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# *Practices that organizations employ to enhance business intelligence agility*

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# Practices that organizations employ to enhance business intelligence agility

Master's thesis

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**Abstract**

In today's rapidly changing business environment, organizations strive to be agile in order to accommodate changes and seize opportunities. Since organizations use information system as a tool to serve their needs, it is important for these systems also to be agile. One prominent type of such systems is business intelligence, which provides organizations with information to gain and retain competitive advantage. This thesis focuses on business intelligence agility, which is widely discussed in practice however not extensively covered in information systems literature. Therefore, this thesis seeks to identify the practices employed by organizations to enhance business intelligence agility. To find the answer to the research question this thesis first compiles a theoretical framework on business intelligence, information systems agility in general and business intelligence agility in specific using academic literature and market white papers. This compiled framework is comprised of four enabling factors 1) sensing business changes, 2) development approach, 3) IT governance, and 4) technical factors. This thesis conducts a qualitative research based on semi-structured interviews with business intelligence experts. Based on analysis of the empirical data this thesis identified a set of practices organized in terms of the enabling factors. The practices in sensing business changes are enabling business staff to sense changes and incorporating business staff feedback into data requirements. Regarding development approach, this thesis identifies the practices as applying an iterative development approach, building collaborative team of skilled members, enabling a centric role of business staff, reducing use of approval documents and learning from each project. In IT governance, applying a centralized or decentralized development were the two practices. Regarding practices in technical factors, this thesis identifies integrating data through either building an enterprise-wide data warehouse or applying an appropriate modeling approach while managing multiple data warehouses, using multiple front-end applications, and adopting cloud business intelligence. The findings of this thesis provide organizations with a pool of practices that can be used to enhance business intelligence agility.

**Keywords**: Business Intelligence Agility, Information Systems Agility, Business Intelligence, Development Approach, IT governance, Sensing Business Changes, Technical factors.

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I would like to thank my amazing family for the love, support, and constant encouragement I have gotten over the years. In particular, I would like to dedicate this master thesis to my parents. Without you, I undoubtedly could not have done this.

Saleh Mustafa

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# 1 Introduction

*This chapter provides background information regarding thesis topic and presents the problem area in specific. Then it describes the motivation for conducting this research which leads to the research question. Next, it demonstrates the purpose of the research and what contributions it has. Finally, it states the delimitation that scopes the research.*

## 1.1 Background and problem area

Organizations operate in rapidly changing business environment. In order to stay competitive, it is important for these organizations to react quickly to the occurring changes (Lönnqvist & Pirttimäki, 2006). In addition, organizations are using information systems increasingly to serve business requirements. Therefore, they seek to align information systems to their business strategies in order to attain their goals in gaining business value and outperforming their competitors (Chan & Reich, 2007; Luftman, 2004). To achieve these goals, information systems themselves should be agile (Hobbs & Scheepers, 2010; Tiwana & Konsynski, 2010; van Oosterhout, Waarts, & van Hillegersberg, 2006; Zimmer, Baars, & Kemper, 2012). Agility of information systems refers to the ability to react quickly and create changes promptly in order to meet business needs (Conboy, 2009; Dove, 2005; Hobbs & Scheepers, 2010).

One of the prominent information systems used today by organizations is business intelligence (Luftman & Derksen, 2012). Business intelligence aims at assisting organizations in the decision making process (Watson, 2009). However, it has grown to provide value to all functions within organizations at different levels: strategic, tactical and operational (Negash, 2004). Whereas, the main promise remains the same, to deliver the right information to the right people at the right time in the right format (Muntean & Surcel, 2013). Timely delivery of information is a very important factor for the success of business intelligence initiatives. In terms of functionality, business intelligence has evolved much in the past decade due to technological advances. However, business intelligence initiatives are still not fulfilling their intended objectives due to time constraints. For instance, many business intelligence projects are failing to deliver on time (Zimmer et al., 2012). This is attributed to many factors such as massive amounts of data, changing data, changing business requirements and shrinking decision window (White, 2011). The amount of data processed by companies is increasing vastly and accumulating exponentially. In addition, the data sources might differ in format and structure. More importantly, business requirements are continuously changing due to variations in the industry and organization. In all cases, managers are having less time to make decisions. Therefore, business intelligence, which is intended to support the decision making process, has less time to accommodate the required changes and thus has to be agile to fulfill its duties.

Furthermore, typical architecture of business intelligence consists of a repository of data that communicates with multiple operational and analytical functions for the entire organization (Chaudhuri, Dayal, & Narasayya, 2011). Due to the complexity of typical business intelligence architecture, business intelligence is difficult to adapt to changes rapidly (Muntean & Surcel, 2013). On the other hand, the aim of using business intelligence is to enable organizations to react fast and stay competitive. In order to increase business intelligence agility, multiple technology based solutions are introduced (Zimmer et al., 2012); and a number of agile software development methods are applied in order to make business intelligence development more agile (Knabke & Olbrich, 2013).

## 1.2 Motivation and research question

Organizations strive to align information systems initiatives with their business strategy in order to improve the organizational impact of information systems. Luftman and Derksen (2012) rank IT and business alignment as the third important issue for IT management. An important factor to increase this alignment is the agility of information systems (Tiwana & Konsynski, 2010). Furthermore, Luftman and Derksen (2012) rank business intelligence as the most important application and technology investment, with a history of ten years of being in top three out of fifty categories of applications.

Moreover, the topic of business intelligence agility is extensively discussed in practice. For instance, it has become one of the trending terms in the industry and there are many related surveys and white papers. However, the concept of agility in business intelligence is not researched enough in academia. A recent research by Knabke and Olbrich (2013) study the agility in business intelligence developments based on literature review and provide a framework for understanding agility in business intelligence. Furthermore, Zimmer et al. (2012) research empirically which business intelligence architectures companies are employing to enable agility. Muntean and Surcel (2013), based on literature review, suggest that agile business intelligence has three key components: agile business analytics, agile business intelligence development and agile information infrastructure. We find that there is a gap in academic literature regarding agility in business intelligence. Even the few publications on the topic are mainly based on literature review with limited empirical data. This research aims at empirically investigating the practices that enhance business intelligence agility in organizations by answering the following research question.

*What are the practices that organizations employ to enhance business intelligence agility?*

## 1.3 Purpose

The purpose of this thesis is to identify the practices employed by organizations to enhance business intelligence agility. This is done by understanding the factors that affect business intelligence agility. Business intelligence as a process is composed of multiple steps; and as an architecture is comprised of many components. Therefore, in order for it to be agile, all of the

steps and components should also be agile. A bottleneck in any of those steps or components would render the entire business intelligence system slow and thus hamper the business instead of assisting it. The findings of this thesis provide organizations with a pool of practices that can be used to enhance business intelligence agility.

## 1.4 Delimitation

This thesis is delimited to studying the practices that enhance the agility of business intelligence within organizations. It does not assess business agility within organizations nor does it measure business intelligence agility within these organizations. Furthermore, it does not study the effects of business intelligence agility on organizational performance. In addition, we consider studying hardware and software specifications out of scope for this thesis. Hence, this thesis does not consider specific business intelligence products or vendors that are discussed on the market of business intelligence.

# 2 Theoretical Framework

*This chapter provides the theoretical background upon which this thesis is based, by reviewing the relevant literature on business intelligence and agility. First, it introduces business intelligence by outlining its origin, definitions, process, architecture and benefits. Later, it clarifies the term agility in information systems and establishes the context within which it is used throughout this thesis. Then, this chapter describes the agility of business intelligence and elaborates on its enabling factors. Finally, it concludes with a compiled theoretical framework to base our research upon*

## 2.1 Business intelligence

One of the prominent information systems used today by organizations is business intelligence (Luftman & Derksen, 2012). Business intelligence aim at assisting organizations in the decision making process (Watson, 2009). However, it has grown to provide value for all functions within organizations at different levels: strategic, tactical and operational (Negash, 2004). Whereas, the main promise remains the same, to deliver the right information to the right people at the right time in the right format (Muntean & Surcel, 2013).

### 2.1.1 Business intelligence origin

Intelligence activities, in general, refer to collecting and analyzing information (Shulsky & Schmitt, 2002). The early use of intelligence was in military (Pirttimäki, 2007). In military context the term intelligence is used as synonymous of espionage. In the 1960s and 1970s businesses experienced the first real use of intelligence with the aim of gather marketing data (Pirttimäki, 2007). In the 1980s, organizations started to be more interested in analyzing the collected data (Gilad & Gilad, 1985). Because of the technological developments in the 1990s, the intelligence activities attained a significant role in the decision making process (Pirttimäki, 2007).

In a technology context, cognitive limitations of humans led to research for tools that support decision making (Paradice & Courtney, 2012). The early development of such systems was done in MIT and Harvard in the 1950s, However, it was in the late 1960s, that a significant contribution was introduced by Michael S. Scott Morton's doctoral dissertation at MIT, which aimed at supporting decision makers in planning for laundry equipment (Watson, 2009). Later, Morton proposed "management decision systems" as an umbrella term of decision support concepts. Moreover, decision support systems evolved due to technological developments like advanced computers, networks infrastructure, data storage, and visualization tools (Paradice & Courtney, 2012). Many research branches appeared like group decision support systems (GDSS) and computer support corporate work (CSCW). Even though the term "business intelligence"

was used in prior research, the term is attributed to be coined by Gartner's analyst Howard Dresner in 1989 (Watson, 2009). After which, the term was widely accepted in business communities in the 1990s (Chen, Chiang, & Storey, 2012) and used as an umbrella that covers all decision support systems (Watson, 2009).

### 2.1.2 Business intelligence definition

The definition of business intelligence concept varies according to the context (Kopáčková & Škrobáčková, 2006). Each definition reflects the perspective and understanding of the researcher (Pirttimäki, 2007). In order to form a discussion about business intelligence, this chapter proposes a number of business intelligence definitions. Comparing these definitions results in a number of shared points which enable the reader to understand the term business intelligence.

Some researchers considered business intelligence as a managerial tool that enables organizations to refine business information about competitors and business environment in order to stay competitive (Gilad & Gilad, 1985; Pearce, 1976). Other researchers consider business intelligence a complex process that converts raw data about customers and competitors to information of great value to organizations (Powell, 1996). Both groups focus on data external to the organization. On the other hand, a number of publications state the importance of internal data in organizations and consider business intelligence a process that refines collected data from internal and external sources (Barndt, 1994; Brackett, 1999)

Table 2.1 includes a number of business intelligence definitions that provide a richer image of what business intelligence is:

Table 2.1 Definitions of business intelligence

| |
|---|
| [Business Intelligence is] the processes, technologies, and tools needed to turn data into information, information into knowledge, and knowledge into plans that drive profitable business action. Business intelligence encompasses data warehousing, business analytic tools, and content/knowledge management. (Loshin, 2003, p.6) |
| BI [Business intelligence] combines products, technology, and methods to organize key information that management needs to improve profit and performance. More broadly, we think of BI as business information and business analyzes within the context of key business processes that lead to decisions and actions and that result in improved business performance. (Williams & Williams, 2010, p.2) |

The definitions stated above have many common points. First, both definitions state explicitly that business intelligence is not only a technology; rather, it is a combination of technologies and processes. Second, both definitions advocate that the objective of using business intelligence is to support decision makers with information that enhance the decision process. Third, both definitions state that business intelligence is deeply connected to business analysis. Finally, both definitions state that organizations use business intelligence in order to remain competitive and improve performance.

Based on the previous discussion in the scope of this research, we define business intelligence as information system initiatives comprising of technologies and processes to identify and collect data, then refine and interpret information in order to enhance the decision making for the sake of improving performance and gaining competitive advantage.

### 2.1.3 Business intelligence process

Business intelligence collects data, converts it to information, which decision makers use to create knowledge (Negash, 2004). In order to establish a better understanding of this process, it is important to understand the difference between the concepts of data, information, and knowledge. This difference is demonstrated in the pyramid of abstraction which is illustrated in figure 2.1.

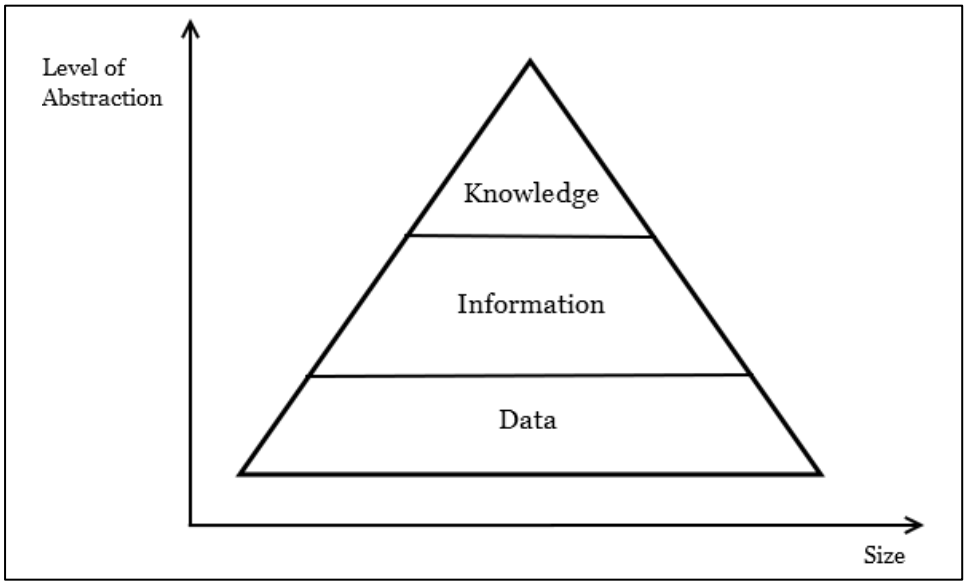


Figure 2.1 Pyramid of abstraction (Loshin, 2003, p.4, modified).

Data refers to raw elements that are not related to a context. These elements include text, images, numbers, characters, and strings. Data represents the first level in the pyramid of abstraction. The receiver of data cannot make use of it since it is not presented in a context. Structuring data, by putting it in a context and building relations between data items, results in what is called information (Loshin, 2003), which is the second level in the pyramid of abstraction. Information is then turned into knowledge when the receiver processes the information and connects it to his mental structure (Pirttimäki, 2007). Thus, the third level of the pyramid of abstraction is knowledge. In this context, the upper levels are more abstract and the process of moving upwards reduces the size of details that decision makers have to deal with.

In general, business intelligence is described as a continuous process (Gilad & Gilad, 1985; Williams & Williams, 2010). Many researchers proposed models that describe the cycle of business intelligence. Each model divides the business intelligence cycle into multiple stages that may vary in names but they perform similar tasks (Pirttimäki, 2007). In the following paragraphs we highlight the models proposed by Gilad and Gilad (1985), Powell (1996), and Pirttimäki (2007) and we conclude with our understanding of business intelligence process.

Gilad and Gilad (1985) propose a model that divides business intelligence process to five main stages: collection, evaluation, storage, analysis and dissemination. Each stage processes the output of the previous stage and subsequently produces input for the next stage. Furthermore, the model shows that each stage reduces the information load, which enhances the decision maker's work.

Powell (1996) proposes business intelligence value chain model, which divides business intelligence process into six transitions. The business intelligence value chain starts with data collection, which leads to an amount of data. The second transition is aggregating the collected data in a structure that produces information. The third transition is analyzing the information which leads to knowledge. The fourth transition is communicating the knowledge to the decision maker. The decision maker makes a decision which is the fifth transition. The sixth transition is the execution of the decision which produces results.

Pirttimäki (2007) proposes a generic business intelligence process model based on a review of the business intelligence literature. The model divides the business intelligence process into five phases which are illustrated in figure 2.2.

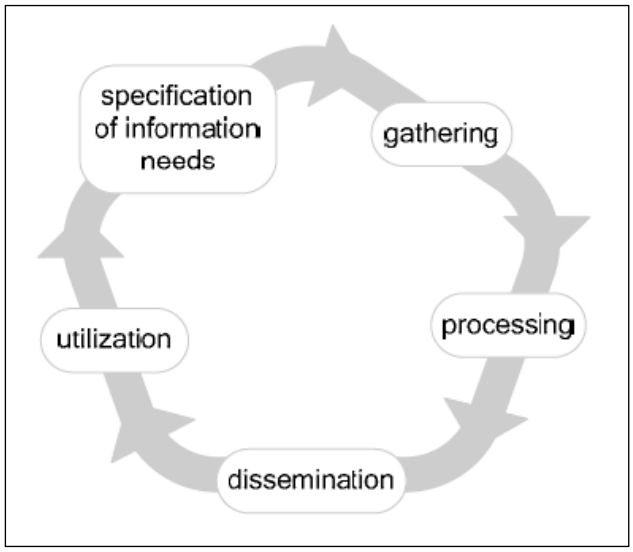


Figure 2.2 Typical phases of business intelligence process (Pirttimäki, 2007, p.74).

The first phase is identifying the related information. In this phase it is important to select the related topics since it affects the success of business intelligence process. The second phase is gathering related information. This phase includes examining all sources of data that are available and selecting the sources that will be used. This allows getting the information specified in the first phase. The third phase is processing the collected data using analysis tools and methods. This phase includes interpreting the information. Fourth phase is dissemination, which refers to supplying the analyzed information to decision makers at the right time using a proper tool. The dissemination can be executed using reports, meetings, or any suitable medium. At the utilization phase, which is the last one, decision makers process the information in order to utilize the knowledge. Furthermore, Pirttimäki (2007) states the importance of feedback after the utilization

phase since this feedback improves other phases. Comparing the three models discussed above, we conclude that business intelligence process is a continuous process that aims at

1) Collecting related data from multiple sources.
2) Aggregating this data in a way that produces information.
3) Interpreting the information using multiple analysis methods and communicating the knowledge to decision makers using proper tools.
4) Enabling decision makers to make decisions that produce results.
5) Capturing decision makers' feedback to improve the performance of the other stages.

### 2.1.4 Business intelligence architecture

Business intelligence refers to a combination of practices, applications, technologies and process that aim at enhancing the decision making process. Hence, there are multiple components that are integrated together in order to implement business intelligence (Negash, 2004). This section explains the typical business intelligence architecture which is illustrated in figure 2.3.

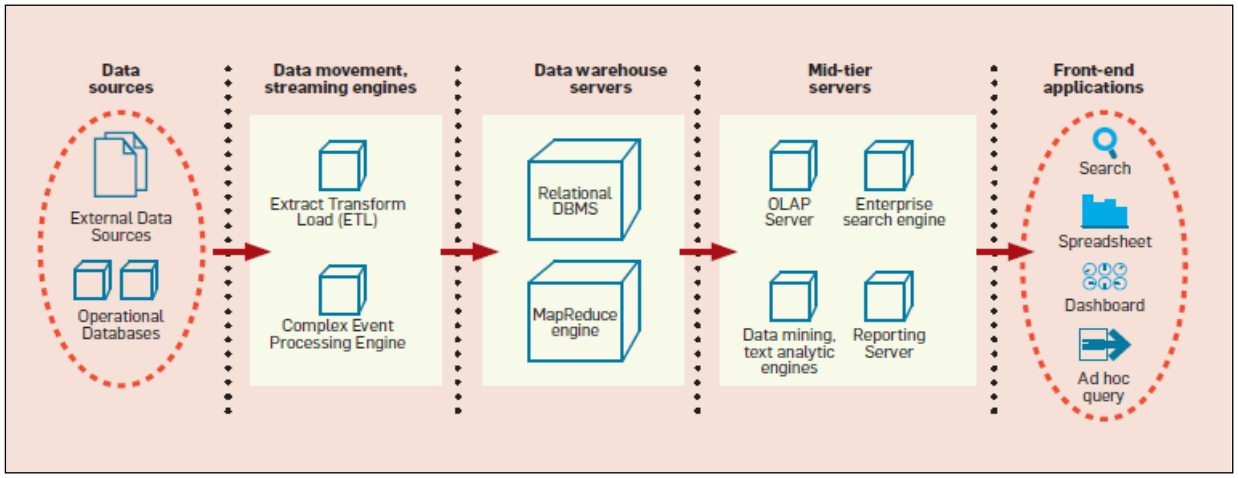


Figure 2.3 Typical Business intelligence systems architecture (Chaudhuri et al., 2011, p.90).

*Data Sources:* Business intelligence gathers data from various data sources and converts it into useful information that decision makers can use (Negash, 2004). Data sources are categorized as internal and external (Chaudhuri et al., 2011). Internal sources refer to all kinds of applications used internally by the organization. On the other hand, external data sources refer to all sources that do not belong to the organization but provide data to it.

*Data Movement Streaming:* Since the input for business intelligence comes from different external and internal sources, the data is not consistent (Chaudhuri et al., 2011). Each data source provides data in a different structure, which may include a number of missing values and unclean data (Simitsis, Vassiliadis, & Sellis, 2005). Hence, there is a need to clean the data and ensure its quality before using it (Rahm & Do, 2000). The set of tools that are used to transfer, integrate and clean the data is called Extract-Transform-Load (ETL) tools (Simitsis et al., 2005).

*Data Warehouse Servers:* The gathered data, after being cleaned and integrated, are then stored in data warehouse servers (Kimball, 1998). Data warehouse refers to a repository that is a result

of integrating data from multiple data source (Theodoratos & Sellis, 1997). The purpose of these data warehouse servers is to provide retrievable data which can be queried easily by organizations (Kimball, 1998).

*Mid-Tier Servers:* Data warehouses are complemented by multiple mid-tier servers that have various functionality (Chaudhuri et al., 2011). For instance, On-line analytical processing (OLAP) servers provide the ability to execute aggregation queries including roll-up, which increase the number of aggregations and drill-downs, thus, reduce the number of aggregations (Chaudhuri & Dayal, 1997). Another type of mid-tier servers is reporting servers that enable organizations to define, execute and extract reports from the data warehouse. Enterprise search engines support keyword search functionality. Data mining servers, which enable applying in-depth analysis, give organizations the ability to construct predictive models like customer behavior and market changes (Chaudhuri et al., 2011).

*Front-end applications:* are a number of applications that enable the end user of business intelligence to perform multiple tasks (Chaudhuri & Dayal, 1997). There are many types of Front-end applications such as spreadsheets, search portals, dashboards and ad-hoc query tools. Dashboards present the information to end users in a graphical interface to assist in making the decision. Ad-hoc query tools facilitate end users with the ability to execute custom queries that were not defined before requirements had arisen (Chaudhuri et al., 2011).

### 2.1.5 Business intelligence benefits

The role of information within organizations has increased significantly (Porter & Millar, 1985). Technological developments, which enhance information processing, have changed the way organizations operate dramatically. For instance, business intelligence has emerged as a managerial tool that enables organizations to refine business information (Gilad & Gilad, 1985). Furthermore, organizations use business intelligence in order to understand the business environment that they operate within (Davenport, 2006), and to collect data about the activities of their competitors (Negash, 2004). According to Porter and Millar (1985), understanding business environment and competitors allows organizations to identify opportunities that lead to competitive advantage. On the other hand, it is critical for organizations to understand the internal capabilities in order to improve the organizational performance and ensure the IT business value (Lönnqvist & Pirttimäki, 2006). For instance, business intelligence enables organizations to collect data from internal data source such as Enterprise Resource Planning (ERP) systems, relational databases or any other kind of operational systems (Hribar Rajterič, 2010). Business intelligence enables organizations to analyze the internal data and measure performance in order to improve the efficiency of business processes (Elbashir, Collier, & Davern, 2008).

Nevertheless, as mentioned earlier in section 1.1, the timely delivery of business intelligence greatly affects the value derived from the benefits of business intelligence. Hence, it is crucial for business intelligence, as an information system, to be agile. This is discussed in the following sections.

## 2.2 Information systems agility

To understand the concept of agility in the context of information systems we go through a historical review and then we elaborate on the need for agility. Later we compare agility with flexibility to differentiate between them because the two terms are greatly interconnected. Finally, we go through the details of agility definition.

### 2.2.1 History of the agility concept

The concept of agility emerged in the 1980s, due to the downturn of the US manufacturing market (Yeganegi & Azar, 2012). It was in the early 1990s that publications regarding business agility started showing up in the academic literature as a management concept (Yusuf, Sarhadi, & Gunasekaran, 1999). In the late 1990s the concept of agility emerged in the Information Systems discipline (Hobbs & Scheepers, 2010). The emergence of agility in the information systems field is a natural consequence since organization's IT capabilities have a significant role in enhancing the ability of the organization to act fast and move towards new opportunities (Sambamurthy, Bharadwaj, & Grover, 2003).

Business agility as a management concept has different definitions in manufacturing (Burgess, 1994). Agility can be considered as the ability to implement business initiatives rapidly (Weill, Subramani, & Broadbent, 2002). Or it can be seen as the ability to identify opportunities and to take advantage of these opportunities by responding fast (Sambamurthy et al., 2003). Furthermore, agility can be defined as the ability to respond smoothly to the emerging changes in the market (Peppard & Ward, 2004). Agile firms are characterized as having the ability of sensing for opportunities in the environment and mobilizing resources to take advantage of these opportunities (Overby, Bharadwaj, & Sambamurthy, 2006).

Sambamurthy et al. (2003, p. 245) argue that agility "comprises of three interrelated capabilities: customer agility, partnering agility, and operational agility". It is obvious that there is no agreement about the definition of agility. Moreover, going through the theoretical literature regarding agility, it is clear that it suffers from certain problems (Conboy, 2009). These problems are not confined to the definition of agility in the management discipline, but also in the information systems field (Conboy & Fitzgerald, 2004).

### 2.2.2 The need for agility in information systems

Organizations strive to achieve agility in order to cope with turbulent and dynamic environment (van Oosterhout et al., 2006). Other potential drivers of agility, common to different disciplines, are: competition, customers, technology, social factors and overhead (Conboy & Fitzgerald, 2004). This is in line with the change factor categories proposed by van Oosterhout et al. (2006). Regardless of the drivers, research shows that information systems might be an enabler or disabler of business agility. The initial streamline in literature revolves around the idea that information systems enable business agility (Rouse, 2007). For instance, Weill et al. (2002) state that IT infrastructure has a significant role in achieving agility. Peppard and Ward (2004) claim

that organizations depend on the information systems as a capability to meet agility more than identifying strategic IT investments. R. Agarwal & Sambamurthy (2002) linked IT with business agility by emphasizing the alignment of IT managerial responsibilities with core business units. In a more explicit manner, Strohmaier and Lindstaedt (2005) characterize information systems as one of the three dimensions of business agility, along with time and control.

The importance of agility is also evident in practice. Hobbs and Scheepers (2010) conducted a survey of business and IT managers in 70 companies whether they discussed agility in information systems. The survey confirmed the interest of top level management and executives in information systems agility. Furthermore, an overview of the annual research titled "Key issues for IT executives" published by one of the most prominent information systems journals, MIS Quarterly Executive, reveals that agility is ranked fifth out of the twenty two top concerns (Luftman & McLean, 2004). Even more interesting, a recent version of the research shows that agility is in the top three positions for consecutive four years (Luftman & Derksen, 2012). The research attributes this great concern with agility to the recession in the United States market; and suggest that organizations are driven by focus on responsive IT approaches to deliver value rapidly (Luftman & Derksen, 2012).

Over time, as the importance of information systems in organizations grew, the focus of agility research shifted from seeing information systems purely as an enabler of business agility to the idea that information systems itself should be agile (Hobbs & Scheepers, 2010; van Oosterhout et al., 2006; Zimmer et al., 2012). Tiwana and Konsynski (2010) advocate the importance of IT agility since it enables organizations to align between IT and their business needs. Woolley and Hobbs (2008) define in a relational model the factors driving for agility in existing information systems as: business environment, operating model and organizational culture. The model explains that not all business environment value agility or all operating models need agility and finally not all organizational cultures drive a need for agility.

### 2.2.3 Agility vs. flexibility

The terms agility and flexibility are very similar in many ways, and often have been used interchangeably (A. Agarwal, Shankar, & Tiwari, 2006) to the extent that it is difficult to distinguish between them (Dove, 1994). However, Wadhawa and Rao (2003) recognize a divide in the literature since some researchers view flexibility as a component of agility (McGaughey, 1999; Sohal, 1999), while others see agility as an extension of flexibility (Overby et al., 2006; van Oosterhout et al., 2006). In addition, flexibility is often used to convey reaction while agility is used to describe proaction (Conboy, 2009; Dove, 1994). This stresses the predictive aspect of agility which entails that it should respond to situations in which requirements are not known at the time of planning, which in turn requires more innovative response (van Oosterhout et al., 2006).

Furthermore, Wadhawa and Rao (2003), in their research about decision information synchronization, compare between flexibility and agility along six factors: scope, focus, change, response, control and delay. On one hand, flexibility has a scope of individual systems with focus

on variety, concern with dynamic and reactive response to known change. On the other hand, agility has a scope of group systems with focus on responsiveness, concerned with dynamic, opportunistic, reactive and proactive response to unknown change with low tolerance of delay. Conboy (2009) distinguishes between agility and flexibility in four points: agility is more concerned with speed of response, assumes change is continuous, emphasizes learning from change, and is more of a management philosophy which is applied collectively through the organization rather than a set of practices.

### 2.2.4 Definition of Information systems agility

The concept of agility in information systems has been widely discussed in the past fifteen years. However, as is the case in agility in management, there is no single definition of agility in information systems research. Even more, some researchers refute the existence of agility in information systems, rather describe it as a state that is targeted and aimed at (Rosenberg & Stephens, 2003). Gherardi and Silli (2007) describe agile information systems as a "double dream" in which designers of information system try to build agile information systems while their focus throughout the design process is to stabilize the information systems, which contradicts the concept of agility. Therefore, in order to discuss information systems agility it is important to explore some of the relevant proposed definitions in the literature.

Dove (2005) defines agile information systems as having the ability to respond reactively and proactively to needs and opportunities, which may be predictable, uncertain or unpredictable. Further, he defines categories for each of the reactive and proactive responses. Conboy (2009) proposes a comprehensive definition of agility in the information systems development built through an iterative process of sixteen iteration based on concept-centric literature review.

> [Agility is] the continual readiness of an ISD [Information Systems Development] method to rapidly or inherently create change, proactively or reactively embrace change, and learn from change while contributing to perceived customer value (economy, quality, and simplicity), through its collective components and relationships with its environment (Conboy, 2009, p. 340)

Hobbs and Scheepers (2010) consider information systems agility as the ability to sense business environment changes and to respond quickly. Furthermore, they propose a model that is based on literature review of a number of information systems related publications. This model consists of four building blocks which are: sensing the future needs, sensing the current situation, agile responses, and digital options.

The definitions above differ in the level of details and broadness; however, they all share a common concern towards the future needs of the business. All definitions consider the agility of information systems as the ability to explore the emerging changes in the business environment and not only respond to changes rapidly but also to create changes quickly.

## 2.3 Business intelligence agility

The agility of information systems as a factor of business agility has become more prominent as organizations increasingly rely on these systems for different purposes. This is also the case for agility of business intelligence, which is a branch of information systems. Agility of business intelligence is still a newly researched topic in academic, yet it is highly discussed in practice (Knabke & Olbrich, 2013). In academic research, the discussion is mainly rooted in agility of information systems with special considerations for business intelligence. Agility, as a principle is largely affected by changes; specifically reactive and proactive responses against changes (Conboy, 2009), which require sensing of past, current and future trends (Hobbs & Scheepers, 2010). This is itself one of the main functions of business intelligence (Negash, 2004). Therefore it seems inherent that the agility of business intelligence will directly enhance business agility.

In the context of this thesis, we consider business intelligence agility as:

> … the ability to react to unforeseen or volatile requirements regarding the functionality or the content of a BI [business intelligence] solution in a given time frame. This can incur changes on all affected layers of the BI [business intelligence] architecture (Zimmer et al., 2012, p. 4191)

## 2.4 Enabling factors of business intelligence agility

Achieving the desired agility in information systems has been discussed from different aspects. The most famous aspect is the agility of software development. For a large extent, the word agile is heavily coupled with software development approaches, which are all different forms of iterative development cycles (Barlow et al., 2011). On the other hand, the less known aspects are equally vital for information systems agility. After reviewing a number of publications in information systems and business intelligence we identify a number of enabling factors that affect the agility of business intelligence: 1) sensing business changes, 2) development approach, 3) IT governance, and 4) technical factors. These four enabling factors guide our research to identify the practices that organization employ to enhance business intelligence agility.

### 2.4.1 Sensing business changes

In order to meet emerging changes in the business, organizations have to first sense these changes (Hobbs & Scheepers, 2010). Changes can be divided into three categories which are internal business driven changes, external market changes, and external uncontrollable changes (Verstraete, 2004). Internal business driven changes refers to changes like mergers and acquisitions, organizational business strategy changes, and internal reorganizations. External market driven changes refers to changes like demand changes and emerging of new technologies. External uncontrollable changes refer to changes due to regulations or natural disasters. Hence, in order to sense these diverse changes, organizations need to collect data from multiple sources. Moreover, Hobbs and Scheepers (2010) consider information systems agility as the ability to sense the business environment changes and to respond quickly. Furthermore, they propose a

model that is based on a literature review of a number of information systems publications. The first building block of this model is sensing future needs. In addition, one of the capabilities of the IT function is the intelligence capability (Woolley & Hobbs, 2008). The intelligence capability entails the responsibility for collecting information from external and internal data and predicting how information systems will respond to the emerging changes (Woolley & Hobbs, 2008).

### 2.4.2 Development approach

Organizations operate in turbulent business environment. This requires processes to facilitate quick response to changes and creation of changes (Cockburn & Highsmith, 2001). Information systems, which serve organizations, have to meet the need of rapid response and creation of change. Information system research has discussed a number of development approaches that facilitate making changes fast in order to meet organizational agility. These methods are called agile developments approaches. There are different agile development approaches; however, all of them have common points that stamp their nature. First point is that agile development approaches depend on connecting end-users and the development team in a way that enhances the development (Cockburn & Highsmith, 2001; Rehani, 2011). For instance, this can be done by enabling end-users to participate in the development as a team member or conducting frequent meetings to get their feedback. Second point is that agile development approaches break down requirements into a number of sets (Chow & Cao, 2008; Cockburn, 2002; Rehani, 2011). Each set represents a number of connected requirements that can be developed together. Each set will be developed in a separate development cycle. Agile development is composed of a number of iterative processes that enables the development team to receive and process requirement changes during the development. Breaking down the project into many sub-projects enables the development team to improve end-users feedback, allows improving the quality of the final product, and increases customer satisfaction as production quality features of the software are being released faster.

In order to ensure the success of agile development, multiple factors are involved. For instance, it is important to select end-users whom are motivated to participate in the development and have the ability to learn and react fast (Cockburn & Highsmith, 2001). Further, management support is an important enabler of agile development approaches since they connect end-users with development teams (Chow & Cao, 2008). In addition, technical tools that are used in the development is another important factor that increases the agility of the development (Chow & Cao, 2008).

Agile development approaches have many benefits. For instance, they decrease the cost of information exchange between people; that can be achieved by relying more on direct communications and reducing the use of documents (Rehani, 2011). Agile development approaches enable the development team to reduce the time required to get feedback. This, ultimately, allows for shortening the time needed for development teams to make decisions (Cockburn & Highsmith, 2001).

### 2.4.3 IT Governance

IT governance defines decision rights and assigns responsibilities for important IT decisions (Weill & Ross, 2004). IT governance does not consider day-to-day activities; however, it identifies the fundamental decisions and the roles responsible for making them (Woolley & Hobbs, 2008). Many enterprises employ IT governance; however enterprises differ in the level of control and communication between decision making processes.

Agile development approaches increase the visibility and control of stakeholders since they participate in the development (Ambler, 2009). These stakeholders and their representatives are encouraged to take the responsibility for governing the fundamental IT decisions (Weill & Ross, 2004). Barlow et al. (2011) argue that IT governance may hinder the agility within the organizations since IT governance models may conflict with agile development approaches. Because of such conflicts, some companies isolate the use of IT governance from projects that need agile development (Barlow et al., 2011). In contrast, Woolley and Hobbs (2008) claim that well implemented governance mechanisms enable organizations to manage the change, which reflects a proactive consideration of business needs. In the same vein, Tallon (2008) claims that effective IT governance enables organizations that operate in turbulent business environment to improve information systems agility. Moreover, IT governance enables organizations to sense business environment changes and respond quickly (Gallagher & Worrell, 2008).

Furthermore, top performing enterprises decentralize a large number of IT decisions and assign IT capabilities to business units (Weill & Ross, 2004). Decentralized IT governance increases the ability of the IT function to create and deliver IT applications that meet the emerging changes (Tiwana & Konsynski, 2010; Zimmer et al., 2012).

### 2.4.4 Technical factors

It is imperative for business intelligence to process data from multiple data sources. These data sources range from individual spreadsheets to operational and enterprise applications. Each data source represents data differently in terms of structure, naming and business terms. Further, many data sources may have data quality issues that appear during the development of business intelligence reports which affect the success of business intelligence implementation (Yeoh & Koronios, 2010). Hence, organizations need to create an integrated and consistent view of the data that will be used in order to ensure the success of business intelligence. The way that organizations achieve integration of data differs according to the circumstances of each organization. Nevertheless, data integration is an important factor that affects the successful delivery of business (Williams & Williams, 2010; Yeoh & Koronios, 2010). As described in section 2.1.4, data warehouses are an essential part of business intelligence architecture which serves to integrate data gathered from multiple sources (Chaudhuri et al., 2011). Moreover, the way organizations approach data warehouses affects the agility of business intelligence (Baars & Zimmer, 2013).

Another important part of business intelligence architecture is front-ends application. The importance stems from the interaction of end-users, who are usually business staff, with these

tools. Since the agility of business intelligence depends of the agility of all its parts, it is important to investigate the agility of front-end applications. This functional agility of front-end applications can be achieved through either allowing business units to bring-in new tools or by allowing them to modify application components to be joined flexibly (Baars & Zimmer, 2013). As we mentioned earlier our research is delimited not to study the details of software products and how they are programmed, therefore we refrain from considering the latter vein and rather we focus on the use of multiple front-ends

Furthermore, an important technical factors is IT infrastructure, since it is a critical for organizational agility (Weill et al., 2002). Moreover, it is important to build agile infrastructure that enables organizations to meet emerging changes in turbulent environment (van Oosterhout et al., 2006). One form of business intelligence infrastructure is cloud business intelligence, which is increasing in popularity but it has not yet become mainstream (Stodder, 2013). However, it is claimed that cloud business intelligence is an important part of future business intelligence (Al-Aqrabi, Liu, Hill, & Antonopoulos, 2014). Cloud business intelligence integrates virtualization technologies along with online cloud data services instead of the traditional business intelligence infrastructure. Chang (2014) finds that the adoption of cloud business intelligence contributes to enhanced performance, enhanced efficiency, reduced costs and better integration with other services. Al-Aqrabi et al. (2014) categorize the benefits of cloud business intelligence as: cost efficiency, flexibility and scalability of implementation, reliability, and enhanced data sharing. Furthermore, the virtualized nature of cloud business intelligence enhances the agility of the business intelligence solution (Muntean & Surcel, 2013).

## 2.5 Compiled theoretical framework

In order to guide our research in a consistent way, we compiled the reviewed literature into a theoretical framework (table 2.2). This compiled theoretical framework consists of four business intelligence agility enabling factors which are: sensing business changes, development approach, IT governance and technical factors. This framework represents the theoretical base that is used to collect the empirical data. Specifically, we use this framework as a basis for developing the questions of the interview guide, which is described in details in the section 3.2.1

Table 2.2 Compiled theoretical framework

| Enabling Factor | Topic | Source/Supporting literature |
|---|---|---|
| **Sensing Business changes** | Type of changes | (Verstraete, 2004) |
| | Sensing changes and information systems agility | (Woolley & Hobbs, 2008).<br>(Hobbs and Scheepers,2010) |
| **Development Approach** | Agile Development Approaches | (Cockburn & Highsmith, 2001)<br>(Rehani, 2011) |
| | Critical Success factors of Agile development | (Chow & Cao, 2008) |
| **IT Governance** | Effective IT governance | (Tallon, 2008) |
| | Decentralized IT governance | (Tiwana & Konsynski, 2010)<br>(Weill & Ross, 2004) |
| | The impacts of agility requirement on business intelligence | (Zimmer, Baars, & Kemper, 2012) |
| **Technical Factors** | IT infrastructure and business agility | (Weill,Subramani,& Broadbent, 2003) |
| | Data Integration | (Williams & Williams, 2010)<br>( Yeoh & Koronios, 2010) |
| | Business intelligence architecture | (Chaudhuri, Dayal, & Narasayya, 2011). |
| | Cloud Business Intelligence | (Muntean & Surcel, 2013)<br>( Al-Aqrabi, Liu, Hill, & Antonopoulos, 2014)<br>( Chang, 2014) |

# 3 Research Method

*This chapter outlines the method followed in the quest to answer the research question; along with the motivations behind each decision made while conducting the research. It first describes the strategy of the research. Then it details the data collection method employed and the subsequent data analysis technique. Later, it outlines the steps and considerations taken into account to ensure the quality of the research. Finally, it provides details about the report structure.*

## 3.1 Research strategy

The selection of the research strategy for this thesis is based on its appropriateness to the objective of the research. The objective of the research lies in the research question (Bhattacherjee, 2012). This research aims at identifying the practices employed by organizations to enhance business intelligence agility; therefore, it is essential for the chosen strategy to be able to capture the opinion, perspective and behavior of the people and groups that are in charge of decisions regarding business intelligence within organizations. Qualitative research is suitable for such a task (Recker, 2013). In addition, the strategy should ensure that the data collected properly reflects the natural context within which the phenomena occurs (Baroudi & Orlikowski, 1989). This enables us to understand the phenomena from different perspectives. Moreover, it is important to note that these different perspectives are due to subjective interpretations of the phenomena by different stakeholders of business intelligence. This leads us to claim that our research is interpretive in its nature, which is in line with the assumption that interpretive research relies heavily on qualitative data (Bhattacherjee, 2012).

This thesis focuses on a fairly emerging concept, agile business intelligence. Even though the two sub-components "agile" and "business intelligence" are heavily discussed, however, the combined concept itself is not (Knabke & Olbrich, 2013). This is in line with Creswell (2012) who posits that qualitative research is useful to obtain deep understanding of the issue at hand. Furthermore, when we conducted our literature review, we only found a few academic sources regarding agility of business intelligence. This supports our decision to use qualitative research strategy (Shah & Corley, 2006).

## 3.2 Data collection

This thesis aims at identifying practices employed by organizations to enhance business intelligence agility. Moreover, it is based on a qualitative research strategy. Hence, it was important to select a data collection method that enables us to explore the agility of business intelligence from various perspectives. Interviews, as data collection method enabled us to

explore business intelligence practitioners' concrete experiences. In addition, interviewing enabled us to get details that are based on the consciousness of the interviewee (Seidman, 2012). Furthermore, the need for information systems agility differ from organizations to another according to the organization's culture and operating model (Woolley & Hobbs, 2008). Hence, we chose to conduct interviews with multiple business intelligence practitioners which enabled us to gain broader understanding of the agility of business intelligence in different contexts.

Qualitative research, in general, depends on structured or semi-structured interviews (Myers & Newman, 2007). As described previously, we conducted a literature review that led us to compile a theoretical framework (table 2.2) as a basis for our research. We decided to use semi-structured interviews which are based on this theoretical framework (Myers & Newman, 2007). Using semi-structured interviews allowed us to follow up the discussion in a way that served the research purpose. Semi-structured interviews has high flexibility that enabled us to elaborate and build arguments to cover hidden details that are related to the research issue (Myers & Newman, 2007). In order to obtain empirical findings we followed multiple phases that are illustrated in figure 3.1. We based our phases on the interview research proposed by Kvale and Brinkmann (2009).


Figure 3.1 Research phases

### 3.2.1 Interview guide

As mentioned earlier, we chose to use semi-structured interviews to collect the empirical data and ultimately answer our research question. In order to conduct the semi-structured interviews, a very important step is to prepare the interview guide (Kvale & Brinkmann, 2009). The interview guide represents the initial script for the conversations that will occur between us and the interviewees; it is simply the set of potential questions that we would ask. Based on Myers and Newman (2007) recommendations, we did not develop a complete script in order to retain flexibility and openness of the interviews. The flexibility in conducting the interview through use of incomplete script enabled us to lead the interview and interact with the interviewee in a way that ensure the efficiency of interviewing process (Myers & Newman, 2007). Moreover, using open-ended questions enabled the interviewees to express their perspectives without restrictions.

In order to craft the interview guide, we based the questions on literature review of related publications (Bryman & Bell, 2011). We started our research with literature review of business intelligence, information systems agility, and business intelligence agility publications. Reviewing the related literature enabled us to explore current theories. After reviewing the literature, we compiled the theoretical framework (table 2.2) which consists of a number of enabling factors that affect business intelligence agility within organizations. We used these factors as a theoretical basis for our interview guide. For each one of these factors, we formulated a number of questions that aim at identifying the practices that organizations employ in order to enhance business intelligence agility.

The interview guide (Appendix 1) is divided as follows

1) We started the interview guide with a short introduction for our research topic. Further, we proposed an explanation of the research question that allows the interviewee to understand the interview context.
2) Introductory questions: This part consists of a number of general questions that enabled us to warm up the discussion and explore the experience and practical background of the interviewee.
3) Sensing Business Changes: We formulated a number of questions about sensing business changes within organizations. The aim of these questions was to identify the roles responsible for this task. Furthermore using these questions, we expected to identify the practices relating to sensing change.
4) Development Approach: We formulated a number of questions that aim at identifying practices that organizations employ throughout business intelligence development in order to enhance the agility of business intelligence. The questions revolved around the responsibilities of development team members, team composition, process style (linear, iterative), interaction between business staff and developers, and learning.
5) IT Governance: We formulated a number of questions that aim at exploring how organizations approach IT governance in order to enhance the agility of business intelligence.
6) Business Intelligence Architecture: We formulated a number of questions that aim at exploring how organizations approach business intelligence architecture in order to enhance the agility of business intelligence. For instance, the questions cover architecture design options such as front-ends, data warehouses and cloud solutions.
7) Closing**:** The aim of this part is to close the discussion. We started by asking the interviewee if he/she has any other practices that were not covered during the interview. Later we thanked the interviewee and asked if it is fine with him/her to contact him/her later to confirm the accuracy of the transcript or to ask follow up questions.

### 3.2.2 Interviewee selection

In selecting interviewees we chose to use purposeful sampling, because this research is based on a qualitative strategy and it would be more appropriate to use purposeful sampling of interviewees (Marshall, 1996). Moreover, our decision to apply purposeful sampling is based on the argument that in qualitative research, random sampling leads to high sampling error since qualitative research does not use large size samples (Marshall, 1996). Using purposeful sampling enabled us to select subjects based on the purpose of the study (Coyne, 1997).

The aim of a qualitative study is to understand a specific phenomenon that is related to human behavior, hence, sampling criteria should be applied (Marshall, 1996). Furthermore, the sampling criteria enabled us to select subjects according to their experience and relevance to the research issue (Marshall, 1996). In order to choose candidate interviewees, we based our selection on a number of variables (Marshall, 1996). We considered the following variables:

1) Length of interviewee experience in the field of business intelligence.
2) Current responsibilities of interviewee.
3) Diversity of perspectives, we chose to make sure that the respondents are active in different industries.

Hence, following the previous criteria led us to select candidate interviewees who have long experience in the domain of business intelligence, are currently responsible for the delivery of business intelligence, and each is active in a different industry.

In order to get a list of candidate interviewees, we collected contacts from the professional network website (LinkedIn) and from friends. We contacted candidate interviewees through LinkedIn or email by sending messages that describe our research purpose and our intent for interviewing. A number of these candidates replied with interest in participation in our research. Hence, we communicated with the interested respondents more about our research and came to an agreement on suitable means to conduct the interviews. Table 3.1 provides details about the interviews. Furthermore, a description of the experiences and current responsibilities of each interviewee is listed.

Table 3.1 Interviews overview

| **Interviewee** | | | **Interview** | | |
|---|---|---|---|---|---|
| **Name** | **Position** | **Industry** | **Date, Duration** | **Method** | **Transcription** |
| Interviewee 1 | Analytics team member | Bank | 29/04/2014<br>63 minutes | Phone Call | Appendix 2 |
| Interviewee 2 | Head of business intelligence group | Insurance | 2/05/2014<br>78 minutes | Phone Call | Appendix 3 |
| Thomas Kelly | Consulting practice manager | Consultancy | 26/06/2014<br>71 minutes | Phone Call | Appendix 4 |
| Interviewee 4 | Business Intelligence Solution delivery | Cosmetics | 27/06/2014<br>37 minutes | Phone Call | Appendix 5 |

*Interviewee 1*

Interviewee 1 has more than thirty years of experience in the banking industry. Out of which the last fifteen years are related to business intelligence such as data analytics, risk analytics and management information, report development and more. Currently, Interviewee 1 works in the analytics team within the area of non-personal banking for small and medium-size businesses. His current responsibilities are the implementation of a new data warehouse and analytical tools

*Interviewee 2*

Interviewee 2 has been working in the IT industry since 1986. He has been working with data warehouse issues for the last 10 years approximately. For the past six years, he has been working for an insurance company. Currently, he leads a group that handles business intelligence requests within the company.

*Thomas Kelly*

Thomas has been working with business intelligence capabilities since the mid 80's. His current responsibilities are to manage a consulting practice that leverages data warehousing and business intelligence technologies to be able to provide customers with better understanding of their market and their business. More specifically, Thomas works in a more specialized category of information management called semantic technology.

*Interviewee 4*

Interviewee 4 had worked at Gartner for ten years, where he served in the role of business intelligence analyst. Within that role he worked on the platform as an administrator, report designer and tester. Furthermore, he participated in the implementation of new business intelligence platforms. Later, in 2010, he moved to another company to serve as a project manager in the business intelligence area for about two years. Then he switched to his current company where he is responsible for solution delivery and rolling out of a new business intelligence platform.

### 3.2.3 Interviewing

There are many methods that can be used to conduct interviews such as face-to-face meetings, video calls and phone calls. Our preferred method is face-to-face meetings, which we prefer because of the flexibility and control that we can have during interviews (Myers & Newman, 2007). Moreover, face-to-face interviews enable us to perceive the reactions and body language of interviewees (Myers & Newman, 2007). However, because of the geographical distance between us and interviewees, it was difficult for us to conduct face-to-face interviews. Therefore, we had to use either phone calls or online video calls using online chatting services. We offered both methods to interviewees, who all selected phone calls as their preferred method because they decided to conduct the interviews during their working hours and there was no video call service available in their offices.

Both of us have participated in all the interviews. Each interview was divided into three main stages which are entry, discussion and closure (Myers & Newman, 2007). Before the interviews, we had agreed about who will start the interview and introduce the researchers and the research topic. During the discussion stage of the interview, we depended on the interview guide (Appendix 1) to discuss the research topic with the interviewee. Since we were using semi-structured interviews, we took the chance to follow up, comment, and ask extra questions. Furthermore, we gave the interviewee the freedom to comment and continue his answers without interrupting. At the closing stage of the interview, one of us took the lead to thank the interviewee for his participation and ask for comments.

We, as researchers, aim at collecting as much data as we can; however, we have to respect interviewee's time and circumstances. Therefore, all interviews were reasonable in duration (table 3.1) which enabled us to discuss the issues that we would like to investigate without annoying interviewees (Myers & Newman, 2007).

## 3.3 Data analysis

Analysis of interview data starts during interview itself (Burnard, 1991; Kvale, 1996). It started when we analyzed the conversation on-the-fly and came up with follow up questions, confirming questions or new questions all during the interview. In addition, as we took notes during the interviews, this is also considered as an early stage of analysis (Burnard, 1991). However, the detailed systematic analysis was performed later. But this should not convey that the analysis was not planned only after the interviews. In contrary, as suggested by Kvale (1996), it would be too late to start thinking of how to analyze data after conducting the interviews. Rather, we had the method of analysis in mind when developing the interview guide and while conducting the interview. Our plan for analyzing the data was to prepare the data by transcribing the interviews into written form. Then, to reduce the amount of data by codifying the transcript. Finally, to actually analyze the data.

### 3.3.1 Interview transcription

The first thing we had to do after conducting the interviews was to transcribe them. Transcription is the step in which the oral conversation, which was held during the interview, is translated into written text (Kvale & Brinkmann, 2009). According to Kvale and Brinkmann (2009), transcription is not properly addressed in research; and that there are no standards for doing it. Therefore, we tried to write as much details as possible about what we have done during the transcription, covering our understanding of why we are transcribing, when was it done, who did it, and how was it done including the decisions that were made throughout the process and the motivations behind them. In our understanding, the purpose of transcribing is to go further with the interview into the analysis. The transcription step itself is an analytical process where the transcriber interprets the audio into text (Kvale & Brinkmann, 2009). Therefore, we performed the transcription right after the interviews because interview impressions and memory, which we had captured during the interview, would be still fresh in our minds. This, in turn, should result fewer transcription errors.

Each transcription was done by one of the researchers, then cross-checked by the other to ensure the quality of the transcript, which is discussed in more details later in section 3.4. Furthermore, we preferred to transcribe the interviews ourselves rather let someone else do it for us. Because, a great deal of details slip away in the transcription process as the audio is abstracted into text. The final transcript will only contain the words spoken during the interview; all the human aspects of the conversation such as voice tone, intonation, emotional expressions and more, will not be reflected. Therefore, we saw the transcription step as an opportunity to obtain better understanding of the conversation and ultimately obtain richer accurate details as basis for our later analysis. Practically, it was a good experience for us to analyze how we managed the interviews; this allowed us to learn from our own interviews and subsequently to sharpen our interviewing skills.

Further, since the interviews were recorded by an application installed on the phone, as opposed to an external recorder, we had the audio as a digital file immediately and the quality of the audio

was relatively high. This allowed us to share the recording easily for transcription and cross-checking. In addition, we had almost no gaps in the transcripts that would usually appear due to confusions in comprehending the recorded audio. Moreover, in the transcript we removed pauses, laughter and such irrelevant audible gestures. In addition we removed conversational unnecessary repeated words, such as “so”, “like”, “i mean” and others, unless they reflect emphasis such as “very very important”.

### 3.3.2 Coding and analyzing

Our approach of data analysis was to gradually decrease the amount of data through multi-staged codification and categorization. We based our analysis on the method proposed by Burnard (1991) because the assumptions made for this method matched our research method. The assumptions being that the interviews are semi-structured with open-ended questions, fully recorded and completely transcribed. However, we limited the number of stages to reduce the effort required to complete the analysis and to avoid letting the analysis overtake the interview project (Kvale, 1996).

Burnard (1991) considers taking notes during the interview and then transcribing the interviews as the first two stages in analyzing interviews. We had already performed these stages and we considered them separately. For us, the first stage of the analysis was open coding (Berg, 2009). In this stage each researcher went separately through the transcripts and thoroughly attached labels to parts of the text. In this coding we were open to adding new concepts to our coding list; therefore the list was considerably long. In addition, we did not use any naming convention for the codes; rather, they were simple, relatively short and descriptive summaries of the idea in the text.

Stage two was to merge the codes generated by the two researchers. Since the codes were, at this point the output of open coding, we did not need to match that both researchers codified the same piece of text similarly. Rather, we merged the codes because the purpose at this stage was to understand the text. At the end of this stage we had a considerably long list of codes attached to the various parts of the text. The codes provided insight into the text in addition to ease of finding blocks of text relevant to a specific idea.

In the third stage each researcher classified the codes into different classifications such as “Characteristic” and “Practice”. Then, in the fourth stage, we separately organized the codes into a hierarchy by placing codes underneath broader codes (Appendix 6). In the fifth stage, each researcher went separately through the transcripts and selected the top two levels of the attached hierarchical codes that were classified as “practices”. These codes were then shortened to initials of its constituent words. The sixth stage was to intersect the codes resulting from stage five from both researchers. These codes are listed in the table 3.2 and are included in the code column of the attached transcripts.

Table 3.2 Coding scheme for data analysis

| Sensing Changes | Development Approach | IT Governance | Technical Factors |
|---|---|---|---|
| **BSSC**: Business Staff Senses Changes<br><br>**DR**: Data requirements | **IA**: Iterative Approach<br><br>**CT**: Collaborative Team<br><br>**CRB**: Centric Role for Business<br><br>**SKM**: Skilled Members<br><br>**LR**: Learning<br><br>**RA**: Reduce Approvals | **DD**: Decentralized Development.<br><br>**CD**: Centralized Development. | **IDM**: Integrated data model<br><br>**MWH**: Multiple warehouses<br><br>**EWH**: Enterprise-wide warehouse<br><br>**MFE**: Multiple Front-Ends<br><br>**CBI**: Cloud Business intelligence |

To assist with the coding, we used qualitative data analysis software called NVivo, which greatly reduced the effort required to perform the coding and analysis. The software provided an easy means of navigation through the text, assignment of codes, classification and categorization of codes and even generating detailed reports regarding the coding.

## 3.4 Research quality

In order to make it easy for readers of this thesis to ensure the rigor of our work, we outline in this section the steps we applied to maintain the quality, which should ultimately increase the trustworthiness of this thesis. As mentioned earlier, our research consists of multiple phases as illustrated in figure 3.1. To ensure the quality of the final product, we kept quality in mind throughout the progress of each phase. Because, improving the quality of each phase affects the progress of the next phase. For instance, our research depends on interviewing business intelligence practitioners; hence, improving the quality of the interviewing phase was critical factor that affects the quality of the subsequent phases like analysis and reporting (Kvale & Brinkmann, 2009).

Despite the huge debate about the use of the terms validity and reliability in the context of qualitative research, these terms are widely used to discuss the quality of a qualitative research (Golafshani, 2003). Accordingly, the quality of this thesis is presented by the discussion of validity and reliability. The next two sections state the steps we have applied in order to maintain the validity and reliability of our thesis.

### 3.4.1 Validity

Our research depends on conducting interviews. In order to maintain the quality of the interviews, we followed a number of guidelines that are proposed by Myers and Newman (2007) and the interview quality criteria that is proposed by Kvale and Brinkmann (2009). For instance, we have built an interview guide that represents the initial script of the interview (Myers & Newman, 2007). Before sending the interview guide to interviewees, we asked one of our classmates, who has worked for six years in the field of business intelligence to read the guide and comment on it. The notes from our classmate made us restructure some questions in a way that makes interviewees understand these questions better. Furthermore, during the interview we tried to ensure the accuracy of our interpretation of the interviewee's answers by asking confirmation questions (Kvale & Brinkmann, 2009).

In order to improve the quality of the transcription phase, we applied researcher triangulation, which enabled us to increase the reliability and validity of the research as well as to evaluate the findings (Golafshani, 2003). For instance, each interview was transcribed by one of the researchers, then cross-checked by the other to ensure the quality of the transcript Moreover, after finishing the transcription of each interview, we sent the transcripts to the respective interviewee to ensure the quality of the transcription and to provide the interviewee a chance to comment or amend any of his/her statements. Moreover, researcher triangulation was used also during the analysis phase. Stages 1, 3, 4, and 5 of the analysis that is described in section 3.3.2, were performed individually by each researcher. Later, in stage 6, and after a discussion the individually produced codes were merged and both of us agreed about the final codes, listed in the table 3.2

Furthermore, external validity refers to which extent the results can be generalized to other contexts (Bhattacherjee, 2012). In the case of qualitative research, adding more respondents is not sufficient to improve the generalizability (Lee & Baskerville, 2003). In the same vein, Kvale & Brinkmann (2009) state that there is no way to determine the required number of interviews to reach a sufficient level of generalizability. Furthermore, Seale (1999) and Marshall (1996) advocate the use of the term transferability in the case of qualitative research. Hence, in our research we enhanced the transferability by providing a detailed description of the research context and a rich report about the findings (Bhattacherjee, 2012). Doing so, enables readers to assess independently to what extent the results of this research are transferable to other settings (Bhattacherjee, 2012).

### 3.4.2 Reliability

We aim at proving the reliability of our research by increasing the trustworthiness (Golafshani, 2003). We did so by providing as much detailed description as possible about the work that we did. For instance, all the phases that we went through in our research are described in detail within the thesis report. In addition, interview guide and all interview transcripts are attached to this thesis. By providing all these details, we aim at enabling readers of this thesis to evaluate the progress of our work.

Furthermore, as mentioned earlier, we planned to record all interviews. Therefore, to ensure the quality of the recording, we installed a call recording application on the Smartphone which was to be used during the interviews. Then we did a quick test to ensure the quality of the phone call by making a mock call with one of our friends with the recording application set on. Then, we checked the quality of the recorded audio in order to ensure that it is comprehendible and it can be properly transcribed later on.

### 3.4.3 Ethics

It is important for researcher to keep in mind that a scientific research involves a number of ethical issues that may occur. During this thesis, we collected data using interviews with business intelligence practitioners. An interview can be described as an event that involves interaction between us, as the researchers, and an interviewee. As a result of the interaction, a number of potential ethical issues might arise. In order to improve the quality of this thesis by avoiding the ethical issues as much as we can, we followed a number of guidelines that enable us to manage the interview and limit the ethical issues (Brinkmann & Kvale, 2005; Myers & Newman, 2007).

For instance, before doing each interview, we sent the interview guide to the interviewee. This provides the interviewee with a chance to understand the context of the research and check the points that will be discussed later during the interview. In addition, at the beginning of each interview we stated explicitly that the interview will be recorded and we asked for the consent of the interviewee about the recording. All interviewees approved the recording of the interviews. Furthermore, we asked the interviewee whether to disclose his/her identity and the name of the organization that he currently works in or to keep that information confidential. Based on their preference, we kept the identities and respective organization names confidential for interviews 1, 2 and 4. Furthermore, Brinkmann and Kvale (2005) describe the interview as an event that involves both democratic and radical attitudes. During the interview we tried to keep a balance between the democracy and radicalism. Hence, we tried to get as much data as we can without annoying the interviewee by questions that embarrass him or questions that he/she is not able to answer. At the end of each interview we reminded each interviewee that his/her participation is voluntary and he/she has the right not to participate in the research. All interviewees confirmed their participation in the research. Moreover, after finishing the transcription of each interview, we sent the transcripts to respective interviewee to enable them to check the transcription and comment or amend any of their statements which will be cited in our thesis.

## 3.5 Reporting

According to Recker (2013), it is important for researchers to base their reports on a structure that is familiar to their audience in order to ease the navigation within the report. Therefore, we explored a number of prior master theses. That gave us an insight about the general structure of theses, which we later followed in writing our thesis report. However, qualitative research strategy can be used for various purposes which affect the content of the final report (Knafl &

Howard, 1984). Hence, it is important to keep in mind that qualitative reports may have the same building blocks but the arguments inside these blocks are motivated in different ways.

In this report, we reflect on the work that we did in order to complete our thesis. For instance, the report describes the research phases in details (Myers & Newman, 2007). Furthermore, the phases are described in a sequential way that reflects the order of their progress. Meanwhile, we tried to provide related definitions and terms in a simple but comprehensive way that enables readers to understand the concepts related to the research topic. Furthermore, keeping in mind the social nature of the interviews, we used a number of quoted sentences in the findings section that give readers the feeling of the social nature of the collected data (Brinkmann & Kvale, 2005). During writing the report, we kept in mind the responsibility toward the ethical issues that are discussed in the section 3.4.3.

# 4 Empirical Findings and Results

*This chapter outlines our empirical findings, which are a set of practices that organizations employ to enhance business intelligence agility. These practices are the result of applying systemic analysis of the interviews. Furthermore, the practices are categorized according to the enabling factors listed in our compiled theoretical framework which is demonstrated in table 2.2 Moreover, at the beginning of each practice we provide a few important quotes from our interviewees in a table.*

## 4.1 Sensing business changes

According to Interviewee 1, sensing business changes represent an important target for businesses (Appendix 2, row 12). Furthermore, all interviewees claim that sensing changes enables their organizations to monitor the market and gives the ability to react quickly to changes (Appendix 2, row 14; Appendix 3, row 16; Appendix 5, row 8). Interviewee 2 states that changes can be either defined and monitored by the organization like the change of address of a customer, or non-defined changes like customer behavior (Appendix 3, row 16). Furthermore, Interviewee 2 claims that organizations sense changes using business intelligence to ease the work of the decision maker (Appendix 3, row 16). From our analysis we identify two main practices, namely: enabling business staff to sense changes and incorporating business staff feedback into data requirements.

### 4.1.1 Enabling business staff to sense changes

Table 4.1 Intrerviewee qoutes regarding sensing changes

| Interviewee 1 | Interviewee 4 |
|---|---|
| "... someone in the business identifying an opportunity and jumping on it and trying to leverage it as quickly as we can" (Appendix 2, row 12) | "I say, listen, you're the representative of business, how is the way the solution that we've implemented tracking to what you need? and is there a potential issue in the horizon?, how do we need to be proactive to adjust it?" (Appendix 5, row 10) |

All interviewees state that each business unit should have the ability to sense changes in their domain of interest. For instance, in the case of Interviewee 1, there is no one dedicated team in charge of sensing changes; however, each business unit has the ability to sense changes in the domains that they are interested in (Appendix 2, row 14). In the same vein, Interviewee 4 advocates that sensing changes is the responsibility of business staff rather than IT (Appendix 5, row 10). Furthermore Interviewee 4 states that enabling business staff to catch the new insights

affects the agility of business intelligence and allows business intelligence practitioners to move fast and act proactively (Appendix 5, row 10).

In the case of Interviewee 2, identifying changes that business is interested in and monitoring them enables business intelligence to serve the business quickly (Appendix 3, row 6). For instance, Interviewee 2 states that the organization has identified a number of events that can happen for a customer and implemented the applications in a way that keeps the business user updated with changes automatically.

### 4.1.2 Incorporating business staff feedback into data requirements

Table 4.2 Intrerviewee qoutes regarding data requirements

| Interviewee 1 | Interviewee 2 | Thomas Kelly |
|---|---|---|
| “we can't magic up data from nowhere. So in term of the business intelligence development we just have to work with what we've got” (Appendix 2, row 16) | “Well, like always, for us to have the right information at right time as close to real time as possible that is very important for us” (Appendix 3, row 20) | “Today we are seeing those times being compressed to become an expert in the data and then start using the data in order to be able start generating new insights” (Appendix 4, row 10) |

Interviewee 4 states explicitly that keeping contact with business staff enhances the ability of business intelligence practitioners to move proactively in case of potential insights (Appendix 5, row 10). In the same vein, Thomas Kelly states the importance of discussing with business staff in order to get insights about potential challenges (Appendix 4, row 22). Furthermore, according to Interviewee 1, sensing changes does not affect business intelligence development itself as much as it affects the availability of data (Appendix 2, row 16). Moreover, Interviewee 1 claims that since business intelligence heavily depends on data that is available, collecting data as fast as possible affects the ability of the business intelligence group to serve the business (Appendix 2, row 16). Thomas Kelly argues that not only the amount of the data is increasing but also the frequency of getting new data is also accelerating (Appendix 4, row 10). Hence, it is critical to be able to understand new data sets quickly, since business intelligence practitioners are limited in time (Appendix 4, row 10). Along the same line, Interviewee 2 states that sensing changes affects business intelligence output, which business user will use in order to take decisions (Appendix 3, row 14).

## 4.2 Development approach

According to Interviewee 2, business intelligence development basically consists of the same stages as that of other information systems development (Appendix 3, row 22). All interviewees claim that, in general, business intelligence development starts by receiving a set of requirements from business staff. Then, business intelligence practitioners take the responsibility for gathering the related information and presenting it in a proper way that fulfills requirements. All interviewees claim that organizations follow a number of practices that enable them to enhance

business intelligence agility, which refers to the ability to react quickly and create change promptly in order to meet business needs. These practices can be summarized as: 1) applying an iterative development approach, 2) building collaborative team of skilled members from business staff and business intelligence practitioners, 3) enabling a centric role for business staff, 4) reducing the use of approval documents and 5) learning from each project.

### 4.2.1 Applying iterative development approach

Table 4.3 Intrerviewee qoutes regarding iterative approach

| Interviewee 1 | Interviewee 2 | Thomas Kelly | Interviewee 4 |
|---|---|---|---|
| "there would be phase one, that wouldn't be perfect, but better than nothing. And the business start to refining that. We normally get to the stage of maybe two or three iterations" (Appendix 2, row 22) | "we don't really go into our rooms and sit there for a year trying to develop something but we have to constantly show parts of how it could be used, what it would be, what it would look like" (Appendix 3, row 24) | "In fact in most case, it is iterative because you are going to take some of these actions and execute them multiple times before moving on to other stages" (Appendix 4, row 16) | "We are taking agile approach to our BI project but not standard like waterfall approach. The reason for that it's very iterative" (Appendix 5, row 14) |

All interviewees state that business intelligence development is mostly iterative (Appendix 2, row 22; Appendix 3, row 24; Appendix 5, row 14). For instance, Interviewee 1 and Interviewee 2 advocate that, the development will consist of a number of iterations that depend on both the data source structure and the size of the data that is needed in order to answer the request (Appendix 2, row 38; Appendix 3, row 26). Each iteration produces new implemented requirements that reflect an incremental processing of the request (Appendix 2, row 22; Appendix 3, row 24). Furthermore, Interviewee 1 states that each iteration output will be presented directly to the business people who have initiated the request and they will provide their feedback, which enhances the process (Appendix 2, row 42). In the same vein, Interviewee 4 advocates that the use of iterative approach enables business intelligence practitioners to improve the quality of development results (Appendix 5, row 14)

According to Interviewee 1, the reason for following an iterative approach is connected to business needs (Appendix 2, row 24). Business intelligence practitioners have to react quickly and create changes rapidly in order to meet the needs of the business (Appendix 2, row 8). Along the same line, Thomas Kelly advocates the use of iterative approach, since the traditional waterfall approach, usually, fails to meet business needs (Appendix 4, row 14). In the case of Interviewee 2, it is important that business intelligence development follow an iterative approach, since most of the business units follow an agile approach in their work (Appendix 3, row 24).

There are many agile development methods that are discussed in academia and in practice. However, all interviewees claim that their organizations are not stuck to one of them for all business intelligence projects. Furthermore, in the case of the Interviewee 2, development teams mix between different approaches to get maximum benefits (Appendix 3, row 28). Moreover, in

the case of Interviewee 1, the business intelligence group is not familiar with the term agile development; rather, they follow a customized iterative approach. This iterative approach depends on doing incremental processing of business intelligence requests based on collaboration between both business staff and business intelligence practitioners (Appendix 2, row 22). Further, Interviewee 4 states that both his current and prior organizations use agile approaches that may slightly differ from each other but they have the same main characteristics (Appendix 5, row 16).

### 4.2.2 Building a collaborative team of skilled members

Table 4.4 Intrerviewee qoutes regarding collaborative team

| Interviewee 1 | Interviewee 2 | Thomas Kelly | Interviewee 4 |
|---|---|---|---|
| "once we got actually down to the details, I think that there would be probably an analyst seeing to that along with a business person. And then they would work reasonably closely together and the business person specify what it was that the business wanted" (Appendix 2, row 22) | "The fortune part for us is that we have the all IT department and the business located in the same area here in Stockholm. It's kind of easy for us to make sure that the projects are sitting together and having these daily meeting and stuff like that" (Appendix 3, row 28) | "They certainly may need to ask questions because they don't have the depth and breadth the business person has but it's that face to face interaction that really creates an opportunity for successful process." (Appendix 4, row 22) | "Close communication with your business partner as well as making sure that they are stakeholders in the project allow us to get over any communication obstacles" (Appendix 5, row 10) |

All interviewees claim that business intelligence development heavily depends on a collaborative work between business staff representatives and business intelligence practitioners. For instance, Interviewee 1 states that business intelligence practitioners will work with business staff throughout the whole development life-cycle with the aim of delivering the business intelligence request (Appendix 2, row 26). Even more, Thomas Kelly states that the collaboration between business intelligence practitioners and business staff is a critical factor to the success of business intelligence (Appendix 4, row 20). Interviewee 2 states that having business staff and business intelligence staff in close geographical location enables them to collaborate easily (Appendix 3, row 28). Similarly, Interviewee 4 advocates the importance of meetings between business staff and business intelligence practitioners during development, which allows for a better understanding of the data (Appendix 5, row 20).

Furthermore, all interviewees state that the selection of team members from both business staff and business intelligence practitioners is based on the skills required to implement the request.

Table 4.5 Intrerviewee qoutes regarding skills

| Interviewee 1 | Interviewee 2 | Thomas Kelly | Interviewee 4 |
|---|---|---|---|
| “we almost tend to pick them, in terms of, this person knows data, he knows all the existing approaches for this team. So we put him in charge of the next request we need for data” (Appendix 2, row 28) | “whenever a project ... needs some sort of BI support they will just ask us for, we need this type of resource for this project and can you please handover someone who we can work with will just support them with the right skills” (Appendix 3 row, 32) | “ Its usually the person who is a good verbal communicator who is able to do the best job because, they can actually have a conversation with the business, they can speak in the business language” (Appendix 4, row 22) | “What we try to look for is people who are not only the code junkies but can actually talk business talk and actually understand what they’re programming to” (Appendix 5, row 18) |

Interviewee 1 states that selecting a business intelligence practitioner who has previously worked on similar data will enhance the development (Appendix 2, row 28). In addition, he advocates that business intelligence practitioners should combine both development and data sourcing skills (Appendix 2, row 26). Moreover, Thomas Kelly elaborates about different skill sets that business intelligence practitioners and business staff must have in order to deliver business intelligence requests. For instance, he states explicitly that it is important for business intelligence practitioners to be able to understand the business language in order to meet business needs successfully (Appendix 4, row 18). In the same vein, Interviewee 4 states that business intelligence practitioners should have the ability to talk business (Appendix 5, row 18). On the other hand, Thomas states that business representatives should be engaged in the business currently rather than being an experienced person who has a deep knowledge but is not involved in business currently (Appendix 4, row 20). Furthermore, Interviewee 4 states the importance of selecting business representatives who are interested and willing to participate in the development (Appendix 5, row 18).

### 4.2.3 Enabling a centric role for business staff

All interviewees advocate the importance of participation of business staff in the development. For instance, Thomas Kelly states explicitly that the participation of business staff is critical to the success of the business intelligence development (Appendix 4, row 20). Further, Interviewee 1 states that the responsibilities of business staff start from the early stages of development and go throughout the whole development lifecycle (Appendix 2, row 22)

Table 4.6 Intrerviewee qoutes regarding business staff role

| Interviewee 1 | Thomas Kelly | Interviewee 4 |
|---|---|---|
| “once we got actually down to the details, I think that there would be probably an analyst seeing to that along with a business person” (Appendix 2, row 22) | “So, acting as the customer, acting as a domain expert and the facilitator of some business response to what was learned from the business intelligence activity. These are the key roles for the business and that makes them absolutely essential to the business intelligence process”. (Appendix 4, row 20) | “ I mean, my experience is that business representation on these projects and their, them being stakeholders is really at the cornerstone of success of the project and the implementation.” (Appendix 5, row 18) |

According to Interviewee 1, business intelligence development involves intensive communication and collaboration between business intelligence practitioners and business staff representative (Appendix 2, row 22). Moreover, Interviewee 1 and Interviewee 4 state that the business representative has a centric role in business intelligence development since business intelligence heavily depends on data, which business staff understands better than others (Appendix 2, row 32; Appendix 5, row 18). Furthermore, Interviewee 1 claims that business staff will check the output of each iteration immediately and send feedback; this enables the development team to enhance the development quickly (Appendix 2, row 42). In the same vein, Interviewee 4 argues that business representatives will take the responsibility for working on data and testing the results by themselves (Appendix 5, row 18) Furthermore, Interviewee 4 argues that these representatives should have the ability to make decisions on behalf of business staff in order to enable a successful implementation of business intelligence (Appendix 5, row 18).

Thomas Kelly argues more about the importance of business staff participation. Moreover, he elaborates about the different roles that business representative can play within the development. For instance, business representative may play the role of business customers who will use the output of the business intelligence development, domain experts who are involved in the business and understand the data better than others, and decision makers who will take decisions based on the output of business intelligence (Appendix 4, row 20).

### 4.2.4 Reducing approval documents

Table 4.7 Intrerviewee qoutes regarding approval documents

| Interviewee 1 | Thomas Kelly | Interviewee 4 |
|---|---|---|
| “We don't have test documents and test scripts getting signed off, but would look for an email or something from the business saying ”yes”, that they're happy with what we've given them is what they asked for” (Appendix 2, row 42) | “I think that in today’s environment the degree to which we must be ready to shift, means that we are working from less documentation and fewer approvals “ (Appendix 4, row 24) | “From a requirement standpoint of the project, we have formal documents. From a communication standpoint, if you consider things like project steering committees on a weekly basis or recurring basis as form of formal communication, those are in place as well.” (Appendix 5, row 22) |

According to Interviewee 1, it is important to free business intelligence development from bureaucracy, which limits business intelligence agility (Appendix 2, row 24). For instance, Interviewee 1 states that the testing stage is done immediately after each iteration without any kind of testing protocol or signed documents; business staff use the implemented work and send feedback immediately (Appendix 2, row 42). Moreover, Thomas Kelly states that the extensive use of signed documents for testing is old work-style and no longer valid in today’s fast-paced work environment (Appendix 4, row 24). Further, Thomas advocates that using fewer approvals enhances the agility of development (Appendix 4, row 24). In the case of Interviewee 4, the organization mostly outsources the development most of the time. He advocates the use of documents at the requirements collection stage and the usage of meetings for other stages (Appendix 5, row 22)

### 4.2.5 Learning from each project

Table 4.8 Intrerviewee qoutes regarding learning

| Interviewee 1 | Interviewee 2 | Thomas Kelly | Interviewee 4 |
|---|---|---|---|
| “we will reuse approaches that if they've gotten well one time, then will try to use the next time so to speed up how we produce business intelligence or analysis” (Appendix 2, row 40) | “we have project review, learn from what was good what was bad, what do we need to improve on the next time” (Appendix 3, row 38) | “You know the old saying that those who don’t learn from history are doomed to repeat it” (Appendix 4, row 28) | “ I think from an agility standpoint, you know, learning from your past, either mistakes or positive, really helps you react much quicker to the needs of the business moving forward ” (Appendix 5, row 58) |

All interviewees state that learning is an important factor that improves future development (Appendix 2, row 40; Appendix 3, row 38; Appendix 4, row 28; Appendix 5, row 58). Furthermore, Interviewee 1 and Interviewee 2 state that learning is done during the iterations of the development as well as after finalizing the project (Appendix 2, row 40; Appendix 3, row 38).

In the case of Interviewee 1, frequent meetings between business intelligence practitioners enable them to identify best practices and improve the development of future projects (Appendix 2, row 40). In the same vein, Interviewee 4 states that, usually, a discussion will take place after each project to identify the strengths and weaknesses of the development throughout the project that discussion enables business intelligence practitioners to improve the process for future projects (Appendix 5, row 58)

Thomas Kelly discusses more about the importance of learning from each project. For instance, he states that, since team members will probably change in each project, some team members will not take the chance to explore the best practices that enable them to avoid repeating previous mistakes. Hence, he advocates the use of technologies that enable organizations to support the learning aspect. In other words, Thomas advocates that the data model should include both the data and the learning practices that practitioners gather overtime (Appendix 4, row 28)

## 4.3 IT Governance

All interviewees stated that their organizations apply either a decentralized or centralized business intelligence development approach. Thomas Kelly advocates that each approach enables organizations to achieve agility of business intelligence depending on the way that the organization applies the approach, regardless of which one it is (Appendix 4, row 32).

### 4.3.1 Decentralizing business intelligence development

Table 4.9 Intrerviewee qoutes regarding decentralize development

| Interviewee 1 | Thomas Kelly |
|---|---|
| “ So that speed of reaction is really what the business have and that's why they have set up these decentralized teams. Because the centralized technologies support model just does not accommodate that all nicely.” (Appendix 2, row 52) | “The distributed groups may have a smaller number of projects that are trying to execute, they are able to focus on specific needs for their customer, their business customer is in a better position to establish priorities so they can end up being much more effective in producing results that their business customer is interested in” (Appendix 4, row 34) |

In the case of Interviewee 1, the bank group has a Technology Service department which is responsible for technical service within the organization. Technology Services department tend to apply a centralized control that enables it to govern the data and tools in a strict way (Appendix 2, row 48). However, the centralized control affects the ability of business units to react quickly (Appendix 2, row 52). Furthermore, the bank group consists of a large number of business units that need to react quickly to changes. In order to enhance the ability of business units to operate fast, the bank group has decentralized a number of responsibilities of the Technology Services department across business units (Appendix 2, row 44). For instance, business intelligence development is decentralized within the organization (Appendix 2, row 52). In more details, each business unit has a group of business intelligence practitioners that receive the business

intelligence request and assign one or more practitioner to work with business staff to fulfill the request. In the same vein, Thomas Kelly argues that the decentralized business intelligence development enables business intelligence practitioners to focus on a specific business domain and gives them the opportunity to build a close connection with domain experts (Appendix 4, row 32; Appendix 4, row 34). Furthermore, Interviewee 1 states that this decentralization enables some business units to be technically independent from other parts of the organizations (Appendix 2, row 44).

Moreover, both Interviewee 1 and Thomas Kelly state that decentralized business intelligence development has a negative point which is high cost, since each business unit will use a separate set of technical tools and resources in order to serve its needs (Appendix 2, row 58; Appendix 4, row 34). However, they both agree that decentralized development enables business units to enhance the agility in their business intelligence development.

### 4.3.2 Centralizing business intelligence development

Table 4.10 Intrerviewee qoutes regarding centralized development

| Interviewee 2 | Thomas Kelly |
|---|---|
| "We do have special checkpoints during the projects but it's not like that you have to contact them and ask for permission every time you make a decision. It's up to the project to deliver whatever the project is responsible for." (Appendix 3, row 78) | " So assuming that you have a certain amount of flex built into your centralized organization you can be much more responsive to a larger number of projects and be able to address them more rapidly" (Appendix 4, row 34) |

In the case of Interviewee 2, the organization applies a centralized IT governance model where a committee controls decisions that are related to projects. These decisions include budgets and technology tools that the organization will acquire. Interviewee 2 argues that applying a centralized model does not create major conflicts with the requirements of agility since the governance model enables the development team to take charge of many decisions (Appendix 3, row 28 and row 78).

Interviewee 2 states that the organization he works for has one group of business intelligence practitioners that take the responsibility for fulfilling business intelligence requests. For instance, in the case of Interviewee 2 within the insurance company, most of business intelligence developments are parts of bigger projects and are not just pure business intelligence projects (Appendix 3, row 28). The business intelligence group receives a request from a project and assigns a practitioner or more to participate in that project. Each project team has certain rights to make decisions as long as they do not exceed the budget and do not conflict with the guidelines of the organization or the project (Appendix 3, row 78). For example, the development team does not have to follow specific development approach; rather, each project team has the freedom and responsibility for applying the development approach that achieves work the best (Appendix 3, row 28). In addition, despite that there are multiple checkpoints during the project; these

checkpoints do not affect the project team's rights in making their own decisions (Appendix 3, row 78).

Furthermore, Thomas Kelly argues that centralized business intelligence development enables organizations to achieve consistency in the practices that business intelligence practitioners apply (Appendix 4, row 32). Moreover, Thomas advocates that the centralized model enables organizations to scale up and down. In other words, the business intelligence group will be more responsive since it has enough resources (Appendix 4, row 34).

In both cases of centralized and decentralized development, conflicts might appear between IT governance model and development. For Instance, Interviewee 1 reported a continuous conflict between the centralized Technology Services department and the decentralized business intelligence development. However, this conflict is not critical as long as independent business intelligence groups meet the agility requirements of the business (Appendix 2, row 48). Moreover, Thomas Kelly states that the backlog of standards creation often leads data governance into trying to prevent business intelligence practitioners from using newly added data until the data is reviewed, which takes a lot of time (Appendix 4, row 30). In addition, data governance often creates single definitions for entirely different things, by trying to unify shared data for everybody, (Appendix 4, row 30). These issues create frictions with IT governance. Therefore, it is better to keep a balanced approach of standardizing only the things that are to be standardized in the first place (Appendix 4, row 30). This balance will further enhance the agility of business intelligence rather than impede it.

## 4.4 Technical factors

The technical factors covered in this thesis include components of business intelligence architecture and infrastructure affect agility. Our findings are outlined in the following paragraphs as 1) building integrated data models including the two methods of doing so 2) using multiple front-ends, and 3) adopting cloud solutions.

### 4.4.1 Building integrated data models

All interviewees advocate the importance of integrating data in order to enhance the agility of business intelligence. However, we found that the way that organizations approach this integration may be different and depends on the circumstances of organizations. For instance, some organizations are able to integrate data for the entire organization into one structure by building an enterprise-wide data warehouse. On the other hand, many organizations are not able to stick to one data warehouse or they do not even intend to, due to many reasons, therefore they manage a number of data warehouse. However, they still achieve the required agility by following a modeling approach that integrates the data. Both ways are discussed next

*Integrating data through building an enterprise-wide data warehouse*

Table 4.11 Intrerviewee qoutes regarding enterprise-wide warehouse

| Interviewee 1 | Thomas Kelly | Interviewee 4 |
|---|---|---|
| "But once we have that data warehouse up and running, I think using data, and using it consistently will be much more easy and will be quicker." (Appendix 2, row 76) | "This is perhaps the best confluence of all these different needs. Keep a single copy of the data so that you minimize the proliferation of repositories and the cost of moving the data around all the time." (Appendix 4, row 38) | "when you have Microstrategy sitting over eighteen to twenty warehouses around the globe, the consistency is such a challenge. So, taking the centralized data warehouse approach is preferred." (Appendix 5, row 36) |

Interviewee 1 advocates that it is time for the bank to move on to an enterprise-wide data warehouse (Appendix 2, row 58). This task is already being worked on by the Technology Services department, however it will take time before it can be used by other departments. Interviewee 1 argued that the benefits of an enterprise-wide data warehouse are seen through cost reduction, reuse, security and the ability to conform to regulatory requirements (Appendix 2, row 58). Moreover, he argues that having an enterprise-wide warehouse will reduce the time taken by the ETL process dramatically and ultimately speed up business intelligence (Appendix 2, row 74) compared to the current state in which business intelligence practitioners in business units have to source the data themselves (Appendix 2, row 72). Similarly, Interviewee 4 claims, based on his experience in working on both single and multiple data warehouse environments, that the biggest challenge in having multiple warehouses is data synchronization and consistency (Appendix 5, row 36). Therefore, it is preferred to have centralized warehouse, even though it is understandable to have multiple warehouses (Appendix 5, row 38). Moreover, Interviewee 4 claims that having no more than a handful of warehouses is manageable, but if it exceeds that, then it becomes a nightmare (Appendix 5, row 40). Furthermore, Thomas Kelly advocates that keeping a single copy of the data is preferred because it "minimize[s] the proliferation of repositories and reduces the cost of moving data around" (Appendix 4, row 38). Further, Thomas sees that having a single data structure with multiple data models is an optimal situation (Appendix 4, row 38). He argues that having a single data structure would reduce data movement while the multiple models would satisfy the diverse needs of the users, since these needs are never identical (Appendix 4, row 38).

*Integrating data through a modeling approach*

Table 4.12 Intrerviewee qoutes regarding multiple warehouses

| Interviewee 1 | Interviewee 2 | Thomas Kelly |
|---|---|---|
| "Multiple warehouses have sprung up through business need. The business have wanted historically, and still do, to move quicker than a centralized function can deliver. So they go ahead and get resources and things are good and they build their own solution" (Appendix 2, row 58) | "Because you are constantly buying new companies and stuff like that or merging companies and stuff like that and you will always always have multiple warehouses. And that is not the problem. If you have multiple warehouses that's not the problem. If you have multiple information models, that's a problem. We are more focusing on having an information model that we all can agree upon" (Appendix 3, row 56) | "So it's not that they started off by saying "we're going to build six warehouses, or twenty warehouses or fifty warehouses". They've just found themselves in this situations where they have all these warehouses and they can't even begin to think about how they could justify the cost associated with integrating them all. So they look for a modeling approach to perhaps give them the same capabilities at a much lower cost." (Appendix 4, row 40). |

According to Interviewee 1 and Interviewee 2, having an enterprise-wide data warehouse is not an easy task to achieve (Appendix 2, row 54; Appendix 3, row 64). Furthermore, all interviewees agree that it is common for many organizations to manage multiple data warehouses, even though not intentionally rather due to circumstances (Appendix 4, row 40). For instance, Interviewee 1 reported that until an enterprise-wide data warehouse is implemented and enabled for all business units, his organization is using multiple warehouses (Appendix 2, row 56). He attributed the reason for having multiple data warehouses to business needs which business units feel that Technology Services department will take too long to fulfill. Hence business units dedicated their own resources and built their own solutions (Appendix 2, row 58). In addition, Interviewee 2 reported having multiple warehouses within his organizations (Appendix 3, row 56). Furthermore, he argues that having a single data warehouse is not even needed; because, as Interviewee 2 describes it, it is only a dream (Appendix 3, row 64). One of the main reasons for having multiple data warehouses is mergers and acquisition of other companies that have their own data warehouses (Appendix 3, row 56). In addition, he states that it would be very time consuming to try to merge data warehouses into one (Appendix 3, row 56). Similarly, Thomas Kelly confirmed that mergers and acquisitions result in some organizations to manage multiple data warehouses (Appendix 4, row 40).

Nevertheless, Interviewee 2 claims that what is really needed is an integrated data model (Appendix 3, row 56). Interviewee 4 confirmed that it is important to have a unified data model (Appendix 5, row 40). It does not have to be strict, eliminating the needs of different units; rather, the overall approach of doing business intelligence should be towards having a unified data model (Appendix 5, row 40). Thomas Kelly mentioned that multiple warehouses will suffer from data consistency issues and conflicting interpretations of data elements. However, he states that a lot of organizations achieve the required agility by compensating for the multiple warehouses

with applying appropriate modeling approaches (Appendix 4, row 40). Such modeling approaches allow viewing the data in a consistent manner regardless of the fact that the data comes from multiple data warehouses. Thus, applying this practice enables these organizations to achieve the required agility

### 4.4.2 Using multiple front-ends

Table 4.13 Intrerviewee qoutes regarding multiple front-ends

| Interviewee 1 | Interviewee 2 | Thomas Kelly |
|---|---|---|
| "I think each business area will have almost settled on a set of tools that are happy with and they're comfortable with. So it probably does help promote agility" (Appendix 2, row 64) | "My belief is, I am pretty sure, that is not the way to look at it. Because it is restricting and putting a lot of limitation to the users. It's better to say. "This is the information. This how it is structured, use whatever you want to access it" (Appendix 3, row 66) | "Sometimes you need a big hammer and sometimes you need a small one. Sometimes you want to be leveraging functionality that is available in one tool and not available in others" (Appendix 4, row 44) |

Interviewee 1 reported that multiple front-end applications are being used in his organization (Appendix 2, row 62). Furthermore, he expects to have even more front-end applications used in the future (Appendix 2, row 62). He believes that even though using multiple front-end applications was not intentional at the beginning but it does increase the agility of business intelligence (Appendix 2, row 64). In addition, Interviewee 2 reported that no dedicated front-end applications are used for business intelligence (Appendix 3, row 60). Rather, Interviewee 2 argues that all the information generated by business intelligence applications should be "integrated into the normal work-flow of the company" (Appendix 3, row 60). This way, Interviewee 2 claims that, an employee using whatever business applications will not have to switch to a business intelligence application to get the information needed to complete his task (Appendix 3, row 60).

Moreover, Interviewee 1 advocates that it is important to use whatever tools that are available within the organization (Appendix 2, row 64). He argues that the advantage of using available tools is that business users are comfortable using them. Interviewee 2 also argues that business user satisfaction with the used tools is critical; otherwise, they will not be used (Appendix 3, row 66). Interviewee 1 reports that different departments use different tools. Furthermore, Interviewee 2 argues that restricting business users to a specific tool will put a lot of limitation to the users. He claims that it would be better to provide the information and its structure and allow the user to access it using whatever tools he likes (Appendix 3, row 66).

Further, Thomas Kelly argues that the issue of front-ends is cultural and what matters is the end-user acceptance for the tools and how they use them. So, he claims that sometimes it is fine to have a single tool and sometimes it is better to have multiple (Appendix 4, row 44).

### 4.4.3 Adopting cloud business intelligence

Table 4.14 Intrerviewee qoutes regarding cloud business intelligence

| Interviewee 2 | Interviewee 4 |
|---|---|
| "why not use the cloud. That's what's going to happen in the future. But the regulations, right now, have stopped that. But in the future it will happen" (Appendix 3, row 76) | "I've seen the turn-over much quicker and staying leading edge with our technology platform working in the cloud. That's at the heart of agility." (Appendix 5, row 60) |

Interviewee 4 strongly argues that the agility of business intelligence is enhanced by cloud business intelligence (Appendix 5, row 53). He claims, based on his experience with both cloud and non-cloud business intelligence, that being a cloud business intelligence customer with close connection to the vendor is at the heart of agility. Because it allows using leading-edge technology quickly, this is ultimately reflected in quicker responses (Appendix 5, row 60). For example, the update and synchronization with the vendor is automatic, frequent and quick (Appendix 5, row 50). In addition, cloud business intelligence platforms can evolve very easily, which is reflected in scalability (Appendix 5, row 60). Moreover, Interviewee 2 confirms that cloud solutions enhance the agility of business intelligence. He does not find any reason why companies would not adopt cloud business intelligence except for regulations, which is their case (Appendix 3, row 74). Interviewee 2 states that his organization is looking into it, but cloud business intelligence has a lot of restrictions due to regulations related to the insurance industry (Appendix 3, row 74). Furthermore, Interviewee 2 advocates that it will definitely be used in the future (Appendix 3, row 76).

# 5 Discussion

*This chapter provides a discussion of the practices detailed in the empirical findings chapter. The discussion is based on relating the practices to our theoretical framework along with our analysis. The discussion is presented in categories based on the enabling factors listed in our compiled theoretical framework which is demonstrated in table 2.2. Namely, sensing business changes, development approach, IT governance and technical factors*

## 5.1 Sensing business changes

Information systems literature connects explicitly between sensing changes and agility of information systems. For instance, Woolley and Hobbs (2008) propose a relational model for the agility of existing information systems; that model identifies sensing changes as one the enabling factors of information systems agility. In the same vein, Hobbs and Scheepers (2010) consider information systems agility as the ability to sense changes in business environment and to respond quickly. Furthermore, they propose a basic model for agility that is based on literature review of a number of information systems related publications. The first building block of this model is sensing future needs. On the other hand, business intelligence literature discusses the functionalities that business intelligence provides to organizations. One of these main functionalities is sensing changes within the market. However, in the literature of business intelligence there is not much discussion of the effects of sensing future changes on the agility of business intelligence. For instance, Baars and Zimmer (2013) provide a definition for business intelligence agility based on literature review of agility related articles. One of the building blocks of their definition is sensing changes, however they do not describe in details how to approach it. Moreover, the agile business intelligence model that is provided by Muntean and Surcel (2013) does not mention sensing changes.

In their relational model, mentioned above, Woolley and Hobbs (2008) propose that sensing future changes is the responsibility of the intelligence team within the organization. Further, Woolley and Hobbs (2008) propose that the intelligence team is classified under the IT function within organizations and is in charge of identifying new requirements of information systems. In contrast, our study reveals that in each organization we have interviewed, there is no dedicated team that is responsible for sensing changes. Rather, business staff within the organizations has the ability to sense changes within the domains that they are interested in. In addition, our study reveals that sensing changes is the responsibility of business staff rather than IT staff. Therefore, organizations seek to enable business staff to sense changes in the environment. This enablement is further enhanced through incorporating feedback from business staff in data requirements. Since, according to our interviewees, if the organization is able to sense changes and gets the data quickly then business intelligence practitioners will be able to understand the situation in a better

way and create changes rapidly. In other words, business intelligence practitioners can serve the business rapidly when they have accurate data. This is in line with the relational model of Woolley and Hobbs (2008) which proposes that the intelligence team is responsible, as part of sensing changes, for collecting data from different data sources, which enables them to understand the market better.

Based on the discussion above, we find a circular connection between business intelligence and sensing changes through data (figure 5.1). As business intelligence allows for sensing changes, while sensing changes provides insight into what data to collect and thus increasing data availability, which allows in return for successful business intelligence.

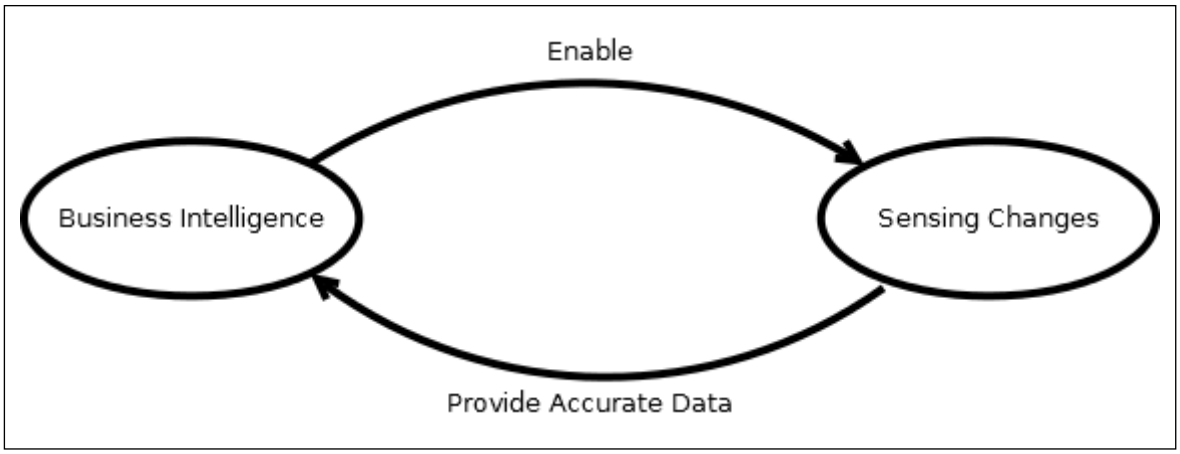


Figure 5.1 Sensing changes and business intelligence

In summary, our study reveals that the practices of enabling business staff to sense business changes using business intelligence applications and incorporating business staff feedback in data requirements allow business intelligence practitioners to move fast and act proactively, which ultimately enhances the agility of business intelligence.

## 5.2 Development approach

Organizations work in rapidly changing business environment that cause continuous changes in the business requirements. In order to stay competitive, organizations have to respond quickly to these changes. Moreover, since organizations increasingly depend on business intelligence with the aim of serving the business, it is crucial for organizations to apply development approaches that serve business needs and enable quick creation of changes (Rehani, 2011). For instance, traditional waterfall development approach mostly fails to meet the rapid changes in requirements (Rehani, 2011). Our study reveals similar results, for instance Thomas Kelly argues that following a traditional waterfall approach is not sufficient anymore since business requirements may be changed long before delivering the old requirements (Appendix 4, row 14). Furthermore, Interviewee 1 states that business intelligence practitioners are not able, in practice, to collect all requirements at once in order to implement them as one batch (Appendix 2, row 22).

As mentioned earlier in our theoretical framework, these development methods, which enable the organization to achieve fast creation of changes, are known as agile development approaches. Our study reveals that each organization we have interviewed is not stuck with one of them for all business intelligence projects. For Instance, some organizations mix the practices of many agile development approaches with the aim of achieving better results, as is the case with Interviewee 2. However, in contrast Interviewee 1 argues that they do not speak of agile development methods as terms. Thus, they do not follow any of the famous agile development methods; rather they have established their own development approach that is basically based on using an iterative approach (Appendix 2, row 22).

As mentioned in our theoretical framework, using iterative development allows rapid creation of changes. For instance, business requirements may be broken down into a number of sets, in which each of them represents a number of connected requirements. Later, each set will be developed individually (Chow & Cao, 2008; Cockburn, 2002; Rehani, 2011). Hence, the development will not be completed from the first iteration; rather, the work will be performed incrementally and the requirement sets might be developed in parallel. Our empirical findings reveal the same since all interviewees advocate the use of iterative approach. For instance, our findings reveal that the use of the iterative approach enables business intelligence practitioners to achieve an incremental and fast implementation of business requirements. Furthermore, we found that there is no specific number of iterations to deliver projects; however the number of the iterations depends on the size of the project and the number of requirement that should be delivered.

As mentioned in our theoretical framework, business staff participation in the development is crucial to insure the quality of development results. This participation could be achieved either by selecting representatives of business staff to be part of the development team or by conducting frequent meetings between business staff and the development team (Cockburn & Highsmith, 2001; Rehani, 2011). This is confirmed by our empirical findings since all interviewees advocate the importance of business staff participation. However, our findings reveal that business staff has a far more significant role in business intelligence projects; to the extent that business intelligence development teams can be characterized as business users with only few business intelligence practitioners. This is a major departure from regular information systems development team structure which usually comprises mainly of technical staff and only few representatives from business. Our study shows the importance of business staff engagement in the development since they are the domain experts and they understand the data better than others. Moreover, business representatives are responsible for testing the delivered work and providing feedback that enables business intelligence practitioners to improve the development. Moreover in some cases, such as the case of interviewee 4, business representative are in charge of doing some of the work on the data by themselves (Appendix 5, row 18).

Furthermore, the literature of agile development approaches shows the importance of selecting skilled members to participate in the work. Our findings reveals the same, furthermore, our interviewees state that since business intelligence development deals with data, it is important to

select business intelligence practitioners who are familiar with the same kind of data or have prior experience in working on such data. This will increase the agility of the development. On the other hand, it is important to select business representatives that are interested in participating in the work and have the ability to make decisions on behalf the business.

The agility of business intelligence development is affected by the way that development team members communicate with each other. For instance, reducing the use of official documents between development team members increases the agility of the development (Rehani, 2011). Our findings reveal the same, in that relieving development from the burdens of using approval documents increases the agility of the development.

Moreover, learning from each project is a practice that allows increasing the agility of future projects. Our study reveals that the learning process can be performed throughout and after projects through discussions between business intelligence practitioners. This discussion aims at improving future development by identifying best practices and solutions for potential problems. Furthermore, Thomas Kelly advocates that it is important to utilize technical tools that support the learning process such as semantic technology (Appendix 4, row 28).

To conclude the discussion regarding the development approach, our findings show that organizations follow a number of practices that enable them to enhance business intelligence agility. These practices can be summarized as: 1) applying an iterative development approach, 2) building a collaborative team of skilled members from business staff and business intelligence practitioners, 3) enabling a centric role for business staff, 4) reducing the use of approval documents and 5) learning from each project.

## 5.3 IT Governance

Our study reveals that organizations may apply a centralized or a decentralized business intelligence development in order to achieve the required agility. The decision of applying the appropriate practice depends on the circumstances of each organization.

As mentioned in our theoretical framework, top performing enterprises decentralize a large number of IT decisions and assign IT capabilities to business units (Weill & Ross, 2004). Decentralized IT governance increases the ability of the IT function to create and deliver IT applications that meet the emerging changes (Tiwana & Konsynski, 2010; Zimmer et al., 2012). Our study reveals similar results, in terms of those organizations with multiple business units could enhance the agility of business intelligence by decentralizing the responsibilities of business intelligence development within the organization. Accordingly, each business unit would have a group of business intelligence practitioners that take the responsibility for receiving requests from business staff and assigning one or more practitioners to collaborate with business representatives to fulfill these requests.

Furthermore, our study reveals decentralized development enables business intelligence practitioners to focus on one specific business domain because of the close connection to business; and thus, serving the business customer in a better way. Moreover, Thomas Kelly

advocates that decentralized business development enables business staff to identify their priorities better (Appendix 4, row 34). Based on the previous two arguments, we conclude that decentralized development approach enables organizations to enhance the agility of business intelligence. This is in line with the proposition made by Zimmer et al. (2012) that decentralized business intelligence development allows business intelligence practitioners to serve business customer rapidly and thereby meeting agility requirements. However, Zimmer et al. (2012) argue that applying the decentralized business intelligence development may affect the consistency of business intelligence within the organization. Similarly, our study reveals that since every business unit has an independent development team, multiple business intelligence practices appear; that affects the consistency of business intelligence practices within the organization as a whole, yet business units achieve the required agility individually. Moreover, our study reveals that decentralized business intelligence development requires higher costs since each business unit formulates an independent business intelligence practitioners group and acquires different tool sets.

On the other hand, our study reveals that many organizations apply a centralized business intelligence development. Such as when the organization has one group of business intelligence practitioners and that group is responsible for receiving the request from the business and accordingly work on addressing the request in collaboration with business representatives. Even though these organizations implement a centralized governance model, it does not conflict with the agility of business intelligence. In order to achieve this state of non-conflict, the organization applies a centralized model, but it gives development teams a lot of decision rights. The centralized model only governs the decisions that are related to budgeting and selection of tools to be acquired. For instance, Interviewee 2 states that despite the fact that there are multiple checkpoints throughout the project, these checkpoints do not affect the ability of the team to make decisions (Appendix 3, row 78). Hence our findings confirm the claims of Tallon (2008) in that effective IT governance enables organizations that operate in turbulent business environment to improve information systems agility.

One drawback of centralized business intelligence development is that organizations at certain times when they have a small number of projects may end up with under-utilized business intelligence practitioners (Zimmer et al., 2012). However, our study shows that this can also be an advantage point. For instance, Thomas Kelly agrees with the previous argument; nevertheless, he advocates that a centralized development with large number of resources enables organizations to have the flexibility of scaling up and down according to project needs (Appendix 4, row 34). In other words, the business intelligence group will be more responsive; this, in turn, increases the agility of business intelligence.

Furthermore, Barlow et al. (2011) argue that IT governance model may conflict with agile development methods. Furthermore, they argue that such conflicts force some companies to refrain from applying IT governance to projects that need agility. This was confirmed in our study; for instance, Interviewee 1 reported a continuous conflict between the centralized IT services and the decentralized business intelligence development. However, this conflict is not

critical as long as independent business intelligence groups meet the agility requirements of the business (Appendix 2, row 48). Moreover, since IT governance seeks to establish unified standards for most IT aspects, it may slow down the development process and may create a distorted representation of shared data. For instance, Thomas Kelly states that the backlog of standards creation often leads data governance into trying to prevent business intelligence practitioners from using newly added data until the data is reviewed, which takes a lot of time (Appendix 4, row 30). In addition, data governance, by trying to unify shared data for everybody, often creates single definitions for entirely different things (Appendix 4, row 30). These issues create frictions with IT governance. Therefore, it is better to keep a balanced approach of standardizing only the things that are to be standardized in the first place (Appendix 4, row 30). This balance will further enhance the agility of business intelligence rather than impede it.

To conclude the discussion regarding the IT governance, many organizations apply a decentralized or centralized business intelligence development. Each practice enables organizations to achieve the agility of business intelligence depending on the way that organization applies the practice, regardless of which one it is. In the case of decentralize business development; each business unit has an independent business intelligence development in order to meet business requirements quickly. Furthermore, each business unit has full freedom to acquire required tools. On the other hand, in the case of centralized development, organizations give the development team certain decision rights, which are usually limited to development approach and daily tasks, as long as it does not affect the budget. This improves the agility of the development process.

## 5.4 Technical factors

It is clear from our theoretical framework that many parts of business intelligence architecture affect the agility of business intelligence. From our analysis of the findings we found a number of technical practices that enhance the agility of business intelligence. These practices are: integrating data, using multiple front-ends and adopting cloud business intelligence.

As discussed earlier, business intelligence heavily depends on data to generate insights. Since this data comes from multiple sources and in different formats and structures, it is of great importance to control its quality and to integrate it properly; so that it can be presented consistently and ultimately to be ready for usage in a way that makes sense (Yeoh & Koronios, 2010). Our study confirms the importance of data integration as an enhancer of business intelligence agility. Furthermore, we found that this integration of data can be achieved through centralizing all data in the organization in a single enterprise-wide data warehouse. Because, enterprise-wide data warehouse supports the organization with a consistent view of the data. Moreover, building an enterprise-wide data warehouse speeds up the business intelligence by dramatically reducing the time taken in the ETL step. Thus, enhancing the agility of business intelligence. On the other hand, many organizations run multiple data warehouses, for different reasons, and cannot or do not intend to consolidate them in a single enterprise-wide data warehouse. Specifically, because moving toward an enterprise-wide data warehouse is not an easy task since it is very expensive

and time consuming. However, these organizations integrate the data through applying a proper modeling approach. Such a modeling approach allows for viewing the data in a consistent manner regardless of the fact that the data comes from multiple data warehouses. Thus, applying this practice enables these organizations to achieve the required agility.

One way of increasing the functional agility of business intelligence front-end applications is to use many of them (Baars & Zimmer, 2013). Our findings support this claim and further demonstrate that the usage of front-end applications is a cultural matter, and the satisfaction of end-user is the focal issue. If users are not satisfied with the front-end application they will not use it. Sometimes users are satisfied by using different tools and sometimes they want business intelligence information integrated in their daily business interfaces. In all cases, using multiple front-ends enhances the agility of business intelligence.

Furthermore, as mentioned in our theoretical framework, cloud business intelligence is not yet mainstream practice (Stodder, 2013). But, it is important part of business intelligence future (Al-Aqrabi et al., 2014). This is confirmed by our findings since only one respondent reported using cloud business intelligence. In addition, Interviewee 2 reported that even though cloud business intelligence is not an option due to regulations, however he claimed that it will definitely take place in the future (Appendix 3, row 76).

Further, the benefits of cloud business intelligence include enhanced performance, enhanced efficiency, flexibility and scalability of implementation, reliability, reduced costs and better integration and data sharing (Al-Aqrabi et al., 2014; Chang, 2014). Ultimately, the use of cloud services contributes to enhancement of business intelligence agility (Muntean & Surcel, 2013). Our findings confirm the positive effect of cloud services on business intelligence agility. One strong reason for this effect is that the use of cloud business intelligence along with close connection to the vendor results in continuous use of leading-edge technology, which is reflected in automatic, frequent and quick updates of the business intelligence platform. In other words, the platform evolves quickly and enables users to respond rapidly. In addition, our study shows that an advantage of using cloud business intelligence is the reduction of problems related to data governance. Moreover, our findings reveal that one main reason for not adopting cloud business intelligence lies in industry regulations which place restrictions and rules on the use of cloud services. This is in line with the claim that regulations are the biggest factor in impeding the adoption of cloud computing paradigm (Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011).

To conclude the discussion regarding technical factors, our research reveals three practices that enhance the agility of business intelligence: 1) integrating data through the use of an enterprise data warehouse or applying an appropriate modeling approach while managing multiple data warehouses, 2) using multiple front-end applications, and 3) adopting cloud business intelligence.

# 6 Conclusion

*This chapter concludes the efforts put forth in this research and summarizes the findings and discussions made throughout this thesis. Doing so, we answer the research question that this thesis is aimed at answering. Furthermore, we demonstrate the implications of these findings on practice and future research.*

## 6.1 Summary of empirical findings

This thesis aims at identifying the practices that organizations employ to enhance business intelligence agility. To guide our research, we compiled a theoretical framework from both academic literature and market white papers. This theoretical framework comprises of four enabling factors: sensing business changes, development approach, IT governance and technical factors. In order to answer our research question we conducted qualitative research using semi-structured interviews with business intelligence experts. Our research shows that agility of business intelligence in organizations is enhanced through a handful of practices that are summarized as follows:

In sensing business changes, our study reveals two practices: 1) enabling business staff to sense business changes using business intelligence applications and 2) incorporating business staff feedback in data requirements. These practices allow business intelligence practitioners to move fast and act proactively, which will ultimately enhance business intelligence agility.

Regarding the development approach, our findings show that organizations follow a number of practices that enable them to enhance business intelligence agility. These practices can be summarized as: 1) applying an iterative development approach, 2) building collaborative team of skilled members from business staff and business intelligence practitioners, 3) enabling a centric role for business staff, 4) reducing the use of approval documents and 5) learning from each project.

Regarding IT governance, many organizations apply a decentralized or centralized business intelligence development. Each practice enables organizations to achieve the agility of business intelligence depending on the way that organization applies the practice, regardless of which one it is. In the case of decentralize business development; each business unit has an independent business intelligence development in order to meet business requirements quickly. Furthermore, each business unit has full freedom to acquire required tools. On the other hand, in the case of centralized development, organizations give the development team certain decision rights, which are usually limited to development approach and daily tasks as long as it does not affect the budget. This improves the agility of the development process.

In terms of technical factors, our research reveals three practices that enhance business intelligence agility: 1) integrating data through the use of an enterprise data warehouse or applying an appropriate modeling approach while managing multiple data warehouses, 2) using multiple front-end applications, and 3) adopting cloud business intelligence.

## 6.2 Implications and future research

Our research aims at identifying the practices employed by organizations to enhance business intelligence agility. Therefore, our findings can be seen as a pool of practices that organizations can selectively choose from and apply in order to enhance business intelligence agility.

Furthermore, this thesis extends the existing literature on business intelligence agility. The findings in this thesis can be considered the starting point upon which future research can be built. Potential future research might be to quantitatively assess the implementation of these practices, thus building a prioritization scheme for these practices. Even more, the quantitative assessment can perform a segmentation of the market based on industry. Thus exploring the relations between practices and industries, if any. In addition, it would be very beneficial to research the reasons behind the adoption of certain practices by each organization and not other practices. We noticed relations between some practices and organizational operating models and other relations with organizational structure. However, they only remain speculations until proper research clarifies more about the reasons. Such research would allow organizations to further fine-tune which practices to apply according to organizational circumstances.

# Appendix 1 Interview Guide

Organizations operate in rapidly changing business environment. In order to remain competitive, information systems should enable organizations to quickly respond to both predicted and unforeseen changes. In our research, we consider business intelligence agility as

> … the ability to react to unforeseen or volatile requirements regarding the functionality or the content of a business intelligence solution in a given time frame. This can incur changes on all affected layers of the business intelligence architecture (Zimmer, Baars, & Kemper, 2012).

Our research aims at identifying the practices that enhance business intelligence agility.

**Entry**

1 Can you briefly describe your experience?
2 Can you briefly describe your current responsibilities?
3 How do you understand business intelligence agility?

**Discussion**

*Sensing business changes*

1 Are companies interested in sensing business environment changes? How do they sense these changes?
2 Who is responsible of sensing environment changes? Is there a dedicated team? What roles comprise this team? How are the members of this team selected?
3 How does sensing changes affect the business intelligence development?

*Development process*

1 Can you briefly describe the development process of a business intelligence application?
2 Is an iterative approach used for BI development? Is it a regular agile method or customized for business intelligence?
3 How do organizations build the business intelligence development teams?
4 In case of emerging unexpected changes, how do responsible teams react?
5 How do you do user acceptance testing of business intelligence applications? How early is it done? How plans those tests?

*IT governance*

1 Who takes the decision regarding business intelligence? Is there a Business Intelligence Competency Center? To what level is it centralized or decentralized? How does it affect business intelligence agility?
2 Are there multiple business intelligence development teams within organizations?
3 How does IT governance affect the business intelligence development?

*Business intelligence architecture*

1 Is there a single or multiple warehouses within organization? Why? How does that affect the react to changes?
2 Are there multiple front-end applications within organizations? Why? How does that affect the response to changes?
3 How is the data integration process (ETL) accelerated?
4 Is cloud business intelligence used? How? Why?

**Closure**

Are there any other factors that we have not covered?

# Appendix 2 Interview 1 Transcription

**Data:** 15:00, 29th of April, 2014
**Duration:** 63 minutes
**Interview format:** Phone call
**Transcribed by:** Jirayr Arzoumanian
**Transcription checked by:** Saleh Mustafa
**Transcription date:** 3rd of May, 2014
**Researcher 1:** Saleh Mustafa: SM
**Researcher 2:** Jirayr Arzoumanian: JA
**Interviewee:** INT1
**Company:** Kept anonymous. Referred to as BANK.

| Row | Speaker | Text | Code |
|---|---|---|---|
| 1 | JA | As we sent in the interview guide, we would like to discuss about the agility of the business intelligence function within the organizations. First of all, we define agility of business intelligence as the ability to predict or take action based on predicted and unforeseen changes within the company. And how can we make the business intelligence function as much as agile as possible to accommodate those changes as soon as possible within time and of course within budget. | |
| 2 | INT1 | Yes, OK. I'll try to give as much as information as I can | |
| 3 | SM | Can you briefly describe your experience? | |
| 4 | INT1 | I have worked in BANK since I have left school. So I've been a banker, I started working in branches thirty one years ago almost. I worked in branches. I worked in a couple of head office departments and that probably saw me through to about fifteen years in my career. And since then I have been largely involved in the area of analytics or management information, so that's obviously your business intelligence or say things that come in. So that last 15, 16 years or so have been data analytics, risk analytics and management information, developing reports, producing business intelligence, distributing that to BANK and BANK branches. Over 2500 outlets that we have to produce output for. | |
| 5 | SM | What are you current responsibilities? | |
| 6 | INT1 | I currently work in business and commercial analytics, That's an area of non-personal banking, small businesses and medium size businesses but not really the big corporations. And I work in the analytics team there. My main responsibilities are to implement a new data warehouse and the analytical tools including the | |

| | | | |
|---|---|---|---|
| | | business intelligence functionality to Business & Commercial. The bank is currently going through a big restructure so whether that continues or no it it's current form, I don't know. But it's temporarily stopped. But I think, certainly data, business intelligence and analytical tools, we will touch on further in the conversation, are very very important to the bank. My main responsibility is to implement Teradata and SAS tools to Business & Commercial. | |
| 7 | SM | How do you understand the term business intelligence agility? | |
| 8 | INT1 | Agility would tend to infer to me that there is speed about it, that you have to react quickly and do something with business intelligence to generate a new insight or react quickly to changing circumstance. So the business intelligence attend to data, so whether that is analysis, a formatted report, whether its a simple spreadsheet or something like that attended to put all these together in business intelligence. And the agility part is to react quickly and give the decision makers the information that they require to make a decision as quickly as you can and obviously as accurately as you can as well. | |
| 9 | JA | Do you differentiate the difference between business agility and business intelligence agility? Or is it the same thing for you? | |
| 10 | INT1 | No, I suppose I would differentiate between business agility and business intelligence agility. I think the business can do things and can react quickly without requiring business intelligence to do it. I suppose somebody can still make a snap decision and go off and implement it. So I would see that as the business agility. If they're looking for a bit more informed debate or analysis or research into a particular topic then that's where the business intelligence side might come up a bit more. | |
| 11 | JA | In our understanding, sensing the changes of the business environment is a key aspect of agility. Do you think companies are interested in sensing these environments? And how do they do so? | |
| 12 | INT1 | Yes, I absolutely do think they are interested in sensing changes in the environment. And, in fact they very costly attuned to that, so certainly BANK is. I've heard of other industries where they have very formal and long term departments, strategy, looking years and years into the future. And I think banking has an element of that, probably not within my area, but certainly there is an element of that. But I think also, just reacting to changes out there in the market, certainly that would be if a particular bank is having problems, we may act very very quickly and look at customers of ours who we think may also bank with this other | BSSC |

| | | | |
|---|---|---|---|
| | | bank and we maybe approach then and try to speak to them if there any business we could acquire of the other bank's problems. Things like that we may act very very quickly and someone in the business identifying an opportunity and jumping on it and trying to leverage it as quickly as we can. | |
| 13 | SM | We would like to clarify more. Is there a responsible team for sensing changes? Or there are multiple teams inside each business unit responsible for this? And we would like to discuss about their responsibilities. | |
| 14 | INT1 | So, within the bank, we probably have numerous different areas who would look at this sort of things. So we will have teams who look at group wide, so that would be globally, for what is happening at various points of the economic cycle or in various regions of the world. So there would be people doing that. And at a more local level, certainly more relevant or I do, we have people with responsibilities in areas like customer insights, we have people with front line product responsibilities. We have customer propositions responsibilities teams. So we have a whole range of people who have an interest in what, what's happening with competitors, what's happening with our customers and what's happening with our products and so on. And they all have a slightly different interest a particular aspect of business environment as such. So there is not a dedicated team. But these areas will have their own specific areas of interest and they will spot changes and identifying opportunities, they are incentivized to identifying opportunities, where they can increase customer satisfaction, increase product sales and so on. So yes, no one area within Business & Commercial that has an overall strategic responsibility for that, but lots of functions who have little responsibility to identify changes and combine all these changes, combine them to a something bigger. | BSSC |
| 15 | SM | How does sensing changes affect business intelligence agility of development? | |
| 16 | INT1 | I'm not really convinced that it does affect business intelligence development. Well, you mean new development, so for example we will quite often have to react quickly to an event, something that happens in the business environment. We are reasonably constrained in the terms of range of tools that we can use. We are also reasonable constrained in the data that we have, we can't magic up data from nowhere. So in term of the business intelligence development we just have to work with what we've got. And so we may not be able to get absolutely accurate picture of whatever that the business actually want to see. But we will use our skills and expertise and our best guess to come | DR |

| | | | |
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| | | up with a reasonable explanation of something for which we don't actually have the data. So probably speed to market is the one of the key things, we may not get to 100%. But if we get 80% of that very quickly, then let's go with that, let's make an assumption. The chances are it will be right. I would say, we are kind of stuck with the tools that we currently have, we just need to use them as much as we can. | |
| 17 | JA | In our understanding that there is, more or less, something called data discovery or ad-hoc data exploration, are you familiar with those terms? | |
| 18 | INT1 | Yes, it means something to me. My interpretation might not be exactly the same as everyone else is but yes certainly I heard those terms used. We don't actually have a lot time to do ad-hoc pieces of work. I when I say adhoc pieces of work I means this is more like analyst driven exercises. And we get ad-hoc requests from the business all the time and that keeps us very very busy. We also have regular requests, regular reports, things like that we do. So the time for an analyst to sit and just get on and investigate something themselves is reasonably limited. And I understand for example that companies like either Google or Amazon, I think they are almost encouraged to spend a least a day a week just playing with data, having a data discovery time. We don't have that luxury unfortunately. And so we certainly can't do that insight, additional insight walk let's say, that we might like to, but we do some, and certainly as experts in data within the bank, I think that the expectation is that if we spot something really good and of value to the business then we would bound to bring that to the people's attention, and to show what we could do and how we can leverage the value in our data. We would probably like to do a bit more data exploration just without the pressure of the business wanting more and more data all the time. | |
| 19 | JA | Would you say that the exploration would be done by the analysts while working on the data, not by the business user side? | |
| 20 | INT1 | Not from the business side. There would some, but not much. We don't have the tools that would go out to the business to let them do this. It would more the analyst that do data discovery. | |
| 21 | SM | Can you briefly describe the development process of business intelligence applications? The main stages. | |

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| 22 | INT1 | A typical business intelligence application, it's probably better if I focus on like a regular report, so that's maybe a more valid type of thing our analyst would be involved but also a business consumer of that report as well. So the way it normally works is that the business would approach us with a request for a new report and we would discuss that with them so we normally have a stakeholder, a manager, relationship manager, to deal with different parts of the business, they would the first part of contact, they would look at work schedule and see how much capacity we had and how had the skills to pick this up potentially and when. So there a whole a lot of administration of the request but once we got actually down to the details, I think that there would be probably an analyst seeing to that along with a business person. And then they would work reasonably closely together and the business person specify what it was that the business wanted. And that quite often is reasonably iterative. So they would normally start off with a bigger list of things they just can't get. Then a bit of cost reading and negotiation. "We can't give you that, would this be a suitable replacement" so a bit of expertise between the two different teams, the analysts and the business, and going through the requirements, what can be delivered, what can hold, whether the data is actually good enough to support what the business want to achieve with it. And I suppose also investigating whether if there any other sources already in place that would answer that question. So once we have done that initial investigation and design almost. Then an analyst would build an application or the report. Again, that is probably iterative, there would be phase one, that wouldn't be perfect, but better than nothing. And the business start to refining that. We normally get to the stage of maybe two or three iterations, and OK, let's look at that now, let's not make any more changes, you sign that off from the business. And at that point launch it. So that would be the standard process here. And in some cases, some of these developments would go on for weeks and months, sometimes a day or two and everything in between. So there are all sizes of different projects in there, and some last for years and some don't last very long at all and they are there for a very short time, but that's the general approach. | IA<br>CT<br>CRB |
| 23 | JA | So it's an iterative process rather than traditional. | |
| 24 | INT1 | Yes, very much so. And we are a reasonably informal department. We are not part of the technology area. So we have a much more formalized technology build area elsewhere in the bank. We don't follow that approach, it's too inflexible for the business. And things like business intelligence enhanced the business speed or reaction. They need data quickly. As I said, it | IA |

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| | | may not be the absolutely perfect data, but that is better that nothing. And the bureaucracy that goes into the traditional project management is not quick enough for the business. We almost span the gap between the business users, who may not know the data that well and wouldn't have the knowledge to build business intelligence type of reports and tools and technology services who have lots of these data skills and design skills and development skills but can't react quickly enough. So we are somewhere in between. We tend to be business focused. We work within the business. We are not a separate department as such, we are part of the business. And we can use technical skill to a quite high level to add value | RA |
| 25 | JA | This kind of answers our next question. It was like: do you have any liaison role between the end users and the it guys So I am presuming that you are that department, or how does it go? | |
| 26 | INT1 | Yes, we don't actually deal with technologies very much. We would be the developers, as well as the designers and the data sources. Working with the business, we tend not to have that much support from technology services. The times that we would use them would be if there is something really critical and we didn't have the data. And it is only then give it to us. And then we would go in a process where by we sat down and describe that data and went through a slightly more formal request methodology with technology to get that data. Once we've got it, it's back to us. Off we go and do our stuff. So yes. I think when we do need to use technology services, or as when the business need to use us, we have relationship manages, people who manage the stakeholder relationship in each of the different areas. | SKM<br><br>CT |
| 27 | JA | When you form a team for development. How do you select the business users and the analysts. Are there any criteria for doing that? | |
| 28 | INT1 | I wouldn't say that it's a formalized criteria. It's more like informal in doing that thing. So to look at the business side, more often than not, the teams are quite small, we don't have dozens of people sitting a particular team. So it's normally quite small. So there is probably one or two people who actually have more data skills in these teams. So, by and large, we almost tend to pick them, in terms of, this person knows data, he knows all the existing approaches for this team. So we put him in charge of the next request we need for data. So to look at analytical team like mine, we would select people to work on a particular project based on their skills, their expertise, their experience of doing | SKM |

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| | | something for this particular team or using the particular data that is require for this business intelligence application. So there is a reason for management thing is not overly formalized at all, but we are just trying to find the best person that has the best capacity at the moment and has the skill set to be able to do what the business actually want. And sometimes their would be conflicts there, and we have to. So we take someone off another project and we bring him to the new request and some goes back to the other project just to try to mix and match the skill sets as best as we can. As it is everyday management things not really a formalized process. | |
| 29 | JA | In case of the business users, do you offer them any kind of training on how to work on data and BI applications, that's in the design phase, do you offer them anything or do you just rely on their expertise? | |
| 30 | INT1 | We would tend to work together on the training side of things. Depending on how big the applications might be, their might be quite formal training. As in most cases, they're reasonably small, just a few people actually seeing the report, then you might sit with them for half an hour of introduction to the tool and walk them through it, give them contact details if they need to come back for any particular reason. I'm trying to look for an example of that. When I worked in the management information department for example, we built systems that were actually used by every branch across the banks network. So that was thousands of users and clearly a much bigger order of magnitude than a reasonably simple report. So there was a training, formalized and put out to the network; and there quite a number of media in terms of coaching and support that was provided. Whereas a simple Excel report, we just sat down and have a talk with the people or have a page in the spreadsheet itself to give a general overview of how to use the spreadsheet. Because most of the people, by and large, can use excel without any great problems. So we have the full range there, but yes, we would expect in most cases to have some level of support and coaching to the business. | |
| 31 | JA | You mean that is for the usage of application after its development. How about the business users involved in the providing the requirements. Are they chosen somehow based on their education or are they trained to understand on how to give requirements for the data or are they regular business users with no training at all? | |
| 32 | INT1 | They would have not much training, I would say. I'm just thinking of few examples. They tend to be people who are reasonably comfortable with data, they know the bank well and they know there are well. So they have a good knowledge of | CRB |

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| | | their part of the business. But I don't think there is formalized training in defining the requirements of defining the data, down to the degree that there would come as vague requests sometimes and then we have to fill in what we can in terms of that data. | |
| 33 | SM | In case of emergence unexpected changes. How do responsible teams react? | |
| 34 | INT1 | Interesting one. I think certainly within BANK, we actually a good ability to react and do to things. A road, a strap line, to make things happen. So, we have not, historically, gone through lots of bureaucracy and hurdles and definition of requirements and so one before jumping and doing something. So we rather get something out there, and it may not be perfect than spend time making it perfect and then miss the boat. So, emerging unexpected are largely would be the sort of things we talked about earlier in the emerging changes section. Something has happened whether it is an error in customer accounts and we need. We need to identify who these customers are and communicate with them. Or something our competitors have done and we want to prevent our customer from going to them or trying to get more business from that competitor. I think in terms terms of how they react, they will identify the trigger or what has actually has happened, and I think there are various committees around the place that will sit and discuss and agree to what they want to do and that request would come in to us and we would be given some sense of the urgency of it, how important it is, how it stack up against other priorities and we would take it from there as a normal piece of work. | |
| 35 | JA | Before we conclude this part. I'm presuming that you do not use a formal agile development methods, or do you use one? | |
| 36 | INT1 | I know that there are quite a number of agile technologies. We don't receive training in any agile methodology or anything like that. We just try and pick something up quickly and deliver maybe sixty or seventy percent of the functionally in the first pass and refine that by ongoing discussion with the business. So certainly not a formalized by way of methodology but certainly iterative approach. Because we would never get it right the first time. It's just impossible. The business don't often know what it is exactly that they want until we give them something. And they they would think about it, and then it gets some thinking about “alright, I don't really want that, I do what this” so we find the business requirements shape change and are refined as we go through that iterative approach, as our own knowledge of what | |

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| | | we are going to achieve and what the details are actually good for and not so good for. | |
| 37 | JA | How long would you say each iteration would take? And how many iterations, on average, per project or requirement? | |
| 38 | INT1 | Ohh, probably not easy to give you an answer on that. Certainly bit of what I have done. I would expect within two of three iterations we are much getting there. The first iteration is probably going to to be a stake in the ground, a stone to mark it off, here is something that we can do. Is that anyway near the mark. Second and third iteration are certainly are getting there. I wouldn't really expect it to be much more than three. It feels like by then, you got that relationship built up. You have hopefully understood what the requirements are and got as much of the data as you can at that point of time. In terms of time, it would be probably measured in a small number of weeks, maybe a few days certainly for the first iteration. Second and third iteration no more that two to three weeks, I would say. Unless it happens to be a very big project, that would take much longer to do. | IA |
| 39 | SM | After finishing a project or a number of projects. How do you improve the process for the next project. Is there a learning aspect from each project? | |
| 40 | INT1 | Yes, I would say that there is. We certainly know if anything goes wrong in the project. The business will either express the displeasure or we will hear certainly if there is something no going according to the plan. But certainly as part of our own internal development we have a quality assurance process. So before we actually hand out something to the business as a completed piece of work. We will have done our own quality assurance within the team. So another analyst would say, “yes I agree to what you've done there”, “it does meet what the business asked for”, “the code is neat, you've got the right data, you've done the right things with that data”. So, that certainly helps us to learn. We also have things that, just simple team meetings, once a month we go through the key works and analyst who did that piece of work would walk through it and show a particular neat they have done something with the data. Or a neat, efficient way of doing something with an excel sheet to present data. So we have that sharing mechanism within the teams where we do share best practice. So I think between the business give us feedback on how things have gone, when we didn't get positive feedback, we didn't get people saying “yes | LR |

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| | | that was good" we certainly will know that something was wrong. And I think our internal processes help the team learn and develop from that. And obviously we will reuse approaches that if they've gotten well one time, then will try to use the next time so to speed up how we produce business intelligence or analysis. | |
| 41 | JA | Do you use user acceptance testing? And how early do you do that for the business intelligence applications? | |
| 42 | INT1 | It's again not overly formalized. We don't have test documents and test scripts getting signed off, but would look for an email or something from the business saying "yes", that they're happy with what we've given them is what they asked for. So, on a scale of bureaucracy, it's not too far in the list. So certainly we would expect the business users to do some testing on reports that we have given them. They are the experts, they are the ones who know whether the output the report had produced is right or wrong. We would spot that as soon as we give them anything, so the very first iteration, they probably have a reasonable feel of whether that is right or not. If we give them complete rubbish in the first iteration, they should be able to pick that up very quickly. And certainly as it gets into the process, certainly by the time you reach the final iteration you would've expect that the business have done quite a bit of testing on it and be in a position to sign that off quite quickly. | RA<br><br>CRB |
| 43 | JA | Who takes the decision regarding the business intelligence function or applications? Do you have a competency center specifically for the business intelligence? | |
| 44 | INT1 | Yes and no. So we have strategy and architecture department in the bank. The responsibility is to work out the future architecture of the BANK group and what tools are preferred and what we should be using for, for example, data and analytical tools are there on their agenda. So we are moving to Teradata warehousing and we are looking to use SAS tools for analysis and business intelligence. We are only at the early stages of that journey though. And I know that there are lots of lots of areas within the bank who have gone and done their own thing anyway. So where strategy architect set the overall strategy but they don't absolutely impose that because I think they realize that this a long long journey; and we don't just, say, move on to a new data warehouse without any pain. So all these other areas, and there must be probably dozens of them, will use many different tools. I know many areas within the corporate bank where they don't use Teradata and SAS. They use other tools, | DD |

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| | | Microsoft tools. We have other areas that use tools like QlikView. I've heard of TIBCO Spotfire being used. So they are not Teradata or SAS. So, I think that would give the technology area a bit headache, because they have to try and support all these. So some businesses have actually set up a little technical support, they've almost become independent from other parts of the group. I think over time, we will probably see that moving back to a more centralized model, where you have much more handle on the cost, much more handle on the size of the platform and the scalability of the platform and so on. But I think the reason these areas springing up and doing things the way they've done them is the centralized approach isn't just quick enough to react to what the business want to do. So, we're a huge business, we've got millions and millions of customers, eighteen or twenty million customers, all managed in a number of different divisions. These decisions what to move quickly and they have to react quickly sometimes. So that's why they set up these different ERP centralized business intelligence to help them get ahead as quickly as they can, because centralized just isn't always quick enough. | |
| 45 | JA | So we would conclude that it is a decentralized business intelligence function that exists within the bank as a whole. | |
| 46 | INT1 | Yes. Strategy should be centralized and I think they will move more towards a centralized approach in future. But at the moment it's quite decentralized. | |
| 47 | SM | Is there any conflict between the IT governance model and this decentralized approach? | |
| 48 | INT1 | Yes there is. And quite a lot of it be honest, not fisticuffs type of conflict. There is certainly strong debate. Technology services would want to lock everything down, be very secure and in doing so being very inflexible in what they can do for the business. The business want data that they don't know, just give us, we want to do this ourselves. So there are definitely conflicts there, because it's not unheard of. I can certainly think of one occasion when it happened; where the business had built their own solution. They had support from technology, but it has become so big very quickly because more and more business user wanting to use that tool or platform that technology were not able to continue supporting that. It just grew too big for them to handle. So things like that were certainly causing conflict. | DD |

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| | | And technology services wanted the platform much much more under their control. They wanted to support it much more formally whereas the business were a bit more relaxed and just wanted to keep on doing what they were doing. So, that's when the conflict comes in. That balance between a really robust, properly supported, fully controlled system and letting users or analysts go and do what they want. Much less control basically. So that's when the conflicts comes in. | |
| 49 | SM | I get to understand that are multiple teams within the organization that are responsible of business intelligence development, not like a centralized team control everything! | |
| 50 | INT1 | Yes multiple teams. | |
| 51 | SM | I got the feeling that the degree of freedom that these teams have, directly affect the business intelligence agility and ability to react. | |
| 52 | INT1 | Yes. They have to have that freedom to be able to react quickly. The really formal technology service model isn't flexible enough to react quickly. It's all about a really core, full backed up full disaster recovery, a platform scalable to meet the future needs. The business doesn't really work that way and has to react quickly to information coming in, and the questions they asked. We just don't have the data infrastructure in place at the moment that would allow the business to ask pretty much any question they want and to build the answer off our warehouses. We have to go off to lots of different places to get data from different sources and do things with it. So that speed of reaction is really what the business have and that's why they have set up these decentralized teams. Because the centralized technologies support model just does not accommodate that all nicely. | DD |
| 53 | JA | So research would claim that properly implemented effective IT governance would increase agility, but I would say that is the case in your bank, is that right? | |
| 54 | INT1 | It is not the case yet. It may indeed do that, but I think the length of time it would take to get there..., the business is will always going to be wanting to move a bit quicker. So, I talked about move to Teradata and SAS, parts of our bank have been doing that for five years and they're really just making progress on it. So it's a very much a long term plan to get onto an enterprise-wide data warehouse. We are just dipping our tools in the water there. We are just starting down the route and that's five years it takes to get to that. So I think the context may always be there, I wouldn't disagree with them, to be honest, but the actual | |

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| | | practicalities on the ground are..., these things take a long long time to do and a lot of money, which I think is one of your next questions, they cost a huge amount of money. The business expected to pay for these. They won't pay if they can't sees quick results. So there is always going to be that conflict | |
| 55 | JA | From an architectural point of view, do you have multiple warehouses? | |
| 56 | INT1 | Yes, we do have multiple warehouses. The time is that we move to one enterprise data warehouse. As I said, we are a quite long way away from that yet. We only really just started getting data fully modeled and into a Taradata warehouse. And it doesn't cover every division of the bank and we are a long way from that. So at the moment we have lots of little tactical solutions across the bank within Business & Commercial, where I work, we have our own, we can say, we create our own data marts every month from our underlying not centralized warehouse but MI database. That would be used by other parts of the business as well, but not exclusively. Other areas have their own data warehouses. So we have just about everything you can think of out there. And the plan is, over time, that we will to single warehouse, but at the moment very much multiple. | MWH |
| 57 | JA | What was the reason for having multiple warehouses? And what are the drivers of having an enterprise one now? | |
| 58 | INT1 | Multiple warehouses have sprung up through business need. The business have wanted historically, and still do, to move quicker than a centralized function can deliver. So they go ahead and get resources and things are good and they build their own solution. So that's where the multiples have come from. The business hadn't been patient. They want things now. And if they can afford they would just go and pay for it now. Where the bank is just now. Clearly we were in a lot of financial trouble. We went bust a few years ago, you probably know. So we are in a much much different situation. So I think now the push is towards this centralized warehouse, the enterprise warehouse. I think is a realization that always practical solutions are not strategically right for the bank. We have build something that half a dozen of people know about in a particular area. It's not supported, it's not strategic. It's not joining in with other data properly. So it's clearly, maybe was the right solution for that particular business at that particular time, but it's not a long term solution. And I | MWH<br><br>EWH<br><br>DD |

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| | | think that the understanding is that the costs of supporting all these little point solutions is actually significant, very significant. And there is an expectation that by centralizing we will actually reduce all these tactical solutions. It will reduce the cost, and have it all paid centrally basically. So, I think that we are moving, I think the business have gone off and done what they wanted in the past. That's no longer the case. The business environment doesn't support that. It's not strategic it's not secure enough. In fact that's another thing maybe to throw in here, additional regulation, much more requirement to be able to show that we adhere to money laundering principles or present regulations or sanctions that the UN are doing. All that sort of requirement of data and we need to show that our data is in a much better state than might have in the past. So everything is moving towards, I think, that centralized model, which controlled, is understood in terms of cost and is built once and used many times. | MWH |
| 59 | JA | That's at the bank level in whole. What about within your department. Do you also have multiple warehouses with the department? | |
| 60 | INT1 | We don't have warehouses as such, we have data marts. Basically individual tables. So we certainly have many of them. But I think it's wrong to say multiple warehouses within our part of the business. I think, in Business & Commercial, if anyone in the business wanted data would come to us. We would source that from, basically, one source. So, I think in our division we have one source of data as opposed to multiple warehouses. | |
| 61 | JA | In terms of front-end applications. Do you use, in your department, multiple front-end applications to the serve the customers? Or how do you do that? | |
| 62 | INT1 | Yes. And I think in the future we would expect to be using multiple applications. So at the moment, a lot our output is actually generated in Excel or PowerPoint. So we use SAS systems to get data from our mainframe systems or other sources. We will then use PowerPoint or Excel to present that for people access, for database as well. So we will use Office to present that data. And we would like to be using much more... in a way of web tools, SAS, business intelligence tools or things like that. Or disturb output to iPads. So certainly we are looking, in the future, to use some more modern tools and some easy to use tools as well. We have elsewhere in the organization people who use Qlikview, I think TIBCO Spotfire is also used. So there are multiple front ends. So we've also used things like OLAP cubes tools in the past as well, Business Objects, Cognos, | MFE<br><br>MFE |

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| | | PowerPlay, things like that. So a whole variety of tools either are still used or have been used in the past within the bank to give the information out. | |
| 63 | JA | Do you think that having multiple front-end applications increase the agility of business intelligence applications? and how? | |
| 64 | INT1 | Probably, it's not the right thing for the organization as a whole. Because, if you have to train everyone on all the different tools, there is a lot of training involved. I think each business area will have almost settled on a set of tools that are happy with and they're comfortable with. So it probably does help promote agility, in so much as, people that we deal with are going to be using Excel and we will give them Excel sheet. So I'm not convinced that there is a lot of pre-thought going into that, there is not a lot of strategic direction there certainly. So, we are just using what we have at the moment. And the business know what we have and they are comfortable in using. So it's more by chance than anything by design that we are where we are. | MFE |
| 65 | SM | Nowadays, in the tool market there is a discussion about something called self-service. Are you familiar with the concept? Or does the bank use such tools? | |
| 66 | INT1 | Yes. So I've heard about self-service, talked about for the fifteen years that I've working with data. I think every analytical team I've been involved in would like the business to self serve. Every business I've met is also keen on that. So I think it one of the overused phrases. I have certainly seen that, a distinct reaction against self-service by the business. Where as we, as and an analyst and a manager and analytical team, would like to see the business doing more of their analysis and insights themselves. I think the reluctance is that, certainly, if you look at our business, they want one page, they want an Excel spreadsheet with one page; they can put off and color, they can scribble on. And they don't want to go in and have to right a query and run it and see the results and do something with it. So I think there is almost, it's wrong to say laziness, but there's a reluctance. They would say, “why would I move from an expert paper where someone has put it out for me so that I can use to me doing all of the work, requiring to make the queries myself or have someone run that query for me”. So I'm not convinced that self-service is | |

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| | | everyone's aspiration. | |
| 67 | SM | I got the feeling that the end user satisfaction is a critical factor in the business intelligence agility is that right? | |
| 68 | INT1 | Yes, absolutely. Everyone in the business that we deliver something to, we really have to be think of them and what they want. Not just satisfy, but to give them something even more that they expected. So yes, we are certainly trying to keep our customers happy, quite happy within the bank. We'd certainly know if they aren't happy. And I think quite a lot of that comes down to how good we are at managing the relationship with them. And being quite clear at the things we can do and can't do. Because there is lots of things that business would to like but we physically have either the data, the tools or the ability to deliver. So, just being honest with them and explaining that and saying that we can't give you this but we can give you something else. Is that something else good enough? So yes, user satisfaction an important factor. | |
| 69 | JA | May I ask in this case, what would limit your capabilities of the BI application you have. Why would you say "I can't deliver this" to a business user? What limits you? | |
| 70 | INT1 | I think the most common one would be that we just don't have the data that they want to see. We have thousands of different systems in the bank and we don't have access to all the data from these systems. We only have access to, an important, but probably quit a reasonably small subset of that. So data would be a common one. If the business are looking for the output to be presented in a particular way, we may struggle in terms of having the tools and skills to do that. So, as I said earlier, we are fine doing a nice spreadsheet for you or doing a presentation. If we had one of these web tools, we could certainly pull up a web report and so on. But if they want a very tailored and bespoke web page, we don't have web development skills, so we couldn't set out and build that for them. These are probably the seeming streams. The data, the tools that we have and the skills of the people we have using these tools. | |
| 71 | JA | I would like to discuss the first case, which is the data. How is the data integration process accelerated? How do you accelerate it to eliminate those problems. | |
| 72 | INT1 | So that's where the strategic projects come in, so the strategic program is to move on to Teradata, where a lot more of the ETL | |

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| | | process is happening. So, our technology services area are looking at core systems, they are identifying a good source of data. The business are going through data modeling with technology areas and with data architects. So they are really going through a very formal process, to say, here where we want to see for this particular type of entity. And going through a formalized process to say "yes, that what wanted, yes, we've tested, yes, that we will get in the warehouse". So, we are quite away from that. We are really starting down the process there. So at the moment, all the ETL that we do, we basically have to source the data ourselves. We write programs to extract information from a number of core sources with our systems. We do that ourselves as analysts. So, we are not doing too much in data integration there. We are just going and finding data that answer a particular questions there. And, we'll keep using that till this enterprise solution comes along. | IDM |
| 73 | JA | Does it take to long time to add a new data source? Or finding the source takes a longer time? | |
| 74 | INT1 | If you look at the strategic project that is underway. I know it has taken them five years to actually get the process working and move it. I think that now they've got it starting and it seems to be working OK. I think that I'm expecting to get a new source of data modeled, all the data profiled and built into formal data warehouse. I think it's a matter of month, maybe two or three months. That sort of timescale. So, that's doesn't feel too bad given that they've five years into the process. In terms of, I if were just picking up a piece of work today, I had to go and source the data myself, in theory I should be able to do that within a day or two as long as I have the data, I can actually build the report on that, within a small number of days. | IDM |
| 75 | JA | So, this would be like having the data modeled and added to the data warehouse takes considerable long time that developing the application itself? | |
| 76 | INT1 | Yes and I think that's because of the stage that the bank is at, at the moment, is. But once we have that data warehouse up and running, I think using data, and using it consistently will be much more easy and will be quicker. We will have more modern tools, much more reliable sources of data and a single source of data. So yes, in the future we should be able to produce more output as our analytical team has a supporting team. And be able to that quickly, because we don't so much data manipulation to do ourselves because that's already have been done for us in the warehouse. | EWH |
| 77 | JA | I presume that you do not use any kind of data visualization, do you? | |

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| 78 | INT1 | No. I don't what that actually is, but no I don't think we do. | |
| 79 | JA | Do you consider using cloud BI somehow, or it is not an option for you? | |
| 80 | INT1 | I don't think that's an option for us. Certainly we are not using any at the moment. And that there are no plans to do that. | |
| 81 | SM | I understand the BI architecture in the bank consist of a number of modules, is it right? | |
| 82 | INT1 | Oh, yes. There are many different tools, different tool sets that we use for business intelligence. We've talked about some of them before. So things like OLAP cube technology, we have used in the past and probably still do use Business Objects, Cognos PowerPlay. But I think we plan to use SAS OLAP tools. We've got web reporting, so that's SAS tools again and I think Qlikview is used also for that. We have some bespoke web reporting tools. We have got also tools like, in terms of presenting data, SAS web reporting, Excel, Office. There are also tools for manipulating data and doing analysis on it. So things like SAS grid, SAS tools, things like that. See, lots of different vendors and lots of different tools within these vendors that we can and do use. | |
| 83 | JA | In terms of BI agility, what other factors do you see that are important and we haven't covered yet? | |
| 84 | INT1 | OK, I'm not really sure. In terms of business intelligence agility. So I think, you've clearly got what do the business want to achieve, so I think we've covered that off. And they always have very high expectations and very short time scales they want the result in. So the business are always a challenge, but in a positive way, because they will need us. So there is business challenges. And we have lots of lots of data, as a bank, and we have lots of different formats of data. So I think putting that all together in one warehouse is the journey that we are on just now. So that makes sense. At the moment we have lots of distinct chunks of data in lots of different places that require different skills to get them out. So, we've covered that. The tools that we use to get the data out and to do things with that, present it and analyze it in different ways, we are a little bit constrained at the moment. But there are a lot of them in use across the bank in different areas. Again, we expect over time to standardize on a single set of tools there. And I suppose, one that maybe we didn't touch on that too much, is how you pay for this and justify it. So I still think with in the bank, there's an awareness that data is an asset. We can drive huge value from our data, but there's a reluctance to actually pay for it. The way the bank works is that the first person to adopt a new technology has pay for the infrastructure to go with it. That can be multi-million pounds in | |

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| | | many cases and certainly for setting up an enterprise data warehouse, it's going to be many millions of pounds to do that. And if the first business to start using is has to pay all the cost, that's clearly a big hurdle to my mind in actual adoption of that technology. That's how seventy percent of these tactical solutions we talked about have sprung up, because someone says "I'm not spending 4 million pounds on a warehouse, I'll spend two hundred and fifty thousands on a quick and dirty solution". That why these little solutions pop up, small teams that can manage them and know what these solutions do and how they sprung up. That's an issue of who actually pays for these technologies and driving value at the end of it, do they actually deliver value; and they convince they do, but they need to show very quick results to the business, to convince them and keep them willing to pay for these tools. | |

# Appendix 3 Interview 2 transcription

**Data:** 10:00, 2nd of May, 2014
**Duration:** 78 minutes
**Interview format:** Phone call
**Transcribed by:** Saleh Mustafa
**Transcription checked by:** Jirayr Arzoumanian
**Transcription date:** 4th of May, 2014
**Researcher 1:** Saleh Mustafa: SM
**Researcher 2:** Jirayr Arzoumanian: JA
**Interviewee:** INT2
**Company:** Kept anonymous. Referred to as INSURANCE

| Row | Speaker | Text | Code |
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| 1 | JA | Can you start first by briefly describing your experience please? | |
| 2 | INT2 | Ok, I have been working in IT industry since 1986 so it's about twenty five years now. Most of time I was working, I would say I have been working with the data warehouse issues for the last ten years approximately. I have been working here for INSURANCE, which as you know is an insurance company in Sweden, for the last six years now, responsible for a group that's handling the business intelligence questions in INSURANCE. Its group approximately with fifteen people and we are responsible for both the collection of information but also our area of responsibility will extend and we will be responsible of the analytics and reporting parts in a short while. The analytics and reports it's been done mostly by the business but the IT department will take more leading role in future in that area too. | |
| 3 | JA | Ok, and how about your current responsibility, what are your tasks at the moment? | |
| 4 | INT2 | Well As I said we are responsible for the handling of the data warehouse, of course, and collecting information from all the different systems inside INSURANCE and also outside of INSURANCE and to present them in a suitable way for the business so they can use it when making analytics or business decision | |
| 5 | JA | In our discussion we would like to introduce our understanding of business intelligence agility. As we have sent in the guide, we understand business intelligence agility as the ability to react to unforeseen and volatile changes regarding the functionality and content of the business intelligence | |

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| | | application. How do you understand the business intelligence agility as far as you experience goes? | |
| 6 | INT2 | We are using the business intelligence or the information both for reporting, the standard reporting functionality, but also for making analytics decisions but also to react when something happens for a person in their live so we use it also to react on new business leads. For example, if you as a person move to a new address, we react on that so we will contact you because that probably means that you need to look into your home insurance. Or if you for example get your first kid we will react on that too because that means that may you first might need to get some sort of insurance regarding your kids and family but also it might mean the you would like to start save some money for your kids for future needs and stuff like that. For our business we have identified approximately 8 different events that can happen in a person's live that would mean that they need to get in contact with their insurance company. Currently we have about, I don't' know, 8, 10 of these events are actually implemented right now and we are working now on implementing the rest of the events so we can react. We don't want to contact the person to sell things; we want to contact them when there is actually a need for them to look at their insurance. | BSSC |
| 7 | JA | Do you differentiate the difference between business agility and business intelligence agility, or is it the same for you? | |
| 8 | INT2 | For me, there is no clear difference in it because I mean, no, not really, we are not using these terms when discussing business intelligence or the agility of business intelligence. We are basically talking about it as one common subject in the company. I mean we use business intelligence in many different ways to make our business grow and make our customers happier and sometimes it is, like, based on historical information and sometimes it based on very real time information. Sometimes it is just used to confirming what we thought and sometime it is used to change our way of selling things or what type of product we should sell. We don't make any distinct between the terms we just handle it as one big area. | |
| 9 | SM | Actually here we would like to investigate the factors for example the technical factors, development process and tools that enable you to increase the agility of business intelligence? | |
| 10 | INT2 | If you are talking about agility, you mean about improving the speed of development and stuff like that is that the area you are looking for there. | |

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| 11 | SM | Yes | |
| 12 | INT2 | Ok, then first of all of course, with all that fuzz going around with big data and stuff like that, of course we are looking into solutions using Hadoop and stuff like that. I mean the old way of doing business intelligence where you sort of have everything in one enterprise data warehouse and and everything, like the information, should be very structured in a very predefined way for company and stuff like that. That area is gone. This is things you can do for the information that you are using for historical reasons or for information that you base your reporting and trends and stuff like that. But when you come to be more agile you need to be able to handle information in much faster and quicker way. And also to be able to do that you need to emphasize on the knowledge of the people or actually the business using the information to be able to understand the information and to be able to use it in a way that they think it's suitable for their business. You can't always wait for the IT department to put everything in a place in a very very strict and ordered way. So, we are currently looking into these areas but not really doing a lot of it in the big data area right now but we are looking into it. | EWH |
| 13 | JA | Ok, You said that the business people should not wait for IT department to do things. How do you do that? How do you enables the users to do whatever they want in terms of business intelligence of course? | |
| 14 | INT2 | First of all, they have their own sources of information which is of course is handled by the IT department. Most of the time IT department makes the information available but you might not get all the information in a uniformed format in one place, that will never happen. It takes too long and with all the constant changes and stuff like that, it takes so long. So what is happening basically, the users are using whatever application they are... In the insurance industry we use a lot of applications from the SAS institute to handle the information and of course they will use that to integrate external information to the company information when doing their analytic processes. Other stuff that can happen like in a sales process, everything should be very integrated for the actual person using the system. I mean it is not like that they go to special place to do business intelligence, that should happen automatically when they are using the system. For example, if we have campaign for let's say selling car insurances and we have identified like a hundred thousand customers and that we would like to contact and talk about car insurances. If something happens to that person while they are in the campaign, for example they have a car accident, we will catch that information and we will | EWH |

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| | | automatically take them out of the campaign for that type of insurance since something happened. Some external event happened and at the point they might not be in our group of customers that we would like to talk to regarding car insurance for example. The actual user, the one who is getting the business intelligence information, they shouldn't be knowing like this is happening, it should be integrated in their normal work process and should happen automatically and that's how we use it. | |
| 15 | SM | Actually here I would like to mention that understand in insurance company, you are always sensing the changes in the market and try to follow up? | |
| 16 | INT2 | Yes. We are trying to do that, of course we are work together with different types of social information systems where you, for example in Sweden, when you move you have to change your address. That type information, you can by it very easily from companies just get the information when something like that happen. And the same thing for other types of events that happen, for example, when you buy a car, stuff like that. Of course we are following that type of information. Some other type of information is very hard to actually catch and follow, and it's not even legal to catch and follow all types of information. Bust as much as possible, we try to do it. I wouldn't say that we are very enhanced if you compare it to retail. Retail is like getting a lot of more information from customers; and for us it's a big challenge since normally you don't have a lot of contact with your customers, it not like you want to talk to your insurance company every month or so. I mean it's not like retail shop where you have people walking in to your store every day and things like that, where you can catch a lot of more information regarding patterns and stuff like that. It's not really that easy in the insurance company, in insurance industry because we are not really, we have even less contact with our customers than in the banks, for example, and it's so more difficult. | |
| 17 | JA | I would just like to ask you to make it clear. How important for you is sensing the change? How critical is it for the business intelligence? | |
| 18 | INT2 | Well, it is important. For example our first studies was regarding people moving and we noticed that if we can get in contact within the first twenty four hours after they have actually changed their address, the hit rates for selling home insurance will increase with approximately 30 percent, which is huge. And if we haven't been able to contact them within 3 day after they have changed their address, the hit rates for new customer are really really low. I mean it's important for us to | |

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| | | really get in contact with that type of customers basically within the first one to three days otherwise it's a lost customer. But when it comes to other types of product, for example like, car insurance and electronical equipments and stuff like that, that type of insurance its very often that we don't actually sell that directly to the customer, its more done with partnerships with car companies and things like that. Because you can't basically buy a new car without having an insurance. I mean it will be signed at the same time as you sign for your car. It is not like that we can do a lot in that area. It's more like when it is time for them to renew the insurance that's when we are interested in getting contact with them. But very often that's done through what we call the white labeling, where you might buy a Toyota insurance but really it is not Toyota who is the insurance company but it's done through INSURANCE instead. We work very much through partnerships. Also if you buy a house in Sweden nowadays, it is very that the bank, to give you loan for the house the bank also implies that you should get the insurance through the bank otherwise you will not get the loan. At that point it is the same type with white labeling, meaning that we work together with the banks to actually have the home insurance for houses done thorough INSURANCE. So very often you don't really see our name but we use other channels, what we call the white labeling market. It is the same thing with the union, the union offers a lot type of insurances for the members but of course the union don't have insurance themselves, I mean, they do it through one of the major insurance companies in Sweden. So that how we label our products. | |
| 19 | JA | What are the implications, the importance of the sensing changes in business intelligence development? | |
| 20 | INT2 | Well, like always, for us to have the right information at right time as close to real time as possible that is very important for us. It's one of our focus areas because both from a selling point of view but also from customer satisfaction and legal point of view. I mean, there are legal things that mean that, for example, you need to catch frauds very quickly, you have something called money cleaning, basically there is a law saying that we need to catch this type of information and see if insurance money might be used for terrorist actions and stuff like that. There are a lot of laws that you need to supply the information to external parts very fast to follow with law. It's a core business for us to work with business intelligence. | DR |
| 21 | SM | Here we will move to the development process, can you briefly describe the development process of the business intelligence applications? What are the main stages for example? | |

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| 22 | INT2 | How I should describe the process, let's see. Often it comes from a business need or some sort of regulations, of course. The development process..., it's not a different process than the process used for other type of development. I mean it's about getting all the needs from different business areas and put it into normal requirements and collecting information and presenting it to the business in a suitable way for them. I mean there is no difference in development process of business intelligence compare to developing other types of applications in the company. We are using the same process. | |
| 23 | JA | Do you use an iterative approach or a traditional waterfall approach in the development? | |
| 24 | INT2 | Since most of the other things are done with using agile approach, we of course need to do the same thing with the business intelligence applications. Meaning that we don't really go into our rooms and sit there for a year trying to develop something but we have to constantly show parts of how it could be used, what it would be, what it would look like and that type of things, so it's more than traditional waterfall. | IA |
| 25 | JA | How long would it take for each iteration, I mean, in average or somehow? And how many iterations does it take, for example, to fulfill the requirements? | |
| 26 | INT2 | Tricky question because it is very much depending on what type of information source it is and also depends on how it would be used. For example, if we are just adding a new source of information but we already have the structure of the information in place, that could be like from couple of weeks to couple of months but if it's completely new structure of information which is not currently available in the business intelligence systems it might take longer, like 3 to 6 months. But its very much depending on which type of information it is. So everything from a week to 3-6 months, it depends on what type of information we are talking about. | IA |
| 27 | SM | Do you use one of the famous agile development methods like scrum and XP, or do you use a customized agile development process customized for the company? | |
| 28 | INT2 | I would say 99% of the projects we are doing are not pure business intelligence projects because it is more like BI is part of bigger projects and these project can themselves decide how they want to run the project. We do have our model for developing or project models and developing model. But we have had projects using both XP, where you are sitting together doing all the coding and stuff like that. Pair coding using scrum with scrum board and stuff like that. We are using | IA |

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| | | Kanban boards for maintenance issues and stuff like that. And we use lean process. So we are not saying that all project must using XP. It's not like it's a prerequisite. But if a project finds its suitable, they can use XP. I would say that we do have some sort of scrum meeting for all projects. But we are not that strict on saying that the scrum meeting must be everyday. It should be like that we have scrum meeting twice a week instead of everyday. It's a little bit up to the project to decide what type of methods that will work best for them. The fortune part for us is that we have the all IT department and the business located in the same area here in Stockholm. It's kind of easy for us to make sure that the projects are sitting together and having these daily meeting and stuff like that. But we are not say anything like you must do this, we are basically saying that ok these are the tools you can. Please use the one the you find most suitable. Yes we've done XP, we've done pair programming, we've done scrum, scrum meeting scrum boards and we use kanban boards. | CT |
| 29 | JA | Do you have multiple teams for the development? Since you said they have the freedom for choosing, so there has to be multiple teams or how does it work? | |
| 30 | INT2 | As I said, most projects are not just pure BI project. It could be like a project for making let's say paying bonus to the sales people, for example. So the main system here might be a system calculating bonuses for sales reps. Part of that process, of course, is to get all the information to that system in a good way, good and fast way. So at that point it is more up to the team who is responsible for the end users solution to decide if they prefer to do the project with XP or scrum or whatever. I mean it's more up to them. Of course we have our process for running projects and stuff like that. But in that process there is the development and testing and stuff like that. If they find it more suitable for them to use pair programming then it is ok for them to use pair programming. Normally, the BI person is part of the bigger team, so it is multiple teams, yes it is always a new team for new projects. | CD |
| 31 | JA | Shall I understand that you are basically a pool of BI analysts who are assigned to projects, for example? | |
| 32 | INT2 | Yes, I would say that. Of course we have our maintenance and that type of things we need to do. But we are more like a pool of people and whenever a project, which is basically most of the projects nowadays, needs some sort of BI support they will just ask us for, we need this type of resource for this project and can you please handover someone who we can work with and will just support them with the right skills. | SKM |

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| 33 | SM | The main concept of agile development is the interaction between business staff and IT staff. Does the company do any training for the business people before starting the project or do they start directly? | |
| 34 | INT2 | Are you meaning like for the BI part? | |
| 35 | SM | Yes, for the BI part of the project. | |
| 36 | INT2 | If its is a core BI project, for example we have a couple of things going on right now, where we are going to change our analytic environment, moving over to newer infrastructure and some newer tools, then we will, of course, give them some education in the new tools and the new environment. But it's not like a specific BI training. Because, first of all as I said before most of people do get decision information but they don't really know it, because it is integrated in whatever graphical interface they are using when they are in contact with the customer or whatever, they shouldn't know. I mean, to jump to a BI system is not the way we think about it. It's more like it's integrated into your daily tools which you are already familiar with. And then, of course, the BI department is constantly informing the business about which type of information is available and how it is available. So we put out quarterly information regarding new information available through the BI department. We will also give them presentations of how to use the information and stuff like that. But its not done like that any specific BI education just because a project starts. | |
| 37 | SM | After finishing a project or number of projects for example. How do you improve the process for the next time? Is the learning aspect from each project? | |
| 38 | INT2 | Yes, always. There is always both during the project like you know like in scrum you do it constantly. But also after a project we have project review, learn from what was good what was bad, what do we need to improve on the next time and stuff like that. So yes, that is always done | LR |
| 39 | JA | Ok, in case there are unexpected changes, what do the responsible teams and how do the responsible teams react for the BI requirements and functionality? | |
| 40 | INT2 | How do you mean? | |
| 41 | JA | In case of unexpected changes thing that have gone other than expected. In general I mean. For example, if business user expected to have, you know the examples more than me, but if the expectation of the user have greatly been affected or changed. The business user expected for example to get 10000 subscriber and that didn't happen how do you react, what do | |

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| | | you do in order to support the business? What do you do in business intelligence? | |
| 42 | INT2 | First of all, we have a couple of data quality and we are constantly measuring things. For example, normally a file from one system is supposed to be a million records all of a sudden it is only 10 records coming. We will get alarms when things like that are happening. We directly inform the business about the issue and we start investigate what is happening, I mean if something is gone or if it's just a something normal. And we will also, at that point, inform them that the information is not updated with the latest information but they are still able to access the old information, which will be like twenty four hours old at that point, and then we will keep them updated while we are working on the issue and will let them know what was causing the problem and also letting them know when it is fixe. And we will communicate with them. Currently we are communicating with them through mail, letting them know through email but we are just about to launch an application where they will actually have a website where they can go and see what type of information is up to date and when it was the last update. So instead of having to send a lot of emails back and forth, we will just have a webpage where we will keep the status of different information sources updated and they look at that page to see if the information is trusted and up to date | |
| 43 | JA | How about in cases of natural disaster? if a natural disaster happens or something that is unpredictable, how do you provide information for the business quickly, what do you do to do that which is something out of your schedules, out of the predictions of the business? | |
| 44 | INT2 | Are you talking about natural disaster when it comes to something happen to our systems. | |
| 45 | JA | No I mean huge change in the environment in general, business or whatever. In the business environment, lets say. For example, a disaster such an earthquake that has affected whole Sweden. I would presume that the business would like to have details and more information about this new thing that is totally not planned. I mean, how fast can you provide information to the business? How do you react? You don't have any information about this yet. You have not planned properly for it? How do you provide information for the business? | |
| 46 | INT2 | You are talking about external factors, not internal factors. First of all we don't have a lot of natural disasters in Sweden, to be honest with you. For example, they do get that information but through other channels not the BI channel. For | |

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| | | example, when there is a huge fire in some buildings, let's say in Sweden, it's not BI how gives them that information. They do get it through other channels and they will react on that making sure to see how many of people living in that building was actually insured by INSURANCE and trying to contact these people to help them get through the situation. I mean, that happens but it is not really done through BI. It's more like, they use the BI information to get a hold of all the people living in that building. Getting the information of how to contact with them. But it's not like that BI is the one who is triggering the actual information flow that such a catastrophe has happened. It's done through other channels. | |
| 47 | JA | In terms of IT governance and decision making. Do you have any competence center for the business intelligence? Or who takes the decision regarding business intelligence? | |
| 48 | INT2 | We have a steering group responsible for the business intelligence. And that steering group is the one making decisions regarding how to develop the business intelligence. And the members of the steering group for business intelligence is not a group of IT people. It's just me and one IT architect who is in that steering group. The rest of the people are from different lines of business. | |
| 49 | JA | Is the decision making process centralized, based on this committee? Or how is it done? | |
| 50 | INT2 | This steering group is proposing for what they want to do and what they what to prioritize and how much money they will need. And then, basically, all types of initiatives are then put up to the responsible people for keeping track of all our projects and initiatives. And they will decide how much money to give to different types of initiatives. | |
| 51 | JA | So it's more like centralized in you understanding? | |
| 52 | INT2 | In a way, it's more centralized. Because, you always have to prioritize whatever you want to do in the business intelligence area compared to what you want to do in different market areas and stuff like that. So it's always a decision you have to make on a higher level in the company of how much money to give to different initiatives. | |
| 53 | SM | Does this kind of centralization affect the ability of teams to react fast? | |
| 54 | INT2 | No, no really. Because it has only have to do with new initiatives. When it comes to like running the daily business or react to that type of initiatives we do have our yearly budget, which we will use for that. But, this has more to do when it | CD |

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| | | comes to long term development and stuff like that. | |
| 55 | JA | Shall we discuss a little bit about the architecture that you have. For example, how many warehouses do you have? And how does that affect the quality of the work? | |
| 56 | INT2 | Well, when it comes to warehouses, you can always argue about what is a warehouse. I mean, if you ask the people in the organization you will probably get, like, thousands of different answers. Saying everything from that we only have one warehouses to someone saying that we have probably couple of hundreds of warehouses. And the actual truth is somewhere in between. We are trying to put as much as possible of the information in one warehouse. That, of course, will never ever happen and it shouldn't happen either. Because, the need that you can only one warehouse is, in my opinion, stupid. Because you are constantly buying new companies and stuff like that or merging companies and stuff like that and you will always always have multiple warehouses. And that is not the problem. If you have multiple warehouses that's not the problem. If you have multiple information models, that's a problem. We are more focusing on having an information model that we all can agree upon. At that point, if you have multiple warehouses, that's not the big issue. We will always have multiple warehouses. It will always happen. Couple of years ago we bought part of a Finnish company. Of course they already have their warehouse. and if you constantly try to put everything in one centralized enterprise data warehouse, that's not going to happen. Because, then you have to work with that issue all the time. So, you have to have processes and ways of thinking and looking at information that make it possible to combine information from multiple warehouses. That's reality. | MWH<br><br>MWH<br><br>IDM |
| 57 | JA | Since there are multiple warehouses, more or less. How about the ETL process, how do you accelerate the data integration? | |
| 58 | INT2 | We are trying to use one product as much as possible for the ETL process. But of course there is a huge huge problem. Not a problem, but the thing is that all major software companies, nowadays, they have their own ETL tools. And of course they are putting more and more, trying to be the application that should be used for everything. And of course that means that we have sort of ETL code running in different application. When it comes to the part where we are talking, the big warehouse, the major warehouse, we are using one for the ETL part. But since we also have SAS, since as you know there is a SAS tool for ETL. We are using SAP for some areas of the business and of course there is like SAP business warehouse, which also do have an ETL tools. If you are talking about reporting, where we are using Cognos all of the time. Of | IDM |

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| | | course Cognos also do have an ETL tool. So of course we do have multiple ETL tools, but the main data warehouse is using one ETL tool. | |
| 59 | JA | And how about front-end. How many front end applications do you have? | |
| 60 | INT2 | It's the same thing there. We don't see business intelligence as something where you should have like a tool to access the information. First of all, it should be integrated into the normal workflow in the company. So,if someone is sitting in front of whatever graphical interface they are using when they are in contact, like the CRM system, when they are in contact with a customer. The BI information should be integrated into that tool, so they can see the information without going to a specific BI system. The same thing for people doing analytical things, they are using SAS as an application. So, of course the information from the BI systems should be available in the SAS tool. When you go to reporting, we are using as I said, Cognos, and of course the information should be available in Cognos. We are using SAP, the same thing there of course. It's not like that a graphical tool or an applications where you access business intelligence information. It's done through multiple process and multiple tools. | MFE<br><br>MFE |
| 61 | SM | Nowadays, in the market there is a huge discussion about self service tools. Do you have experience with this kind of tools? and do you use them? | |
| 62 | INT2 | Sort of. SAS is sort of self service tool, where you can connect to different information sources. We are not really going to deciding right now on which tool is self service tool. It's not really a tool that we call self service tool. No, not really. | |
| 63 | JA | How does having multiple data warehouses, multiple tools and multiple ETL processes affect the flexibility and agility of business intelligence? How does it affect the whole process? | |
| 64 | INT2 | I would say both in a positive and negative way. Of course, the dream of having only one warehouse and one flow of information and one tool, that's a dream. First of all it takes too long to do it, getting everything uniformed into one tool. That's the reason why we are talking about Hadoop and big data nowadays. But don't really have to have one tool. You can just put everything into a NoSQL place and basically say OK, don't even try to figure out exactly how to convert that system information so it is streamlined with that system information. It's more like saying, let's map this one using whatever tool you like, whatever tool you feel comfortable with and use that tool. And that tool could be different from different business perspectives. There isn't going to be one tool that would suit | |

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| | | all. That's life. It would be much more inflexible to put it into just one tool. It's not going to happen. Even less, nowadays, when you are talking about things like bring your device or bring your own tools. The important thing is to make the information available to whoever is supposed to have the information and to make it available in a structured way so they know what they are actually looking at. And then if they prefer to use SAS because they've been working with SAS application for ten years, let them use SAS. But if they prefer to use another tool, then the information should be available for them using the other tool. Of course we always have to make sure that we are not drowning into information data warehouses. But to try to limit the number of tools to just one or two, it's not going to happen. | |
| 65 | SM | Does using multiple tools enable you to increase the business user satisfaction? | |
| 66 | INT2 | Yes. To limit them to just using one tool would be like, then they wouldn't even think about using the information because they don't understand the tool. And also, if you go for example if you look at for example at the analytics part of an insurance company, the non-live side of the company is very used to use SAS. But the live side is not using SAS that much. There are other applications used for analysing life insurance. If we would force the life insurance to use SAS as a tool, they would be handcuffed and not able to do their work in a productive way. And it's the same thing when you come to other departments responsible for other things in the company. It's not possible to say that if you want to so this information that you need to use this too. My belief is, I am pretty sure, that is not the way to look at it. Because it is restricting and putting a lot of limitation to the users. It's better to say. "This is the information. This how it is structured, use whatever you want to access it. | MFE |
| 67 | JA | And in terms of ad-hoc data discovery and explorations. Do you have such requirements from the user? Do you provide such functionality, enabling the user just to go and wander around in the data and try to find patterns and detect things? | |
| 68 | INT2 | We do support some of our users with that type of information. Let's say, in the future we will do more of that. Because if we don't do it, the only thing that will happen is that they will just try to find the information from other sources; and then we will have no control over what type of information they are using. So, yes. Currently we are doing it, partly we are doing it, not really. But, we will do it more in the future. | |
| 69 | JA | In terms of infrastructure, do you any kind of virtualization? | |

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| | | How and why? I don't know if you are familiar with the term. | |
| 70 | INT2 | Not really. | |
| 71 | JA | It's obviously a new method of virtualizing data so that it can be used very quickly within the data warehouse. I would presume since you are not familiar with the term that you don't use it. | |
| 72 | INT2 | There's a new term all the time. Data virtualization, yes we are using data virtualization for ourselves when we add new sources to our data warehouse we use a tool to see how conform the data is and what type of information is. But it's not that type of virtualization that you're talking about. I'm not sure actually what you mean with it, No. | |
| 73 | JA | Ok, how about cloud business intelligence? Do you consider using such services? | |
| 74 | INT2 | We are looking into it. But especially for data quality issues. But there are a lot of restrictions about how you can use the information in an insurance company. So, it's not clear right now if the government actually allows you to send your information out in the cloud to use that for business intelligence. It's an area which is kind of restricted right now. | CBI |
| 75 | JA | But do you think that it would increase the agility of the business intelligence functionality and speed, regardless of regulations and law? | |
| 76 | INT2 | Yes, I think so. But I think that most companies, I mean, why not use the cloud. That's what's going to happen in the future. But the regulations, right now, have stopped that. But in the future it will happen. | CBI |
| 77 | SM | I would like to discuss something related to IT governance again. As I a understand, the decision of starting the project is centralized. There are two persons who take the decision according to meetings with business units. After making the decision of starting the BI project. To which extent the BI team members have freedom to make decisions. Or do they have, for example, to get back to this centralized committee each time? | |
| 78 | INT2 | As I said before, we are not really doing business intelligence projects. BI is part of a bigger project, normally. It's not like that we are doing specific BI project, not really. It's part of other projects. At that point, whenever you get a decision, if the project gets the funding, as long as you are following the directives for the project and you're not spending more money than whatever amount you've received from the central fund, you can do whatever you find suitable to make it happen. But if you change the scope completely, or not following the | CD |

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| | | directive for the project or if you're not following the architectural guidelines, the general architectural guidelines for the company or stuff like that, of course you need a decision for doing something else. We do have special checkpoints during the projects but it's not like that you have to contact them and ask for permission every time you make a decision. It's up to the project to deliver whatever the project is responsible for. | |
| 79 | JA | May I ask the name of the committee. Was it specifically only for business intelligence. | |
| 80 | INT2 | No, it is not. | |
| 81 | JA | It is for IT in general you mean? | |
| 82 | INT2 | It's for the projects in general. Because when starting up a project you need to have the funding, the real money, and then of course you have to have the resources. Whatever project you are running resources mean, do you have enough developers? I mean IT resources. But that's the easy part, you also need business resources. The people understanding the business and understanding more of the business needs. And that's, most of the time, that's the type of resources that are harder to find, because when it comes to IT, we have our preferred companies that we work together with, it's huge companies, so I mean we can always get a lot of resources when it comes to IT resources developers and stuff like that. That is not the sector that is narrow or hard to find resources in. The sector or the resources that is difficult to find is the ones closer to the business. | CT<br>SKM |
| 83 | JA | Do you think there are any differences in the level of business user involvement in general IT projects and BI projects. Is the involvement of business user in BI projects a lot higher or is it the some, or how does it compare? | |
| 84 | INT2 | I would say, it is not something that you would say high or low. Because there some business users who are very interested in business intelligence. Like for example people responsible for doing analytical work. In insurance you have something called "actuaries" for like mathematic people who are calculating risk and stuff like that. Profitability of a product and stuff like. These people are very interested in the BI. But if you come to someone who is the responsible for the claims process in INSURANCE, they don't really care about business intelligence. When it comes to getting the right reports and getting the right understanding of which type of claims cost a lot of money and stuff like that, then they are interested in the BI. But their main focus might be handling claims faster or more automatic. It's like BI is not the central focus point for all | |

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| | | business lines. So it depends on the business line. | |

# Appendix 4 Interview 3 transcription

**Date:** 17:00PM, 26th of June, 2014
**Duration:** 71 minutes
**Interview format:** Phone call
**Transcribed by:** Saleh Mustafa
**Transcription checked by:** Jirayr Arzoumanian
**Transcription date:** 27th of June, 2014
**Researcher 1:** Saleh Mustafa: SM
**Researcher 2:** Jirayr Arzoumanian: JA
**Interviewee:** Thomas Kelly: TK
**Company:** Cognizant Technology Solutions

| Row | Speaker | Text | Code |
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| 1 | JA | Can you describe your experience within business intelligence and what are you current responsibilities? | |
| 2 | TK | Actually I have been working with business intelligence type capabilities since the mid 80's. So, roughly, thirty years. We called them something else way back then, but its essentially the same type of capability over that time. My responsibilities, in general I manage a consulting practice that leverages data warehousing and business intelligence technologies to be able to provide customers with better understanding of their customers, their market and their business. More specifically, I work in a more specialized category of information management called semantic technology. This allows us to actually begin applying intelligence to the management of the data and to its analysis so that we can provide not only information about what happened but also the ability to predict and prescribe what is likely to happen next and what should someone do in order to be able to manage what happens next. | |
| 3 | SM | First of all we would like to ask you about your understanding for business intelligence agility, How do you understand the business intelligence agility? | |
| 4 | TK | Ok well first I think we need to make sure that we are defining the right terms. So first of all with business intelligence there actually what I consider to be two categories. One is something that gives you information about what has happened. The other is something gives you information that is not immediately available when you look at the raw data. In other words the intelligence part that gets applied to the data is more than just reporting on the facts. It's drawing insights from those facts to either predict something is going to happen or to prescribe an action would that make sense to take. We often use the term business intelligence to merely refer to reporting on here what happened, give you the data. But it's not really intelligence until someone says based on what I see here is what is really happening. I see a particular curve on the data and here is what I think is | |

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| | | happening and here is why. So when we start thinking about agility in business intelligence. It is how quickly we can go from a hypotheses to some results that answer those important questions. Agility means can I get some type of epiphany in my drive into work and have an actionable result before I have lunch. That's agility. If I have a customer presenting an opportunity for our organization to make them successful and I'm able to recognize and then respond within a time frame makes the customer successful. So, that's what I consider to be agile business intelligence. | |
| 5 | JA | I see. Just to make it clear. In our research we have the first topic sensing changes in the business environment, I believe this is more like what you call the insights that business intelligence gives. | |
| 6 | TK | yes | |
| 7 | JA | Are companies in sensing these business environment change and how can sensing changes provide agility to business intelligence? | |
| 8 | TK | It is absolutely what companies are looking for. You know, perhaps, having a better understanding of what has happened; that was something important back in 80's and 90's. But today, organizations see the business changes frequently. In some cases all the way up to the business model has to change rapidly. So, they need to be able to understand when they have reached an inflection point when their business now needs to shift into a new direction. Now, that business could be focused on a single customer and, you know, the hundreds of other customers that they are dealing with may not be at that point yet. But, they may reach a point with a customer where they have got to change the nature of the relationship they have with that customer. Or the way in which they are able to respond to that customer. In other organizations it may be that they are seeing that there are some multiple signals that they are reaching a point at which how they are operating as an organization has to change across all of their customers, all the customer base. So, being able to recognize the signals rapidly is something that is very important. | |
| 9 | SM | In our understanding, actually, that sensing changes affects data availability and enables you make more accurate image about the situation in the market. Does this affect the business intelligence agility? For example, enables the business intelligence practitioners to move fast and develop things faster if they are sensing changes? | |
| 10 | TK | Ok. First of all I think what thing we need to recognize is that the velocity in which new data is being introduce is accelerating. So what is that mean? Not only the amount of new data accelerating but the rate in which new data is being presented is accelerating. So, this means that organizations are challenged in being able to move rapidly enough in order be able to make use of this data. This, in many cases, means that the tool they work with may need to change. Certainly, a lot of the practices that they need to follow need to | DR |

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| | | change. It used to be back in the early days of the business intelligence that you have a lot of time to become an expert in the data before you could start actually working with it, you had the time to do that, because nobody was expecting anything quickly. Today we are seeing those times being compressed to become an expert in the data and then start using the data in order to be able start generating new insights. Barely, you've gotten a set of data before there's got a new set of data the you need to start learning about. And so, this means that everyone becoming an expert in all the data just slows down the process or delays the process, I should say, to an unacceptable degree today. So, where in the past we may have had weeks or months to become knowledgeable. Now we got hour and days to be ready to start working with the new set of data we have been presented with. So, its tools, meaning BI products, as well the practices that we engage to be able to start using that data. | |
| 11 | SM | So I can understand that as much as fast you get the data as much as you can improve the business intelligence agility? | |
| 12 | TK | Yes. If we just keep doing things the way we have, we are taking too long to learn the data and we are slowing our ability to respond rapidly, which is the agility all about. | |
| 13 | SM | I think this is enough with the sensing changes, can we move to the next topic which is the development process. Can you briefly describe the main stages of the development process of business intelligence? | |
| 14 | TK | It's first of all understands what it is that someone is trying to accomplish. So, understanding the requirements that they might have. Though, too much time spent on this is actually counterproductive. In the past the practice has been thoroughly understand all of the requirements so that you can build a capability that responds to those requirements. The problem is that probably not long after you have finalized those requirements but requirements start to change because the business is changing. So, instead, the practice today is for an agile business intelligence environment is to rapidly capture an initial set of requirements. In other words, what is sufficient to start demonstrating success, because you have to anticipate the day after you demonstrated that initial success you may have to be doing things differently in order to demonstrate the next success. So, you rapidly collect a set of initial requirements, you anticipate what is likely to be the future, but you don't expect that what you need to do is just limited to this report, this set of requirements that has been presented. From those requirements then you start looking into the data; what data is going to be needed in order to answer those requirements? how owns that data? do you have permission to be able to access that data? what is needed to be provided access to that data? data usually comes from a variety of sources so you also need to start thinking as well how to integrate that data. Here again is another challenge to agility and that is if the person who is doing the analysis has to go figure out about all these | IA |

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| | | answers, they probably wasting between 60 and 80 percent of the time that is going to be spent on coming up with an answer just focusing on these activities. So, the business intelligence person, the analyst if you well, is now doing the work of a data management person to address all of these questions. So in agile environment something has been provided, some capabilities in place, that supports being able to answer these questions very quickly, in minutes not hours or days. So, once someone has a set of data that is ready to start answering some of the questions then comes the selection of the appropriate analytic computation, aggregation, filtering what not is needed in order to be able to answer the question. There is a good strong business rationale behind the application of this algorithm towards answering the question. Once the algorithm has been selected and is applied in the business intelligence environment, then some result is produced. Now, here is the true analysis, someone looks at that result whether it's a set of data or single answer or something that has given some response. Then they need to determine is that kind of response that makes sense to a business person. This is a very important part of this process because, one of the thing that experienced analyst does is to realize that sometimes their experience describes a world view which the data response does not fit within. So, you expect your customers to respond in one of three different ways and now all of a sudden somebody has presented you the fourth way. You just dismiss it as an anomaly in the data, less experienced people tend to do that or do you look at this and say this bears further investigation to verify that it is in fact a new way which customers are looking to engage or truly it is some type of anomaly in data that should be excluded. So, that analysis is a very key part of the process. In a lot of organizations, failure to do this probably causes them to miss an insight. And it could be weeks, months or years before they finally figure out that they truly did get a signal of something new but they just chose to ignore it. Finally once a result has been determined then there is a story that needs to be told. Someone is going to want to take the results of this business intelligence activity and do something with it, but they need to understand it. So the person who is putting these analyses together has to compose a narrative that describes this is the results we got, this is why we got this result, this is what this means from a business perspective and anything further that can be add to it to help explain it. Here is where the data came from, here is the transformations that the data went through. Very often when someone is presented with a number at that end some type of a rapid BI process the first thing they do is to question the number saying "That can't be right. How did you come up with this number?" Specifically when two different people are given the same business intelligence assignment and they come up with different results? They are both suspects and someone has to be ready to be able to explain how do I come up with this number. So this is a key component of that narrative. It goes to the ability to trust the results. It's just a piece of that total last step which is being able to explain to | |

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| | | someone the end result. Now, it still sound like a fairly lengthy, well thought-out process. In fact agile business intelligence, sometime has to be able to operate in less than a second. In other words, the point at which the customer clicks on an update my recommendations link some business intelligence process has to execute and give them a personalized interaction immediately. So business intelligence isn't just for analysis. In some cases it is also for customers, someone says here is my situation tell me who is the doctor that I should be making an appointment with, a system that is guiding them through the selection of physicians should be able to give them an immediate answer even though there might be a comprehensive analysis that supports the answer that is ultimately provided. So those are the key steps. But from the timing standpoint this is something as well that is an important consideration. | |
| 15 | JA | I See, Shall we describe this process as regular traditional waterfall or is it more iterative approach? | |
| 16 | TK | Well I've highlighted the major steps. In fact in most case, it is iterative because you are going to take some of these actions and execute them multiple times before moving on to other stages or you are going to be doing pieces of the analytic through to completion in order to verify that you are progressing on the right path before you start working on the next part of what all ultimately result in your end product. So, certainly there is a lot of folks who are familiar of doing it from an waterfall standpoint, but more often than not not, it's a series of repetitive activities either producing an actionable result at the end of each or at least a learning at the end that guides how you approach the next set of work. | IA |
| 17 | SM | I would like to clarify a point here, from the first answer I understand that the business intelligence team consists of one business intelligence practitioner who will work with the business team to achieve their requirements ? | |
| 18 | TK | There are certainly multiple roles in this activity and there are also multiple opportunities for automation of these roles. But I would see that you've got a business customer, you've got an analyst, you've got a role involved in data sourcing, data management, you've got the actual analyst who determines the appropriate algorithm to be applying against a defined set of data. You got someone who is able to interrupt the results. Now, all of these roles could be potentially held by one person. More than likely, that's going to be split across multiple people because there are just few people who can do all these roles. Data scientist has be thrown around as someone with that potential skill set but that's a slippery slope. There are so few people who have that broad set of knowledge and experience that, you are either really challenged by the fact that there are few people that are available to step into that role, or you have people who are able to operate across all those different roles but there experience is wide but not very deep. More often than not, I have seen and have recommended, for lack of a better term, a data science team. | SKM |

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| | | Meaning that you have all those roles are represented by the team but you don't depend on any one person to bring everything to the table. That way if you should lose a team member, it's much easier to replace someone who focuses on particular role rather than someone who has the experience in all roles and everything depends on him. | |
| 19 | SM | As I understand, the business customer participation is important in the development process, to which extent this participation, is important for you as business intelligence practitioners? | |
| 20 | TK | To put it bluntly, if you don't have a business person involved, you might as well not bother. First of all the business person is a customer of this type of responsibility. Second they are some type of a domain expert so they know aspects of the business much better than someone who is in role or just doing business intelligence work. And domain expertise is not just someone who has depth of knowledge but also someone who is currently engaged in the business to an extent that is not available to people, say in IT. You can have an IT person, let's say who has a former background as a chemist but if they are not actively engaged in research, they start losing connection to what is going on today in the world of chemistry. So you can do business intelligence, you got that grounding from your prior experience but that enables you perhaps to have better conversation with the business as opposed to actually representing the domain experience of the business. So, those two roles are very important. Finally, it is the business person who needs to determine how to apply the results of the business intelligence activity. And it's that connection to the business community that has them in a role that allows them to take some actions based on the result. So, acting as the customer, acting as a domain expert and the facilitator of some business response to what was learned from the business intelligence activity. These are the key roles for the business and that makes them absolutely essential to the business intelligence process. | CT<br>CRB<br><br>SKM<br><br>SKM |
| 21 | SM | Here, I have question about the communication between the business staff and the BI practitioners, will the communication happen using documents? are there test documents, for example for each stage do you have to sign documents? | |
| 22 | TK | Communication is a very big challenge for focus in IT organizations, since they tend to think more in terms of their technologies. And because of this challenge they very often will resort to documents as a mechanism for communications. Its usually the person who is a good verbal communicator who is able to do the best job because, they can actually have a conversation with the business, they can speak in the business language. They certainly may need to ask questions because they don't have the depth and breadth the business person has but it's that face to face interaction that really creates an opportunity for successful process. Anyone can define a process and certainly all the elements will be there for success, but it's the commitment of the participants towards that process being successful | SKM<br><br>CT |

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| | | that actually makes it happen. So I think that the most successful business intelligence activity is the one begins with face to face conversation with the business persons, talking with them about business challenges, talking with them about potential solutions, getting agreements on not only what is going to be done and the result but how you are going to do what needs to be done and that collaboration over results and process, ultimately results in a successful business intelligence activity. | CT<br>BSSC |
| 23 | SM | So I understand since the development process is iterative, there will not be signed documents after each iteration. | |
| 24 | TK | Oh, that is very 1980s and 1990s, no. Certainly when someone is doing some type of contractual basis there's probably a need of some type of a sign-off document. But, I think that in today's environment the degree to which we must be ready to shift, means that we are working from less documentation and fewer approvals and we are focusing on we've got this immediate term objective we want to accomplish in this short defined timeframe, lets reach that and then we are probably going to shift direction but until we get there we are not going to know what that direction will be. If we bog that down a significant amount of process. Certainly, we will control the schedule and costs as much as we could in the past but we are going to actually slow down our ability to support that business. At a time when the technology could barely keep up, you know, you tended to slow things down in order to be able to make sure that everything was lined up perfectly and well defined so that you only had to do the technology part once. Today we are seeing more technology that has faster turnaround, greater ability to flex and so the business process and the technology process need to reflect the ability in order to be able to rapidly change. So agility is as much about process as its is about technology and some cases that may mean that you look to minimize the amount of process they have to go through before you produce some type of result. | RA |
| 25 | JA | About the learning aspect after each project, does that affect the agility of the business intelligence? | |
| 26 | TK | Sure it does | |
| 27 | JA | I mean the experience that you build up from BI projects one after one. Does it affect the agility of the business intelligence. | |
| 28 | TK | It certainly does. You know the old saying that those who don't learn from history are doomed to repeat it. That's the starting point, so where organizations had taken to include a step in the process to learn and capture those learning that certainly benefits the team but teams often change, and add people and lose people and the traditional approach of what generates lessons learned document at the end of the project very often, after a couple of iteration of your agile process, even those learnings start to evaporate. The knowledge of them becomes less, new people never had the opportunity to sit through sessions so they didn't get the learning and next thing you | LR |

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| | | know you're repeating some of those problems of the past which can then be very much frustrating for your business community. Instead what we are seeing is now certain technologies that are allowing taking some of those lessons and incorporating them within the technology so that captured expertise is now part of the data and methods that are employed when you are executing your agile project. This one of the reasons that why I focus in on semantic technology these days is that we can take things that we have learned, expertise practice and so forth and actually we can embed it to the model of the data. So that we say "Oh, when we see data that looks like this it should indicate that we should be taking that kind of action". We can take that lesson learned and actually embed that within the model so that the definition of the data is able to persist those learning not just the data. | LR |
| 29 | JA | If we move on to the next topic which is IT governance. Does the structure of IT governance affect the agility of the business intelligence? Such as who takes decision regarding business intelligence? Is there a business intelligence competency center? Is it business intelligence centralized or decentralized? Does all this affect the agility of business intelligence? | |
| 30 | TK | In some organizations, data governance has a lot of power; and because of the need to govern the data that can extend to a lot of decisions that traditionally have been outside of the data governance. And so, there are certainly cases where data governance makes choices for the organization that are outside of what should be consider its domain. So you certainly have the risk that it can influence almost anything. Further, even the data governance needs to shift some of its methods to take into account the agility requirements that we have today. Data governance is very often thinking about establishing standards but many of their practices are still pretty manual efforts. So, this means that they can't move very fast; and they often have a backlog of standards creation that projects may find that they have to wait for if they are going to leverage a standard, and yet if they choose to progress to the pace of business requirements the governance group may say "wait a minute, you are looking to start using a whole bunch of data that we didn't have the opportunity to establish standards for, you can't start". So, data governance ends up being an impediment to agility rather than facilitating it. One of the things that we recommend is that there be a dual approach. Data governance first of all focus on data that is shared, that it does not try to determine standards for everything and that the progress through the process of establishing standards for shared data, it stops fighting battles for data that is not so shared. So for example different business units may have similar or the same terminology for different things. Someone can make a case that a term like customer is shared by everyone and therefore there should be a single definition where in fact it's entirely different form one business unit to another. Sale may identify the purchase organization as the customer whereas the medical may consider a patient Is being | |

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| | | the customer, manufacturing may consider the distributor to be the customer. So these respective definitions are not shared. Yet, we hear all the time about the data governance getting people representing all the different groups together in one and wanting to hammer out a single definition so that everybody then complies with that standard. This is one of the things that slows down and cause friction with the data governance, it's because its trying to impose this artificial sense of standardization over things that are not to be standardized. So, we see that there is a need for being able to have data governance bring standardization to the things are in common, that should increase agility of the business intelligence. But they should stay out of the areas where there is little benefit from standardization from the governance perspective and very often that is trying to address the diversity of the data across various organizational business units. Multiple people having different perspectives about the same data or having similar terminology about different data, is a very natural way of in which business operates. Data governance should streamline what it can but try to avoid standardizing things that don't naturally standardize. So when you consider data governance taking up that kind of perspective they can be a great contributor to the agility of the business intelligence. | |
| 31 | JA | You said there is a conflict between IT governance and business intelligence in taking the decisions. Is it better to keep it decentralized business intelligence development, among departments within the company for example, or is it better to keep it centralized and enforce everything from that department? | |
| 32 | KT | There are certainly cases for either approach. It kind of boils down to this. The centralized business intelligence organization can gives you opportunities for economies of scale and consistency in your practices. On the other hand, distributed business intelligence groups will be more focused on their domain and are able to gain the benefits of a closer connection to the domain experts and ultimately their business customers. Different organizations will find more success with one approach than the other but they approach by themselves don't lend themselves to greater success. It really depends on the operation of the organization. | CD<br><br>DD |
| 33 | JA | Then what are the effects of having decentralized or centralized business intelligence group on the agility of the business intelligence? | |
| 34 | TK | Well, some of the negative effects would be that you may have with a decentralized approach you may have a very divergent practices, you may have very different tools that are engaged or maybe that's not so bad. I tend to look at technology products as tools in a toolbox. Governance will tell you should need one only one hummer in your toolbox, practical use tells you that I am not going to use the same hummer for repairing delicate furniture as I'm for knocking down walls.So, some group may need to have multiple though similar tools because certain tools or products are going to be better suited to | |

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| | | particular purposes. However, it's when you merely proliferate the tools rather than fit them to specific purposes. So if everybody came alone and just said well my tool of choice is X and that X is different from every group. Not for any other reason than its their preferred choice of tool. And that any of the tools could do an equal job, you have a lack of consistency without a particular reason or benefit for having that diversity of tools. So certainly a decentralized function could potentially open you up to greater costs for licensing, supporting the technologies different practices and so forth. The Centralized group, the negative impact is that they, before long, skip the reputation, they don't know what they are doing and drift from something interesting and new to this was a group that really doesn't deliver any value and let's not invest our time or funding in this group because they really don't know what it is that we are really doing and they are really not in the position to support us. So, that is the negative effect. Now, how do these promote agility? The distributed groups may have a smaller number of projects that are trying to execute, they are able to focus on specific needs for their customer, their business customer is in a better position to establish priorities so they can end up being much more effective in producing results that their business customer is interested in. For the centralized group, you are more likely to have a larger team, a larger group of resources which means that you can flex your team up and down as needed. Today's project maybe only needs a couple of people working on it. And yet tomorrow, another project starts up that needs twenty or thirty people working on it. So assuming that you have a certain amount of flex built into your centralized organization you can be much more responsive to a larger number of projects and be able to address them more rapidly. so this means that the distributed teams probably manage a small number of projects, less ability to scale up and down. Scaling down means people sit around with very little to do; so they are given make-do work projects rather than focusing on their attention on the most effective thing of value to the organization. The larger team, with that flex, can get a better return on investment of employee time. So, better return per hour, in other words, can potentially result from the centralized organization. | DD<br><br>CD |
| 35 | JA | I see. Actually, your reply even moves us to the next topic, which you covered couple of items from, business intelligence architecture and infrastructure. Does having a single or multiple data warehouses within organization affect the agility of business intelligence? How? | |
| 36 | TK | It certainly does. Certainly, there is value behind organizing data to support a specific category of analytics. That's a major justification of doing data marts. However, over time, the data movement processing becomes very expensive. And every time someone says "I've got a new way of thinking about how I group this data, I need a data mart". Next thing you know your IT organization is dealing with a vast proliferation of data marts, they are just slightly different from each other. But, if you try to manage that proliferation by saying | |

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| | | "We're coming up with one size fits all model to support everybody". Then, they'll say "That's fine, that lowers your cost to manage these resources, but it increases my cost to have the necessary resources available to me and the agility with which I produce analysis results". So, up to a certain point, data marts provide optimization to support agility and analytics. But beyond that point, they start creating more problems that then put the IT and business organizations in contention that we're trying to manage, you know, the growing cost of the proliferation. | |
| 37 | JA | How about having a single data model, how does that affect the agility of business agility, if you can do that of course? | |
| 38 | TK | Well, if someone says that they are going to build only one model of car and that's all anyone could buy, regardless of their personal family situation. That's the only choice you have. How would that work for everybody? You'll get a few people who would say that's perfectly in line with my needs. And everybody else would says that's completely wrong for me. Some would say I need something bigger, I've got a bigger family. Someone else would say I need something smaller because I'm an individual I just need something to get me to work quickly and inexpensively. So you find very small population that say "this meets my needs" and everybody else is upset that it doesn't. So, a single model used to be the only way that you could do things in the past because of the cost and effort required to build multiple versions. Much like I was describing with the proliferation of data marts, you got to deal with a proliferation of moving the data in order to support these various models and as well keep the data in sync between all these different repositories. Some people look to get updates on a daily basis, others need it once a month, other need a continuous update. Now, that's physical repositories. There are technologies that support using a single repository but multiple models. This is perhaps the best confluence of all these different needs. Keep a single copy of the data so that you minimize the proliferation of repositories and the cost of moving the data around all the time. But you give each group the model of data that is optimized to their requirements. Further, Giving them the ability to create an instance of a shared model that they are able to personally extend and enhance. That gives them the flexibility to manage the data in an organization that is more familiar to them, perhaps using a terminology more familiar with, but the only changes going on are in the model that they are creating, it is not changing the structure of the data. So, here I'm using a couple of different terms. From the model standpoint, we're looking at organization. From the database and repository standpoint, we are talking about structure. So there is a single structure that manages all the data, but there are multiple models that describe different organization of the data and it is the technology that supports being able to have the data available through the model rather than people interacting with the database structure, which, probably, is the lowest common denominator | EWH<br>IDM |

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| | | implementation. | |
| 39 | JA | But actually, what we got from another respondent is that having multiple data warehouses is something that doesn't bother them at all. And practically it happens all the time, whether they want it or not. But, what they cared about is that the data is inherent and that there is a single data view that they have eventually. It doesn't really matter how many data warehouses they have, that's the understanding that we had. For example, in the case of a merger, it is more efficient to build a single data model rather than try to combine those data warehouses. | |
| 40 | TK | So, let's dig into that a little bit further. They would like to have single model, until somebody says "except this model doesn't need my needs. I need my own model". And further, you got folks who are saying, I don't mind having multiple warehouses until I have to pay for it. But unfortunately it's less costly, on an annual basis, to maintain all of these existing warehouses than it does for me to time and effort to integrate them all into a single warehouse. So it's not that they started off by saying "we're going to build six warehouses, or twenty warehouses or fifty warehouses". They've just found themselves in this situations where they have all these warehouses and they can't even begin to think about how they could justify the cost associated with integrating them all. So they look for a modeling approach to perhaps give them the same capabilities at a much lower cost. Certainly, this is the approach a lot of organizations would take. There are a lot of case where it doesn't make sense to integrate these things on a physical basis. Particularly, if they are dealing with different categories of data. But if you got, for example, a pharmaceutical company; and it, through the course of mergers that were conducted over the last ten years, it's got twenty different molecule databases. Some of which are talking about the same molecules. But, they are using different test results, different assy processes, different quality metrics and things like that. Someone says, "I want to look at all the different tests that we have run against this molecule of interest, because this could be our new blockbuster drug. Somebody has to go figure out how to integrate all that stuff at least for that molecule, but that process gets repeated all the time. It's a number of different challenges that no one has come up with one single way in which they address it. So we're looking at it from the standpoint of what you have, what makes a reasonable migration to a future point that allows you to manage your investment, but also what can you do to support the flexibility and agility requirements of the people who are analyzing the data. You may end up in a multi repository, multi model environment, that allows you to keep your investment to a reasonable level and still giving the people the agility that they need and the integration tend to happen at the model level. | MWH<br><br>IDM |
| 41 | JA | The way that I understood it is that the multiple data warehouses, even though it might be costly, but it provides tactical agility while integrated data model provides strategic agility, long term one. | |

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| 42 | TK | If the structures of the data warehouses don't also need to be agile then I would say, that's probably true. But more often than not, what I have seen is that organizations who have said we have these tactical warehouses, but we seem to replace every couple of years. If they are going through that, then I would say they don't have quite the tactical agility that they are seeking. Because they have keep making these big investments to have the warehouses keep up with the business. | |
| 43 | JA | OK. They my final questions would about front-ends. Does having multiple front-ends enhance the agility of business intelligence? | |
| 44 | TK | Yes. I'll go back to my toolbox analogy. Sometimes you need a big hammer and sometimes you need a small one. Sometimes you want to be leveraging functionality that is available in one tool and not available in others. But they have to be treated in just that fashion. What often happens is, you make a suite of tools but individual practitioners pick one tool and try to do everything with it. That is counter to the benefit of having the multiple tools. So, if your practitioners are willing to make the investment in learning the multiple tools, so that they can use them for the right jobs, then it makes sense to have multiple tools. If everyone just wants to have one tool that they going to use to do everything, then it's probably better to pick a one single tool that everyone can learn to work with. | MFE |
| 45 | JA | OK. What other factors do you think could contribute and enhance the agility of business intelligence? What practices could companies employ? | |
| 46 | TK | One thing is the mindset that the need for agility is going to continue to escalate. We're dealing with now a vast proliferation of data technologies that didn't exist even just a few years ago. Social media certainly has been a topic of discussion over the last few years. So people think OK, social media that means Facebook, Twitter and maybe LinkedIn. Maybe there is one or two other media channels out there that I should pay attention to. Well, the realization is that today there is probably closer to 300 social media channels that organizations should be paying attention to. Not just three to five. And that number is going to continue to grow. You and I as individuals could create a whole new social media channel overnight. And very quickly afterwards, because it appeals to some people on a level that other social media doesn't. All of a sudden, you find that you are running the next Facebook. Because you have some features in it that the other don't. All out of a sudden, it's extremely appealing. Like for example, you actually build a social contract with your users of your social media site, that they have complete control over their data and that no one sees it from outside that contract. All out of a sudden, you're offering something Facebook wouldn't even dare touch. And, all else being equal, you're going to start seeing the hundreds and thousands and millions of people gravitating towards your new social contract-based Facebook. These things, organizations have to start paying attention to and build the skills to be able to leverage that data. And it's not just pull it all into a big | |

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| | | data repository. Nobody has the ability to store a copy of a Facebook within their organization. So each of these social media sites has their own APIs, their own language, their own data structures and so forth. So, the ability to monitor and adjust and respond to shift in acceptance of new sources of data, social media being one example, is going to be very critical to business intelligence. The key behind this is that more people are interacting with their businesses through online activities than they ever will face to face. Even doing grocery shopping, we are starting to see a shift towards more people wanting to engage with the supermarket on an online basis, even though they still pop into the supermarket once a week. So organizations that are able to leverage the data that is available in the online world gives them a better perspective of their customer, so that each time they interact, whether it is in person or on online, gives them an opportunity for a more personalized engagement. The ability to understand all of that data is what's going to it make possible for organizations to be able to have that kind of engagement. I walk in to some stores, they have no idea who I am, and when I've left, they have no idea that've been there. They have no engagement with me whatsoever. So, that kind of limits their ability to influence my choosing them to make a purchase. And over time, I may just stop showing up and they'll never know. Other stores, on the other hand, may know the moment that have arrived and are engaging with me throughout, whether it is personal or electronically. I can, In some cases, have some sort of virtual concierge at my elbow helping throughout my shopping experience, if I continue to using the grocery store analogy. And that I am being offered information that helps me to my next decision point, and to make that decision, and then ushers me to my next decision point in a fashion that I am appreciative of, because it helps get accomplished with what I'm looking to do while I'm in that store. And then ultimately, as I'm leaving, they may know enough about me to then offer me something that is with a partner of theirs or something like that, that they have now figured out would be of interest to me. So, for example I'm leaving the supermarket, I've not yet had dinner. Knowing that here are the local restaurants that I tend to visit after that I go grocery shopping, and saying hey this one over here has a 10% offer if you visit them within the next two hours. It shows that they are committed to my being more successful in the things that I need to do. And so, I will want to patronize them more because, they are providing that type of engagement. Business intelligence sits in the middle of all of this. And it's getting the necessary data, using to analyze customer patterns and having that close, intimate electronic engagement or providing the information for a personalized in-person engagement, so that my experience with them were very successful. These are some of the kinds of the things that organizations need to think about as they are working with their data and thinking about how should I be applying business intelligence capabilities. And ultimately, the user of the business intelligence capability is not the analyst, it's not the business user, it's the | |

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| | | customer. So, how do you build those business intelligence capabilities to enable that customer more? | |

# Appendix 5 Interview 4 transcription

**Date:** 18:30PM, 27th of June, 2014
**Duration:** 37 minutes
**Interview format:** Phone call
**Transcribed by:** Jirayr Arzoumanian
**Transcription checked by:** Saleh Mustafa
**Transcription date:** 2nd of July, 2014
**Researcher 1:** Saleh Mustafa: SM
**Researcher 2:** Jirayr Arzoumanian: JA
**Interviewee:** INT4
**Company:** Kept anonymous. Referred to as Company 1 and Company 2.

| Row | Speaker | Text | Code |
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| 1 | SM | First of all, please describe your experience in the business intelligence domain. | |
| 2 | INT4 | I'm at my third location doing BI. I started in the BI space when I was in Gartner. I worked at Gartner for ten years. Just about a few week under ten years. In a number of different roles, from tech support to working on their some deliverables. But I ended up in the BI side. I wanted to get back towards technology and business technology though. I served in the role of business intelligence analyst when I was at Gartner. Within that role I played on the platform as an administrator, report designer, did testing, did implementation of new BI platforms when I was at Gartner at the time. We were implementing a new data warehouse as well as a new BI platform. We were moving from what was know as BRIO or Hyperion to OBIE, which is Oracle Business Intelligence Enterprise edition. I was the owner of the implementation of OBIE at Gartner. I played that role until August, 2010. I decided to leave Gartner just for nothing more than career purposes. I served as the project manager in the BI space at COMPANY 1. Hopefully, you guys are familiar with COMPANY 1, a cosmetics company. While at COMPANY 1 I worked there in the role of doing BI rollouts. I was at COMPANY 1 for about two years and decided to move to COMPANY 2 with the director I used to worked with at COMPANY 1. Now, I'm responsible of solution delivery and rolling out a new platform at COMPANY 2. Hopefully that wasn't too quick. That was the quick and dirty version. I worked on Oracle BI, BRIO/Hyperion, and currently Microstrategy. | |
| 3 | JA | OK. Before we go into details, let's describe our understanding of business intelligence agility. We define it as the ability to react to unforeseen or volatile requirements regarding the | |

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| | | functionality and contents of business intelligence solutions in a given time frame. | |
| 4 | INT4 | Yeah, It sounds about right. | |
| 5 | JA | The first we would like to ask is how do you understand business intelligence agility from your side? | |
| 6 | INT4 | I guess you summed it up the way I understand it, which is being able to react and quickly adjust to the changing needs of the business. One of the key things when you come into a business intelligence project, and this is at ground floor guys I'm not even talking from a reporting standpoint, I'm talking about putting in a data warehouse as well as the ETL processes, you need to build a platform front-to-back or bottom-to-top, that scale. So, what we just did at COMPANY 2, we implemented a data warehouse as well as the ETL processes within Microstrategy's cloud. And when we built it, we build it to scale out past what the business was asking for and more towards the information at the source systems deliver. So, if we built a warehouse to the requirements that the business wanted on day one. Like in week three, things would have changed. So, keeping scale and scalability in mind when you roll these platforms out is key to the agility of the systems which completely aligns with having an agile platform that can support the business. | |
| 7 | SM | Here we would like to start with our first topic in our research, sensing business environment changes. How does sensing changes in the business environment affect the agility business intelligence. | |
| 8 | INT4 | It's funny. You can't build your systems to fit everything. In all my position in different companies we had to adjust. I'd say sensing business changes vs being communicated business changes are two different things. A lot of times when you are on the IT side, I don't know if you guys are currently working in IT or what you situation is, but sensing business changes can be a challenge from an IT side. But usually with our BI platforms in my experience, we can adjust within a few months of development to be able to keep up with the business. I think anything outside of that if you have a situation when the business does change and you are not able to keep up with the business. It can impact the credibility of the BI program. So I'd love to say that sensing business changes is as easy as going out to the web and reading things but that is not always the case. But usually if you can get the foundation of your BI program scaled correctly, you can adjust pretty well for the way the business looming. | |

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| 9 | JA | So, I would understand that the responsibility of sensing environment changes is thrown on the business side rather than the IT side. | |
| 10 | INT4 | You are exactly right. And I think what is good, if you guys want to get into the piece of how an organization is structured, I have been in a situation in one of my prior companies where I worked in business intelligence, at COMPANY 1 for 2 years and I have a limited exposure to individuals in the business and the communications up there it a higher up level it is above me. At COMPANY 2, the way we do our projects we have close alignment individuals in the business at all of our projects, we bring the stakeholder on to our project from the business and what that does is, I don't have to mind-read. I go to a PM who's part of my program and I say, listen, you're the representative of business, how is the the way the solution that we've implemented tracking to what you need? and is there a potential issue in the horizon?, how do we need to be proactive to adjust it? Close communication with your business partner as well as making sure that they are stakeholders in the project allow us to get over any communication obstacles. Hopefully that answered your question guys. | BSSC<br>DR<br>CT |
| 11 | SM | Here we could like to clarify more, in our understanding sensing business changes in the environment enables you get the data in a faster way and business intelligence heavily depends on the data. So when you have the data faster you will increase the agility of the business intelligence. Is that right? | |
| 12 | INT4 | Yes absolutely. I wouldn't say performance and agility are the same thing. It depends on your definition of performance. I mean, performance is more fundamental of the success of any BI program. But being agile and agility of the BI, it's more about changing to adapt to the individual needs of the business in a quick manner not performance meaning from system standpoint. Quick manner meaning we can foresee changes in the business and react to them and implement solutions quicker. | |
| 13 | JA | Since you mentioned the implementation. Lets delve into the development process. Could you briefly describe how the development process of business intelligence is being done, roughly? | |
| 14 | INT4 | We are taking agile approach to our BI project but not standard like waterfall approach. The reason for that it's very iterative. We want to make sure that even from the beginning, once we have all our requirements that we do take the approach of putting the right solution from an ETL standpoint we test it, then we can move on and we get to the warehouse where we have data flowing from our source system, we take a very | IA |

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| | | iterative approach to testing data, making sure we're are meeting our goals from testing standpoint before moving on, if we need going back and revisit. Any of the data testing or the design of data architecture, all of this done guys in a very iterative and agile approach. Now, its not going to be a cookie cutter. A lot of this stuff is very fluid and it's tough to work with a lot of our BI projects. We are working with a PPMO, a Portfolio management group, where they want dates and they want us to be on a fixed timelines. When you are working in an agile environment trying to establish a data warehouse or a BI platform, it's much different than your SDLC model, where things are very black and white. We work very agile in approach and this is even a COMPANY 2 thing. This goes back for the past two companies as well. | |
| 15 | JA | Is it a formal agile method or is it an informal one, customized based on your needs? | |
| 16 | INT4 | We have processes we have to follow in our company, that are agile processes, part of the PPMO. What I've seen when I was at COMPANY 1, their agile process was a little different. The agile process at COMPANY 2 is a little different. But, for the most part it is a process defined formally within our portfolio office. | |
| 17 | SM | Can you describe a little bit about how do you formulate the team for the development. For example, how do you select the representative of the business team and the representative of the BI experts. | |
| 18 | INT4 | Sure, absolutely. The model that I followed in the past two position that I had, we did it from a development standpoint, it was external resources. So, for the pure project development we go outside. What we tend to do is, I would say, the first three to five months of the project we ramp up on consulting resources, we drop off anybody who is not good fit. What we try to look for is people who are not only the code junkies but can actually talk business talk and actually understand what they're programming to. We usually look for people who are entrenched in the business market. So, from a development standpoint, we look outside to provide the ETL, data architecture, data warehouse, database development. And from a BI platform standpoint, we can have few folks in-house to do it as well external. That would be from the development side. From the business standpoint, which I think is the import role, we try to identify an individual from the business team, no matter what work stream we are working with, who is savvy enough to understand the transactional data or source systems data. For example in finance we would reach out for an analyst or a controller who is familiar with the sourcing of data, the | SKM<br><br>SKM |

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| | | business rules as well as the potential reporting needs of the business. We want someone who can make decisions on behalf of the business, so we're not chasing people. Or, he reaches out to his business to get those decisions made. And somebody who is willing to gets his hand dirty test the data, sign-off on the data as well as the report structure. It's funny, we had to workstreams we've been working on for the past year that had someone who was really like a heavyweight when it came to being a PM to the business side. And the project went extremely smooth. And then we had somebody on the other side who was too business centric and not too close enought to the technology to understand to understand the source data, that's what caused problems to the project. So, I mean, my experience is that business representation on these projects and their, them being stakeholders is really at the cornerstone of success of the project and the implementation. | CRB<br>SKM<br><br><br><br><br>CRB |
| 19 | SM | We got this understanding from your description. Here I would like to ask about the communication between business staff and IT staff. Is it a formal kind of communication or informal? Do you use testing documents or these kind of formal documents or do you use more like informal? | |
| 20 | INT4 | From a requirement standpoint of the project, we have formal documents. From a communication standpoint, if you consider things like project steering committees on a weekly basis or recurring basis as form of formal communication, those are in place as well. So, with our projects we have numerous meetings between the project stakeholders on recurring basis, at minimum monthly, those go through the project on a weekly basis, those formal meetings. | CT<br>RA |
| 21 | SM | And these meetings are almost face-to-face meetings! | |
| 22 | INT4 | We're a global company. Many of them are over… Actually no. You know what, depending on the executive who are in our office at the time they will attend, that includes up to the CIO from our side. | |
| 23 | JA | If we move on to the IT governance. How does the IT governance within a company affect the agility of business intelligence? | |
| 24 | INT4 | I look at governance in two ways, from a data standpoint as well as from infrastructure. I would say in our case, we have a completely cloud based solution. So, it's not really a problem with us I could see how it could be with other companies. We align very closely with a lot of governance of…. We have a very lean IT shop, so governance is not really a problem with us staying agile. | |

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| 25 | JA | OK. Then, should we understand that the decision regarding business intelligence are decentralized or centralized? I mean | |
| 26 | INT4 | Yes. We follow a center of excellence model. So all the BI decisions are centrally designed | |
| 27 | JA | You mean it's a centralized model | |
| 28 | INT4 | Yes, From a BI standpoint, BI specifically, yes. | |
| 29 | SM | Does this affect the agility of the BI functionality or it works normal for the company | |
| 30 | INT4 | No, it doesn't. No impact on the platform. No negative impact I should say. | |
| 31 | JA | Is there a single team for business intelligence development? | |
| 32 | INT4 | Yes. I'll be completely candid with you. We are in our infancy. We are just completing the first round of a year-long implementation of Microstrategy. A lot of this stuff is very new to COMPANY 2 and is being figured out. But right now, our group is lead by our director, which rolls up to the CIO. And all the BI decisions come of the combination of those two individuals. | |
| 33 | SM | So, I can understand that inside the company you have like a pool of BI practitioners and for each report you will assign one of these guys to participate with the business team! | |
| 34 | INT4 | Yes, exactly. So, right now it's centralized, if it evolves, it could potentially evolve. | |
| 35 | JA | OK. Then we'll move on to the architecture and infrastructure. Does having a single or multiple data warehouses within the organization affect the business intelligence agility and how? | |
| 36 | INT4 | Yes. Absolutely. Good luck finding somebody who has more experience with both sides of it. In the three locations that I've worked in, I worked in two centralized enterprise warehouses and I worked in one that did not. So, at COMPANY 1 they had warehouses in each of their locations. The biggest challenge we had was keeping everything in synchronization. So, having a standard set of interfaces, the interface specifications for each warehouse was a nightmare to manage. To be honest with you, when you have Microstrategy sitting over eighteen to twenty warehouses around the globe, the consistency is such a challenge. So, taking the centralized data warehouse approach is preferred. | EWH |
| 37 | JA | OK. According to another respondent, he said that, at least for their company, it was impossible to have a single enterprise warehouse. So for him, what was important was to have a | |

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| | | single data model. | |
| 38 | INT4 | That's fine. If you get into the numbers of how many warehouses they have, if you only have a handful, I can see it. When you have an amount over ten or twelve, it's a challenge. Each on is a different IT group, and this my experience. It depends on the maturity of your company, it depends on a number of things. If you had the opportunity to centralize your warehouse, it is the preferred approach, in my experience. Sorry to be so passionate. I went through it at COMPANY 1 and it was a complete nightmare. And probably could be the result of the way that they did it. That's my feedback. | |
| 39 | SM | So, as I understand, the aim of building a single warehouse is to build a unified data model? | |
| 40 | INT4 | Yes, exactly. I mean, it's certainly not one size fits all approach, you have to take into account what your source systems are. If 80% of your company use the same transactional system, it makes sense. If you have a number of transactional systems, maybe it doesn't make sense. Your company is distributed all around the globe, that's another issue. It just feels, from my experiences, the centralize is a much better approach and easier to manage. | IDM<br><br>EWH |
| 41 | JA | And how about the ETL process, how can it be accelerated? And how does that affect the agility of business intelligence? | |
| 42 | INT4 | There are a number of different ways that you could accelerate it. I don't think the ETL impacts the agility. When you're extracting the data,probably the only challenge if you're a global company. But at least, in the cases I've worked in, the biggest challenge we had with agility was just making sure data was available when people needed it. When you're working in a multinational company, somebody is going to be impacted on ETL load. When west coast of US business closes, somebody is going to be impacted by data availability. That's not an issue that only to us, that's for any global company. That's the only impact from scalability standpoint, making sure your ETL processes can get the data available to the people in a timely manner, but also realistic. | |
| 43 | SM | So the challenge is not the ETL process or extraction process, the challenge is the data integration process. | |
| 44 | INT4 | It's not the extraction, at least in our case. Integration always takes a bit of time. Here, maybe it's the type platform we are working on, ETL is less of our concern. We don't have as many problems. I guess I was lucky in my career that ETL hasn't been an obstacle to scale to the business need. Now, people who want to do data update more in real-time or on continuous | |

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| | | basis, that's where the ETL process can be stretched, and you need to have the right tools in place to be able to get that frequency. You see that more, at least I have, in financial firms. | |
| 45 | JA | As I understood from you solution, obviously you BI solution is cloud based | |
| 46 | INT4 | Yes | |
| 47 | JA | You had experience with non-cloud solutions | |
| 48 | INT4 | Correct, in two organizations I had the solutions sitting in-house. | |
| 49 | JA | How did the cloud-based solution add to the agility of business intelligence? | |
| 50 | INT4 | I'll give you the perfect example. The update and synchronization with our vendor is much more expedite process than it was when we had to do the individual updates ourselves when we sitting in-house. You stay up-to-date much more frequently than we would if the platform was sitting on a server in your data center. | CBI |
| 51 | JA | Should I add cloud BI as an enhancer of business intelligence agility? | |
| 52 | INT4 | Oh, absolutely. | |
| 53 | JA | Ok, how about virtualization of data, do you use such a thing | |
| 54 | INT4 | No, not right now. | |
| 55 | SM | I would like to go back for the development process Do you apply any learning process after every project? | |
| 56 | INT4 | From an end-user standpoint? | |
| 57 | SM | No, for BI practitioners. Do you identify best practices after each project and share them with others? And how does that affect the agility of business intelligence? | |
| 58 | INT4 | Yes we do actually. What we do is post-mortem after each project, where we talk about the highs and lows and the things that we need to carry on with future projects. So, yes that part of our standard process for any of our projects. And I think from an agility standpoint, you know, learning from your past, either mistakes or positive, really helps you react much quicker to the needs of the business moving forward. Especially when you end up working with individual business units, multiple times. You realize how they work, how they tend to respond to BI, how are their engagement in projects. So, yes I think it's important to capture those learnings from a project and leverage them future projects with those specific business partners. | LR |

| | | | |
|---|---|---|---|
| 59 | JA | Ok. That covers the questions that we had in mind. The last question would be, what other practices employed by companies that enhance the agility of business intelligence. | |
| 60 | INT4 | I have to be honest with you guys. Being on both sides of the cloud vs in-house. I'm learning, when your system sit under a cloud vendor, that connection to the vendor and their transparency into your system really helps keep a stable and leading-edge product being produced back to your ending user. I've seen, worked like I said before in Microstrategy shop where we hosted at COMPANY 1. Things took longer. There are a lot features that BusinessObjects and Microstrategy are pushing out that you can get in the hands of your users much faster. And be able to react to some of their needs much quicker than if you have to do these upgrades and update in-house where you have to depend on your own folks. I've seen the turn-over much quicker and staying leading edge with our technology platform working in the cloud. That's at the heart of agility. And it's not only that, if you're interested, take a look at what Microstrategy offers, it's not only the platform, the infrastructure piece really keeps us leading edge. So, right now we're trying to get the transactional data reporting up and running. But, we are on a system now, which Microstrategy offers, I'm not telling anything proprietary. We're on a platform right now that could allows to do big data analysis tomorrow. We are evolving right now to that point. But if you want to talk about being agile in BI, it's certainly being a cloud customer is one of the things that will be at the heart of being and maintaining our agility and moving forward. | CBI |

# Appendix 6 Coding hierarchy screenshot

# References

Agarwal, A., Shankar, R., & Tiwari, M. K. (2006). Modeling the metrics of lean, agile and leagile supply chain: An ANP-based approach. *European Journal of Operational Research*, *173*(1), 211–225. doi:10.1016/j.ejor.2004.12.005

Agarwal, R., & Sambamurthy, V. (2002). Principles and models for organizing the IT function. *MIS Quarterly Executive*, *1*(1), 1–16.

Al-Aqrabi, H., Liu, L., Hill, R., & Antonopoulos, N. (2014). Cloud BI: Future of business intelligence in the Cloud. *Journal of Computer and System Sciences*. doi:10.1016/j.jcss.2014.06.013

Ambler, S. W. (2009). Scaling agile software development through lean governance. In *Proceedings of the 2009 ICSE Workshop on Software Development Governance* (pp. 1–2). IEEE Computer Society.

Baars, H., & Zimmer, M. (2013). A Classification For Business Intelligence Agility Indicators. In *ECIS 2013 Proceedings* (p. 163). Association for Information Systems AIS Electronic Library (AISeL).

Barlow, J. B., Keith, M. J., Wilson, D. W., Schuetzler, R. M., Lowry, P. B., Vance, A., & Giboney, J. S. (2011). Overview and Guidance on Agile Development in Large Organizations. *Communications of the Association for Information Systems*, *29*.

Barndt, W. D. (1994). *User-directed competitive intelligence: closing the gap between supply and demand*. Greenwood Publishing Group.

Baroudi, J. J., & Orlikowski, W. J. (1989). The problem of statistical power in MIS research. *MIS Quarterly*, 87–106.

Berg, B. L. (2009). *Qualitative research methods for the social sciences*. Boston : Allyn & Bacon, cop. 2009.

Bhattacherjee, A. (2012). *Social Science Research: principles, methods, and practices* (2nd ed.). Createspace.

Brackett, M. H. (1999). Business intelligence value chain. *DM Review*, *20*.

Brinkmann, S., & Kvale, S. (2005). CONFRONTING THE ETHICS OF QUALITATIVE RESEARCH. *Journal of Constructivist Psychology*, *18*(2), 157–181. doi:10.1080/10720530590914789

Bryman, A., & Bell, E. (2011). *Business Research Methods 3e*. Oxford university press.

Burgess, T. F. (1994). Making the leap to agility: defining and achieving agile manufacturing through business process redesign and business network redesign. *International Journal of Operations & Production Management*, *14*(11), 23–34.

Burnard, P. (1991). A method of analysing interview transcripts in qualitative research. *Nurse Education Today*, *11*(6), 461–466.

Chan, Y. E., & Reich, B. H. (2007). IT alignment: what have we learned? *Journal of Information Technology*, *22*(4), 297–315. doi:10.1057/palgrave.jit.2000109

Chang, V. (2014). The Business Intelligence as a Service in the Cloud. *Future Generation Computer Systems*. doi:10.1016/j.future.2013.12.028

Chaudhuri, S., & Dayal, U. (1997). An overview of data warehousing and OLAP technology. *ACM Sigmod Record*, *26*(1), 65–74.

Chaudhuri, S., Dayal, U., & Narasayya, V. (2011). An overview of business intelligence technology. *Communications of the ACM*, *54*(8), 88. doi:10.1145/1978542.1978562

Chen, H., Chiang, R. H., & Storey, V. C. (2012). Business Intelligence and Analytics: From Big Data to Big Impact. *MIS Quarterly*, *36*(4).

Chow, T., & Cao, D.-B. (2008). A survey study of critical success factors in agile software projects. *Journal of Systems and Software*, *81*(6), 961–971. doi:10.1016/j.jss.2007.08.020

Cockburn, A. (2002). Agile Software Development Joins the" Would-Be" Crowd. *Cutter IT Journal*, *15*(1), 6–12.

Cockburn, A., & Highsmith, J. (2001). Agile software development, the people factor. *Computer*, *34*(11), 131–133.

Conboy, K. (2009). Agility from First Principles: Reconstructing the Concept of Agility in Information Systems Development. *Information Systems Research*, *20*(3), 329–354. doi:10.1287/isre.1090.0236

Conboy, K., & Fitzgerald, B. (2004). Toward a conceptual framework of agile methods: a study of agility in different disciplines. In *Proceedings of the 2004 ACM workshop on Interdisciplinary software engineering research* (pp. 37–44). ACM.

Coyne, I. T. (1997). Sampling in qualitative research. Purposeful and theoretical sampling; merging or clear boundaries? *Journal of Advanced Nursing*, *26*(3), 623–630.

Creswell, J. W. (2012). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). SAGE Publications.

Davenport, T. H. (2006). Competing on analytics. *Harvard Business Review*, *84*(1), 98.

Dove, R. (1994). Tools for analyzing and constructing agility. In *Proceedings of the Third Annual Agility Forum Conference/Workshop, Austin, TX*. Sage Publications.

Dove, R. (2005). Fundamental principles for agile systems engineering. In *Conference on Systems Engineering Research (CSER), Stevens Institute of Technology, Hoboken, NJ*.

Elbashir, M. Z., Collier, P. A., & Davern, M. J. (2008). Measuring the effects of business intelligence systems: The relationship between business process and organizational

performance. *International Journal of Accounting Information Systems*, *9*(3), 135–153. doi:10.1016/j.accinf.2008.03.001

Gallagher, K. P., & Worrell, J. L. (2008). Organizing IT to promote agility. *Information Technology and Management*, *9*(1), 71–88.

Gherardi, S., & Silli, A. (2007). Agile information systems as a double dream. In *Agile Information Systems* (p. 110).

Gilad, B., & Gilad, T. (1985). A systems approach to business intelligence. *Business Horizons*, *28*(5), 65–70.

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The Qualitative Report*, *8*(4), 597–607.

Herring, J. P. (1992). The role of intelligence in formulating strategy. *Journal of Business Strategy*, *13*(5), 54–60.

Hobbs, G., & Scheepers, R. (2010). Agility in information systems: enabling capabilities for the IT function. *Pacific Asia Journal of the Association for Information Systems*, *2*(4).

Hribar Rajterič, I. (2010). Overview of business intelligence maturity models. *Management: Journal of Contemporary Management Issues*, *15*(1), 47–67.

Kimball, R. (1998). *The data warehouse lifecycle toolkit: expert methods for designing, developing, and deploying data warehouses*. John Wiley & Sons.

Knabke, T., & Olbrich, S. (2013). Understanding Information System Agility -- The Example of Business Intelligence (pp. 3817–3826). IEEE. doi:10.1109/HICSS.2013.581

Knafl, K. A., & Howard, M. J. (1984). Interpreting and reporting qualitative research. *Research in Nursing & Health*, *7*(1), 17–24.

Kopáčková, H., & Škrobáčková, M. (2006). Decision support systems or business intelligence: what can help in decision making? *Scientific Papers of the University of Pardubice. Series D, Faculty of Economics and Administration. 10 (2006)*.

Kvale, S. (1996). The 1,000-Page Question. *Qualitative Inquiry*, *2*(3), 275–284. doi:10.1177/107780049600200302

Kvale, S., & Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research interviewing* (2nd ed.). SAGE Publications.

Lee, A. S., & Baskerville, R. L. (2003). Generalizing Generalizability in Information Systems Research. *Information Systems Research*, *14*(3), 221–243. doi:10.1287/isre.14.3.221.16560

Lönnqvist, A., & Pirttimäki, V. (2006). The Measurement of Business Intelligence. *Information Systems Management*, *23*(1), 32–40. doi:10.1201/1078.10580530/45769.23.1.20061201/91770.4

Loshin, D. (2003). *Business Intelligence: The Savvy Manager's Guide, Getting Onboard With Emerging IT (savvy manager's guides).* Morgan Kaufmann Publishers.

Luftman, J. (2004). Assessing business-IT alignment maturity. *Strategies for Information Technology Governance*, *4*, 99.

Luftman, J., & Derksen, B. (2012). Key Issues for IT Executives 2012: Doing More with Less. *MIS Quarterly Executive*, *11*(4).

Luftman, J., & McLean, E. (2004). Key Issues for IT Executives. *MIS Quarterly Executive*, *3*(2).

Marshall, M. N. (1996). Sampling for qualitative research. *Family Practice*, *13*(6), 522–526.

McGaughey, R. E. (1999). Internet technology: contributing to agility in the twenty-first century. *International Journal of Agile Management Systems*, *1*(1), 7–13.

Muntean, M., & Surcel, T. (2013). Agile BI - The Future of BI. *Informatica Economica*, *17*(3/2013), 114–124. doi:10.12948/issn14531305/17.3.2013.10

Myers, M. D., & Newman, M. (2007). The qualitative interview in IS research: Examining the craft. *Information and Organization*, *17*(1), 2–26. doi:10.1016/j.infoandorg.2006.11.001

Negash, S. (2004). Business Intelligence. *Communications of the Association for Information Systems*, *13*.

Overby, E., Bharadwaj, A., & Sambamurthy, V. (2006). Enterprise agility and the enabling role of information technology. *European Journal of Information Systems*, *15*(2), 120–131. doi:10.1057/palgrave.ejis.3000600

Paradice, D., & Courtney, J. F. (2012). A Look Toward the Future: Decision Support Systems Research is Alive and Well. *Journal of the Association for Information Systems*, *13*(5), 315–340.

Pearce, F. (1976). Business intelligence systems: the need, development, and integration. *Industrial Marketing Management*, *5*(2), 115–138.

Peppard, J., & Ward, J. (2004). Beyond strategic information systems: towards an IS capability. *The Journal of Strategic Information Systems*, *13*(2), 167–194. doi:10.1016/j.jsis.2004.02.002

Pirttimäki, V. (2007). *Business intelligence as a managerial tool in large Finnish companies* (Doctoral Dissertation). Tampere University of Technology, Tampere.

Porter, M. E., & Millar, V. E. (1985). *How information gives you competitive advantage*. Harvard Business Review, Reprint Service.

Powell, T. W. (1996). Analysis in business planning and strategy formulation. *GILAD, B.; HERRING, JP Art and Science of Business Intelligence Analysis*.

Rahm, E., & Do, H. H. (2000). Data cleaning: Problems and current approaches. *IEEE Data Eng. Bull.*, *23*(4), 3–13.

Recker, J. (2013). *Scientific Research in Information Systems: A Beginner's Guide*. Springer Berlin Heidelberg.

Rehani, B. (2011). Agile way of BI implementation. In *India Conference (INDICON), 2011 Annual IEEE* (pp. 1–6). IEEE.

Rosenberg, D., & Stephens, M. (2003). *Extreme programming refactored: the case against XP*. Apress.

Rouse, W. B. (2007). Agile information systems for agile decision making. In *Agile Information Systems:Conceptualization, Construction, and Management* (1st ed., p. 16). Routledge.

Sambamurthy, V., Bharadwaj, A., & Grover, V. (2003). Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms. *MIS Quarterly*, 237–263.

Seale, C. (1999). Quality in Qualitative Research. *Qualitative Inquiry*, *5*(4), 465–478. doi:10.1177/107780049900500402

Seidman, I. (2012). *Interviewing as qualitative research: A guide for researchers in education and the social sciences*. Teachers college press.

Shah, S. K., & Corley, K. G. (2006). Building Better Theory by Bridging the Quantitative–Qualitative Divide*. *Journal of Management Studies*, *43*(8), 1821–1835.

Shulsky, A. N., & Schmitt, G. J. (2002). *Silent warfare: understanding the world of intelligence*. Potomac Books, Inc.

Simitsis, A., Vassiliadis, P., & Sellis, T. (2005). Optimizing ETL processes in data warehouses. In *Data Engineering, 2005. ICDE 2005. Proceedings. 21st International Conference on* (pp. 564–575). IEEE.

Sohal, A. S. (1999). Developing agile manufacturing in Australia. *International Journal of Agile Management Systems*, *1*(1), 60–63.

Stodder, D. (2013). *Achieving greater Agility with Business intelligence: Improving Speed and Flexibility for BI, Analytics, and Data Warehousing*. TDWI.

Strohmaier, M., & Lindstaedt, S. N. (2005). Beyond flexible information systems: why business agility matters. In *Sixth Workshop on Business Process Modeling, Development and Support (BPMDS'05) during CAiSE'05* (pp. 1–9).

Tallon, P. P. (2008). Inside the adaptive enterprise: an information technology capabilities perspective on business process agility. *Information Technology and Management*, *9*(1), 21–36. doi:10.1007/s10799-007-0024-8

Theodoratos, D., & Sellis, T. (1997). Data warehouse configuration. In *VLDB* (Vol. 97, pp. 126–135).

Tiwana, A., & Konsynski, B. (2010). Complementarities Between Organizational IT Architecture and Governance Structure. *Information Systems Research*, *21*(2), 288–304. doi:10.1287/isre.1080.0206

Van Oosterhout, M., Waarts, E., & van Hillegersberg, J. (2006). Change factors requiring agility and implications for IT. *European Journal of Information Systems*, *15*(2), 132–145. doi:10.1057/palgrave.ejis.3000601

Verstraete, C. (2004). Planning for the unexpected [business agility]. *Manufacturing Engineer*, *83*(3), 18–21.

Wadhawa, S., & Rao, K. (2003). Flexibility and agility for enterprise synchronization: knowledge and innovation management towards flexagility. *Studies in Informatics and Control*, *12*(2), 111–128.

Watson, H. J. (2009). Tutorial: Business Intelligence–Past, Present, and Future. *Communications of the Association for Information Systems*, *25*.

Weill, P., & Ross, J. W. (2004). IT governance on one page. *CISR WP*, *349*(2).

Weill, P., Subramani, M., & Broadbent, M. (2002). IT infrastructure for strategic agility. *MIT Sloan Working Paper*, *No. 4235-02*. doi:http://dx.doi.org/10.2139/ssrn.317307

White, D. (2011, April). Agile BI – Three Steps to Analytic Heaven. Aberdeen group, Inc.

Williams, S., & Williams, N. (2010). *The profit impact of business intelligence*. Morgan Kaufmann.

Woolley, B., & Hobbs, G. (2008). Agility in Information System. *ACIS 2008 Proceedings*.

Yeganegi, K., & Azar, M. S. Z. (2012). The Effect of IT on Organizational Agility. In *Proceedings of the International Conference on Industrial Engine* (pp. 2537–2544).

Yeoh, W., & Koronios, A. (2010). Critical Success Factors for Business Intelligence Systems. *Journal of Computer Information Systems*, *50*(3).

Yusuf, Y. Y., Sarhadi, M., & Gunasekaran, A. (1999). Agile manufacturing:: The drivers, concepts and attributes. *International Journal of Production Economics*, *62*(1), 33–43.

Zimmer, M., Baars, H., & Kemper, H.-G. (2012). The Impact of Agility Requirements on Business Intelligence Architectures (pp. 4189–4198). IEEE. doi:10.1109/HICSS.2012.567