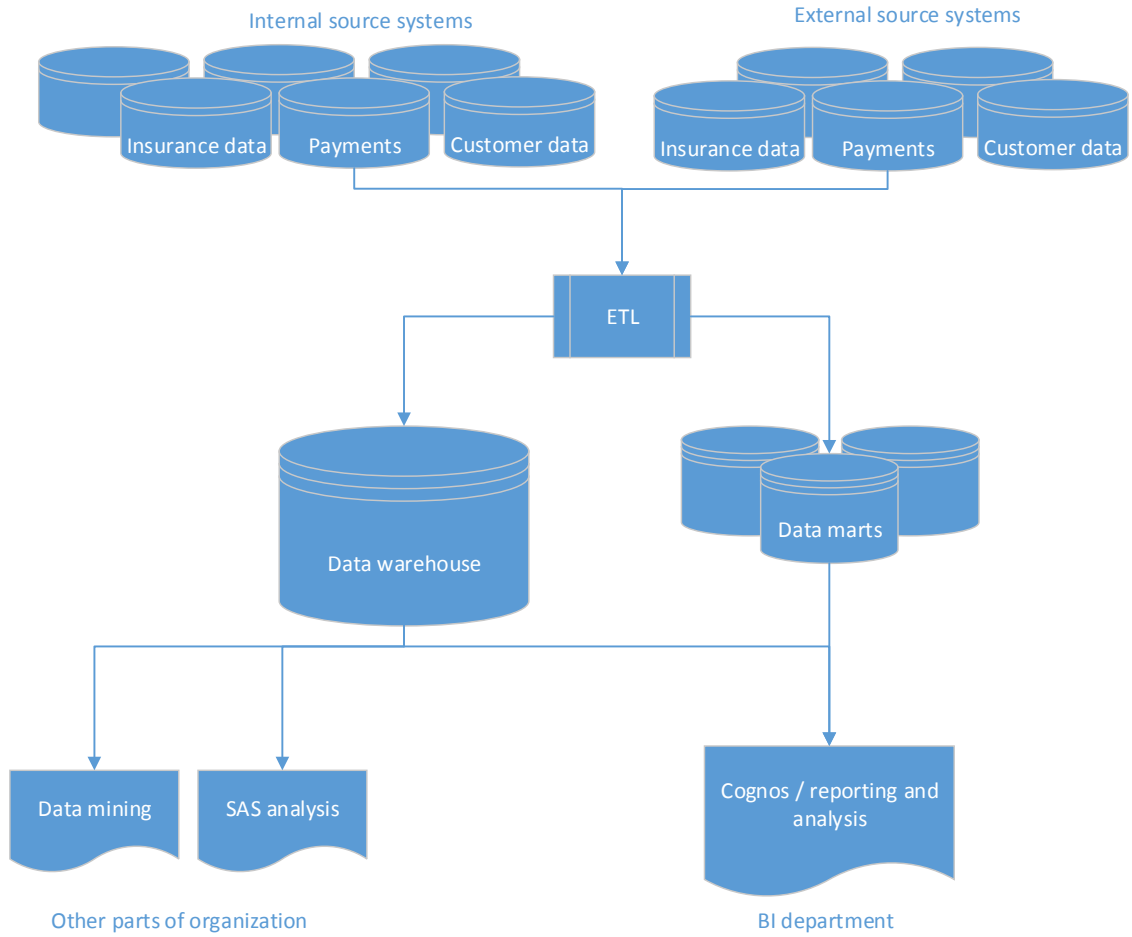

Figure 12 BI system architecture of organization B

Organization C gathers data as a part of their monthly management reporting and submits this data to the foreign parent company's server. This data is then viewable using QlikView. These data are already aggregated, and if the user wishes to see data on a more granular level, they must use the source systems. Even though the organization also acquires external data and information, there are no connections to external source systems. All external information, such as market or industry analyses, comes from either external service providers or in-house analysts in the form of "powerpoints or web-based presentations". The external data gathering is a "routine, centralized process in which the participants' knowledge and contextual wisdom cumulates". It is relevant to note, that the interviewee values this information and holds it as a meaningful part of their business intelligence, regardless of the fact that the data are not integrated into their DW in any way. The organization has a great number of users for the BI system, "thousands" in the company group and about a hundred, mostly white collars, in the local organization. User rights are managed centrally and there are limits on what information a specific user sees. This, according to the interviewee, stems from the strict insider trading rules that publicly traded companies have to comply with. (Organization

C, Interview, 15.05.2012). The BI system architecture of organization B can be seen in Figure 13. The users in the local organization have access rights to both the reporting system on the parent company's server and the files produced about the external market situations.

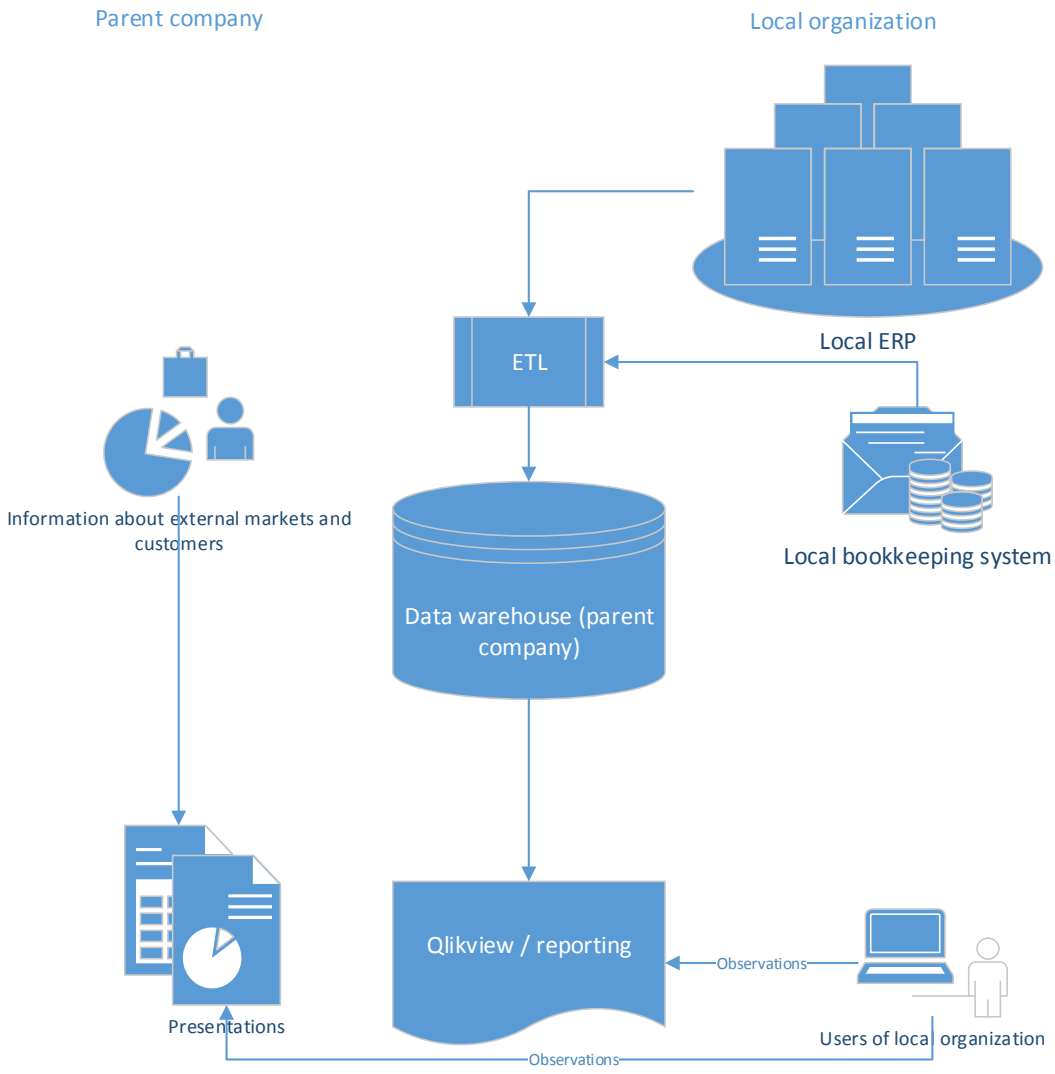

Figure 13 BI system architecture of organization C

4.4 Management control and business intelligence in the case organizations

As discussed in chapter 3.2.2, business intelligence should be suitable for planning, cybernetic, and interactive controls. Additionally BI can also be utilized as a boundary system. In the following paragraphs the ways the case organizations use their business intelligence systems are presented. These ways of use are analyzed with relation to both

the forms of management control suggested in the literature, and the framework presented in chapter 3.3.

The case organizations had different reasons for using BI. For example, interviewee B stated that the "fundamental reason is making profit", whereas the interviewee in organization C stated "the goal is for each decision maker to know how we are performing internally and what the surrounding world looks like". In organization A, the goal is, as mentioned previously, to "be able to help in making the information more attainable so that one has all the information needed for guiding and managing actions." The organizations also had different user bases which varied both in size and abilities. In all of the case organizations the systems were used for multiple different forms of management control.

4.4.1 Planning and budgeting

The goals for organization A ultimately come from the Welfare committee, a subset of the political decision making organ, City council. Based on the upmost level political goals, the three different service area directors derive their goals and decide the metrics that are followed in the organization. These metrics can be either quantitative or qualitative. (Organization A, Interview 26.04.2012). Organization C receives upper level goals from the company group management team and board of directors. These goals are then interpreted and converted to local goals and metrics. The interviewee emphasized that the goal setting is "not a strict top-down or bottom up -process, but a combination of the two" and that the local organization can also affect the goals. (Organization C, Interview, 15.05.2012). The interviewee in organization B was unable to provide the answer for where the goals for the organization come from as they are not inserted into the BI system. He suspected that the goals are derived from historic data and followed in Excel sheets. (Organization B, Interview, 10.05.2012).

Organizations A and C both used the information in their BI systems as a basis for planning and budgeting, and they used the systems for presenting the information after it has been inserted in the source system. The actual budgeting and planning were done elsewhere. In organization A budgeting is done in SAP, and in organization C in different systems depending on the business unit. In organization C different versions of forecasts can also be compared in QlikView. (Organization A, Interview 26.04.2012 and Organization C, Interview, 15.05.2012). When asked about the budgeting process in organization C before the implementation of QlikView, the interviewee stated:

> *"The numbers were input into the corporate group accounting in a different way. QlikView is just a user interface, a way to look at the information. A way that has proved to be user friendly and interactive… I*

> *can't say that QlikView has brought BI here. It is just a nice way to look at information." (Organization C, Interview, 15.05.2012).*

Organization B differs from the other two other organizations, as they do not insert their budget or planning data into their data warehouse or display it with their BI system. Budgeting is done either with a specific application, or more commonly with Excel, also depending on the unit. (Organization B, Interview, 10.05.2012). This lack of inserting the data in to their BI system also means that no comparisons between the plans or budgets and real performance can be made – the feedback loop cannot be used with regard to these figures. However, it is clear that the organization follows the figures, just not with the BI system. To conclude, none of the organizations conduct their planning or budgeting activities using the BI tools, but A stores their planning data and C stores their budget and forecast data in their BI system. Both of the organizations also use the historic data in the BI system as a basis for the planning.

4.4.2 Cybernetic control, reward, and boundary systems

As discussed earlier, the capabilities of business intelligence systems should enable their use in cybernetic control. In this subchapter the ways the organizations utilize their systems in different types of performance measurement are described. The chapter focuses both on performance measurement on a general level, and on reporting as an important subset of performance measuring. This subchapter also provides a brief outlook on the usage of business intelligence in rewarding and boundary setting in the case organizations. All of the interviewed organizations use their business intelligence systems for performance measurement and management, albeit in somewhat different manners.

Organization A had its budgets and most of the financial measuring in their ERP-system, or more specifically SAP's own BW data warehouse. At the time of the interview they had made some tests with transferring the data from SAP to the local data warehouse, and performing more calculations in the DW. The interviewee stated that the organization was in the middle of deciding how to allocate the costs and the question of the device with which to do this would follow afterwards. The organization also has a lot of non-financial measurements, both quantified and qualitative. The interviewee mentioned that they do not have explicit goals for all the numbers they measure and that finding measurements that would accurately describe the development of health and welfare is challenging. These measures and the possible goals originate from the agreements made between the service provider part and the service ordering part of the organization. One example of these goals is that the amount of +75-year-olds on home care should be growing. From this goal the organization has derived a metric and follows its development. (Organization A, Interview 26.04.2012).

A wide array of measurements are observed in Organization B. A large part of measuring is related to financial performance, and especially sales – which areas of the sales organization are performing well, how well the newly launched product is selling and what the costs related to it are. In addition to the financial metrics there are also non-financial measurements, such as the handling time of the reimbursement application, or how fast a doctor's statement is transferred. The organization does not have a single "performance management -service or portal with green or red lights" in use, although they have built dashboards for some application areas. The performance measurement metrics also have an effect in managing the organization. For example, one of the measurements describes in which geographical areas most of the accidents happen. Based on the results the organization decides which areas or product types to avoid, or at least in which product types they should increase the prices. On the other hand, the measuring is not limited to only measuring financial performance on the external market, as the organization also tries to optimize the efficiency of their internal processes based on their non-financial measuring. In organization B the measurements are also connected to rewarding, even on a relatively low level; for example a salesperson can see his or her sales figures and see how much sales bonuses they will yield. The performance and the rewards can be seen at a glance. (Organization B, Interview, 10.05.2012).

Similarly, in organization C the measuring is done both financially and non-financially. The interviewee stressed that the higher the level of the organization, the more the financial figures are emphasized. This, according to him, is mostly caused by the fact that "quarterly the performance of this company group is evaluated solely in the financial sense." The financial measurement is done in the company group reporting system using ClikView. The actual performance of the organization is compared against the budgeted and forecasted performance. In case the set goals are not met, according to the interviewee, the first step is to figure out what the cause for the deviation was. There are a lot of different possible reasons that have caused the deviation, and the interviewee stressed that the most important thing is to understand the cause and learn from the deviation. This understanding leads to changes: either the goals are set wrong and they must be altered, or the organization has not performed in a desirable way and the actions or processes need to be changed. The interview talked about management by exception:

> *"The greatest bottleneck is in the time of the management. This combined to the huge information flow means that in order to keep the focus on the right things, the deviations from the optimal performance need to be brought forward." (Organization C, Interview, 15.05.2012)*

Conversely, non-financial measurement in organization C is not done in the business intelligence system, but rather the data are downloaded from the operational systems into Excel and from the excel files as graphs into PowerPoint. The interviewee mentioned that these were important tools for communication, and that sturdier and less

flexible systems were not required for reporting of the non-financial figures. (Organization C, Interview, 15.05.2012).

Reporting in organization A is done in many different systems; the BI system, the social services production systems, and financial reporting using SAP's BW. The more strategic the reported task, the more likely it is done with the BI system. The interviewee mentioned a report for showing the amount of visits by home care personnel divided by areas or teams as an example of a report that is done using the BI system. The building of the reports is done by the "super users" (the users with the user rights and capabilities and skills needed to build reports) based on the needs of the organization's management. On the other hand, reports that are closer to the end customer, such as a doctor's report of the development of a diabetic patient's blood sugar levels over time, are more likely to be made using the production systems. The interviewee mentioned two main reasons for this divide: firstly, the data is currently uploaded into the BI system only once every month. This timeframe is too scarce for operational reporting. Secondly, there is a problem with user rights and sensitive information. As the data in the operational systems are extremely sensitive, as they hold for example medical records, the access needs to be strictly modified. This combined to the fact that the patient's doctors need to be able to search for a specific patient using for example their social security number, but practically no one else should be able to see them creates a problem for user rights management. The production system's reporting uses the same user rights as the main program. At the moment the organization only uploads to their BI system data of which all identifiers, such as names, addresses and social security numbers have been removed. One of the reasons for this is that they want to keep their data warehouse "open to all the users" without compromising sensitive patient information. (Organization A, Interview 26.04.2012).

The focus of report building in organization B is transforming from the DW unit towards the end users. Previously the DW unit used to do almost all the reports, but now the focus has shifted:

> *"Previously the DWH produced all the reporting solutions to the business side and they of course made their own adjustments on top with their tools. Now, as our resources are scarce and ETL and other things take our time, we don't really even want to use time producing the reports nor do we want that a report is built for every single need. It is rather that we produce ad hoc -environments and analysis cubes, so that the users can do them (reports) as much as possible by themselves.* ***This is a good direction in my opinion, as they*** *(the users)* ***understand best what is wanted from the data****." (Organization B, Interview, 10.05.2012, emphasis added).*

If measured only by the amount of reports, those built by the business side has surpassed the amount of reports produced by the data warehouse organization, although some of the reports built by the users are used only once. The reports made by the data warehouse organization still have the most users and are also used more often. As stated by the interviewee, one of the reasons enabling this transformation of report building responsibility are the younger users who are accustomed to using ICT systems and combining information. The organization's reports mostly reside in a portal, although they also use a set of reports that are sent to the users in specific intervals. The reports are dynamic, meaning that they can be filtered and drilled down. The organization also uses burst reports, in which a report is sent to a user or a group of users when specific requirements or events are met. These reports are a very good example of cybernetic control (see chapter 2.2), as it only directs attention to the areas in which deviations from the preset goal values are noticed. All of the reports are not for internal use only, as part of the reporting done is mandatory and submitted to the authorities. (Organization B, Interview, 10.05.2012).

Organization C does its reporting using the same method that all the country units in the company group use. The data, which come from either the bookkeeping system or the transactional ERP system, is uploaded into the global server either fully or semi-automatically. All the data are financial, so no information about for example human resources subjects or competitors are reported in the system. After the data has been uploaded, the results are viewable the following morning. The reports in the BI system are displayed in a portal. The company has numerous reports containing information about for example a specific device's profitability in the value chain. The reports are pre-built and the users are not able to make entirely new reports or change the layouts of the reports. However, the users can filter the data and make selections on different dimensions, such as sales areas and months. The interviewee stressed that special emphasis has been put on making the reports easy to use. The interviewee stated that the BI system is especially suitable for attention directing reporting, in which deviations from the preset standards can be noticed easily. (Organization C, Interview, 15.05.2012).

As discussed in chapter 3.2.2, according to the literature the BI system should be a suitable tool in managing boundaries. It should manage the task that an information system should do with regard to boundary control, namely enable continuous monitoring (Vaassen 2002, 209). However, the only case organization to use their BI system as a boundary system is organization B. The organization has set up business conduct boundaries in their BI system to be used for example in fraud detection activities. In fraud detection certain parameters for suspicious behavior are set, and if a customer's behavior exceeds these parameters, an alarm is triggered. These parameters are set so that the employees do not have to assess whether a certain act is deemed acceptable or not – instead the limits are set and automatically enforced. Most of these fraud detection

activities are performed in a different part of the organization, and the interviewee was unable to provide deeper information about them. In addition to the fraud detection activities, the system also has an internal boundary management mechanism in place. The system maintains a full audit trail and keeps logs of who has visited which information set, especially with regard to the personal details of customers. The organization has also set up different check lists and reports about the quality of the data and the ETL-process, meaning that inconsistencies in the data trigger an alarm. (Organization B, Interview, 10.05.2012).

4.4.3 Interactive control

As discussed in chapter 2.2, the role of the interactive control system is to enable formalizing new strategies by responding to new opportunities and threats (Simons 1995, 91). As stated by Vaassen (2002, 210), information systems can be utilized in interactive control by using their abilities in transforming complex data into more understandable form, using the information systems in gaining better understanding about the market situations, and by performing analyses. BI systems should be especially suitable for these tasks, as the ability to analyze the vast data in the data warehouse is also one of the key capabilities of a BI system (Sabherval & Becerra-Fernandez, 2011). As the interviewee in Organization A stated, “the data warehouse makes performing analyses possible”. In the following chapter the ways the case organizations utilize their BI systems in interactive control are presented. The focus lies mainly on analysis tools and data mining.

Organization A has bought a service from an external consultant, in which the consultant analyzes the patient flow data from the data warehouse. The goals of these analyses are, according to the interviewee, better understanding about the organization’s operations and being more prepared for the future. The organization has also taken part in a “municipality-IT -project”, in which they have built cost accounting and performance related models on top of the data warehouse, and then used these models for comparing costs of different services, and for running different simulation scenarios. In addition to taking part in the project, the organization also uses the BI system to perform various ad hoc -analyses; such as how many visits in every home care area are made, or what kind of patients reside and diagnoses are made in certain areas. According to the interviewee, these analyses are especially important during the planning process. The analyses are performed by the super-users based on requests from the management. The interviewee stated that the organization holds this service important, and that their goal is to continue to perform these analyses – even though they might try to train some users in other parts of the organization to have more capabilities in perform-

ing the analysis by themselves also. To provide these analysis capabilities for a larger part of the organization, they are discussing providing some ready-made data cubes for the rest of the users. (Organization A, Interview 26.04.2012)

In organization B the users mostly apply Cognos in performing the analyses. Some analysts only download data from the data warehouse, combine it with some other sources and perform the analysis using SAS. Conversely, some of the users, especially the ones in "middle management or planning duties" mostly use the ready-made OLAP cubes and reporting services for their analysis needs. The interviewee stated that the users can for example open a folder with different customer attributes that relate to the insurance, and combine this with specific transactional fact tables via drag-and-dropping them to a format of their choosing. They can also open a ready-made report and then perform different operations on the data; such change the dimensions, drill down, and add metrics. Sometimes they also download the data and continue to work with it in Excel. The users analyze for example the profitability of products and use the information gained to change the pricing structures. (Organization B, Interview, 10.05.2012).

The interviewee in organization C considers their BI system to be more of a reporting than an analysis tool. According to the interviewee analysis-wise the system is best suited for exception tracking. Comparison between a set target and the actual performance can be performed using the system. For other analytics, the interviewee favors more old-fashioned methods:

> *"The system is not suitable for a deeper or more specific analysis, such as searching for trends or time series, searching for correlations or the delay between the correlations. For this I find Excel to be a very good tool. We delve into a specific subset of BI, business analytics. It fits under the umbrella, but it requires somewhat different tools." (Organization C, Interview, 15.05.2012)*

However, the interviewee states that the data for the analysis is most often downloaded from QlikView. At least partly the problem seems to lie in the user interface, meaning that the users consider Excel to be a more suitable tool for performing the analysis. The interviewee in organization B spoke about the same dilemma:

> *"In our company, in a way, Excel is probably the most significant reporting tool. Meaning that it is used very much, even though the figures might be dug out with BI-tools. That, as a matter of fact, is a thing that has troubled me a little, a thing I have wanted some change into. Why always use the Excel when the same (tasks) could be finished more automatically?" (Organization B, Interview, 10.05.2012)*

As an example of analysis performed outside the BI system the interviewee in organization C mentioned the analysis performed on their sales process. If the actual sales

deviate from the forecasted performance, every occurrence is analyzed; this happens on both the cases that were forecasted but lost, and the cases that were won but were not in the forecast. However, it is relevant to note that the data regarding the success of the offer process is not even inserted in the BI system. (Organization C, Interview, 15.05.2012).

One of the facets of interactive control with regard to business intelligence is data mining. Organization A has had one pilot made regarding elderly care in the municipality area. They tested in which situation home care costs, which until a certain point are usually lower, exceed the costs of care in a nursing home. This information combined to the different service levels of the home care unit led to a better understanding of what a more optimal structure might be. According to the interviewee these effectiveness and cost analyses are one of the greatest challenges in the health care field, and these tools shed light on the subject. (Organization A, Interview 26.04.2012). The interviewee in organization B stated that although he knew that data mining is performed in the organization, their DW unit did not do it and he was unable to provide more information on the subject. In organization C no data mining is performed due to the "low data intensity" nature of the business. However, the interviewee emphasized that the external competitor and customer related information provided by the BI function is paramount in preparing for the future – even though it needs to be pointed out again that this information is not technically connected to the BI system. (Organization B & C, Interviews, 10.05.2012 & 15.05.2012).

Although outside the scope of this study, the way the BI system is used for instant decision support in organization B is worth mentioning. As a customer contacts the company customer service and is identified, the customer service agent gets the customer's information on his or her screen. This screen of an operative system also has a direct link to information in the data warehouse. Based on different attributes of the customer, such as purchase history and other classifications, the customer is graded and the customer service agent is provided with information about what other products or services the customer should be offered. (Organization B, Interview, 10.05.2012). This is a good example of the value real-time business intelligence can provide for customer-facing applications, such as those in call centers or check-ins (Watson et al. 2006, 7).

4.5 Conclusions and discussion

The goal of this study is to explore the different ways business intelligence systems are used or can be used in management control. In chapters 2 and 3 different frameworks for management control were presented. The literature surrounding business intelligence systems was introduced, and the possibilities of using business intelligence systems for

management control were discussed. A framework for business intelligence in management control was introduced in chapter 3.3. The empirical part of the study in chapter 4.1 – 4.3 introduced the case organizations, their business intelligence systems and the ways these systems are used in management control. In this chapter the findings are discussed and conclusions are presented.

The interviewees' views on the meaning of the term "business intelligence" were all compatible with the view of business intelligence as a process, product and technology (Shollo & Kautz, 2010, see chapter 3.1). There were different emphases, such as the interviewee in organization C stressing the difference between internal and external BI, or the interviewee in organization C leaving data mining out of it. Despite these differences, all of the interviewees described the essence of business intelligence almost similarly: it is about the *process* of turning data into *information* and providing this information to users via *technology*.

Technology-wise all of the organizations had somewhat fractured IS architectures with multiple different operational systems. In all of the organizations the data from these systems were collected in a data warehouse. For reporting purposes organizations A and C use QlikView whereas organization B mostly uses Cognos. Organizations A and C also gathered only internal data in their data warehouse. However, this data was quite complex: organization A gathered the data from multiple different types of source systems, whereas in organization C the same type of data from multiple different country units was gathered during the monthly reporting. Conversely, organization B added data to their warehouse from several internal and external source systems.

As stated earlier in the literature analysis (see chapter 3.2.2), BI systems are considered to best support planning, cybernetic, reward, and boundary controls. They should also be capable of supporting interactive control. When exploring the first research question of this study, namely "*what kind of control systems use or could use the data and information enabled by the BI system?*" these assumptions were found to be quite precise. The actual control systems and the utilization of the BI systems differed in the case companies, but all of the uses were in these categories. The organizations' utilization of BI systems in management control can be seen in Table 3:

Table 3 The use of BI in management control in the case organizations

	Organization		
MCS	***A***	***B***	***C***
Planning	Limited	No	Limited
Cybernetic control	Yes	Yes	Yes
Interactive control	Yes	Yes	No (although instead as a data provider)
Rewarding	No	Yes	No
Boundary system	No	Yes	No

With regard to planning and budgeting, both organizations A and C used the data in the system as a foundation for their forecasting and budgeting. Organization B did not have budgeting or forecasting in the BI system. The suggested uses in the literature ranged from similar type of utilization, namely using the data as the basis for forecasting and budgeting (Williams 2008, 28) to creating specific loyalty programs and customer segmentations (Sabherwal & Becerra-Fernandez 2011, 14–19) and predicting future staffing and field office needs (Wixom et al. 2011, 67). The BI system was used, but it is perhaps justified to say that the usage was not as extensive as the literature suggested to be possible. The systems were also not used in the actual budgeting or scenario planning; they were rather just repositories for the old data and platforms into which the future budgets and forecasts were inserted after they had been created. Why then were only a small part of the capabilities used? In organization A the budgets were done separately in the ERP-system, where all the other financial activities were also made. Their planning process was at least partly political, as their goals came from the Welfare committee, and thus the whole process was somewhat far from the organization. However, the interviewee stated that the information in the BI system is considered very important and it is used during the planning stage. In organization C the budgeting platforms varied on the local organizations. The process of budgeting was not unified, only the format of the end results was. The reasons for the lack of more advanced uses of the system, for example in scenario analysis, would benefit from more research.

The most widespread and extensive use of business intelligence for management control in the case organizations was in the field of cybernetic control. All of the organizations used their BI systems for performance measurement and reporting. The focus of organization A was the least financial figures oriented, as their financial figures resided in their ERP-system. Although they had made some transfers of financial figures to the systems, they mostly measured other operational measures. Organization B had both financial and non-financial measuring. Performance was measured on multiple different criteria, such as the financial performance of different products as well as on the effi-

ciency of their processes. At the other end of the spectrum was organization C, in which the performance measurement in the BI system focused exclusively on financial performance. The interviewees mentioned that the results of the measuring have an effect on the actions the organizations take. The process of measuring, tweaking the organization's processes, measuring again and making changes to the goals if necessary, as described by the interviewee in organization C, is directly compatible with the framework presented in chapter 3.3. Organization B utilized a similar kind of feedback loop on measuring the performance of their insurances. Technology-wise the organizations were utilizing dashboards and portals to see the performance measurements, which are the technologies also suggested in the literature.

In the study reporting was separated from the rest of cybernetic control as it forms such a significant part of the performance measurement. In organization A the focus of reporting in the BI system was more on the strategic level, as the operational systems were used in everyday reporting. The reports were built in QlikView by the super-users for the organizations management, and the reports were also viewable in there. In organization B the amount of reports was much larger, and the users are also able to build their own reports. They have also encouraged the users to build their own reports, as the view is that they are the best experts on what knowledge is required of the data. The organization used portals and burst reports for distributing the information. In organization C, similarly to their measuring systems, the reports resided in a portal and displayed only financial figures. The users were not able to create new reports or modify old ones – other than by filtering or making selections. Technologically, A and C mostly used portals from which the users could go look at the reports. In addition to having a portal, Organization B was the only organization to use event triggers of some sort. These triggers, when set, perform a specific action, such as sending a report to predefined users. This capability in management by exception, which the interviewee in organization C talked about, is an important part of cybernetic control (see chapter 2.2, and Simons 1995, 70; 121) and is also compatible with the view of Vaassen (2002, see chapter 2.2) where the information systems are used for focusing managerial attention on exemption handling. The system was used for management by exception also in organization C, but the systematic way organization B had incorporated alarms into the system took the best advantage of the technological capabilities.

The use of these systems for cybernetic control is quite well aligned with the suggestions in the literature (see Table 1), as the systems were used as "tools for performance management" in all of the organizations, and they provided "a clearer relationship between operational performance and financial results" especially in organizations B and C; and in the case of organization C also "helped IT to move past being the provider of standard reports" (Williams 2008, 28). Organization C also used their system to provide "real-time information about performance, enabling the identification of aspects that

need improvement" and enabled "faster responses to new situations through alerts about surprising events and trend monitoring". (Sabherwal & Becerra-Fernandez 2011, 14–19). To conclude, the fit between BI systems and cybernetic control seems to be quite good.

These cybernetic controls were also connected to rewarding in organization B. In organization B the sales people were able to see how much sales bonuses they were going to get. The information was made available for them to see whenever they wished. The availability of the reward information provided a clear causality between the performance and the reward. This use is compatible with the literature analysis, as the BI system is utilized only in direct connection to the cybernetic control. Organization B was also the only organization in which the BI system was used as a boundary system, both with external (fraud detection activities) and internal (data quality tracking) behaviors.

As stated earlier, perhaps the most important capability absent in the framework of Elbashir et al. (2011) is using the BI system in interactive control. In organization A the analyses, even though thus far the biggest are performed by external partners, were deemed important. The interviewee even stated that the data warehouse "enables performing analyses". The analyses were considered especially important during the planning cycle, during which the management actively sought for the information provided by the BI organization. In organization B the analyses were performed on multiple levels of the organization, using a wide set of tools ranging from pre-made reporting cubes to downloading the data to SAS and combining the data with data from other sources. Organization C differed from the other two organizations on this front, as there the BI system was considered more a reporting than an analysis system. However, the BI system was used as the data provider in both organizations B and C, as the users downloaded the data to be analyzed in other systems; usually Microsoft Excel. The same division of using the system could be seen in the relationship to data mining: organization A had done some tests which were considered to be useful, whereas organization B had data mining activities, but they were performed in other parts of the organization, and organization C did not use data mining tools. Therefore, the fit between BI systems and interactive control is also quite significant.

To conclude and answer the first research question, namely "*what kind of control systems use or could use the data and information enabled by the BI system?*", the theory suggested that BI systems could be used in planning, cybernetic, reward, boundary, and interactive controls. In the case companies, the use for planning was either quite limited (organizations A and C) or non-existent (organization B). With regard to cybernetic control, all of the organizations used their systems quite extensively and their use was relatively well aligned with the suggested uses in the literature. The focal points were somewhat different, ranging from organization A's no financial performance measured to C's only financial performance measured. Reporting was emphasized as an

important cybernetic control in all of the organizations. Organization B was the only case company in which the BI system was directly used in rewarding and boundary control. Concerning interactive control, organizations A and B held the BI system as an important tool for analysis, whereas organization C considered it to be better suited for reporting and preferred Excel over their BI system for analysis-purposes.

When exploring the second research question, "*how the BI system is or could be utilized – as the data or information feeder or directly as the tool?*", the answer differed based on the control system type. For planning purposes, the systems were used only as information feeders and repositories. For cybernetic control the systems were used extensively as the tools. Organization B used the BI system directly in rewarding and boundary control. The use in interactive control was divided, as the systems were utilized both as stand-alone tools and data feeders. In organization C the use of the BI system as an information feeder into Excel was considered a very good way of using the system, whereas in organization B the interviewee stated that the use of Excel troubled him because the BI system could perform some of the tasks easier and more automatically. In both organizations A and B the systems were used directly as analysis tools.
The third research question, namely "*has the BI system enabled new forms of control or changed old ones, and if, how?*" receives a resounding "yes" as an answer on both accounts. Theoretical preconceptions were in favour of the possibility of the BI systems' ability to change management control. As stated earlier, Granlund & Malmi (2002, 301) had a working hypothesis suggesting that "a well-built data warehouse underlying the corporate information system should make it easier to build new management accounting constructions"; Elbashir et al. (2001) suggested that the capability of BI systems could enable them to be used as an "integrated MCS"; numerous authors described the new and improved ways BI systems could be utilized in management control (see Table 1). In the case organizations the answers varied. In organization A most of the actions performed with the BI system were new. The reporting on the operational performance, such as the development of the amount of the home care patients, was obtained from the BI system. The more extensive analyses and data mining the organization has performed would not have been possible prior to the BI system. This information is used widely to support the planning process, and in preparing for the future. In organization B the BI system has been in use for a much longer period, for over ten years. Therefore the view of "how things were done" was before the time the interviewee worked in the organization. However, when taking into account their extremely fragmented IS architecture, it is almost impossible to conceive other ways the organization could have achieved such a unified and integrated reporting and analysis without their BI system. As they follow metrics ranging from the speed of doctor's statement moving through the system to the sales in a certain area, building and maintaining reporting on the source systems alone would probably be, if not entirely impossible, surely so time con-

suming that it could not have been done with the same kind of resources. The organization also utilizes analytical tools and data mining, both of which enable interactive control that was previously unknown. The use of the BI system has also enabled returning some of the power of reporting and analysis to the business side, as they are able to themselves build and have access to reports of their liking.

The interviewee in organization C was perhaps the most skeptical about the BI system bringing any new forms of management control to the organization. As stated earlier, the interviewee said that for him the BI system is nothing more than a pleasant user interface and thus a good way to view the information. (Organization C, Interview, 15.05.2012). It is relevant to note that organization C uses the BI system mostly for cybernetic control; one could even go as far as to state that the system is only a financial reporting system. There are no connections to external information systems, nor are there any external data integrated into their database. Even though the interviewee stressed that the information about the external marketplace situation acquired via "powerpoints and web-based presentations" is important to the organization, it cannot be perceived as business intelligence in the sense of BI being based on integrated data. Additionally, more complex analyses are performed outside the BI system, and the organization does not utilize data mining. Because of these self-imposed limitations, it is conceivably not a surprise the interviewee does not think the system has not enabled new forms of management control. However, the interviewee stressed that the technology has brought the access to this information to the entire organization, and transformed the use of this information by changing it from being the privilege of top management into almost every level in the organization. This is one of the examples in which the BI system is used in a clearly enabling, rather than coercive (see chapter 2.4) manner.

The aforementioned access to information on all levels of the organization is an example of global transparency (see chapter 2.4; Adler & Borys, 1996). However, it is relevant to note that organization C only has *local* global transparency[1], meaning that performance information is available about the local organization, not the entire company group. This, as previously mentioned, is at least partly due to the insider trading rules that publicly traded companies have to comply with. On the other hand, in organization A the database is "completely open" to all the users. However, this decision to provide complete access to all the users has imposed some restrictions on the usability of the system. As the operational systems handle sensitive information, such as medical records, any data that can lead to identifying the patients or clients has been left out during

[1] Cf. internal transparency (see chapter 2.4) which is about the availability of information about the system itself.

the ETL process. This exclusion has in turn made using the BI system in the lower operational levels impossible.

The use of the BI systems is quite enabling also with regard to the other forms of enabling control. For example, in organization B the system is also very flexible, meaning that the users can for example build their own reports. In organization A this is also theoretically possible, although there the users have not yet been trained to use the system this way. In organization C only smaller changes, such as filtering the data, are possible. With regard to internal transparency and repair the usage is twofold: although the systems provide a clear view on the processes and effects of the users' actions, the complexity of the systems is a problem. Yes, the performance of the system in organization B is monitored and reported and alerts trigger messages to relevant users if there is a problem. However, a regular end-user cannot really do very much in case of an ETL failure or some other complex failure of the data warehouse. This is due to the inherently complex nature of the data integration from multiple source systems. The whole topic of the enabling or coercive nature of BI system usage raises more questions, such as what is the relationship between information overload and global transparency, or does flexibility impair some types of using the system as seems to be the case in organization A. More research would be beneficial in shedding light on these questions.

The final research question was "*does the BI-system support some forms of control that the literature has not thought of, or is the BI system not used for some forms of control the literature suggests it should be used?*". The answer to the first part of the question is negative. In none of the case organizations were the BI systems used for some form of management control that the literature had not considered. As the control system types that were deemed not to be supported by the BI system were mostly cultural or personnel related, the lack of support from the systems is not very surprising. The other part of the question proved to be more interesting. In none of the case organizations was BI used for all of the suggested possible uses (planning and budgeting, cybernetic, boundary, reward, and interactive control). Organization B had the most widespread utilization of the BI system, as they used the system for all of the suggested possibilities with the exception of planning and budgeting. Organization A had a relatively new system and they used it mostly for cybernetic and interactive control with a supportive role in planning and budgeting purposes. In organization C the uses focused mostly on cybernetic control, with some interactive control and support for forecasting and budgeting. As the system was utilized in the actual budgeting in none of the organizations, the results do not support the BI system being an appropriate tool for this. The systems were, however, used in accessing past data when starting the budgeting process and storing the budget data and making comparisons between the budget figures and the actual performance. To conclude, the strongest evidence for the suitability of using BI in management control was found in cybernetic control with interactive control coming

in as a close second. For other types of control the support was not as widespread, and for budgeting and forecasting uses the system was only utilized in supporting activities.

When considering the framework presented in chapter 3.3, the case organizations' actions and usage of the BI system follows it quite closely. The planning and goal setting phase needs to also take into account lower level goals, such as "the profitability of a new insurance" or "the amount of homecare patients". The organizations do set goals, measure their performance, analyze deviations and change their operations if necessary – all based on the information they receive from the BI system. The interactive control is also used and can have an effect on the organizations' strategy.

The outlook for the future of the BI system in organization A is bright. To ensure that the development goes toward desired goals, they have set up a roadmap for the development of the system. They plan on developing a portal, and streamlining and systematizing the report delivery. As a long term goal they are striving towards providing the managers of the organization different levels of financial, human resources, process, and customer information through different portals. The interviewee described the future of their BI system in the following way:

> *"Constant development and maintenance. **It will never be ready**. It is a continuous action planning and monitoring, it takes time and resources. On the other hand that sets the whole core of the operations and we need to make it work and use as little time as possible in all sort of process mix-ups and ensuring the correctness of the data. We have spent too much time on that. We need to be able to focus on analyzing and taking advantage of the information." (Organization A, Interview 26.04.2012, emphasis added).*

In organization B the future of the BI system is also positive. It is relevant to note that the interviewee in organization B also stated that the BI system "**will never be ready**." As far as future developments go, he stated that the enterprise-wide data warehouse makes the "process more controlled and fixed", which according to the interviewee makes the life of the BI-organization easier. The interviewee wished for a clearer strategy with regard to the BI infrastructure and considered the future challenges to be in budgeting, forecasting and master data management. Interestingly, the development of the forecasting and budgeting capabilities would bring their system to encompass all the capabilities predicted in the literature. Conversely, in organization C the development of the business intelligence system "has not been thought about in a while". The interviewee stated that the near future will most likely hold small, incremental development.

To conclude the results of the study, the literature supported the view of business intelligence systems being capable of supporting many different control systems. The empirical part of the study supported most of these predictions. The case organizations

differed greatly from each other, with regard both to what they were doing and how they utilized their BI systems. Organization B had the most mature BI landscape, with a relatively long history of utilizing the BI system, a wide variety of users and usage. Organization A had a younger system and hence the use was also not as advanced. However, the goal they aim towards represents the system in organization B more than it does the system in organization C. In organization C the system is mostly used as a financial management reporting system, rather than it being a fully-fledged business intelligence system.

This study contributes to the existing literature by providing insight in what kind of control systems could utilize BI systems via the means of a literature analysis. The framework presented in chapter 3.3 can be used in later studies to examine the usage of business intelligence systems. The study also is among the very first studies providing empirical findings on how organizations really use their BI systems for management control. By doing this, the study not only proved that the notion of business intelligence as an "integrated MCS" presented by Elbashir et al. (2011) is accurate, but also showed that BI systems are used in even more ways than they stated, as they had not taken interactive control (Simons, 1995) into account.

As the study showed, business intelligence does have a place in management control. As the "three V's" (volume, variety, and velocity) of data are growing in what the buzzword loving industry is calling "big data", the tools that continue to inform organizations of how they are performing and how to prepare for the future will surely have a place in the future – although they probably won't be called "business intelligence". Despite what they will be called, the need for readily available, accurate information about internal and external performance will not go away; it will probably only grow hand in hand with the growth of the data.

5 SUMMARY

The purpose of this study was to explore the possibilities of utilizing business intelligence systems in management control. Information technology is used widely in modern organizations, and the relationships between management control and technology have been studied extensively in the past. The research has focused on ERP systems, and the results have mostly shown a moderate impact on management control. The topic of this study was explored through four research questions. Firstly, the study set out to find what kind of control systems use or could use the data and information enabled by the BI system. Secondly, the nature of how the BI system is or could be utilized was explored. Focus was put on the nature of the BI system either as the data or information feeder vis-à-vis using the system directly as the tool. Thirdly, the possibility and nature of the BI system enabling new forms of control or changing old ones was studied. The fourth and final research question was whether the BI system supports some forms of control that the literature has not thought of, or is the BI system not used for some forms of control the literature suggests it should be used. The study was conducted as an extensive case study.

The second chapter of the study introduced the main theories in the field of management control. The view on management control has changed during the years, as the focus has shifted from strictly financial, quantifiable information to also entail broader types of control. The first presented framework was Simons' (1995) levers of control. In this framework four kinds of control systems exist: beliefs systems, boundary systems, diagnostic control systems, and interactive control systems. The second presented framework was Merchant & Van der Stede's (2007) objects of control. In this framework results, action, personnel and cultural controls were identified. The third framework was Adler & Borys' (1996) framework of enabling and coercive control. In this framework the control system can be either coercive or enabling. Enabling systems have four distinctive features that separate them from the coercive control systems: repair, internal transparency, global transparency, and flexibility. The fourth and final presented framework was Malmi & Brown's (2008) management control systems as a package. In this framework the interactions between all the management control systems in the organization should be taken into account when conducting research. In this framework the control systems package is divided into five broader categories: planning, reward and compensation, cybernetic, administrative, and cultural controls.

The third chapter focused on business intelligence. Their development from earlier decision support systems was explained, and the multiple different definitions for what constitutes as business intelligence were discussed. Shollo & Kautz's (2010) definition of BI as a process, a product, a set of technologies or some combination of the three was deemed to be the most thorough. This view takes into account gathering the data from

different sources by using ETL-tools, storing this data in a data warehouse, analyzing this data to turn it into information and using this information and turning it into knowledge. All of the three different views were presented in detail. The mechanisms for the governance of business intelligence were also presented in the chapter. Following this, a literature analysis of the uses of business intelligence for management control was presented. This analysis showed that business intelligence systems mostly support different cybernetic and planning controls. The BI systems could also be utilized in interactive control, reward systems, and boundary systems. The literature did not show compatibility between BI and different cultural and personnel controls. Following the literature analysis corporate performance management was introduced. The chapter ended in the construction of a framework for business intelligence in management control. In the framework, the different types of control systems suggested in the literature review were integrated into a single process cycle with the strategy and goals as a starting point. The metrics the company wants to follow are induced from the strategy and goals. The actual process cycle starts with the integrated internal and external data as the center of everything. This data is used when the goals and metrics are put into more specific plans and targets. The performance of the organization is tracked and this performance is compared with the plans. If the targets are met, rewarding can be linked to this phase. If there are deviations, a deeper analysis is performed. The reasons for the deviations are researched, adjustments on the processes are made if necessary, after which a new cycle begins with new target setting, monitoring and adjusting. The framework also takes into account the effect the BI system might have on the strategy by pointing out that the current assumptions of causalities are wrong. These problems can be revealed when even intensive tweaking of the processes does not bring the wanted change. Then the problem is likely in the assumptions and they need to be changed. The other possibility is that through the utilization of the data in the database entirely new possibilities or threats might emerge, and in order to respond to these changes in the strategy need to be made.

The fourth chapter presented the empirical findings of the study. The chapter started with the introduction of the three case organizations and their ICT architectures. Following this the interviewees described what business intelligence means to them and the case organizations' BI technologies and governance structures were explored. Following this, the different management control systems of the organizations' were presented. If applicable the ways that BI systems were utilized in using these systems were also presented. Two of the three organizations utilized their BI systems for planning and budgeting by using the data in the data warehouse as a basis for the plans. These organizations also put the finished budgets and plans on their BI system and compared their performance against these numbers. The most widespread use of BI systems in management control was in cybernetic control, which all of the studied organizations used.

Both financial and non-financial figures were measured in the organizations. Reporting represented a big part of the cybernetic control, with all the organizations using portals to store their reports. One of the organizations also used their BI system for boundary control and had direct links to rewarding. The organizations also used their BI systems for interactive control. However, one of the interviewees found the system to be better suited for reporting than analysis purposes. The other two organizations utilized their system for deeper analysis and data mining and thought that the systems are well versed for interactive control. The chapter ended in conclusions and discussion, in which the results of the study were discussed and presented. The main findings of the study are that BI systems can be utilized in the fields suggested in the literature, namely in planning, cybernetic, reward, boundary, and interactive control. The systems are used both as the data or information feeders and directly as the tools. Using BI systems has also enabled entirely new forms of control in the studied organizations, most significantly in the area of interactive control. They have also changed the old control systems by making the information more readily available to the whole organization. No evidence of the BI systems being used for forms of control that the literature had not suggested was found. The systems were mostly used for cybernetic control and interactive control, whereas the support for other types of control was not as prevalent.

The main contribution of the study to the existing literature is the insight provided into how BI systems, both theoretically and empirically, are used for management control. The framework for business intelligence in management control presented in the study can also be utilized in further studies about the subject.

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APPENDICES

Appendix 1 – Interview Questions

- Background of the interviewee
- Strategy of the organization
- Information systems in use
  - Is there an ERP system
  - Time of implementation if applicable
  - Reporting and analytical capabilities if applicable?
- Other information systems
- Business Intelligence
  - Perception / defining the concept
  - Software in use
  - Data sources (internal, external, competitor data)
  - Data warehousing
- To what and how is BI used
  - To which actions
  - Who uses the systems
  - How the systems are really used
  - Is the use direct or indirect, meaning that is the system the data feeder or also the user interface
  - How were these tasks done previously or were they
  - If measuring, where do the metrics come from
  - The relationship between analyses and resetting the goals
  - The relationship to strategy
- What about the other forms of control that are not yet discussed about
  - Long and short term planning
  - Budgeting
  - Analysis (queries, graphs, ad hoc)
  - Performance measurement, financial and non-financial
  - Hybrid performance measurement (if BSC, where does the data come from, how it is displayed, what is the organizational relationship between BSC and BI)
  - Reporting (what systems perform the measuring, sharing, and to whom is the information shared)
  - Decision support (investments, pricing, make or buy)
  - Boundary systems (setting the boundaries, controlling them)
  - Interactive control, searching for new possibilities and threats

- Data mining
- Outlook of the future
- Development needs
- Other comments