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Master Degree Project in Accounting

Business Intelligence Use as Levers of Control and Enabling or Coercive Control

Fredrik Jacobson

Supervisor: Elisabeth Frisk
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Abstract

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Author: *Fredrik Jacobson*

Supervisor: *Elisabeth Frisk*

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Background and problem: *The business environment is becoming increasingly complex, requiring firms to be more adaptive. Firms need to be able to operate their business while innovating and being responsive to their surrounding. At the same time, the amount of generated data is increasing exponentially, making it increasingly difficult to analyse. Designed to facilitate information retrieval and analysis, Business Intelligence (BI) systems provide capabilities which could support the organization's management control system.*

Research aim: *The research aim of this thesis is to increase the understanding of how BI is or can be used for the management control.*

Research questions: *To achieve the research aim, the guiding research questions to this study are: What BI tools are used or can be used for management control, and what information sources (internal or external) do they use? To study this, BI was divided into three categories of use: self-service BI, data analytics and business performance management. Second, what different levers of control do these BI tools support and how? This was studied using Simons's (1995) levers of control framework. Third, how are or can BI tools be designed - in an enabling or coercive manner? This question sought to answer how the design of BI impacts its management control use, or vice versa, and was operationalized through Adler & Borys's (1996) concept of enabling and coercive control.*

Research Design: *The research questions were studied using a comparative design and semi-structured interviews. Three case organizations and two BI consultants were interviewed. This way, in-depth information on how organizations use BI from the case organizations was complemented with general knowledge on how it can be used from the BI consultants.*

Discussion and conclusion: *The findings suggest a gap between management control use and BI capabilities. Currently, BI tools are mainly used for reporting and business performance management. Alongside this, there is also a development where organizations are investigating the possibilities of using data analytics and more advanced analysis. Further, the findings suggest that external data is not yet being integrated in the BI tools. Additionally, the findings corroborate the notion of BI as an integrated management control system. Through the different BI tools, support was found for all levers of control. However, balance between the levers did not occur per se, requiring managers to balance the use of all four levers. Finally, the different BI tools could be designed in either a coercive or enabling manner, contingent upon the tightness of control desired. This also varied depending on the organizational level where BI was used.*

Keywords: *Management Control, Business Intelligence, BI, Enabling and Coercive Control*

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Fredrik Jacobson,

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Contents

1. Introduction

This chapter first describes a background to the challenges businesses face today and how management control needs to adapt. This falls into a problem discussion introducing business intelligence and how it might support management control. Results from previous research are discussed, leading to the presentation of research questions and the overall aim of the thesis. Finally, delimitations are made and the thesis disposition is outlined.

1.1. Problem Background

The business environment organizations operate within today is becoming increasingly complex (Reeves et al. 2016). This is fueled by three factors: diverse environments, technological innovation and interconnected business ecosystems. The time when one single approach to strategy was valid is gone (Reeves et al. 2012). The golden era of rising profits is over, instead a period of increased competition and reduced profits awaits (Dobbs et al. 2015). Additionally, the pace of innovation has increased the rate at which change occurs. Product life cycles are becoming shorter and companies must adapt more swiftly.

In light of this, firms need to be ambidextrous - capable of operating the business while simultaneously innovating and being adaptive to their surroundings. In spite, firms continue to use "traditional" strategies assuming stable and predictable markets where short-term profit is the goal, not long-term robustness (Reeves et al. 2012). In parallel, management control has been used to implement intended strategy, not looking for emergent strategies.

Viewing the company as a complex adaptive system, Reeves et al. (2016) suggest organizations to be more responsive. The company needs to be viewed as a system made up by its employees, where top-down control needs to be balanced with a feedback system enabling bottom-up creativity. At the next level, companies are also part of the business ecosystem. Therefore, firms need to monitor change and reduce uncertainty by collecting signals and detecting patterns.

However, scanning the environment is no easy task. The data created is doubling every two years creating vast amounts of data for analysis (Turner et al. 2014). Further, 90% of that data is in unstructured form making analysis increasingly difficult (Schubmehl & Vesset 2014). This has resulted in knowledge workers spending on average 16% of their time searching for information, and another 10% consolidating information, amounting to more than one day each week spent on information retrieval. Still, only 56% feel that they find the information they need.

1.2. Problem Discussion

Consequently, how to efficiently leverage information technology (IT) for management control becomes crucial and has been an important topic in both practice and research since the advent of computers (Gorry & Morton 1989). Recent developments in IT have spurred continued interest and calls for further research on the relationship between IT and management control (Granlund 2011, Elbashir et al. 2011, Forsgren & Sabherwal 2015).

Alongside the developments in IT, there has been a discussion on whether technology leads to deskilling or upgrading of employees (Zuboff 1988, Robey & Boudreau 1999). On the one hand, a deskilling approach leads to reduced reliance on employees, and the creation of a fool-proof system where employees are seen as operators. On the other hand, technology can be upgrading, designed as a tool for employees to leverage their skills and intelligence.

Analogously, management control has been discussed with similar dichotomies. Directly related to the concepts of deskilling and upgrading are the terms coercive or enabling forms of control (Ahrens & Chapman 2004, Jordan et al. 2012, Wouters & Wilderom 2008). Traditionally, management control has been concerned with the processes to assure accomplishment of organizational objectives (Anthony 1965). From this perspective, management control is performed on a top-down command-and-control basis. Characterized by formal rules, standard operating procedures and routines, control systems are primarily concerned with delivering efficiency. In contrast, more recent management control conceptualizations emphasize the dual role of controls (cf. Simons 1995). Management control is argued to not only be used to exert control over goal achievement, but also charged with the task of enabling employee creativity and the search for opportunities.

Management control systems (MCS) need to balance this tension between control and flexibility. This is not a straightforward task as IT has been associated with the former type of control - a coercive formalization (Adler & Borys 1996) - from the implementation of large enterprise resource planning (ERP) systems. Capable of imposing its own logic on business processes, ERP systems formalize

work procedure and require rules to be adhered to (Lowe & Locke 2008). As a result, they focus on operational efficiency. Additionally, post-implementation reviews have found only moderate impacts on management accounting, where previous practices were simply transferred to the ERP system (Granlund 2011, Rom & Rohde 2007).

Conversely, Business Intelligence (BI) systems are designed to increase effectiveness by facilitating information retrieval and analysis, providing the capabilities of an integrated MCS (Elbashir et al. 2011) and an enabling type of control. Studying management control from a holistic perspective, Elbashir et al. (2011) conclude that BI supports several different control systems. BI is different from ERP systems in two ways. First, it enables the integration of both internal, external and customer data. Second, it is able to present timely information in a user-friendly and ad-hoc manner. Chapman & Kihn (2009) find information system integration, a technical feature of BI, to be positively correlated with an enabling form of management control. Similarly, Forsgren & Sabherwal (2015) find that BI is associated with internal benefits and competitive benefits. These findings suggest that BI can be used to support management control by facilitating management, refinement and analysis of available data. However, the use of BI as an integrated MCS and what control systems it supports has not been studied further.

In total, the understanding on how BI can be used for management control remains limited (Granlund 2011). Where BI has been studied in relation to management control, the scope has been too narrow either focusing only on one accounting control (e.g. budgetary processes: Chapman & Kihn 2009) or one aspect of control (interactive vs diagnostic use: Forsgren & Sabherwal 2015).

This thesis addresses this gap in research by studying BI as an integrated MCS. Further, it takes a holistic perspective, as suggested in management control literature, where studying management control as a system (Simons 1995) or as a package (Malmi & Brown 2008) has gained increased importance. Simons's (1995) levers of control framework provides a structured way through which management control can be studied (Kruis et al. 2015, Mundy 2010, Widener 2007, Tuomela 2005). Using four control levers - *belief system, boundary system, diagnostic control system* and *interactive control system* - managers are able to balance the MCS between control and flexibility. Next, this thesis studies the design characteristics of BI, as a way of explaining its enabling or coercive use drawing upon the works of Adler & Borys (1996) and Ahrens & Chapman (2004). Contingent upon how BI is designed, it is expected to support management control in different ways.

The contribution from this study to the MCS literature is twofold. First, it extends Forsgren & Sabherwal (2015) by studying all four levers of control, increasing the understanding of which control levers are supported by BI. In doing so, it also provides insight into possible interactions between control systems. Second, this study examines the enabling or coercive design of control systems adding to the literature on enabling or coercive control (Ahrens & Chapman 2004, Chapman & Kihn 2009, Jordan et al. 2012).

This study also contributes to accounting information systems (AIS) literature. By drawing upon management control literature it complements the traditionally technical-focused AIS research (Granlund 2011). Looking from a management control perspective, a gap between BI capabilities and assimilation is identified.

Finally, there are managerial implications from this study. It provides a description on the various ways in which BI can support the existing management control, as well as leverage it in new ways. This can act as guidance for managers when adopting BI, as it enables them to use BI purposely and be wary of the challenges presented.

1.3. Research Aim and Questions

The thesis uses an exploratory approach, with the main aim *to increase understanding of how BI is or can be used for management control.* To achieve this, a qualitative study is performed where BI use is studied from a management control perspective. By interviewing both case organizations and BI consultants, the in-depth description from case organizations on how BI *is used* is complemented with general knowledge and understanding from BI consultants on how BI *can be used*.

More specifically, this study examines what different BI tools are used for management control and what information sources are being used. Next, it studies to what extent BI is used to support various control systems as defined by Simons's (1995) levers of control framework. Further, how the BI tools are designed in terms of enabling or coercive formalization (Adler & Borys 1996) is also studied. This results in the three following research questions:

- *What BI tools are used or can be used for management control, and what information sources (internal or external) do they use?*
  - *What different levers of control do these BI tools support and how?*
  - *How are or can BI tools be designed - in an enabling or coercive manner?*

1.4. Delimitations

In order to effectively study these research questions, some delimitations are necessary. First, the report will not aim to make normative suggestions, but rather uses an exploratory approach trying to provide a snapshot of the situation and how BI is or can be used. Second, the study is limited to a user perspective of BI, focusing on how it is used for management control. BI is likely to also be used for different purposes than management control, such as data infrastructure, master data management and consolidation of information falling outside the scope of this study. Finally, the focal point of interest is BI in relation to management control and not to find all MCS used (cf. Mundy 2010). Therefore, control systems not using BI will not be studied further.

1.5. Thesis Disposition

The remainder of the thesis is structured as follows:

2. *Frame of Reference:* Summarises the current research done within management control and BI, resulting in the analytical framework used for data collection and analysis.
3. *Research Approach:* Describes the methodological choices and data collection methods used in this study.
4. *Findings:* Presents the empirical data gathered from the case studies.
5. *Discussion:* Analyses the empirical data through the analytical framework.
6. *Concluding Comments:* Summarises the findings made in this thesis by attempting to answer the research questions. Practical and theoretical contributions are discussed.

2. Frame of Reference

In this chapter literature on business intelligence and management control is presented. First, business intelligence is defined and structured into three components. Second, developments in management control are outlined, leading to a description of Simons's (1995) levers of control framework. Third, Adler & Borys's (1996) theory of coercive and enabling control and how it has been used in management control is presented. BI is then discussed in terms of an integrated control system, synthesizing the theories into an analytical framework used for collection of empirical data and analysis.

2.1. Business Intelligence

Business Intelligence has evolved from being a decision support system to providing MCS capabilities. BI is considered an umbrella concept covering several different activities and technologies (see Turban 2011). As a result, there exists multiple definitions of what constitutes BI (Shollo & Kautz 2010). At the core of BI, however, is the objective to improve business performance and decision-making through efficient use of data and information (Turban 2011).

One way of conceptualising BI proposed by Chen et al. (2012) is to categorize it by temporal progression and key capabilities. BI is separated into BI 1.0, BI 2.0 and BI 3.0 depending on industry adoption and research maturity. BI 1.0 constitutes the technologies and applications adopted today by industry, where data is typically structured and sourced from the organization's internal systems and put into a common database. Data management and extract, transform and load (ETL) are the fundamental tools used to integrate data. Analysis is performed using database queries, OLAP cubes and reporting.

While BI 1.0 relied upon data from internal systems, BI 2.0 targets data created also outside of the organizational boundaries. The core features are text analysis and web analytics, based on unstructured data. Consequently, BI 2.0 is not only concerned with ETL processes but also where and what information to collect (Chen et al. 2012). Clickstream logs from the web can provide insight into users' browsing and purchasing patterns etc. Further, user-generated content in the forms of social media can also be analysed to get customer feedback and responses. However, unlike BI 1.0 tools, text mining and web mining tools are currently not integrated with the existing BI tools, still at an exploratory stage in a business context.

Next, BI 3.0 is an emerging research field with emphasis on mobile and sensor-based content. Gartner (2016) expects that more than half of the business processes will incorporate Internet of Things (IoT) by 2020, which will significantly increase the amount of sensor generated data. Together, these have the capabilities to provide mobile, location-aware and contextualized information which firms could leverage in their operations.

Another way of looking at business intelligence is to structure it based on how it is used. In specific, there has been a discussion to separate business analytics from BI (Gnatovich 2007, Lim et al. 2013). Gnatovich (2007) argues that it should be separate, as business analytics is more user centred and focuses on the enabling aspects of BI as opposed to only informing use. Following this reasoning, this paper uses the BI structure presented in Turban (2011) where BI comprises four components: *data warehousing, business analytics, business performance management (BPM)* and *user interface.* Further, consistent with Turban (2011), business analytics is also divided into self-service BI and data analytics to distinguish its separate use cases. Moreover, the technical aspects of integrating the data through data warehouses and designing user interfaces fall outside the scope of this study and are not discussed further (for an overview, see Chaudhuri et al. 2011, Baars & Kemper 2008). This results in three categories of BI: self-service BI, data analytics and BPM which are summarized in the following sections.

(i) *Self-service BI*: Self-service BI are the tools and techniques used to provide users with information from the data warehouses. It is based on a bottom-up approach, encouraging users to extract information and insights from data. Further, the use of the systems is widely dispersed throughout the organization, not just limited to senior management (Gnatovich 2007). Alpar & Schulz (2016) separate the self-service concept of BI into three different tasks: usage of information, creation of information and creation of information resources. At the most basic level, self-service BI tools give the users access to a set of predefined reports. Users are able to filter the reports and perform drill-downs but the analysis remains limited to what was prepared by the developer of the report. At the next level, access is granted to the data in a disaggregated form. This way, users are able to conduct ad-hoc analyses, enabling them to select data and choose what analysis to perform. The objective is to create a dynamic reporting, accomplished through ad-hoc queries, multidimensional views (OLAPs), drill down capabilities etc. (Turban 2011, p. 30). Dynamic reporting is important, as it enables the users to customize their reports to their own needs, in contrast to static reports distributed on a monthly or weekly basis (Eckerson 2009). Finally, at the third level of self-service BI, not only the analysis is at the user's discretion, but also what data sources to use. Analysis should not be limited to the data that resides in the central data warehouse, but also allow users to autonomously include external data not pre-processed by IT into their analysis. In summary, the objective of self-service BI is to empower users to start asking questions and making fact-based decisions (Gnatovich 2007).

(ii) *Data Analytics:* In parallel to the use of BI by casual and power users, BI also comprises data analytics tools designed for powerful analysis utilizing vast amounts of data. Using advanced statistical methods, mathematical modelling and machine learning, data mining tools search for unknown relationships or information (Turban 2011). By identifying patterns and relationships, data mining transcends traditional retrospective analysis by also providing predictive analytics from historical data.

The analysis can be performed on both structured and unstructured data. While tools to perform data mining have been included in most BI software, analysis of unstructured data such as text is still in its infancy (Chen et al. 2012). Further, data mining distinguishes itself from self-service BI in that it is not performed locally. Instead, it is more commonly performed by a centralized unit, specialized in analytics (Hopkins et al. 2011).

(iii) *Business Performance Management*: BPM, also referred to as corporate performance management, is a management methodology that extends monitoring and measuring with a feedback loop. At the centre of BPM is the diagnostic control system (cf. Simons 1995) used to monitor performance in a cybernetic fashion. Outcomes are compared to standards and deviations are acted upon in a single feedback-loop. The balanced scorecard and performance dashboards are examples of two BPM methodologies used to plan, monitor and analyse (Turban 2011). Common for these methodologies is the breakdown of strategic objectives into critical success factors. This provides BPM with top-down control of the achievement of corporate strategy (Turban 2011).

Eckerson (2009, p. 13-14) distinguishes the different information need for strategic, tactical and operational level and states that "strategy rolls down and metrics roll up". Consequently, strategy is cascaded into key performance indicators meaningful for each organizational level.

	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

Table 1: *Dashboard Designs (Eckerson 2009, p. 13)*

Then, from operational to strategic level these measures are aggregated. Table 1 shows the different characteristics of BPM at the different organizational levels.

2.2. Management Control

There exist several management control conceptualizations, each using their own definition of what is included in management control and whether to include strategy formation or not (Strauß & Zecher 2013). Anthony (1965) provides the narrowest view of management control, comprising the processes to assure accomplishment of organizational objectives. This perspective views strategic planning and management control as separate things, implying a top-down command and control structure. Similar in understanding are Merchant & Van der Stede (2012), but they also include informal controls in management control. Building on transaction cost economics, their objects of control framework aims to control human behaviour, avoiding divergence between organizational objective and outcome (Strauß & Zecher 2013).

In an effort to map out a new path, Simons (1995) includes an interactive control system, thereby incorporating strategy formation into management control. Doing this, he provides an alternative to the traditional top-down command-and-control perspective. Seeking out to answer the dilemma of how managers can balance innovation and control, strategy formation and strategy implementation become interlinked. Through the four levers of control, managers can balance intended strategy with emergent strategies. This provides a novel way of acknowledging the external environment viewing management control as a system affected by both internal and external forces.

This bottom-up attribute of the interactive system resonates well with business intelligence's objective to facilitate data retrieval and equip the organization with the tools necessary to integrate internal as well as external data sources. Additionally, Simons's (1995) management control conceptualization provides a holistic view, where formal information-flows can be studied. The next section summarizes the framework and its empirical testing.

2.2.1. Levers of Control

Simons's "levers of control" framework was developed from a series of articles studying the relation between management control systems and strategy, and management control as a mean for strategy formation through interactive use (Simons 1987; 1990; 1994; 1995). The framework adopts notions from the new philosophies of control and management such as continuous innovation and empowerment. However, this is not made at the cost of sacrificing accountability or control, rather empowerment necessitates *more* control (Simons 1995, p. 163). The framework has received both quantitative and qualitative empirical testing. Among others, Widener (2007) and Henri (2006) performed statistical analysis of the levers of control framework, Tuomela (2005) performed a longitudinal field study investigating the interplay of the four

levers and Mundy (2010) studied the dynamic tension in MCS using a case study setting. In total, the studies corroborate the levers of control framework and emphasize the importance to study the *actual use* of management control as opposed to mere existence (cf. Langfield-Smith 2007). Further, management control needs to be studied holistically to be able to capture the inter-relations between control systems.

At the core of the model is system theory. Simons (1995) views MCS as the levers through which it is possible to balance the dynamic tension within an organization. Emphasis is put on management control as a system to balance the tension between freedom and constraint, top-down control with bottom-up creativity and experimentation jointly with efficiency (ibid). Further, these subsystems are interrelated, and must be managed holistically to ensure organizational success. Another influence from system theory is the double loop learning concept developed by Argyris & Schön (1995). After the interactive control system has identified a new strategic opportunity, double loop learning is needed as the strategy and assumptions for performance need to be revisited.

To achieve this, positive control systems (belief systems and interactive systems) are used to foster creativity and inspiration and negative control systems (boundary systems and diagnostic systems) to ensure compliance. Below, the levers of control and their respective function are explained, summarized in figure 1.

(i) *Belief system*: Firstly, the belief system consists of:

> "*the explicit set of organizational definitions that senior managers communicate formally and reinforce systematically to provide basic core values, purpose and direction for the organization.*" (Simons 1995, p. 34)

This is achieved through the communication of organizational documents such as credos and mission statements. The reliance on belief systems increase as organizations grow, since informal controls are no longer sufficient to ensure a unified purpose. Further, the belief system needs to be general enough to be relatable at all organizational levels. As such, it is not tied to formal incentives; instead it acts as guidance towards acceptable behaviour. Designed to be a fallback when prescribed action is missing, it has been prevalent in organizations actively searching for new business ventures and organizations with high interdependencies requiring communication (Kruis et al. 2015).

(ii) *Boundary system*: Second, as an opposite force to the opportunity search behaviour instilled by the belief system is the boundary system. The boundary systems:

> "*delineate the acceptable domain of activity for organizational participants. Unlike beliefs systems,*

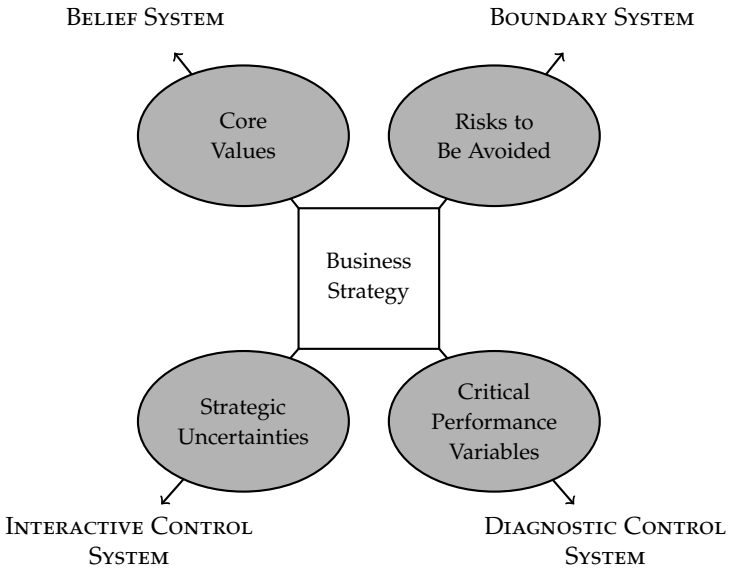

Figure 1: *Levers of control framework (Simons 1995, p. 159)*

> *boundary systems do not specify positive ideals. Instead, they establish limits, based on defined business risks, to opportunity-seeking "* (Simons 1995, p. 39).

Consequently, they limit the opportunity space allowed to pursue, thereby mitigating business risk. Boundary systems are divided in two: business conduct boundaries and strategic boundaries. Business conduct boundaries are often mandated by society's laws, standards of behaviour from industry standards and professional associations. They are commonly written in proscriptive form as risks to be avoided. Strategic boundaries relate to the strategy search encouraged by the belief system. By stating capital budgeting requirements, accepted geographical markets or industries, the search can be limited.

(iii) *Diagnostic control system:* Thirdly, the diagnostic systems are the:

> "*formal information systems that managers use to monitor organizational outcomes and correct deviations from preset standards of performance."* (Simons 1995, p. 59)

As such, the diagnostic system is used to implement intended strategy through performance measurement and management, commonly using exception-basis management, where key performance indicators are compared to predetermined goals and deviations are acted upon in a single feedback loop cybernetic system. The key performance indicators are derived from the intended strategy and thereby aligning behaviour with strategy. Although the diagnostic system limits employee creativity (similar to boundary systems) by directing attention to certain goals, it preserves the freedom of goal achievement. This distinguishes the diagnostic system from process control where all freedom is removed. Examples of diagnostic systems are performance measurement (PM) systems, budgets and standard cost accounting systems (Simons 1995, p. 61).

(iv) *Interactive control system:* Finally, the levers of control framework consists of the interactive control system which stimulates search for strategic uncertainties. Interactive control systems are defined as:

> "*formal information system managers use to involve themselves regularly and personally in the decision activities of subordinates."* (Simons 1995, p. 91)

This control system is complementary to the diagnostic system, as it questions the underlying reasoning behind current realized strategy. As new opportunities and threats are identified from both the internal and external environment, an emergent strategy is formed. Subsequently, this new strategy needs to be incorporated into the other control system in order to become realized. Moreover, the interactive control system is not a separate type of control: what makes it an interactive control system is the actual use of the system. Managers decide which control system to use interactively (e.g. PM system, brand management or budget process). Due to the managerial attention required for an interactive use, it is usually limited to one of the controls. Four features distinguish the interactive use of a control system:

> *"1. Information generated by the system is an important and recurring agenda addressed by the highest level of management. 2. The interactive control system demands frequent and regular attention from operating managers at all levels of the organization. 3. Data generated by the system are interpreted and discussed in face-to-face meetings of superiors, subordinates, and peers. 4. The system is a catalyst for the continual challenge and debate of underlying data, assumptions and action plans"* (Simons 1995, p. 97).

Only when the positive and negative forces of the control systems are in balance does an organization obtain control. To achieve control, then, all four levers of control have to be used together, acknowledging their complementary forces. Using the strategy definition in Mintzberg (1987), strategy is disaggregated into four parts with each part being supported by a control system. First, strategy comprises the traditional perspective of a plan. This command-and-control attribute of strategy is realized through the use of diagnostic control systems. Secondly, viewing strategy as a pattern of actions interactive control systems are employed to increase attention and be watchful of strategic uncertainties. Thirdly, strategy as a position is ensured by boundary systems limiting the opportunity space searched by employees. Finally, belief systems help communicate core values reinforcing the purpose of the organization.

2.2.2. Enabling and Coercive Design of Control

Related to the duality of controls put forth in the levers of control framework are the two concepts enabling and co-

ercive use of control (Adler & Borys 1996). Although originally developed within organization theory with regards to workflow formalization, its application has been found useful within management control (Ahrens & Chapman 2004, Chapman & Kihn 2009, Wouters & Wilderom 2008, Jordan et al. 2012).

Under an enabling control system, users regard the input and feedback from the system as a valuable tool in performing their tasks. Viewing the controls as tools, they are considered to have positive attitudinal effects (Adler & Borys 1996). Conversely, coercive controls do not value user feedback and instead force compliance. Adler & Borys (1996) present four design properties of a control system - repair, internal transparency, global transparency and flexibility - which distinguish an enabling system from a coercive.

(i) *Repair:* Repair relates to the extent that users can contribute to dealing with unexpected problems or identify opportunities (Adler & Borys 1996). In a coercive system, the room for this creativity would be kept to a minimum. Instead, routine use of the system and repair and improvement activities are separated, performed by different categories of employees. As such, the controls risk being decoupled from practice becoming irrelevant for users meanwhile compliance is enforced. Procedures are written for contingencies in a pre-emptive manner with the objective to exhaust all possibilities.

In contrast, in an enabling system the use and improvement activities are intertwined. Problems and opportunities are expected to arise, and the users should be able to act upon these. Employees are encouraged to discuss problems and thereby help develop solutions (Ahrens & Chapman 2004). Best practices are developed collectively and constantly challenged. In a control system setting, managers are able to discuss performance indicators and have the ability to alter the measurement or definition (Jordan et al. 2012, Wouters & Wilderom 2008).

(ii) *Internal transparency:* Internal transparency refers to the visibility of internal processes to the users. It is related to the concept of repair as the act of repairing necessitates an understanding of how the processes are built up - or how measures are calculated in case of control systems. Internal transparency can be improved in the MCS by integrating budgeting processes with operational planning thus linking activities with target outcome (Ahrens & Chapman 2004). Similarly, for performance indicators to work in an enabling way there needs to be an understanding of how actions taken lead to the observed outcomes (Jordan et al. 2012). By disclosing information such as sales margin, employees are better informed on what financial implications their actions have (Ahrens & Chapman 2004). However, layered access to information is important, as fully transparent operations would cause information overload (Adler & Borys 1996).

(iii) *Global transparency:* While Internal transparency refers to understanding of the processes performed by employees, global transparency refers to how these processes are contextualized within the overall structure of the firm (Adler & Borys 1996). Similar to the case for internal transparency, information sharing is kept to a minimum under a coercive use of controls. Operations are performed in a silo-fashion with little connection to the rest of the organization.

However, global transparency can improve both hierarchical and lateral coordination. Budgets are a ubiquitous control system capable of providing global transparency. Notwithstanding, the enabling use of budgets are at senior management's discretion as they decide whether to distribute budgets on a "need-to-know" basis or make them available throughout the organization (Ahrens & Chapman 2004). Another way to achieve global transparency is the use of balanced scorecards, which helps create causal links between operational performance and strategic objective through key performance indicators (Kaplan & Norton 1996). As a result of global transparency, then, managers are able to question performance indicators not being related to the organizational goals initiating a repair process (Jordan et al. 2012).

(iv) *Flexibility:* Flexibility concerns the degree of freedom existing in the use of controls; both in terms of intensity of use and customization. An enabling control system allows users to tailor the use of that system to their specific need (Adler & Borys 1996). A control system example would be ad hoc queries and customized reporting (Ahrens & Chapman 2004). Moreover, an enabling control system also gives the user discretion over the intensity of use. Jordan et al. (2012) found this to be associated with the tightness of controls. When targets were communicated as visions and not directly linked to performance evaluations they were used in an enabling way. In contrast, when targets were stipulated as goals, goal achievement became crucial reducing the flexibility with which the managers could use the control systems.

Consequently, although these design characteristics largely decide whether a control system is perceived as

enabling or coercive, the actual use of the system and attention patterns from senior management also have implications on the perception of controls (Jordan et al. 2012). This is in line with Simons's (1995) levers of control framework which distinguishes between different use of control, as discussed in section 2.2.1.

2.3. Business Intelligence and Management Control

BI provides its users with timely information, powerful analytics and monitoring of performance (Turban 2011) making them an important information source for management control. Similar reasoning is found in Simons (1995, p.5), where he positions information at the core of management control:

> *"[...] management control systems are information-based systems. Senior managers use information for various purposes: to signal the domain in which subordinates should search for opportunities, to communicate plans and goals, to monitor the achievement of plans and goals, and to keep informed and inform others of emerging developments.* [emphasis added]*"*

Consequently, BI helps form the infrastructure of information on which decisions are made. However, the quote also highlights the pluralistic role of management control. This relates to the discussion of the four levers of control in section 2.2.1 and is consistent with the different uses of BI presented above.

Chou et al. (2011) draws upon Simons's (1995) four levers of control when studying how BI might transform the MCS. The authors find that by having access to timely data, BI fostered a fact-based decision-making, in contrast with experience-based or decisions made on instinct, creating an emphasis on data in the diagnostic and interactive system. Further, insights made from BI also generated changes to the belief and boundary system. Identifying patterns in the data, belief and boundary systems were changed to align with strategy. As a result, the implementation of BI had impact on all four levers of control, highlighting the managerial-centric effects from IT.

In addition, Forsgren & Sabherwal (2015) study BI in relation with management control, but use a slightly different categorization, distinguishing between BI's "inside-out" and "outside-in" capabilities linking them to the diagnostic and interactive control systems (Simons 1995). By integrating data sources, BI facilitates a diagnostic use of the MCS. Providing enterprise-wide data and visualization tools it enables an organization to monitor and measure performance through its BPM methodology. This emphasizes internal operations and efficiency. Forsgren & Sabherwal (2015) consider this feature of BI an "inside-out" capability.

Simultaneously, BI provides analytical tools to perform ad-hoc queries and dynamic reporting. Such processes are associated with interactive control systems, where underlying assumptions are questioned and search for opportunities and threats is encouraged. Moreover, BI enables the integration of external data widening the scope to include forces outside the organization. Incorporating environmental data gives rise to an "outside-in" capability and focus on effectiveness by heightening attention to changing market conditions, customer preferences and benchmarking performance (Forsgren & Sabherwal 2015).

Moreover, BI has also been studied in relation to Adler & Borys's (1996) concept of enabling control. Chapman & Kihn (2009) studied the enabling and coercive properties of information system integration (ISI), an outcome of BI, and how it was related to perceived system success and performance. Researching the relationship between ISI and management control, they found ISI to be positively associated with enabling forms of control. Further, they found a significant relationship between enabling control and both perceived system success and performance. These results suggest a mediating role for enabling control between ISI and performance. Studying BI assimilation, Elbashir et al. (2011) make similar findings. Successful use of MCS capabilities from BI does not occur automatically from the acquisition of "state-of-the-art" software. Instead, emphasis is put on the use of the system, where a bottom-up approach was positively associated with greater BI assimilation throughout the organization.

Another contribution made is the discussion of BI and MCS. The authors argue that BI is to be considered an integrated MCS, in that they are not designed for only one single control system but support several aspects of control (planning, performance management, decision support etc.). Drawing upon the conceptualization of management control as a package (Malmi & Brown 2008), they link BI capabilities to planning, cybernetic, reward and administrative controls.

In summary, BI has been found to support central MCS capabilities through its data analytics, performance

management and information integration tools and processes (Elbashir et al. 2011, Forsgren & Sabherwal 2015). Further, implementing BI has been found to impact the MCS design, through both direct and induced effects (Chou et al. 2011). By integrating external data BI tools also increase awareness of the contextual factors surrounding an organization. Nevertheless, there are some methodological issues limiting the findings made. Notwithstanding the reference to the levers of control framework, Forsgren & Sabherwal (2015) does not include the boundary and belief system in their study, possibly leaving out important interactions between control systems (Widener 2007, Mundy 2010). Likewise, Chapman & Kihn (2009) only studies the use of budgetary controls, leaving the remaining control systems unstudied. Finally, findings by Chou et al. (2011) suggest that BI has an effect on MCS design, but does not address how BI might be used to support the MCS. This leaves the understanding of BI and MCS somewhat fragmented. In an effort to synthesize the findings from these articles, an analytical framework is presented in the next section. This framework will subsequently be used to analyse the empirical data.

2.4. Analytical Framework

Based on the frame of references discussed above, an analytical framework is synthesized. Merging the concepts of BI as an integrated MCS with the levers of control and enabling or coercive formalization results in the framework depicted in figure 2. The framework is presented from a micro to macro approach, meaning that BI tools will be discussed first. Then, BI tools in relation to levers of control will be introduced followed by how the BI tools are designed.

At the core of the framework is BI, capable of supporting the overall management control. It is conceptualized as an integrated MCS, and therefore expected to support an organization's management control in various way. To operationalize this and see how different BI tools cater to different MCS needs BI is structured into three categories - self-service BI, data analytics and business performance management (BPM), based on their use and objectives. Firstly, self-service BI provide means for users to analyse the available data in an enabling way. Secondly, data analytics include powerful tools to detect patterns and relationships in an organization's large amount of data,

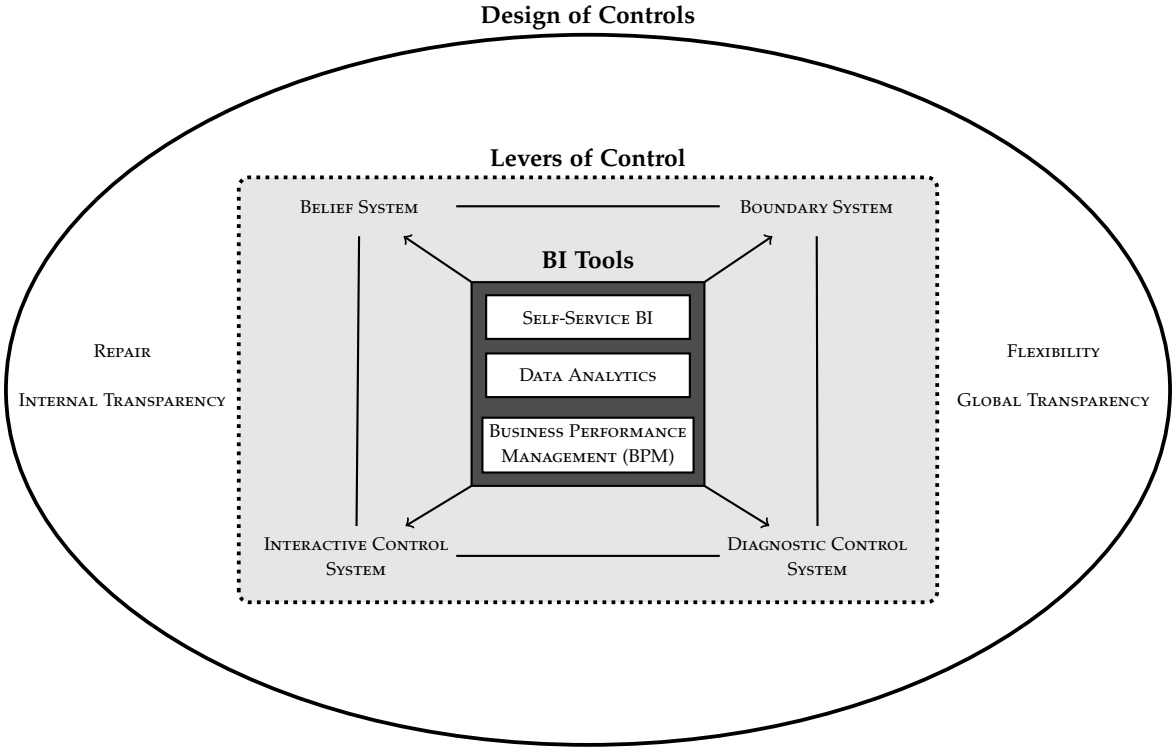

Figure 2: *Analytical Framework: Illustrates the concept of BI as an integrated management control, exhibiting enabling or coercive characteristics.*

which can then act as decision basis. Thirdly, BPM can automate reporting and formalize the information-flow.

Through these BI tools, the overall management control is supported. For this, Simons's (1995) levers of control framework is used to study which aspects of control that are supported by the BI tools, representing the second level of the analytical framework. To provide a holistic view, the levers are studied in relation to each other, illustrated by the connected lines in the framework.

Finally, surrounding this is the design of the BI tools used. The BI tools can support the MCS in an enabling or coercive way - impacting the user perception of the control systems. This degree of formalization is operationalized in terms of four characteristics, as defined by Adler & Borys (1996). Contingent upon the extent that the respective BI tools exhibit these characteristics they will be experienced as enabling or coercive. When these characteristics are present, users are empowered from the BI tool consistent with a bottom-up approach. Conversely, absent these attributes the BI tool is likely to be perceived as coercive acting as a top-down control.

Altogether, the analytical framework conceptualizes the role of BI as an integrated MCS and how it is used. It differentiates between different aspects of BI, which levers of control that are supported and how the BI tools are designed. Next, the research approach and design to study the research questions are presented.

3. Research Approach

This chapter describes how the study was performed, and motivates the choice of a qualitative approach. It outlines the data collection procedure, including literature search, sampling of case organizations and interview method. Additionally, how the data analysis was conducted is presented. Finally, different concepts of research quality for qualitative studies are addressed and discussed in relation to this study.

3.1. Methodology

Research objective and prior theorization have methodological implications (Collis & Hussey 2003). First, with the research aim to increase understanding, richness of data was essential. Additionally, the research questions focus on how BI is *designed* and *used*. In order to capture this a qualitative methodology was chosen, ensuring rich data and avoiding the necessary data reduction for statistical tests (Collis & Hussey 2003). Second, since the relationship between BI and management control lacks sufficient theorization and testable hypotheses, the study used an exploratory approach. Thus, in order to be responsive to emerging patterns in the empirical data, semi-structured interviews were used to allow for flexibility.

The choice of a qualitative methodology affects the study in terms of scope, generalizability and method. A common concern for qualitative studies are that they provide little basis for scientific generalization and may not be generally applicable to the underlying population (Barbour 2014). This concern, however, is associated with quantitative research. The research aim in this study is to expand and develop theoretical propositions which can be viewed as analytical generalization (Yin 2014, Barbour 2014) supported by qualitative methodologies.

Moreover, a comparative design (Bryman & Bell 2015, p. 72) or multiple-case study (Yin 2014, p. 18) was used to get a thorough understanding of the research phenomenon. Both BI consultants and organizations using BI were interviewed. This way, in-depth interviews of an organization's BI and MCS were complemented with expertise knowledge and general trends on how BI is used to support the MCS. Contrasting findings from different cases also promotes theoretical reflection and can help identify important concepts in emerging theories (Bryman & Bell 2015, p. 71-74). Additionally, studying multiple cases strengthen analytical generalization, as it enables theoretical replication (Yin 2014).

In summary, this study used a qualitative methodology and semi-structured interviews as data collection method. This allows the study of contemporary phenomenon in detail and within its context (Bryman & Bell 2015). For this study, keeping the organizations' BI and MCS within context enabled a holistic view and identification of interactions.

3.2. Literature Study

Prior collection of empirical data, a theoretical framework was compiled. Qualitative and quantitative studies alike benefit from prior development of theoretical propositions to guide data collection and analysis (Yin 2014). The framework was synthesized from literature in management control, organization theory and BI literature. The system theory approach implicit in the MCS and organization theory makes them theoretically compatible. Moreover, although the BI literature mainly adopts a technical perspective, this view was seen as complementary in creating the analytical framework. As a means

of critical evaluation of sources, the papers used have been peer-reviewed and published in an academic journal. In addition, article from professional literature has been included when discussing BI.

3.3. Data Collection

Interviews were chosen as the method for primary data collection. Interviews are time-efficient methods, and are able to reflect the opinions and thoughts of the interviewees (Bryman & Bell 2015, p. 480). Conducting interviews was essential in gaining access to several case organizations as a field study approach would have been too time-consuming to perform across organizations. The following two sections describe how selection of case organizations were made and how the interviews were performed.

3.3.1. Sampling of Case Organizations

In order to conduct the study, organizations using BI had to be identified. With the objective to increase understanding and not deduce generally applicable truths, statistical generalization was not significant in the research design and selection of organizations. As a result, sampling representative case organizations from a general population was less critical (Collis & Hussey 2003, p. 69). Instead, convenience sampling was performed to identify relevant organizations. Convenience sampling is a common sampling-method within business research and is useful for studies pursuing analytical generalization rather than statistical generalization (Bryman & Bell 2015, p. 201). Further, the findings can act as a springboard for future studies which is consistent with the research aim. Consequently, case organizations were chosen selectively ensuring that they used BI. The organizations were identified and contacted using the supervisor's and author's networks.

A total of 5 interviews were performed, between the dates 2016-03-03 and 2016-04-20, ranging from 40 to 90 minutes. Table 2 summarizes the details of the interviews conducted.

At VehicleTechnology, the CFO was interviewed. During his 6 months' tenure as CFO, he had initiated the implementation of SAP's ERP system and an OLAP cube. Before this, he had a combined 16 years of experience as a controller.

Next, the business controller (BC) responsible for the implementation and development of the organization's BI at SportRetailer was interviewed. The BC had 7 years of experience with the management control and BI of the company. Consequently, he was well-grounded in the various uses of BI, making him a suitable interviewee.

Thirdly, the chief controller at PublicTransport was interviewed. His responsibilities were the controller group, planning- and analysis processes. As a part of that role, he was also engaged in the BI-governance. The controller had been working 6 years within management control and BI at PublicTransport.

Finally, two BI consultants at two different consulting firms were interviewed. Both of them had more than 4 years experience in BI and how to use it for management purposes. BI Consultant 1 was currently working with supply chain analytics and how to use BI throughout the value chain. BI Consultant 2 was responsible for the business consulting department where emphasis is put on how to use BI for management control purposely.

3.3.2. Interviews

As neither a structured interview with standardized answers nor an unstructured interview would gener-

Table 2: *Summary data of interview respondents*

Organization	Title / Department	Experience in BI & MCS	Date	Length
VehicleTechnology	CFO	16 Years	2016-04-04	40 min
SportRetailer	Business Controller	7 Years	2016-03-03	90 min
PublicTransport	Business Controller	6 Years	2016-04-20	70 min
BI Consultant 1	Analytics	4 Years	2016-03-23	75 min
BI Consultant 2	Business Consulting	4 Years	2016-04-15	80 min

ate the desired data, semi-structured interviews where performed to gather data from the respondents. Semi-structured interviews are suitable when studying several case organizations to form a basis for comparison (Bryman & Bell 2015, p. 480, Blumberg et al. 2011, p. 266). Using an interview guide, questions were prepared in advance to ensure relevant topics were covered. The questions were structured based on the analytical framework developed from the literature review (see Appendix A). These questions acted as a guideline, while follow-up questions and additions by the interviewee were still allowed. This allows interviewees to highlight and elaborate on areas of interest producing richer nuanced data (Bryman & Bell 2015, p. 486).

The interview guide was sent to the interviewees in advance followed by a brief description of the study. This way, respondents were able to provide more well-rounded answers and "off-the-cuff" answers were avoided. On the other hand, this results in less spontaneous answers. Taken together, it was deemed preferable to send the questions in advance to receive well-reflected answers. Further, to ensure common understanding and fluent dialogue all interviews were held in the first language of the respondents - Swedish. Consequently, all quotes provided from the interviews have been translated into English.

Additionally, recording the interviews provided a way to ensure data quality and it facilitates data analysis (Blumberg et al. 2011, p. 267). Moreover, during semi-structured interviews, it can enhance the data retrieved by being perceptive to the interviewee's responses with follow-up questions instead of taking notes. Subsequently transcribing the interviews gives an accurate representation of the interview (Bryman & Bell 2015, p. 494) and keeps chain of evidence from source to conclusion (Yin 2014). Nevertheless, transcripts themselves do not guarantee good analysis themselves, instead a systematic and thorough approach to data analysis is required as to reduce selective interpretations (Barbour 2014).

3.4. Data Analysis

To address threats of analytical bias associated with qualitative data, a systematic approach was used to conduct analysis. The transcribed texts were analysed using qualitative content analysis (Kuckartz 2014). The method resembles the general analytical procedure in Collis & Hussey (2003, p. 263) and thematic analysis (Bryman & Bell 2015, p. 599). The approach distinguishes itself from grounded theory by incorporating previous literature in the coding process (Kuckartz 2014). The first part was reading through the data, creating in vivo codes. This process mitigated the risk of ignoring relevant data due to only using predefined categories. After initial coding, these codes were subsequently compared to the categories from the analytical framework synthesized in section 2.4. This way, the analytical framework could be validated and potentially new categories could be identified. Moreover, having pre-analytical categories not only facilitated cross-case comparison but also enabled the empirical results to be analysed based on previous literature. After categories had been constructed, the coded segments were put into each category, forming the basis for the analysis. Once structured into categories, pattern matching and cross-case analysis was performed. Word tables and matrices were used to look for potential relationships between BI and management control.

3.5. Research Quality

Quality constructs of qualitative research are not as well defined as its quantitative counterparts construct validity, internal validity, external validity and reliability (Fejes & Thornberg 2015, Flick 2007). Collis & Hussey (2003) discuss the issues regarding quality constructs for qualitative studies and conclude that reliability and validity concerns are different from the traditional quantitative issues. Similarly, Yin (2014) elaborate on quality in case studies using the concepts from quantitative research; adapting them to a case study setting.

Another strand of literature within qualitative research quality rejects the quantitative methodologies' concept of quality altogether (Kuckartz 2014, Bryman & Bell 2015, Flick 2007, Barbour 2014). Because the research setting is non-standardized and context-specific criteria like reliability and validity become obsolete (Flick 2007). Nevertheless, qualitative studies are still interested in ways to assess whether the results are valid and whether one can rely on them. To do this, emphasis is put on process-oriented standards (Kuckartz 2014) and new criteria such as credibility, transferability and dependability (Lincoln & Guba 1985). To increase credibility in the research findings, methodological rigour is suggested. This can be achieved through transparency of the analytical process and use of methodological standards.

Using input from both of these approaches, several

measures have been taken to improve the quality of the study. Below follows a summary of the actions taken, presented more in detail throughout the method section. Quality is discussed using the three qualitative terms *credibility*, *transferability* and *dependability* which largely parallels the quantitative quality criteria.

3.5.1. Credibility

To reach the credibility criterion in this study, previous literature was used when defining measures and concepts wherever possible. Additionally, an analytical framework was developed to provide consistency between measures and a logical model for analysis (Yin 2014). Moreover, respondent validation (Bryman & Bell 2015, Yin 2014) was used to ensure that the data collected exhibited high validity. This was performed by sending the transcribed interviews to each interviewee asking for any misrepresentations.

3.5.2. Transferability

Related to the discussion on statistical vis-à-vis analytical generalization, external validity is different for qualitative studies. One central decision to improve analytical generalization was to conduct a multiple case study compared to a single case (Yin 2014). Studying organizations within different contexts enabled a basis for comparison. Further, by providing context to the case organizations the aim was to produce a thick description (Bryman & Bell 2015) of the research findings. This way, readers can make their own judgements of the possible transferability to another setting.

3.5.3. Dependability

Next, as qualitative studies are inherently context-specific, issues concerning reliability have tended to be haphazardly ignored (Collis & Hussey 2003, p. 58). On the contrary, a systematic approach and transparent procedures are essential in a good case study (Yin 2014). The process of recording and transcribing the interviews increase dependability as it creates an audit trail (Bryman & Bell 2015) or chain of evidence (Yin 2014). Additionally, in order for a study to be dependable, it requires methodological rigour (Kuckartz 2014). In an effort to increase the dependability of this thesis, data collection and data analysis procedures were thoroughly explained in this chapter, and based on established research methods.

4. Findings

In the following chapter findings from the BI consultants and case organizations are presented. First, potential use of BI is outlined based on the interviews with the BI consultants. Subsequently, three cases outlining how BI is used for management control in practice are presented to provide an in-depth perspective.

4.1. BI Consultants: Potential Use of BI for MCS

This section provides a general account of the potential use of BI for management control. A shared view among the BI consultants interviewed was that there exists a large gap between BI's technical capabilities and BI adoption among organizations. Two underlying reasons emerged. First, one explanation to this is that there is a general lack of knowledge from business managers, as put forth by one of the consultants:

> "*[Organizations] don't really understand what possibilities exist and that's one of my tasks: to explain what is possible and how it works. To show demos and show: 'this is what you can do'.*" (Consultant 1)

> "*There are still a lot of things being done manually. And not advanced text analysis but the simple collection of information and making it accessible in an easy way. [...] Many are not there yet; they sit 2-4 hours each week preparing reports. Employees coming to work at 6 am Monday to make sure the reports are done by 9, you are still there in a lot of organizations.*" (Consultant 1)

Second, a direct effect of this is that the majority of BI projects become initiated and managed from the IT-department instead of the business department. IT projects tend to be efficiency driven and there is a sense of push more than pull in what gets included in the BI solutions. Consequently, the projects tend to revolve around automation. However, in order to also *create value* from BI, the business side needs to be included:

> "*We look at what data exists and try to transform it to information and some form of knowledge. We're good at that, but if we don't include the business we're only looking at costs really. We don't have the value part, and we need both to find some form of benefit.*" (Consultant 2)

Without projects anchored in the business, BI solutions are being used to support the old MCS, and not leverage new forms of MCS. Altogether, this results in BI projects being skewed towards efficiency and automation:

> *"[A] lot of projects are initiated because one wants its old [Microsoft] excel-report, but in a tool where you no longer have to do it manually. They'll be damned if there's a different font or background colour, then the consultant hasn't done its job."* (Consultant 2)

In light of this, BI is primarily used for BPM purposes. A large bulk is predefined reports, allowing basic filtering, which are now being prepared automatically. Nevertheless, self-service BI is an increasing trend still in its early phases:

> *"We work more and more with self-service tools - Qliksense, Tableau, Power BI - but self-service in its true form is not as widespread yet I would say. [...] They [users] can drag and drop, but on a very predefined dataset with predefined logic."* (Consultant 2)

Finally, more advanced data analytics tools are not yet widely used. However, the consultancy firms are performing pilot tests and doing proof of concepts for these techniques, trying to identify its applicability. Drawing upon large datasets data analytics supports predictive and prescriptive analysis which is expected to support MCS in novel ways. Simultaneously, changing to become more data-driven is also expected to demand the overall MCS to adapt.

Nevertheless, integration of external data to validate the current strategy is not widely used in any of the BI tools. Information overload and difficulties with internal data, together with market analysis being based on qualitative data are obstacles in adopting BI for this:

> *"[use of external data] It's a lot of marketing [from BI vendors]. An absolute majority is still internal data, it's not as easy as everyone says. [...] Even if you integrate it, what are you going to use it for? A lot of companies still struggle with their internal data quality and master data."* (Consultant 2)

> *"Market analysis is another type of data set. BI is primarily used to automate large data sets, while market analysis has its own data, it's more qualitative. I think it has to do with the fact that you don't fully utilize BI in senior management. You don't have the full competency, instead there's someone preparing a report for you presented using a PowerPoint."* (Consultant 1)

The next two sections present how the BI tools can be used to support the different levers of control, and in what way the BI tools are designed based on the interviews with the BI consultants.

Levers of control supported by BI

Neither of the consultants find BI to actively support the *belief system* by communicating the vision or mission. However, BI is found essential when moving towards becoming a data-driven organization. Further, data analytics is central to achieving a fact-based search behaviour. In this regard, BI does support the *belief system* and promotes a data-first philosophy. This represents a new way of performing business:

> *"If we start working with predictive or prescriptive analysis [data analytics], then it's very much about experiments. You formulate a hypothesis, which may or may not be true. This means that we are not sure if there is any value in it. There might be, but we need to do a pilot or test case. [...] How do you allocate a budget to such a team? We're not even sure it's supposed to be a project?"* (Consultant 2)

Hence the other control systems need to adapt accordingly. First, the diagnostic control system needs to be flexible enough to allow for search behaviour. Simultaneously, the search domain has to be restricted by the boundary system.

Additionally, the belief system can be supported by BPM. Having a well-defined scorecard can help employees as they can assess their decision as to whether they help accomplishing the vision.

In parallel, BI can support the *boundary system* through data analytics and BPM. Using predictive analytics, historic data can be used to suggest what action to take:

> *"Take predictive maintenance for instance, which is something we can't calculate. If we use all sensors from a truck or machine, or whatever it might*

> *be, we can use statistics. What's the worst that could happen? We service it a bit too early, but that's better than a little too late. These are things I believe will be the first step."* (Consultant 2)

Similarly, through the BPM tool backlogs can be created, guiding employees in short-term decisions. This holds true at the operational level, where decisions can be automated. At higher organizational levels, however, the output is more likely to serve as decision basis, and not as prescriptive action:

> "*On an operational level you can receive flags and get a backlog. Then you work your way through the list and get guidance on short-term decisions. But on larger decisions, then you initiate some sort of action plan"* (Consultant 1)

Next, the majority of BI tools today are used to support the *diagnostic control system,* achieved through self-service BI and BPM. Self-service tools allow the user to filter and select among predefined measures through dynamic reports, giving the users freedom in gauging their performance. On the contrary, BPM leverage the MCS by automating predefined reports, as well as enabling exception-based reporting. The benefits with this are twofold: first analysis is facilitated by highlighting deviations and second resources are freed to more value-creating activities:

> "*[Exception-based reporting] is something I try to push and recommend using to look at deviations: 'what is my backlog, what haven't we delivered in time or what exceeds its limit?' To use top 10, or deviations from last week in reports is often met with astonishment and 'can we do that?' from customers. Step one for me is automate the report and avoid doing it manually and put those four hours on it. Next, when you start making the report you add more functionality."* (Consultant 1)

However, achieving an organization-wide reporting that supports the diagnostic system on a strategic, tactical and operational level is not without difficulties. A prerequisite before implementing BI is that the organization's management control needs to be well-defined and coherent between all organizational levels. Otherwise it will not support BI on a strategic level:

> "*I would say that a lot of our customers think they work at a strategic level but they don't. It's tactical if anything. They have a lot of measures, KPIs, reports etc. but it's hard or very few who have linked it to their strategy and really use it. [One reason] is you still work a lot in silos. It's both that you don't use BI to follow a whole process, but also that you look at the same thing on different places receiving inconsistent figures."* (Consultant 2)

To remedy this, the business need to be work with master data and promote one view of the organization through common definitions. Performing this also lays the groundwork for using BI in the *interactive control system.* With consistent measures and definitions from the diagnostic control system, less time is spent arguing over the data and more time can be put into analysis. This can then be leveraged from self-service BI as users have common measures to discuss.

In addition, data analytics can support the interactive control system by automating the strategic validity check and promote a data-first decision philosophy in the interactive control system, as discussed previously:

> "*If you start using more advanced analytics, statistical modelling, this means that you can predict forecasts with a better accuracy, faster and more often than if you have a formalized forecasting process quarterly."* (Consultant 2)

> "*You can take much more factors in consideration than with a calculator and your brain. We're still very far away from someone trusting this a 100% to make a strategic decision. [...] To develop new go-to-market strategies, customer offerings, things that change the company's image these models can be used but more as an input to a discussion."* (Consultant 2)

In summary, BI has the potential to support all levers of control, by automating old MCS or leveraging new control systems such as predictive analytics. Additionally, BI has to be designed coherently to support the MCS at all organizational levels. The next section discuss how this is achieved by balancing an enabling and coercive design of the BI tools.

Enabling and coercive design characteristics of BI

The discussion on the design of the BI tools was two-pieced: On the one hand infrastructure, master data and definitions should be governed centrally while on

the other hand BI tools could be allowed to be *used* autonomously. This affects the design of BI in terms of the four characteristics of enabling control.

With regards to *repair*, the consultants experience a reaction where organizations are moving from an enabling design towards a more coercive design. Without central governance in BI projects, they have been performed in a silo-fashion, creating difficulties when trying to join information and look at a strategic level:

> "*What is revenue, a customer, or actual cost for this? [Organizations] haven't taken a holistic approach, worked with structures and definitions of such things. It's tough work, and it hasn't been done. So even if you might say 'we have [measure] everything for our strategy', there might be three, four or five versions of it which results in you not knowing which one's correct.*" (Consultant 2)

As a consequence, organizations are shifting towards reducing the repair attribute and instead control what data is used and define measures. This creates internal consistency enabling the use of BI at a tactical and strategic level.

This has implications for other aspects of BI design. Governing the information centrally increase the *internal transparency* by increasing trust in the numbers. Using both self-service BI and BPM, performance can be monitored with timely and accurate information. Related to this is also the question of *how much* information to show. Exception-based reporting is one way in which BPM can be used to reduce information overload by highlighting deviations. Additionally, by using self-service BI and BPM in parallel, user-access can be controlled to reduce information while still giving access to pertinent information in their respective areas. Likewise, data analytics can increase internal transparency of the MCS, by performing tests and experiments. By testing hypotheses of important relationships or cause and effects business-central insights can be untangled and then leveraged in the ordinary business:

> "*To falsify a hypothesis is also a result. To know that no, this relationship or cause and effect we believed exists in fact does not. Customers don't buy more if we do this or that, it doesn't matter. Good, then we don't need to spend a whole marketing budget on it!*" (Consultant 2)

Moreover, BI has the potential to increase *global transparency* with one caveat: measures need to roll up from an operational level to a strategic level to be internally consistent. The difficulty is not system-wise but lies with the business, where decisions have to be made on what to measure and how:

> "*It is often there, somewhere in-between a tactical and operational level that BI has existed, but in silos. KPIs have been developed, but you haven't really looked at how they are inter-related. You say that we should be LEAN in our production process, but procurement is being measured on how much it can push prices down from suppliers. What happens? We buy in bulk and build inventory so that we are LEANmyass.*" (Consultant 2)

Again, this relates to the central governance of master data and data quality. Creating a common data layer where the data can be joined and cleaned is one way in achieving global transparency. Although representing a significant challenge, the benefits are a more coherent management control where sub-optimizations are avoided.

Finally, BI can increase the *flexibility* of the MCS through its data analytics and self-service BI tools. Flexibility in data analytics tools is essential as to discover new patterns. Further, the benefits with self-service BI compared to working in a spreadsheet is that the organization can have governance and that the analysis is performed on a predefined data set. This way, analysis can be done autonomously on quality assured data.

In total, BI is shifting to a coercive design in terms of data quality and data management. This has a positive impact on internal and global transparency by creating consistency in the data and reducing silo-based management. Then, users can access the quality assured data and select what they want to analyse, increasing flexibility. Table 3 summarizes the different uses of BI for MCS purpose.

The next section complements this view by presenting three cases, and how each of these organizations use BI for their MCS.

4.2. Case Organizations: BI Use in Practice

The studied case organizations exhibited varying levels of BI adoption, ranging from simple cost management tools to a structured BI portal to gather all information in one

Table 3: *BI consultants: The BI tools, MCS supported and design of controls*

BI Tool	Lever of Control	Design of Control	Potential Use of BI
Self-Service BI	Diagnostic, Interactive	Internal Transparency, Flexibility	Allow users to filter and select among quality assured data. Used in an enabling way to equip employees with information.
Data Analytics	Belief*, Boundary, Interactive	Internal Transparency, Flexibility	Discover patterns and validate business logic through hypotheses, can be fed into either boundary or interactive.
BPM	Belief, Boundary, Diagnostic	Internal Transparency, Global Transparency	Automate reporting, freeing up resources. Use exception-based reporting to focus attention. Promotes global transparency through organization-wide definitions.

* Data analytics foster data-driven core values, affecting the belief system

place. As such, the cases highlight different ways BI is used in practice to support an organization's MCS. Each case begins with a brief description of the organization, followed by a summary of the BI tools in use and what information sources they utilize. Then, BI is discussed in terms of support of the MCS and how the BI tools are designed.

4.2.1. VehicleTechnology: Automating reporting and controlling information-flow

VehicleTechnology is a young subsidiary to a multinational automotive corporation. The organization was founded in 2013 and has since experienced rapid growth. VehicleTechnology acts as an engineering and development centre for future consumer cars. Using modular architecture, the designs are going to be used in two of the parent company's car brands, one being a premium quality brand and the other a low-cost producer. Today, the company employs a total of 2000 people, through both employment and consultancy. Roughly 1600 work in Sweden, and 400 in China.

The exponential growth has resulted in an underdeveloped management control. Traditional MCS have not been applicable, due to the large amount of uncertainty, lack of defined processes and the risk of becoming obsolete as they are deployed. Slowly, accounting and management control are catching up through the implementation of an ERP system and more distinct processes. Alongside this, a cost management tool has been developed to provide managers with information on performance compared to targets. The self-service BI tool builds on an OLAP cube[1] to facilitate and automate comparisons between targets and outcomes. Additionally, the organization is planning on adding a BPM tool to control the information-flow. Common for both the OLAP cube and the BPM tool is that they will use internal data. VehicleTechnology is also discussing how to integrate data from its parent company, which is currently obstructed by inconsistent formats and a lack of ownership.

In total, BI is viewed as an auxiliary function to the MCS. Consequently, there is a strong sense of logical progression in the work with management control and BI which was emphasized by the CFO:

> *"One could think that it is risky to work without a system, which it is. At the same time, I don't want to pick a solution before we have a clear understanding of our needs because then we risk having to redo everything. [...] The first process is about structuring the management control. After that, you can start and build system support. Instead, many choose to opt in for standard solutions, but don't know neither what they want nor what's possible."* (VehicleTechnology)

This holds true for several fields within VehicleTech-

[1]Online Analytical Processing-Cube, a multidimensional dataset enabling analysis of performance on several dimensions such as project, time, actuals, budget.

nology's MCS, hampering the use of BI. Related to the potential of BI tools for timely cost information the CFO remarked:

> *"it's not only about retrieving the BI systems but also deciding on the processes to continuously perform accruals and provisions for projected costs."* (VehicleTechnology)

The following two sections summarize how VehicleTechnology uses, or aspire to use BI tools to support its management control and the design characteristics of its BI tools.

Levers of control supported by the BI tools

At VehicleTechnology, the *belief system* plays a major role in the overall management control. Without defined processes or KPIs, the organization works actively with its mission statement. Its mission is *to develop quality cars tailoring to its premium brand parent, while still accomplishing the cost requirements from the low cost car firm, twice as fast*. Although implicit in other parts of the management control, BI is not used to communicate this mission. Further, lacking processes leaves the organization also without a clear *boundary system*.

Instead, the current BI tool at VehicleTechnology was implemented to support its *diagnostic control system* through cost management and timely information. Before implementing BI, data was retrieved and consolidated manually. This caused a significant time lag, rendering the information useless:

> *"When we didn't have a system for retrieving it [cost data], we would require two weeks to collect and prepare the information. At that pace it's too late to make a decision."* (VehicleTechnology)

In addition to providing more timely information, another benefit with using system support for reporting was reduced work-load.

Finally, the *interactive control system* is currently unsupported by the BI tool. During recurring meetings with the parent company quality issues, costs and deadlines are discussed. Preparation of the information used in these meetings requires a lot of manual work; some data is manually fed into spreadsheets, while other data is sourced from various systems. Integrating this data would both facilitate information retrieval, but also improve analysis by gaining a unified picture. To do this, VehicleTechnology needs to extract data from the parent company's ERP-systems which obstructs information integration:

> *"Only getting the cost of material from China for a car requires us to go into three different SAP systems configured differently, plus the last one running a home-made solution. [...] That's the issue, not what we got ourselves, because we have nothing. It's when we have to extract data from other instances."* (VehicleTechnology)

To summarize, VehicleTechnology has relied on loose control, with a strong focus on the belief system and interactive control system. Alongside the organization's growth, it is experiencing an increased need of a tighter control. To accomplish this, is has implemented BI to support its diagnostic control system, and aspires to let BI help it formalize the information-flow.

Enabling and coercive design characteristics of the BI Tools

The CFO's view on BI tools' enabling or coercive characteristics was two-pieced. On the one hand *use* of BI was seen as enabling, allowing users to easily extract data. On the other hand, due to VehicleTechnology's rapid growth its needs keep changing. In order to cope with this, the organization's systems need to continuously evolve. This was something which was regarded as coercive due to the *maintenance* and *reconfiguration* of the BI tool requiring external resources. In the next paragraphs these two aspects are discussed from the four dimensions of enabling control.

Firstly, *repair* was a primary concern regarding implementing new BI tools at VehicleTechnology. This was especially true when using data from the parent company due to lack of ownership or authority to improve the data management:

> *"[Y]ou can have a BOM (bill of materials) which differs between them [parent company's ERPs]. Either you build an extremely smart top layer which handles this, or alternatively you need to change in every production plant. 'You should not follow-up on your operations like this, you should do it this way', then we can look at the big picture. [...] They have the solution for it. Unless, again, we have something smart on top. But the problem is that these BI-tools used on top still need configuration.*

> *As soon as they make a change down here [parent company's ERP-system], one has to hire these expensive consultants to make the reconfiguration."* (VehicleTechnology)

This was also a consequence of BI being managed solely by the business department, without support from IT. Consequently, the organization did not have the expertise to reconfigure the BI tool.

Secondly, in spite of this, the CFO still expressed the need of using BI to support the management control and increase *internal transparency*, and help mitigate information overload:

> "*We need an analytical tool capable of handling large amounts of data, enabling monitoring from both a high and low level. My experience is that very few people can deal with lots of data. That's why you need something that can generate decision basis from the data, or in some way filter it into standard reports with predefined measures."* (VehicleTechnology)

Thirdly, as discussed previously the BI tool is currently only used for cost data. Without integration of the various data sources, the BI tool does not help promote *global transparency.* One obstacle to improving global transparency at VehicleTechnology is silo-based thinking:

> "*The data is in different systems, but it [integration of data] is no impossibility. But as usual when something is built, the organization builds watertight bulkheads between things. They fail to consider the need to integrate financial and non-financial information"* (VehicleTechnology)

Finally, BI has a dual relationship to *flexibility* at VehicleTechnology. Within the business and finance controller function, the OLAP-cube is used as a self-service tool. Although much of the data is retrieved from the ERP-system, the BI tool is more user-friendly and allows easier selection of data: "*It is more Excel-based, therefore more people are comfortable extracting data from it"* (VehicleTechnology).

Conversely, BPM is also planned to be used to formalize reporting and reduce flexibility. Today, the parent company sends ad-hoc requests for information to various parts of the organization:

> "*[O]ur owners love getting lots of data. It doesn't really matter what kind of data; they want a lot of data quickly so they ask several people. [...] Currently it's 'Excel-to-hell', everyone has its own spreadsheet and send different variants, different versions. Almost all controllers do use assumptions when they calculate, e.g. how to allocate fixed costs. Then different people might use various assumptions resulting in conflicting numbers reducing the reliability."* (VehicleTechnology)

To remedy this, the CFO plans to use BPM to formalize information flow. By using system support, the objective is to control information output so that it is uniform, standardized and not performed on an ad-hoc basis.

In total, BI is used purposely, exhibiting both coercive and enabling characteristics contingent upon the need of the organization. Self-service BI and the OLAP-cube were perceived as enabling, as they helped promote internal transparency and flexibility. Simultaneously, BPM is planned to be used to reduce flexibility in reporting. Further, the implementation and maintenance of BI was seen as coercive, requiring outside expertise.

Table 4 summarizes the findings on how the BI tools are used for management control and its implications.

4.2.2. SportRetailer: BI as a centralization tool

SportRetailer is part of an international corporation with over 5500 stores located in 44 countries. Globally, its sales reached €10 billion in 2014. The business unit studied is the Swedish branch consisting of approximately 150 stores and roughly SEK4 billion in sales. SportRetailer operates as an autonomous business, able to make strategic decisions. Historically, the retail chain has been decentralized, with merchants owning their stores and having decision authority over how to operate.

Gradually, SportRetailer has become more centralized, with assortment, marketing and product development being performed at headquarters. Additionally, during 2015 most stores were bought from the merchants, giving SportRetailer control over a large majority of the store network. This has spurred new efforts into making the business more centralized and homogeneous, impacting the MCS.

SportRetailer's IT infrastructure consists of several systems. At the core is its ERP-system used for accounting, orders and accounts receivable. For purchase, logistics and budgeting, separate systems are used. To integrate

Table 4: *VehicleTechnology: The BI tools, MCS supported and design of controls*

BI Tool	Lever of Control	Design of Control	Implications
Self-Service BI	Diagnostic, Interactive	Internal Transparency, Flexibility	Olap-cube to improve diagnostic control system. Increase understanding and flexibility to select info. Potential to use interactively and promote global transparency, need to integrate external data.
Data Analytics			*Not used*
BPM	Diagnostic	Internal Transparency	Control over information-flow, consistent reporting and more timely information. Reduced flexibility to create uniform reporting.

the data, SportRetailer feeds the data from the various systems into a common data layer. From this data warehouse data is fed into Qlikview, the analysis and reporting tool used at SportRetailer.

Qlikview is used for two purposes - both as a self-service BI tool for business and finance controllers but also for BPM purposes distributing reports throughout the organization. In addition, the organization utilizes an intranet to distribute information, documents and reports. Finally, by integrating sales data and inventory-levels data analytics is used to automate refills of base assortment. External data, however, is not integrated with SportRetailer's internal reporting and analysis. Due to lack of data quality, Qlikview contains no measures benchmarking with competitors. Instead, sales are compared on an ad-hoc basis to the general retail market index, separating it from the rest of the analysis. The following two sections describe which levers of control these BI tools support and how they are designed at SportRetailer.

Levers of control supported by the BI tools

The centralization has initiated a stronger emphasis on core values and how to communicate the *belief system*. One way in which SportRetailer aspires to guide employee behaviour is through a more explicit BPM tool. By having periods with emphasis on a single key performance indicator the aim is to redirect focus on how to achieve that measure. To achieve this, the BI tool will be used to customize the reports to provide less, but more relevant, information.

The *boundary system* is supported at SportRetailer through data analytics and automated decision making. By integrating its planning and forecasting tools with actual sales data, procurement of base assortment is automated. This way, the BI tool effectively limits the autonomy of individual stores.

The BI tools also help leverage the *diagnostic control system* at SportsRetailer by providing both analytical and reporting capabilities. The business controller commented on this when discussing the benefits of BI:

> *"The benefit is that we can control [steer], and decide what to show. [and to] have focus on what we want centrally and the ability to communicate it the whole way is the large benefit. And that we can use one tool to communicate."* (SportRetailer)

The budgeting process is performed in a separate system, which sources its data from the central data warehouse. Using historical sales and orders as input, deviations are analysed and the new budget is created for the group level. Once budget data for the group is set, KPIs and sales budgets are derived for each store. These figures are then exported to Qlikview. Simultaneously, targets are set for each KPI which could also be put into Qlikview, supporting BPM for each individual store. In total, the BI tools both facilitate creation of budget data and diffusion of the budgets throughout the organization.

In addition to supporting planning, BI is also used for performance management. Qlikview is used both

centrally and at all stores to monitor performance. Every 15 minutes, sales data and KPIs are updated. Sales are compared to budget, and the other KPIs are used as a benchmarking tool against other regional stores and last year's performance. Since the centralization, how to utilize exception-based reporting is also investigated to facilitate analysis. Finally, through BI's integrative capabilities, data from different systems can be joined together to form new KPIs. By integrating sales data with labour costs, SportRetailer recently added new KPIs for benchmarking its stores.

For the *interactive control system*, one of the primary benefits of the BI tool is integration of data. SportRetailer joins all its data into a data layer, making data accessible for analysis. For business controllers at SportRetailer, this facilitates analysis and makes it possible to look at deviations from a holistic perspective using self-service BI tools. Through weekly meetings, information from the Qlikview reports are discussed with controllers in different constellations - assortment, region managers and sales managers - in an effort to flag deviations and detect possible market changes. Consequently, SportRetailer's internal data, primarily from Qlikview, forms the basis for its interactive control system.

More extensive analysis, however, is typically performed outside of the BI tool in separate spreadsheets:

> "*Forecasting uses data from Qlikview, but the analysis part is often performed in [Microsoft] Excel. [...] The threshold for performing the twist and turn operations [manipulating the data] in Qlikview is higher. It is often a scenario-analysis one wants to test.*" (SportRetailer)

Overall, SportRetailer is adapting its BI tools to the ongoing centralization in an effort to achieve a tighter control. This is accomplished through a more explicit belief system, targets on more KPIs and exception-based reporting.

Enabling and coercive design characteristics of the BI Tools

SportRetailer's centralization efforts have begun to permeate its MCS. Moving from a tradition with loose control and autonomous store owners, changing the control systems represent a significant challenge.

Traditionally, *repair* has been high, as BI has been designed in an enabling way, distributing dynamic reports and allowing users at all levels to perform analysis and customize their reports. However, this has caused difficulties in supervising the analysis centrally and maintaining the Qlikview applications: "*each group optimizes and develops their things and it [Qlikview application] grows fast.*" (SportRetailer)

As a result, insights made from the analysis and how it was performed are not being leveraged centrally. Remedies were discussed in terms of how to better manage the analysis:

> "*Absolutely, that shall be done [capture feedback from users]. We only need a filter somewhere to prevent everyone from optimizing everything [develop locally] and add their own KPIs. Rather, we should take feedback and set up a list of priorities for development and jointly discuss the changes. [...] We don't want people not to think, creativity should still be there, but the question is how to get the essence of it. Many times, the information already exists, but instead a separate report is generated.*" (SportRetailer)

Consequently, the repair characteristic in the BI tools is diminishing as decisions are increasingly being made on a central level at SportRetailer. The BI tools are moving from being used as self-service BI to BPM purposes and the organization is moving from dynamic reports to more static reports, thereby separating analysis and reporting tasks:

> "*The reports are predefined, but there are some possibilities for filtering and focus on different parts. In the future we've said that we are going to control it more based on permission, at least towards the stores; but we can also improve it internally. We don't want our sales personnel to sit and analyse the reports, the reports should come ready-made.*" (SportRetailer)

With regards to *internal transparency*, SportRetailer currently reports on several measures enabling users to gauge their performance. Through Qlikview, stores are able to follow up on their performance in close to real-time giving them information on how they perform compared to budget. Currently, this is only done with sales, while the other KPIs are not compared to goals but act as tools for the managers. As SportRetailer moves to control reports centrally, the question of what information to include arises:

> "*Too much information is made available for the user, and Qlikview has been allowed to grow too big which now makes it unwieldy. [...] Reports should always go through controllers in some way to prevent everyone from developing their own reports, it should be controlled.*" (SportRetailer)

At the same time, reducing information access affects the *global transparency.* To reduce information overload, SportRetailer has structured its Qlikview applications after business functions: sales, logistics, assortment, procurement, stores etc. For each department, this reduces global transparency:

> "*If a root-because analysis is going to be performed, more information [than in the reports] needs to be retrieved and arranged in Excel and then sent back. 'We see that these are the reasons causing the deviations'. Preferably one wants to drill-down in the report, but it's not always possible.*" (SportRetailer)

This represent a difficult trade-off between transparency and information overload. On the one hand, too much information requires screening of information and is time-costly. On the other hand, with restricted access to information, analysis has to be performed centrally by the business controllers. Further, without a common data access, this has also caused frustration among business controllers:

> "*Even we experienced users [controllers] can have a hard time finding where the information is; it's not good when it comes to that, which is why we need to look into it. All the information is there, but sometimes you need to go to one Qlikview application for sales or inventory, then the next for order flow and a third for something else.*" (SportRetailer)

However, what previously was impossible due to technological reasons now becomes feasible, where BI now can create a fully integrated data set which would enable controllers to get a holistic view:

> "*It could be that we [controllers] have an application with most of the information, but not so many users; potentially in Qlikview or somewhere else. It's quite an extensive task, but we need to do the work.*" (SportRetailer)

The reasoning behind how much *flexibility* that is sought after in the BI tools at SportRetailer was related to tightness of control. Currently, the control systems are to a large extent a legacy of the decentralized management control. Instead of using the data for BPM purposes, it is used to equip the users with information and self-monitoring. The business controller remarked on this decentralized way of doing performance management:

> "*You don't have an influence and you're not controlling but you have to work on other things. I chose to work with the BI solution: equipping the stores with Qlikview.*" (SportRetailer)

Additionally, several of the KPIs do not have targets, giving users freedom to select which KPIs to focus on:

> "*We measure them, but there is no budget on them in Qlikview. [...] the KPIs can be used to benchmark against previous years and other regional stores*" (SportRetailer).

However, the shift to a more centralized approach has initiated a tighter control. The plan is to have fewer KPIs, but include targets for the KPIs used together with a BPM methodology. This way, SportRetailer can work more effectively with its diagnostic control system and act upon deviations.

> "*We're moving to a more homogeneous control, and tighter. We have to do it; to reap the benefits of what we can do now that the centralization is done. [...] The idea is that we can also control and say that this period we focus on hitrate [a KPI measuring the ratio of purchasing customers] due to low visitor number.*" (SportRetailer)

In total, SportRetailer's BI tools originally exhibited enabling characteristics. By letting users freely develop their reports, they could customize them to fit their respective needs. Additionally, without targets for the KPIs they acted primarily as tools for self-assessment rather than being included in the diagnostic system. In parallel, this has led to information overload. To mitigate this and achieve a more homogeneous management control, autonomy in its BI is in the process of being reduced. Different use-cases are being identified, to simplify for casual users and make the BI tools more powerful for power users (controllers). Table 5 summarizes the findings on how the BI tools are used for management control and its implications.

Table 5: *SportRetailer: The BI tools, MCS supported and design of controls*

BI Tool	Lever of Control	Design of Control	Implications
Self-Service BI	Diagnostic, Interactive	Internal Transparency, Global Transparency, Flexibility	Dynamic reporting with drill-down capabilities, allowing for analysis and customization.
Data Analytics	Boundary		Automated decision making for inventory-refills.
BPM	Belief, Diagnostic	Internal Transparency	Moving towards homogeneous reporting, centralized control and signalling through KPIs. Reducing global transparency and flexibility.

4.2.3. PublicTransport: BI as a distribution and analytics tool

PublicTransport is responsible for all public transport in its region, ranging from trains to trams, ferries and buses. The company is owned by the region and its operation is financed through roughly 50% in revenues and the rest in subsidies by the region; in 2015, its revenues were SEK4 billion, with an equal amount in subsidies. PublicTransport is in charge of the infrastructure, transport services and stops while it subcontracts all operating activities. The organization is divided into three units: supply, development and sales/market with a total of over 300 employees.

For information purposes, however, PublicTransport also needs to reach all 9000 employees involved in its operations indirectly through its subcontractors. Consequently, its task is to find a BI solution supporting the work of its employees, while still being flexible enough to provide all external users with information.

The organization uses a multitude of systems to support its operations. The data used in the BI tools comes primarily from three sources: ERP system, sales system and specialized niche software. With similar information residing in several systems, the data layer is managed centrally to ensure consistency in definitions and information. Although using external data for various purposes, PublicTransport does not currently integrate it into its BI. When looking at external data, it is used in an ad-hoc manner, resulting in a report. Further, the data used in the BI tools is primarily quantitative data in structured form. The controller commented on the difficulty to communicate non-quantitative data of strategic importance:

> "*We have a few questions that are essential that everyone is engaged in. Unfortunately, they don't have an exciting number, but then you have to find another way to show it anyway.*" (PublicTransport)

For PublicTransport, this was especially the case with communicating the vision and mission, discussed more in the next section on the levers of control supported.

Moreover, reports and data are presented using an organization-wide intranet. During the time of the interview, PublicTransport is also in the middle of an ongoing process of creating a BI portal to facilitate information retrieval and integrate these various use cases. The objective is to create a two-sided BI solution where readymade information and BPM use is combined with access to self-service BI and data analytics. The next two sections outline PublicTransport's use of BI to support its MCS and how it balances the enabling and coercive characteristics.

Levers of control supported by the BI tools

PublicTransport is planning on using BI to support the *belief system* in two ways. First, by communicating its vision and mission using a balanced scorecard and strategy map:

> "*In that control system [vision and mission] there are a number of targets. These goals are what I see before me on the front page [of the BI portal]. That becomes PublicTransport's outside: 'look, these areas are important'.*" (PublicTransport)

This way, it is possible to communicate important areas and redirect attention to critical activities. The second way in which PublicTransport aims to use BI for the belief system is by sharing its vision and mission through interactive content. Even though the information might not change, the controller sees benefits with including it in the BI portal to diffuse it widely:

> *"We have a [strategic] pyramid with a few ingredients used for controlling and the idea is to present them using sound and image, so that everyone can see them and have them explained. They will never change, but something happens when you look at them. What's important is that it's available, everyone can access it."* (PublicTransport)

Next, the *boundary system* is currently unsupported at PublicTransport. However, using data analytics and statistical methods the organization is looking into the potential to use big data analysis to better predict traffic conditions. Although in its test phase, such information could be used at an operational level to reduce traffic during certain weather conditions such as extreme cold.

In contrast, BI is actively used for *diagnostic control system* purposes. Centrally, BI is used to combine data from the various systems to one data layer thereby ensuring data quality. Data in the systems use different definitions, therefore this process of extracting, transforming and loading the data into a common database is essential in securing consistent information:

> *"You can't just take the total sum [from a system] and present it as number of travellers, because all information needs to be cleaned, adjusted and remade."* (PublicTransport)

Subsequently, the data is used for both self-service BI and BPM. To analyse sales, PublicTransport uses the self-service BI tool Qlikview. In Qlikview, users are able to drill-down and analyse sales based on sales channel, product category, time etc. In addition, the organization is in the process of using BI more extensively to monitor its balanced scorecard and reporting. Currently, part of the process is done manually and reports are either published in static form on the organization's intranet or sent personally.

Using a strategy map PublicTransport links its balanced scorecard to activities and KPIs from a strategic to tactical and operational level. This way, performance can be viewed on an aggregated level, while still allowing drill-down and root-cause analysis within the BI portal.

Additionally, by using BI the organization hopes to both give more users access to information while also automating reporting:

> *"We're experiencing a dilemma, it should be that additional users get access to a bit more information, in an easier way. [...] A part of my task becomes to balance this and make sure we still keep our principles of data quality and understandability."* (PublicTransport)

> *"BI is what we've chosen for the reason that it [reporting] requires a lot of time today. When someone needs information, he often has to go to the controller group because we have access to all systems. It requires a lot of manual work, which we want to reduce."* (PublicTransport)

Consequently, one of the benefits with BI for reporting is freed up resources which can be put into the *interactive control system*. Using self-service BI tools, users have access to a wide range of KPIs and information in their respective areas and are freely able to select, filter and analyse the information. By governing all information centrally, this ensures that everyone looks at the same data creating a unified picture.

Moreover, PublicTransport is discussing the possibility to link the diagnostic control system and the interactive control system using BI. Currently, BI is used solely to extract information for analysis. Linking the information with the insights drawn from the analysis would help bridge the gap between the diagnostic and interactive control system:

> *"In reality, two things happen: there is a follow-up and analysis of KPIs because there is a deviation. Then, hopefully a decision on measure is taken. That's how it works in reality. In BI, we're discussing if we can include at least the output of the analysis in BI. So that when you see the red figure, you can click and read an explanation from the accountable person."* (PublicTransport)

This way, the BPM tool can include both historic data as well as planned activities.

Finally, data analytics is used to support the *interactive control system*. This occurs in a two-step process where first analysis is performed, and then insights and output

of the analysis are communicated using a report. When discussing data analytics and big data, the controller commented on the technical expertise needed to perform analysis:

> *"[Advanced analytics] is not easily accessible. It's not only a matter of getting an idea and test it, you also need a resource who can carry out the analysis in practice, and use these statistical softwares."* (PublicTransport)

Subsequently, in order to act as decision basis and be used interactively the results need to be interpreted and made available. Insights need to be made understandable, as all users do not possess the necessary statistical competence, and therefore usually end up in a report format:

> *"The analysis falls into some sort of a report. You could make the data available, but it's more likely to be a report which is used as decision basis in meetings and discussions on future action plans."* (PublicTransport)

This way, information in the report can be explained and made understandable.

Altogether, PublicTransport is in the process of adopting BI to support the *belief system, diagnostic and interactive control system* and testing the potential to use it for the *boundary system.* To achieve this, the BI portal was an important component where the organization aspires to join self-service, BPM and data analytics. The idea is to create a central point of information access with secured data quality, where users are able to retrieve information catered to their specific need.

Enabling and coercive design characteristics of the BI Tools

The concept of enabling and coercive design is central at PublicTransport. With the objective to equip more people within the organization with BI, this has to be balanced with maintaining control over what information is distributed and how it is used. This has implications on the balance between an enabling and coercive design as some parts of the BI tools need to be coercive to achieve this, and vice versa.

PublicTransport manages its data centrally, and uses a common set of data definitions. This reduces the *repair* characteristic as KPIs, measures and data access are predetermined:

> *"There is a number of special measures such as vehicle kilometre, passenger kilometre etc. This information exists in several systems; therefore, we work with ensuring that when we look at this then it's really the same thing."* (PublicTransport)

At the same time, it creates a foundation on which a more distributed BI use can be achieved. With ambitions to reach a greater number of all the 9000 workers involved in PublicTransport's operations, information needs to be understandable. With well-defined concepts, *internal transparency* is increased in the BI tools, while the risk of drawing faulty conclusions is mitigated by limited access:

> *"It's very important that information access is controlled. The more information available, the stricter requirements on making it understandable in order for the user to directly understand what it sees. The higher up you get, the more prepared [information]. You can't 'mess up' by selecting/filtering wrongly."* (PublicTransport)

> *"The challenge is if you have the ambition that the user should always draw the right conclusion from what it sees - always - then it's a challenge to balance and not give too much information which could lead to the wrong conclusion."* (PublicTransport)

This represents a balance between *internal transparency* and *global transparency* on one hand and information overload on the other. Using a central data layer, the organization is working towards creating a two-layered access with BI where both a "window" and an "inside" exist:

> *"Every area presents itself, e.g. sales get to tell: 'this is what we want to show'. Not what we want to* ***work*** *with, but what we want to* ***communicate****. When you come as an outsider, you can choose an area and see its performance. The other side is deciding what we want access to as insiders in order to analyse and dig deeper. It becomes an inside and an outside.* [emphasis added]" (PublicTransport)

This way, both internal and global transparency is increased while information overload is avoided. The planned use of a BI portal will also increase global transparency, as all areas will present their 'window' together with an organization-wide scorecard, helping employees

get a better understanding of the different parts of the organization.

Finally, *flexibility* of the BI tools is divided into three levels depending on the use case: presentation, self-service and drill-down analytics. At the highest level is presentation of prepared information and reports. At the second level, users are allowed to take part of the information and choose what to look at, filter and select among predefined measures. E.g. sales are analysed using Qlikview, using information from both the ERP system and sales system. Finally, at the lowest level, analysts are allowed to drill into the data performing more advanced analytics using statistical software packages.

In total, PublicTransport utilize BI purposely to balance enabling and coercive aspects. Data quality is controlled centrally, while the use of the system is highly distributed. A BI portal is in development to integrate the various systems and create a unified access point. Additionally, BI 2.0 and big data are in test phases where potential use is evaluated. Table 6 summarizes the findings on how the BI tools are used for management control and its implications.

5. Discussion

The following chapter discusses the findings made, synthesizing the results from BI consultants and use within the case organizations. First, what BI tools are used and the information sources they utilize are discussed. Next, the support of each lever of control is discussed based on the findings from the case organizations. Finally, the chapter ends with a discussion on how the BI tools are designed.

Although the empirical results support the notion of BI as an integrated MCS, they are not used holistically per se. Instead, BI forms a common tool which can be used for management control, nevertheless, it is still up to the managers to balance the emphasis of the various control systems. In turn, BI should also be viewed as a composite MCS, made up by self-service tools, BPM tools and data analytics tools with each one supporting the overall management control in different ways. Additionally, depending on management's intention the BI tools can also be designed in either a coercive or enabling way.

BI tools and information sources

The three case organizations showed different levels of BI adoption, from VehicleTechnology with a cost management tool to PublicTransport moving to an integrated BI portal. Consequently, which BI tools that were used by the organizations differed, and they were used for different purposes. *BPM* was primarily used as an automation tool, preparing predefined reports and distributing them throughout the organization. Emphasis was put on efficiency and the potential to reduce the manual parts of reporting. Both the consultants and the organizations regarded this as one of the major benefits. This is in line with Turban (2011), who discusses BPM in terms of its reporting and monitoring capabilities. However, in contrast with Eckerson (2009), who discusses BPM in terms of an information pyramid where the strategy is cascaded into KPIs and operational measures, the consultants found that this part of central governance and strategy breakdown too seldom was performed. As such, the higher

Table 6: *PublicTransport: The BI tools, MCS supported and design of controls*

BI Tool	Lever of Control	Design of Control	Implications
Self-Service BI	Diagnostic, Interactive	Internal Transparency, Flexibility	Empower users with access to information, drill-down capabilities and several measures.
Data Analytics	Boundary*, Interactive	Internal Transparency, Flexibility	Testing potential of big data for operational decision, data analytics used to make data-based decisions and test hypothesized relationships.
BPM	Belief, Diagnostic	Internal Transparency, Global Transparency	Automate reporting, gather information, redirect attention using scorecard and facilitate information retrieval

* Currently in test phase

the organizational level, the harder to achieve a consistent control. The consultants argued that this was due to BI projects traditionally being owned and managed by the IT-department. Consequently, they become skewed towards efficiency and cost saving, while business applicability is obscured. Another reason is that BI projects have been initiated and implemented on a department-level. This leads to inconsistencies in data when trying to aggregate to a strategic level.

Next, *self-service BI* was also used for MCS purposes. These tools were used to allow the users to explore the data by filtering, selecting and visualizing. This enables dynamic reporting, increasing user freedom while still maintaining control over data quality. This possibility of governance was a differentiating factor compared to working with spreadsheets. This was also a major reason for adopting self-service BI at VehicleTechnology: to allow users to access the data in the ERP system without working in their own spreadsheets. All three organizations utilized self-service to some extent depending on user level and purpose with BI. At SportRetailer, for example, self-service tools had been used at all levels. This had caused information overload at lower levels, and the organization was now moving towards less self-service to increase clarity and understandability. This way of designing BI tools was reinforced by the consultants, who emphasized the different needs at a strategic, tactical and operational level and how these need to be coherent.

Finally, *data analytics* was used for management control at SportRetailer and PublicTransport. Its use was not as widespread as the other BI tools, and it was typically performed centrally. At SportRetailer it was used to automate decisions, and at PublicTransport it was used for statistical analysis and mathematical modelling, primarily acting as input for strategic discussions.

Overall, the organizations still used BI from a BI 1.0 approach, consistent with Chen et al. (2012). Accordingly, BI primarily utilized internal data, mainly from the ERP systems. Neither of the organizations used BI with external data, still struggling with levering all internal data. PublicTransport has tested using external data and big data analytics to predict traffic conditions, but it is not used in production.

This suggests that how to use BI with external or unstructured data is not yet fully understood, and the lack of commercial products (Chen et al. 2012) leaves it in the hands of BI consultants and organizations themselves. Currently, it is in test phase where proof of concept is evaluated. The consultants provided several plausible explanations as to why external data is not widely used. First, a lot of organizations still struggle with their internal data and achieving a high data quality. This obstructs integration of external data, which might require cleansing and transformation to a format consistent with the internal data. This process can be difficult, as the external data can also be a different type of data such as qualitative or even text data requiring a common denominator to be found. Further, there is a lack of ownership, hindering data management to be performed, something that halted VehicleTechnology's efforts to integrate data from its parent company. Second, external data can be subjective, and might also be associated with uncertainty. Finally, there appears to be a lack of knowledge in how it can be utilized, especially true for unstructured data. This view was shared by the case organizations, who were aware of the possibility to extract external data, but uncertain how to leverage it in their business.

Interestingly, these findings are at odds with Forsgren & Sabherwal (2015) who find that part of BI's potential for MCS is its *outside-in* capability to integrate external data. One reason for the inconsistent findings is that the article measures preference as opposed to adoption. Additionally, organizational level is another variable. Both the consultants and case organizations found BI to be used most extensively on a tactical and operational level. Difficulties with aggregating data as well as senior-management preferring prepared reports made BI less prevalent at a strategic level.

Levers of control supported by the BI tools

The findings from the studied cases corroborate the notion of BI as an integrated MCS (Elbashir et al. 2011), able to support the various levers of control. However, as table 7 depicts, BI is not used holistically per se, but needs to be balanced according to organizational needs. Further, each BI tool is capable of supporting the various control systems in distinct ways. The belief and boundary system were least supported by BI, while all organizations used BI for the diagnostic and interactive control system.

The *belief system* was only supported by BPM, which helped communicate the vision through having an explicit breakdown of strategic priorities into KPIs. This way, the organizations could centrally communicate their values and redirect search behaviour by periodically emphasizing critical measures. This was in line with the

Table 7: *Type of control systems: levers of control and the supporting BI tools*

	Organization								
Lever of control	**VehicleTechnology**			**SportRetailer**			**PublicTransport**		
	SSBI	*DA*	*BPM*	*SSBI*	*DA*	*BPM*	*SSBI*	*DA*	*BPM*
Belief system						✓			✓
Boundary system					✓			✓*	
Diagnostic sontrol system	✓		✓	✓		✓	✓		✓
Interactive control system	✓			✓			✓	✓	

SSBI = Self-service BI, DA = Data Analytics, BPM = Business Performance Management

* Currently in test phase

view from the consultants, who saw the benefit of using BPM to monitor a scorecard. Another way in which PublicTransport wanted to communicate its vision and mission was through sound and image in its BI portal. This way, the organization can communicate them alongside its performance management, providing a novel way of including non-quantitative information. The consultants also noted on the potential impact on the belief system from adopting data analytics. In order to leverage data analytics, an organization needs to change to a *data-first* decision philosophy. As a result, data analytics both support the belief system, as well as impacts it, suggesting a bi-directional relationship. This was the case at PublicTransport, where the use of data analytics had resulted in the development department being divided in two parallel tracks: operating activities and projects. This way, the organization could allocate resources to explorative activities such as testing patterns and relationships while still performing its daily operations efficiently.

Next, the *boundary system* was supported by data analytics. SportRetailer used data analytics to automate order refills, thereby centralizing procurement and delineating the operational activities of its stores. Likewise, PublicTransport evaluated the possibility to use data analytics to support its boundary system by predicting traffic conditions and deciding whether to stop traffic services or not. Another way to support the boundary system, as suggested by the consultants, is through BPM. At an operational level, BPM can produce a backlog containing task to be performed in the short-term.

The *diagnostic control system* was supported by both self-service BI and the BPM tools. However, they differed in terms of how they were used and at what organizational level. Self-service was typically the tool used by controllers, giving them access to a large amount of data, and the flexibility to filter and select what to look at. They were also used to analyse deviations and perform root-cause analysis through drill-down capabilities. BPM, on the other hand, was used throughout the organization. One of the primary benefits with this was automating reporting, reducing time spent on preparing reports allowing it to used on more value creating activities. Additionally, by using exception-based reporting, reports could be designed to highlight deviations. The use of BI to support the diagnostic control system was quite similar in the case organizations, and also in accordance with the consultants' view, with the variable factor being how much information that was presented. Moreover, the consultants reinforced the importance to have governance over definitions and measures to ensure consistency in the reporting. Also, in order to support the diagnostic system at a strategic and tactical level, BI needs to be managed centrally to secure data quality and master data management.

Finally, BI supported the *interactive control system* through self-service BI and data analytics. By integrating data, it promotes a holistic approach. Nevertheless, a prerequisite in order to be suitable for interactive use is consistent data. Without common definitions, the information in the BI tools is not appropriate as decision basis, due to subjectivity and lack of trust in the information. Once the data and measures are quality assured they can be used in the interactive system. Allowing users to twist and turn, filter, visualize and analyse the data self-service BI encouraged users to be inquisitive. In the studied organizations, this analysis would then also be

discussed in meetings, acting as decision basis. Similarly, data analytics encourages users to look at the data, but is performed centrally, and enables an organization to use more advanced statistical methods to look for patterns in the data. Due to the technical competence this requires, the insights made are presented in report form and act as decision basis when making strategic decisions.

Overall, BI was found to support all levers of control, consistent with Elbashir et al. (2011). By finding support for the belief system and boundary system, the findings also extend Forsgren & Sabherwal (2015) by identifying support for all four levers of control. However, in contrast to Forsgren & Sabherwal (2015) who found that the interactive control system is supported by an *outside-in* capability, this study suggests that it is through integration of internal data and the possibility to analyse this data that BI supports the interactive control system.

Enabling or coercive design

The case organizations exhibited varying levels of enabling characteristics in their BI tools. In addition, differences were also found between each BI tool. Table 8 summarizes the enabling and coercive design of the various BI tools at the three case organizations. VehicleTechnology's BI was designed in the least enabling way, followed by SportRetailer who used self-service BI in an enabling way and BPM coercively. Lastly, all PublicTransport's BI tools exhibited enabling features.

However, neither of the organizations' BI tools exhibited the *repair* characteristic. At VehicleTechnology the task of reconfiguring the BI tool was seen as too difficult, as the organization lacked an IT-department which could handle this. In contrast, at SportRetailer and PublicTransport the decision to not allow repair has been deliberate. The choice was also consistent with the consultants' opinion to manage the BI centrally. Doing this enables organizations to quality assure their data and work with common definitions, allowing the *use* of the BI tools to be more enabling as users would work with the same data and definitions.

Providing consistency in the information resulted in the BI tools increasing *internal transparency* in the MCS. Common to all organizations were that the BI tools provided the users with relevant information *faster.* Automating the task of reporting shortened the time required to collect and prepare reports, allowing the organizations to take more timely decisions and gauge their performance using current information. This was leveraged through self-service BI and BPM, which were present in all three organizations. Data analytics, however, was used to increase internal transparency in a different way. Using statistical methods, hypothesis of expected business relationships could be tested. This can help an organization discover patterns in its data, test the validity of its ideas and foster a data-driven decision process.

Further, BI affected *global transparency* in different ways, depending on the objective with BI from the organization. On the one hand, information integration was an obstacle in achieving global transparency. VehicleTechnology, for instance, struggled with integrating data from its parent company, as it was inconsistent and the organization did not have the authority to change it. This issue was also emphasized by the consultants, who cautioned against using BI in silo form as it would obstruct the aggregation of data. On the other hand, was the deliberate decision over *how much* information

Table 8: *Design of BI: Enabling or coercive attributes of BI tools*

	Organization								
Enabling characterstic	**VehicleTechnology**			**SportRetailer**			**PublicTransport**		
	SSBI	*DA*	*BPM*	*SSBI*	*DA*	*BPM*	*SSBI*	*DA*	*BPM*
Repair									
Internal Transparency	✓		✓	✓		✓	✓	✓	✓
Global Transparency				✓					✓
Flexibility	✓			✓			✓	✓	

SSBI = Self-service BI, DA = Data Analytics, BPM = Business Performance Management

to share at each organizational level. This was characterized by a balance between increasing global transparency and causing information overload. SportRetailer used its self-service BI tools to allow the controllers to look at all the information, while a selected amount of information was distributed through BPM. Similarly, PublicTransport used a BI portal and BPM to present overall performance. Regardless of the tool used, both of the organizations managed information access based on who the user was to reduce information overload.

Flexibility was determined by how the organization wanted to use the BI tool. Full flexibility would mean that the users could include whatever data they liked (Alpar & Schulz 2016). This was only allowed in data analytics, where data was used for test-purposes and the users had the required competence. In the self-service tools, users were allowed to select, filter and visualize freely but worked on a predefined data set with predefined logic. This way of working was encouraged by the consultants, as it enables the data to be used interactively while still having governance. Flexibility was also one of the divides between self-service BI and BPM, where BPM were used for standardized reports. Again, the degree of flexibility was up to the organization and depended on the tightness of control. SportRetailer was moving from using self-service BI at all levels to BPM at the operational level. This way, analysis can be managed more centrally and the organization can achieve a more homogeneous management control. In contrast, PublicTransport was pursuing the opposite change, where it wanted to equip more users with more information allowing them to make sound decisions.

Altogether, the findings suggest that BI can be designed in both a coercive and enabling way, depending on which BI tool is used, and the organizational objective with it. Nevertheless, central governance of data quality and definitions, a coercive characteristic in itself, acted as a prerequisite to achieving truly enabling BI tools *on all organizational levels*. This is consistent with Chapman & Kihn (2009) who conclude that information system integration was a mediating factor to an enabling use of management control. However, it is at the discretion of the organization whether it wants to use it in an enabling or coercive way. BI can be designed to fit both MCS purposes. At VehicleTechnology, BI was partly used to formalize information-flow, SportRetailer used it to have a homogeneous reporting and PublicTransport used it so it could show one picture of the organization and create a common foundation for autonomous use. Consequently, it can be catered to organizational need, as well as adjusted based on organizational level.

6. Concluding Comments

This final chapter concludes the study by addressing the research questions and discussing theoretical contributions. In addition, managerial implications and potential limitations are discussed followed by suggestions for future research.

Prior research has identified BI as related to management control, but does not address how. Consequently, this study has sought to explore more in depth how BI is or can be used for management control. This was achieved using three guiding research questions, operationalized in the analytical framework developed in section 2.4. The analytical framework helps to answer which BI tools are used for MCS purposes, what levers of control they support and if they are designed in a coercive or enabling manner.

The findings in this study suggest that organizations can use several different BI tools simultaneously, and that they each support the MCS differently. First, business performance management tools were most widely used, automating the reporting process. Second, self-service BI was used at higher levels to enable users to navigate through the data freely. Third, data analytics was performed centrally using statistical methods. Common for all BI tools were that they exclusively used internal data, where external data was analysed separately.

The study also found BI to support all four levers of control, reinforcing the concept of BI as an integrated MCS. Nevertheless, a balance between the different levers of control was not achieved automatically, requiring BI to be put in relation to the overall management control. How each BI tool supported the different levers of control also differed, with no single tool supporting all levers of control.

How BI was designed partly depended on the BI tools, as they supported a coercive or enabling design differently. Additionally, the study also suggests that whether BI is designed coercively or not is also up to the organization. The BI tools can be used at different organizational levels for different purposes, therefore it is neither coercive nor enabling per se.

Theoretical contribution

The current study contributes to existing literature in several ways. First, it adds to the literature on BI as an integrated MCS by studying it in relation to the whole management control (Elbashir et al. 2011). The findings from this suggest that although BI can be viewed as an integrated MCS, it does not support all control systems equally much. Consequently, BI can not be expected to automatically balance the MCS but has to be regarded as one piece of the whole management control. Moreover, the study extends Forsgren & Sabherwal (2015) by also incorporating the belief and boundary system. As such, it contributes with how BI can support the overall management control. Additionally, interrelations between the control systems were found, where each BI tool can have impact on several control systems. In light of this, when studying BI as an integrated MCS it is important to include all levers of control.

Second, BI literature has primarily been discussed in terms of its enabling capabilities (Gnatovich 2007, Chapman & Kihn 2009, Alpar & Schulz 2016). Although the findings support the possibility for BI to be designed in an enabling way, it can also be designed coercively by formalizing information-flow and centralizing control of information. Consequently, it is proposed that how BI is designed is dependent on the tightness of control, and therefore at the discretion of the organization.

In addition, the study also contributes to AIS literature by identifying a gap in knowledge between BI capabilities and BI adoption. On the one hand, BI literature discusses the possibilities of joining external data or utilizing big data (Chen et al. 2012), fully autonomous self-service BI (Alpar & Schulz 2016) or text analytics (Chaudhuri et al. 2011). These are the technical capabilities of BI. On the other hand, this study found that organizations still struggle with their internal data quality and do things manually. Further, the business is not aware of all the possibilities with BI. In light of this, AIS literature need to approach the question of BI adoption from a non-technical perspective, increasing business managers' BI maturity.

Managerial implications

Similarly, the study also has managerial implications as the findings present suggestions on how to use BI to support management control. More importantly, the findings emphasize the importance of BI being managed at a strategic level. This way, the organization can control data quality and create common definitions thereby enabling data to be aggregated from an operational level to a tactical and strategic level. Otherwise, BI will be skewed towards efficiency and not look at effectiveness, creating a silo formed solution which might lead to suboptimal decisions when viewed from a strategic level.

Limitations to the study

The study is subject to several potential limitations. Although a multiple case study was used, a limited number of respondents were interviewed. As such, findings may be difficult to be generalized to other settings, but on the other hand they provide a rich description on the use of BI and can be useful in other settings by comparing conditions. Further, the study has used BI consultants to get an understanding of the potential with BI. Likely there exists idiosyncratic BI solutions, developed internally by organizations therefore falling outside the scope of the BI consultants' knowledge. Notwithstanding, they give an account of the potential use of BI offered by larger BI vendors. In addition, the study is made from a controller's perspective. Nevertheless, the controllers could give an indirect view of how BI is used elsewhere, and all respondents were involved in the BI project of their respective organization.

Future research directions

The findings of the thesis suggest avenues for further research on the relation between BI and management control. The study synthesizes an analytical framework that aims to capture how BI is used for MCS purposes. Further testing is required to determine its validity.

Additionally, while much of the research on BI has focused on its technical capabilities, the current study indicates a gap in knowledge and BI maturity among organizations. Therefore, further studies are needed on how BI investments are performed, as well as determining the BI maturity. For example, BI maturity could be studied as a mediating factor between BI use for MCS and perceived system success or control systems supported. This would help assess the importance of increasing BI maturity in order to leverage it for new MCS and not only support old control systems.

Finally, future studies might benefit from differentiating between organizational levels. This study identi-

fied differences in BI use between organizational levels, with higher level management experiencing larger difficulties in using BI. More emphasis on qualitative data, subjectivity, IT-owned BI projects and difficulties with integrating all data are possible explanations suggested from this study. Future research could investigate this further through in-depth studies across organizational levels shedding light on variances in BI use within an organization. Interviewing users at each organizational level would also allow to study the perception of control in addition to design.

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Appendix A Interview Guide used with the case organizations (adapted for BI consultants as appropriate)

A.1 Part 1 - Context and Responsibilities

How many years of experience within business intelligence and management control? How long have you worked in the company?

- What is your professional role and primary work tasks?
- Which are your key responsibilities?

What does your IT-infrastructure look like, what different systems do you use?

- What different BI tools do you use?
- What information to they utilize?

A.2 Part 2 - Levers of control supported

To what extent is BI used for the following management control systems:

- Budgeting and planning
- Analysis of sales
- KPIs & Scorecards
- Policy documents / code of conducts
- Communication of vision and mission

How is it decided? How are the control systems communicated?

Is there any control which is working not as good, why? How could you improve control?

A.3 Part 3 - Enabling or Coercive use of BI tools

Who uses BI within the organization? Is it used as a report tool and/or analysis tool?
Prompts:

- If only for reporting, why not analysis?
- How is analysis performed?

How much information is made available to the user?
Prompts:

- Area-specific, restricted access, organization-wide data

Are the users able to question the data in the system such as budget figures? Are users allowed to freely choose information and KPIs? What degree of freedom does the users have in determining how much BI is used?

What difficulties/challenges do you experience with BI? What possibilities?